



Chapter 1 | Introduction

Chapter 1 | Introduction

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1 INTRODUCTION

Burapha Agroforestry Co. Ltd (hereafter 'Burapha'), a Lao-based company headquartered in Vientiane, implements and operates agroforestry plantations (primarily Eucalyptus timber species) in Vientiane Prefecture and the Provinces of Vientiane, Xayabouly, and Saisomboun. Burapha currently operates a total of approximately 3,000 ha of active plantation at various locations across these four provinces, and currently holds land-use rights for a total of approximately 8,000 ha for plantation purposes. Burapha proposes to expand this agroforestry operation to as much as 55,000 plantation ha by selectively acquiring new land-use rights for underutilised swidden agricultural land in the four provinces in which it currently operates, requiring a total of 68,750 ha of concession / lease area to account for uncleared / unplanted buffers and special management areas. Burapha has demonstrated that their model of agroforestry plantation operations is beneficial for the local economy and is consistent with government policy to reduce swidden agriculture and reliance on a subsistence economy.

In accordance with the regulatory requirements of Lao PDR, Burapha has commissioned an independent Environmental and Social Impact Assessment (ESIA) of the proposed expansion of the Burapha Plantation Project (hereafter 'the Project') to assess the benefits and potential impacts of expansion utilising current operations as a basis for assessment.

Burapha has commissioned Earth Systems Sole Co. Ltd, a licensed EIA consultant in Lao PDR, to prepare the ESIA for the expansion Project. This ESIA and associated impact assessment documents have been prepared in accordance with the requirements of the Government of Lao (GOL) *Environmental Impact Assessment Guidelines* (2012) and *Ministerial Instructions for the Conduct of ESIA's* (No. 8030, December 2013).

The expanded Project will be supported by Burapha's existing sawmill and furniture manufacturing facility in Xaythany District, Vientiane, and a proposed veneer and plywood manufacturing facility (which is the subject of a separate regulatory impact assessment) in Hin Heup District, Vientiane.

1.1 Project Description and Context

Burapha currently holds the rights to approximately 8,000 ha of land for the Project in lots across Vientiane Prefecture, Vientiane Province, Xayabouly Province, and Saisomboun Province (the 'four provinces'). Approximately 3,000 ha of this landholding has been developed as active plantations of predominantly hybrid Eucalyptus trees. The plantations are located within the boundaries of approximately 35 villages across 10 districts (Figure 1-1). Land use rights are currently acquired from villages, individuals and/or the GOL through various agreements and tenure categories. Project expansion (the subject of this ESIA) will involve planting the remainder of its existing concessions and leased land, and by acquiring and utilising new land use rights in the same four provinces. The timber produced by the plantations will be processed at a new veneer and plywood manufacturing mill in Hin Heup District, at Burapha's existing sawmill and furniture manufacturing plant in Xaythany, and potentially at a high value cellulose bio-refinery in the future.

As the proposed Project will transform the scale of Burapha's operations, an ESIA is required to meet Lao PDR statutory requirements and to acquire the applicable Project permits. In accordance with Burapha's corporate commitment to environmental and social sustainability, the ESIA shall meet national statutory requirements as well as adhere to international best practices for development projects, including the development and implementation of management plans that considers the obligations of potential certifying bodies such as the Forest Stewardship Council (FSC) or the Program for Endorsement of forest Certification (PEFC).

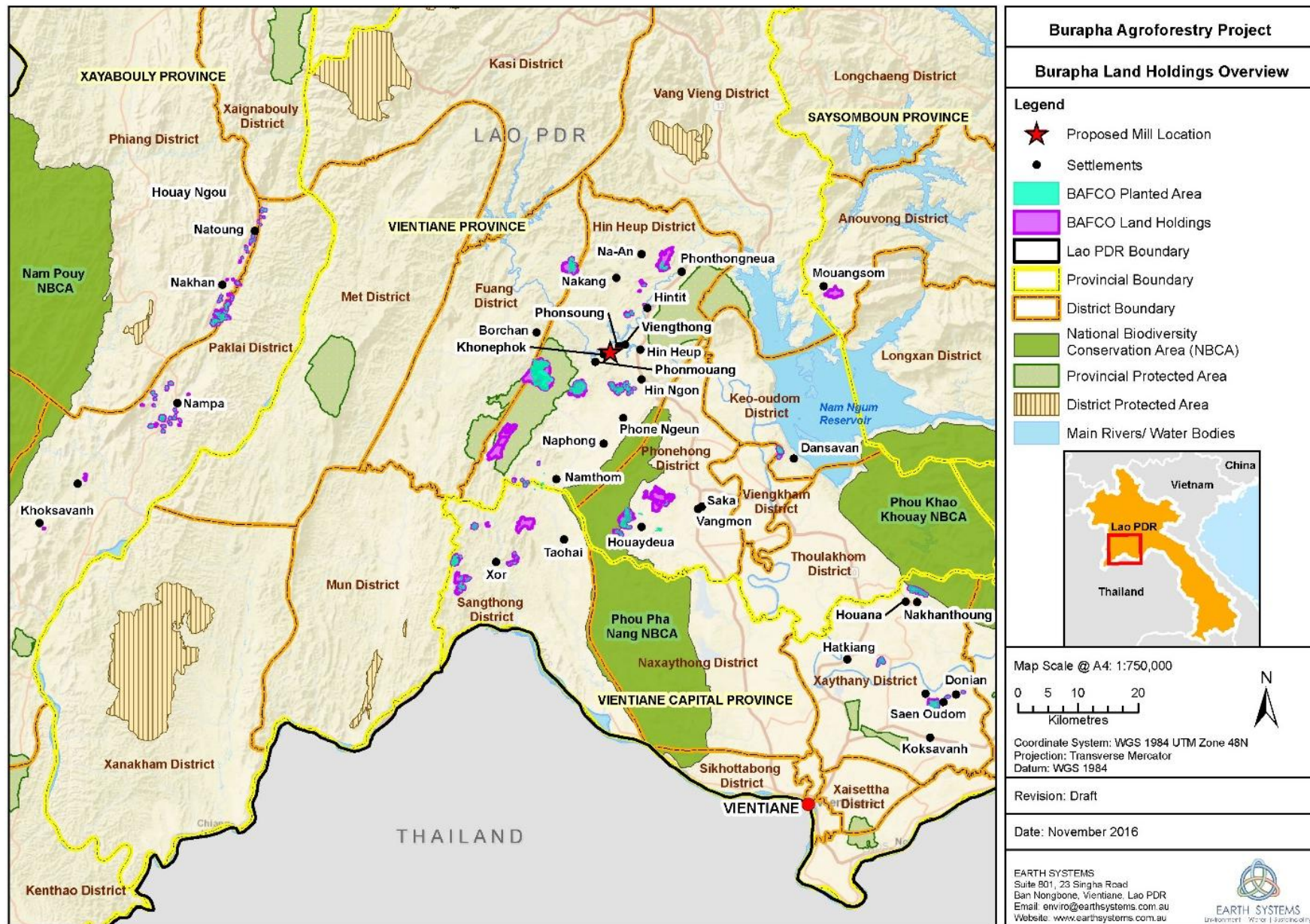


Figure 1-1 Burapha landholdings overview, planted and unplanted areas*

*Mapped boundaries may not be consistent with current District boundaries, due to ongoing updating of GOL data

Commercial Objectives

The commercial objective of the Project is to establish and maintain a plantation asset large enough to supply a viable industry that will provide revenue for the company and generate significant financial value for the country through taxation on revenue, land leases, job creation, etc.

The operation of the Project will be undertaken in accordance with industry best practice and will comply with the conditions and standards prescribed by the GOL. Further, the operation will be undertaken according to the socio-economic and environmental objectives presented in this ESIA.

Environmental Objectives

The environmental objectives of the Project are to identify and mitigate any potentially negative environmental impacts that may result from the Project. Environmental impacts will be minimised through adherence to GOL and international environmental standards and regulations through the application of international best practice.

Socio-Economic Objectives

The socio-economic objectives of the Project are to; (i) generate revenue for the Company and tax benefits for the Government of Lao PDR (GOL); (ii) provide community level lease fees, and community development initiatives that will improve the socio-economic status of individuals and participating communities; (iii) provide employment opportunities for local residents; and provide increased food security for participating communities through the agroforestry model.

1.2 Project Proponent

Burapha Agroforestry Co. Ltd is a Lao-based company established in 1993 through a Lao-Swedish joint venture. Burapha is based in Vientiane and has regional offices in Vientiane Prefecture, Vientiane Province, and Xayabouly Province. Burapha currently operates a tree nursery and sawmill/furniture manufacturing facility (Nabong Farm) in Xaythany District, Vientiane Prefecture. In addition to the proposed Project, Burapha is also currently conducting a separate feasibility study and ESIA for the development of a veneer and plywood manufacturing facility in Hin Heup District, Vientiane Province to further its wood processing capabilities.

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1.2.1 Environmental Credentials and Experience

Burapha maintains and adheres to a Corporate Social and Environmental Responsibility (CSER) framework model, which assures opportunities, land user rights and long-term production for local people. Burapha's operations are governed by an Environmental and Social Management System (ESMS), which comprises a hierarchy of documentation including policies, operations manuals, standard operating procedures, work instructions, and databases, forms, reports and plans. The ESMS documentation includes a series of commitments to environmental and social sustainability that are applicable to its agroforestry operations, sawmill and wood manufacturing facility, and nursery. The commitments most applicable to Burapha's agroforestry operations are articulated in the following policies:

- Burapha Occupational Health and Safety Policy;
- Burapha Land Acquisition Policy;

- Burapha Communications Policy; and
- Burapha Human Resources Policy.

Burapha is also affiliated with various environmental initiatives, including:

- UNDP Standard Environmental and Social Obligations for Agriculture and Forestry Projects project stakeholder (2014);
- UNDP ESIA Decree Compliance Project Partner (since 2013); and
- WWF Global Forest and Trade Network Member (since 2009)

Burapha is committed to meeting national and international standards with respect to environmental and social sustainability. In addition to national requirements, Burapha's agroforestry operations will meet the obligations of the following:

- World Bank General Environmental, Health, and Safety Guidelines (2007);
- IFC Environmental and Social Performance Standards (2012); and
- Forest Steward Ship Council Forest Management Certification Principles and Criteria (FSC-STD-01-001-V5, (2012) and or Programme for Endorsement of Forest Certification Standards (PEFC ST:2010).

1.2.2 Experience with Management of Socio-Economic Issues

Burapha has developed a business model that promotes improved social welfare in Lao PDR while implementing their business in a socially responsible manner.

Community Development

For their agroforestry operations, Burapha contributes to poverty eradication through:

- Development Funds for Village Cooperation and Concessions, including contributions to Village Development Funds (1 – 3 million Kip / ha), Khum Development Funds (40,000 Kip / ha); and District Development Funds (80,000 Kip / ha);
- Concession payments according to applicable laws and regulations; and
- Agricultural development for farmers (land use comprises 30% for plantations and 70% for agriculture).

The Company also contributes to village infrastructure development directly, through upgrade of roads and construction of bridges in various locations that are associated with plantation operations.

Employment Opportunities

Burapha currently employs approximately 119 full time staff and a seasonal workforce comprised of representatives from communities participating in their agroforestry operations.

The Company conducts its business in a manner that ensures adherence to national labour policies / requirements for full-time staff and casual employees. Burapha articulates its labour policies in the ***Burapha Code of Conduct, Human Resource Policy, Burapha Employee Handbook, Employee Representatives Manual***, and in signed contracts.

The *Burapha Code of Conduct* clearly identifies Company policies with respect to promotion of international human and labour rights; promotion of a workplace that is safe, healthy and free of discrimination; and policies regarding honesty, transparency, ethics, and equal opportunity.

Burapha is committed to standards / guidelines of the UN's Universal Declaration of Human Rights and the Core Conventions of the International Labour Organization (ILO) from which Burapha has derived the following principles:

- **Safe and Healthy Workplace** - employees are entitled to safe and healthy workplaces. No employee shall be subject to any physical, psychological or sexual harassment, punishment or abuse;

- **Diversity** – Burapha recognises diversity as strength. Discrimination against any employee in respect of race, ethnic background, gender, disability, sexual orientation, religion, political opinion, maternity, social origin or similar characteristic is prohibited;
- **Forced Labour** - Any form of involuntary labour is prohibited;
- **Child Labour** - Use of child labour is not permitted. The minimum age for employment shall be in accordance with the ILO Convention or the age specified by local legislation if higher. The employment of young persons shall not jeopardise their education or development.
- **Wages** - Wages are paid directly to the employees. Employees shall be paid at least the minimum legal wage or the wage specified in an applicable collective labour agreement;
- **Working hours** - Working hours shall not exceed 48 hours and overtime 12 hours per week on average over a year, unless other conditions are specified in local laws or an applicable collective labour agreement.

1.3 Environmental and Social Consultant

Burapha has commissioned Earth Systems Sole Co. Ltd, a licensed EIA consultant in Lao PDR, to prepare the ESIA for the expansion Project.

1.3.1 Consultant's EIA Licence Details

Earth Systems Sole Co. Ltd is part of the Earth Systems Group, as follows:

- Earth Systems Sole Co. Ltd, part of the Earth Systems Group, is a licensed EIA consultant in Lao PDR with considerable experience conducting environmental and social assessments in the region; and
- Earth Systems Consulting, part of the Earth Systems Group, is a consulting firm comprising technical experts and specialists in environmental and social impact assessment, with offices located throughout the world.

Earth Systems Sole Co. Ltd will be required to provide appropriate environmental assessment licence information to the Ministry of Natural Resources and Environment (MONRE) (e.g. Environmental Management License and/or Environmental Impact Assessment Services Registration License).

1.3.2 Earth Systems' ESIA Experience

The Earth Systems Group is a multidisciplinary environmental and social consulting firm that develops and implements innovative and effective environment, water and sustainability projects throughout the world. Established in 1993, the company has successfully completed over 500 major projects in Australia, Asia, Africa, South America, North America and the Pacific.

Earth Systems has been operating in Lao PDR for more than 20 years, completing a range of environmental and social consultancy projects, including ESIA's for some of the country's most significant development projects and environmental and social assessments of plantation and agroforestry projects in the country. Earth Systems' impact assessment expertise includes managing multi-disciplinary teams composed of international and local experts in preparing international standard ESIA's that meet national regulatory and, if required, investment bank requirements for project permitting.

1.3.3 Main Contributors to the ESIA

The main contributors to the ESIA study team are listed in Table 1-1.

Table 1-1 Main contributors to ESIA

Key Earth Systems Staff	Position	Qualifications
Earth Systems Staff		
Nigel Murphy	Project Director / ES Director	M. Env. Sc., B.Sc (Hons), MEIANZ, CenvP.
Justin Mercer	Project Manager/ Principal Env. Scientist	M.Sc. Nat. Res./ B.Env.Sc.
Chris Smithies	Senior Environmental Scientist	BEnvMgmt, BBusTech, MAppSci
Bounta Nuanvixay	Senior Environmental and Social Consultant	M EnvMgm, B.Sc (Forestry), Dip Eng (Irrigation)
Sengkeo Thongvanna	Senior Office Manager / Project Assistant	BA (English); Dip. Account/Admin
Souchitta Chemcheng	Environmental Engineer	BE (Environmental)
Megan Price	Senior Ecologist	PhD / B.Sc (Hons)
Joanne Nightingale	Senior Ecologist	BSc, DPhil
Gwendoline Raban	Senior Environmental Scientist	B.Sc / B.A. MEIANZ
Naveena Wijesekara	Senior Environmental Scientist	M.Sc.Env./ B.Sc (Hons), GradCert EnvPlanning
Tom Callander	Principal Social Scientist	M. SocSc, B.Bus.
Brett Davis	Senior Environmental Scientist	B.Sc, M.Sc, PhD, MEIANZ, MIMWA, MAusIMM
Paul Quinn	Senior Environmental Scientist	PhD, B.Sc (Hons), GradInstP, CAZANZ
Stephen Isaac	Senior Environmental Scientist	M.Sc Env Sci / B.Sc, MIEMA, CEnv
Wayne Pagel	Senior Environmental Scientist	BE, PGDipEarthSci, CPESC
Associates		
Dr Pheng Phengsintham	Terrestrial Biodiversity Specialist	PhD / M.Sc / B.Sc
Mr Sisomphone Soukhavongsa	Cultural Heritage Specialist	M.Sc / B.Sc

1.3.4 ESIA Consultant Contact Details

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1.4 Structure of the ESIA and Assessment Strategy

1.4.1 ESIA Approach

The ESIA identifies the baseline conditions, the environmental and social risks and benefits of Project implementation, and the potential impacts associated with the Project. The likelihood and magnitude of these impacts are assessed based on available Project information. A framework for further community and Government consultation is also provided.

The overarching objectives of this ESIA are to:

- Provide a description of the proposed Project;
- Identify key environmental and social management issues associated with all stages of the Project;

- Describe how Burapha will plan and operate the Project to prevent and mitigate adverse environmental and social impacts;
- Describe how Burapha will monitor and manage environmental and social aspects; and
- Assess any significant residual or cumulative impacts associated with the proposed Project.

1.4.2 Structure of the ESIA Report

The ESIA is comprised of four volumes:

- Volume A: Executive Summary;
- Volume B: ESIA Report;
- Volume C: ESIA Appendices; and
- Volume D: Environmental and Social Management and Monitoring Plan.

The format of the ESIA report is as follows:

- Chapter 1: Summary of the proposed Project, the proponent, and the report's author
- Chapter 2: The policy, legal and administrative framework for environmental assessment of the Project
- Chapter 3: A detailed description of the scope of the Project, including project alternatives considered and needs / benefits at the local, regional and national scale
- Chapter 4: The existing physical setting within and around the Project Area
- Chapter 5: The existing biological setting within and around the Project Area
- Chapter 6: The existing social setting within and around the Project Area
- Chapter 7: Potential physical impacts and proposed management
- Chapter 8: Potential biological impacts and proposed management
- Chapter 9: Potential social impacts and proposed management
- Chapter 10: Risk assessment of the Project
- Chapter 11: Potential cumulative impacts
- Chapter 12: The stakeholder consultation process and public involvement in the Project
- Chapter 13: A summary of the environmental and social management and monitoring program
- Chapter 14: The conclusions derived from the ESIA
- Chapter 15: References used in the ESIA

1.4.3 ESIA Specialist Studies and Data Sources

The studies listed in Table 1-2 were commissioned as part of the EIA process to provide information in areas of importance or where gaps in data were identified. Results of field studies were incorporated into the ESIA (Volume B) and / or informed the development of technical reports / appendices (Volume C; Table 1-3).

Table 1-2 Specialist studies commissioned as part of the ESIA

Specialist Study Title	Author	Reference
Air, Noise, and Vibration Study	Earth Systems	Volume B, Ch. 4
Archaeology and Cultural Heritage Study	Mr Sisomphone Soukhavongsa	Volume B, Ch. 6
Terrestrial Biodiversity	Dr Pheng Phengsintham	Volume B, Ch. 5
Hydrology	Earth Systems	Volume B, Ch. 5

Table 1-3 Other technical appendices supporting the ESIA

Specialist Study Title	Author	Reference
Terrestrial Biodiversity and Forest Resource Use Species Lists	Dr Pheng Phengsintham	Volume C
Aquatic Biodiversity and Resource Use Species Lists	Earth Systems	Volume B, Ch. 4
Water Quality Baseline Data Tables	Earth Systems	Volume B, Ch. 4
Stakeholder Consultation Records	Earth Systems	Volume D

1.5 Impact Assessment Methodology

1.5.1 Baseline

Mapping

Boundaries for current plantations and management units were obtained from Burapha and applied to historic (1992–1993) and recent (2014–2016) satellite imagery and GOL forest cover assessment / land use assessment (FIPD, 2010) to characterise baseline conditions prior to and after plantation establishment.

Mapping and assessment of land use was extended to cover all of Vientiane Prefecture, Vientiane Province, Saisomboun Province, and Xayabouly Province to identify the availability of land meeting Burapha’s Land Selection Criteria to aid impact assessment for future plantation areas that have not yet been identified.

Stakeholder Consultation

Stakeholder consultations were conducted in March, August, and November 2016, and included meetings with collaborating villages, GOL, and regional experts in forestry, biodiversity, and social sciences.

Local Knowledge Surveys and Participatory Land Use Mapping

To establish a baseline reference based on Burapha’s existing plantation operations, 28 of the 32 villages that currently have Burapha plantation landholdings (i.e. planted or unplanted concessions / leases) were subject to Local Knowledge Surveys (LKSs). A representative subsample of men and women attended. LKSs were used to source baseline social data and to qualify and/or quantify cultural information, socio-economic information, food security, land and water uses, natural resource requirements (species level), and land tenure, etc.

A participatory village mapping exercise was conducted as part of the consultations (refer to Plates 4-1 and 4-2) to delineate village boundaries and where possible the Burapha lease area, settlement area(s), water resources, agricultural areas, timber and non-timber resource collection areas (flora and fauna), access, watercourses and wetlands, areas of cultural or archaeological significance, protection, conservation, and production forests, livestock pastures, and important fisheries (aquaculture and native streams / wetlands).

Biodiversity and Resource Use Focus Group Discussions

Biodiversity Focus Group Discussions (FGD) were conducted in May and August 2016 for a subset of 12 collaborating villages across each of the four Project Provinces, namely: Ban Nongkhone, Ban Houay Deua, Ban Phonmuang, Ban Phonngeun, Ban Phonsoung, Ban Borchan, Ban Taikhai, Ban Sor, Ban Natung, Ban Nakhan, Ban Mouanpa, and Ban Nakang. Villages were selected for spatial distribution across the FMU and to capture a range of plantation ages as well as uncleared / unplanted leases. For each village, village authorities and a representative sample of men and women were consulted. Dr Pheng Phengsintham, a local biodiversity specialist with extensive field survey and consultation experience in Lao PDR, led the consultations.

The intent of the interactive survey was to collect information on biodiversity and resource use within village boundaries and within Burapha plantation concessions. Villagers shared information regarding:

- Non-timber forest product (NTFP) availability and use;
- Timber forest product (TFP) availability and use;

- Fauna presence and hunting activity;
- Presence / absence of globally threatened / nationally rare species;
- Resource availability and potential impacts of plantation establishment;
- General resource use (food, sale, construction material, firewood, etc.);
- Location of sensitive ecology (e.g. wetlands); and
- Location of nearest conservation / protection areas and associated land use.

Information was collected to the species level, when possible. Discussion regarding presence / absence of threatened or endemic flora and fauna were aided by photographs of species known to occur in the greater region.



Plate 1-1 B. Borchan Land Use Mapping Exercise

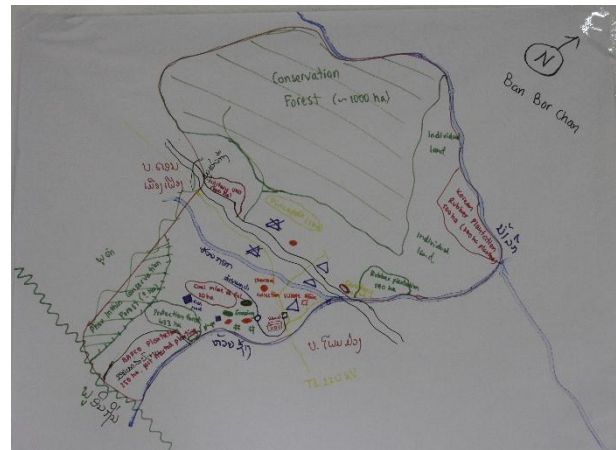


Plate 1-2 Ban Borchan Land Uses

Archaeological and Cultural Heritage Focus Group Discussions

Archaeology and cultural heritage FGD were conducted in the same 12 villages as for the Biodiversity FGD. The intent of the survey was to identify and map regional and village-level sites and artefacts of archaeological or cultural significance. Where villagers identified a significant site, a field survey was conducted. The consultation was led by Mr Khammanh Siphanhxay, a cultural heritage specialist with the GOL Ministry of Culture and Tourism.

In summary, the following information was collected:

- Village ethnicity and religion statistics;
- Village history;
- Archaeological and cultural sites of significance (location and meaning) within and outside of village boundaries; and
- Artefacts of significance (location found and meaning).

Sites of cultural importance (primarily cemetery forests, spirit forests, religious sites, and natural sites of significance) were visited, photographed, with GPS coordinates recorded. Artefacts were photographed for further assessment.

Household Surveys

Household surveys were conducted in 26 villages across the four Project Area Provinces that focused on socio-economic baselines (and benefits / impacts of Project implementation for livelihoods and income).

Government Consultation

The GOL at the Central, Provincial and District levels (including various Ministries and line agencies) were consulted in March, April, and November 2016, with further consultation planned for December and January. The consultations covered broad Project-wide issues. The Burapha Agroforestry Project was described and potential benefits and impacts discussed, and feedback requested and responded to.



Plate 1-3 Saisomboun Provincial Consultation



Plate 1-4 Vang Vieng District Consultation

Secondary Information

A range of secondary information informed environmental and social baseline assessments, summarised as follows:

- GOL data (District and Provincial Development Plans, census data, etc.);
- Scientific literature (assessment of physical, biological, and social components of relevance to the Project Provinces);
- Burapha information (policies, manuals, standard operating procedures, databases, etc.).

1.5.2 Risk Assessment

A risk assessment approach was used to conduct an initial analysis of potential for environmental and social impacts to inform the need for management and mitigation measures. The methodology is based upon ISO31000 Risk management — Principles and Guidelines, 2009 and ISO31010 Risk Management – Risk Assessment Techniques, 2009.

The risk assessment was first conducted prior to consideration of management and mitigation to identify the most significant potential risks (refer to Chapter 10). Risks were qualified (Low, Medium, High, Very High) according to the likelihood and consequence of impacts in the absence of mitigation. Once initial risks have been assessed and ranked, proposed controls are identified to avoid or reduce anticipated impacts. Management and mitigation measures focus on either reducing the likelihood of occurrence or on decreasing the magnitude of the consequence to reduce the residual risk to a level acceptable to stakeholders.

Refer to the ESMMP (Volume D) for a comprehensive description of the risk assessment methodology.

Table 1-4 Risk assessment criteria matrix with Likelihood and Consequence rankings

Likelihood		Consequence				
		1	2	3	4	5
Level		Slight	Low	Medium	High	Extreme
5	Almost Certain	Medium	High	High	Very High	Very High
4	Likely	Medium	Medium	High	High	Very High
3	Possible	Low	Medium	Medium	High	High
2	Unlikely	Low	Low	Medium	Medium	High
1	Rare	Low	Low	Low	Medium	High

1.5.3 Impact Assessment

Existing Burapha plantations and communities participating in agroforestry operations were assessed for environmental and social benefits and impacts derived from implantation of agroforestry operations. Current operations serve as a 'case study' from which benefits and impacts are extrapolated for a larger footprint.

The end use of timber derived from plantations was considered in evaluating the benefits of Project expansion, including the current Burapha sawmill, the proposed Veneer and Plywood Manufacturing Facility in Hin Heup, and the potential for a biorefinery for further value added to Eucalyptus plantation forestry.

The assessment of the potential impacts and risks of the Project has incorporated the following steps:

1. Baseline setting - Description of the environmental and social conditions in the Project Expansion Area and for current operations.
2. Risk Assessment - Adopting internationally accepted risk assessment methodologies to rate the significance of potential environmental and social risks.
3. Potential impacts - Assessment of potential impacts associated with expansion of the Burapha Agroforestry operations to 60,000 ha based on Project design and receptor sensitivity.
4. Management and mitigation - Proposed measures to avoid or minimise potentially adverse impacts or to enhance benefits, provided for appropriate stage of operations (refer to below).
5. Impact Assessment - Identification of the potential residual impacts and evaluation of their significance considering application of proposed management and mitigation measures.

Impacts

Where applicable, impacts are categorised accordingly.

- *Direct Impact* - A consequence of an activity occurring in the same location and time as the activity.
- *Indirect Impact* - A secondary effect of an activity, may occur in the future or outside of the project's area of influence.
- *Residual Impact* - Residual impacts remain after avoidance, mitigation and management measures have been implemented.
- *Cumulative Impact* - impacts derived from Project Expansion are added to or interact with impacts associated with other projects or actions within a time and place. The combined, incremental effects may be compounded, leading to environmental and social impacts that exceed that associated with implementation of any individual project or action. For this Project, cumulative impacts may include establishment of multiple plantations within a single catchment or in close proximity if impacts are expected to be magnified as a result.

Impact Duration

The duration and reversibility of an impact may vary according to local conditions, the type of impact, and / or the efficacy of management measures. Where applicable, these are defined as:

- *Permanent impacts* arising from an irreversible change in the environment (i.e. the removal and / or construction of physical features), such as for road construction;
- *Temporary (short-term) impacts* likely to occur for a specific period (e.g. hours, days, months) and is persisting only until natural or anthropogenic activities negate the impact; and
- *Temporary (long-term) impacts* occurring over a longer time period (e.g. years), but natural processes or human activities likely to negate the impact after the action ceases.

Impact Significance

Potential adverse impact significance under normal operating conditions has been evaluated on two main factors, impact magnitude and receptor / resource sensitivity, each classified as Nil/Neutral, Low, Medium or High (Table 1-5). The impact magnitude is estimated from the Project design, engineering and modelling, while the receptor / resource sensitivity is estimated from existing environmental and social baseline conditions. These classifications are input into the impact significance rating matrix presented in Table 1-5. Impact significance is rated as Negligible, Minor, Moderate or Major.

Table 1-5 Impact significance rating matrix

Receptor / Resource Sensitivity	Impact Magnitude			
	Nil / Neutral	Minor	Moderate	Major
Low	Negligible	Low	Low	Medium
Medium	Negligible	Low	Medium	High
High	Negligible	Medium	High	High

1.5.4 Management and Mitigation

Where applicable, the ESIA (Chapters 7-9) and the ESMMP (Volume D) provide the applicable phase for implementation of respective management and mitigation measures, as follows:

- **Land Identification** – Potential plantation land will be assessed for its suitability for agroforestry operations, including consideration of physical aspects (e.g. slope, watercourses, etc.), environmental aspects (e.g. status of vegetation), social aspects (e.g. village land availability), and land tenure (e.g. compatibility with GOL land use planning).
- **Land Acquisition** – The formal processes for surveying, government and community consultation, and acquisition of concessions / leases for operations.
- **Site Preparation** – Activities associated with preparing the site for agroforestry implementation, including vegetation clearing / burning and construction or upgrade of infrastructure (e.g. roads, accommodation camps).
- **Operations** – The Operations phase includes all activities undertaken throughout the life of plantation and agroforestry rotations (e.g. planting, fertilising, herbicide applications, thinning, cropping, harvesting, training, operation of work camps, and additional operational activities conducted).
- **Decommissioning** – The decommissioning phase addresses activities that will be undertaken at the end of lease / concessions for Burapha operations. As Burapha leases have an option for extension (pending agreement with applicable village / GOL authorities and the Company), the Project decommissioning is considered the period leading up to the termination of project activities.

The image shows a field of young trees, likely a nursery or plantation. The trees are arranged in rows and have bright green, lanceolate leaves. A semi-transparent blue horizontal band is overlaid across the middle of the image, containing white text. The background shows a line of taller, more mature trees under a clear sky.

Chapter 2 | Policy, Legal and Institutional Framework

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2 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

2.1 Corporate Environmental and Social Policies

Burapha is committed to its Corporate Social and Environmental Responsibility (CSER) framework. The Company operates within the confines of its *Environmental and Social Management System (ESMS)*, with a hierarchy of documentation including Policies, Operations Manuals, Standard Operating Procedures, Work Instructions, and Databases / Forms / Reports / and Plans. Within the ESMS documentation are a series of commitments to environmental and social sustainability for its agroforestry operations, sawmill and wood manufacturing facility, and nursery. Many of these commitments are articulated in the following policies:

- Burapha Occupational Health and Safety Policy;
- Burapha Land Acquisition Policy;
- Burapha Agroforestry Policy;
- Burapha Outgrower Scheme Policy;
- Burapha Communications Policy;
- Burapha Human Resources Policy; and
- Burapha Corporate Social and Environmental Responsibility Policy.

Burapha is committed to establish and maintain its agroforestry plantations to meet national and international standards with respect to environmental and social sustainability. In addition to national requirements, Burapha will establish and maintain the agroforestry plantations to meet obligations of the following:

- Forest Steward Council Forest Management Certification Standard (FSC-STD-01-001 V5-0 D5-0 EN) – the agroforestry Project will be certified for FSC for forest management, which requires meeting ten (10) Principles and Criteria; and
- World Bank General Environmental, Health, and Safety Guidelines (2007) which specify best practices for environmental and social considerations.

2.1.1 Experience with Management of Socio-Economic Issues

Burapha has developed a business model that promotes improved social welfare in Lao PDR while implementing their business in a socially responsible manner.

Community Development

For their agroforestry operations, Burapha contributes in poverty eradication accordingly:

- Development Funds for Village Cooperation and Concessions, including contributions to Village Development Funds (1 – 3 million Kip / ha), Khum Development Funds (40,000 Kip / ha); and District Development Funds (80,000 Kip / ha);
- Concession payments according to applicable laws and regulations; and
- Agricultural development for farmers (land use comprises 30% for plantations and 70% for agriculture).

The Company also contributes to village infrastructure development directly, through upgrade of roads / implementation of bridges in various locations (associated with plantation operations).

Employment Policy

Burapha articulates its labour policies in a number of documents, including the ***Code of Conduct, Human Resource Policy, Burapha Employee Handbook, Employee Representatives Manual***, and in signed contracts.

The *Burapha Code of Conduct* identifies Company policies with respect to promotion of international human and labour rights; promotion of a workplace that is safe, healthy and free of discrimination; and policies regarding honesty, transparency, ethics, and equal opportunity.

Burapha is committed to standards / guidelines of the UN's Universal Declaration of Human Rights and the Core Conventions of the International Labour Organization (ILO) from which Burapha has derived the following principles:

- **Safe and Healthy Workplace** - employees are entitled to safe and healthy workplaces. No employee shall be subject to any physical, psychological or sexual harassment, punishment or abuse;
- **Diversity** – Burapha recognizes diversity as strength. Discrimination against any employee in respect of race, ethnic background, gender, disability, sexual orientation, religion, political opinion, maternity, social origin or similar characteristic is prohibited;
- **Forced Labour** - Any form of involuntary labour is prohibited;
- **Child Labour** - Use of child labour is not permitted. The minimum age for employment shall be in accordance with the ILO Convention or the age specified by local legislation if higher. The employment of young persons shall not jeopardize their education or their development.
- **Wages** - Wages are paid directly to the employees. Employees shall be paid at least the minimum legal wage or the wage specified in an applicable collective labour agreement;
- **Working hours** - Working hours shall not exceed 48 hours and overtime 12 hours per week on average over a year, unless other conditions are specified in local laws or an applicable collective labour agreement.

2.2 Relevant National Legislation and Guidelines

2.2.1 Lao PDR Institutional Framework and Environmental Permitting Process

The key government agency responsible for environmental and social assessment of the Project via the EIA process is the Department for Environmental and Social Impact Assessment (DESIA), Ministry of Natural Resources and Environment (MONRE). The ***Decree on Environmental Impact Assessment (2010)***, the ***Environmental Assessment Guidelines (2012)*** and the ***Guideline on Public Involvement in the Environmental and Social Impact Assessment Process (2012)*** currently guides the environmental and social assessment process in Lao PDR, which has considerably strengthened the associated permitting requirements and applicable industry requirements. Recently released ***Ministerial Instructions for the Conduct of ESIA's (No. 8030 – December 2013)*** outline the updated format and procedural requirements of this process.

Duties of MONRE include:

- Providing technical guidelines for report preparation, including the EIA, Environmental and Social Management and Monitoring Plan (ESMMP);
- Conducting field surveys in collaboration with the local administration and the concerned agencies;
- Participating in discussions at village and district levels, together with the project affected people and other stakeholders;
- Actively coordinating discussion meetings at Provincial or Capital level;
- Reviewing EIA and ESMMP reports; and
- Consideration and issue environmental compliance certificates to approve reports and plans, where applicable.

The responsibilities of concerned agencies in the EIA process, as described in the EIA Decree, include:

- Providing technical comments for EIA and ESMMP Reports;
- Participation in meetings at the District level (where Provincial or Capital divisions participate), Provincial level or Capital level (where ministerial agencies participate); and
- Participation field surveys, with MONRE.

The role of local authorities in the EIA process includes:

- Cooperation with project developers in field surveying and in data collection for report preparation;
- Organisation of consultation meetings with project affected people and other stakeholders;
- Dissemination of information to relevant people, including: the objectives of investment projects, potential benefits for stakeholders, social and environmental impacts which may arise from investment projects and measures to prevent and minimise those impacts; and
- Assessment of ESMMPs before MONRE will issue environmental compliance certificates to approve those plans.

The current EIA and environmental permitting process in Lao PDR is described below and is illustrated in Figure 2-1. The first step is the screening process to determine whether the project is a Category 1 or Category 2 project. Table 2-1 outlines the definitions of Category 1 and 2 projects as stated in the *Decree on Environmental Impact Assessment (2010)*.

Table 2-1 Project Categories as defined by the Decree on Environmental Impact Assessment (2010).

Category	Project
Category 1	Small scale investment projects with minor environmental and social impacts.
Category 2	Large scale investment projects which are complicated or create significant env. or social impacts.

Category 1 projects require an Initial Environmental Examination (IEE), while the Category 2 projects require an Environmental Impact Assessment (EIA) to be undertaken.

During the project scoping phase, the Project Developer prepares a Scoping Report and detailed Terms of Reference (TOR) for the preparation of the EIA as required in Decree 112/PM (Article 11). MONRE will revise, comment and approve the TOR to ensure the proposed EIA approach satisfies GOL requirements.

The preparation of the EIA Report and ESMMP require consultations with local authorities and affected peoples. MONRE conducts administrative and technical reviews of the EIA Report and ESMMP. The Project Developer is required to revise the EIA Report and ESMMP to comply with the consolidated comments provided by MONRE. Once MONRE is satisfied with the EIA Report and ESMMP (if applicable), the Environmental Compliance Certificate is issued with specific conditions, where required. Figure 2-1 provides a schematic representation of the current EIA cycle in Lao PDR.

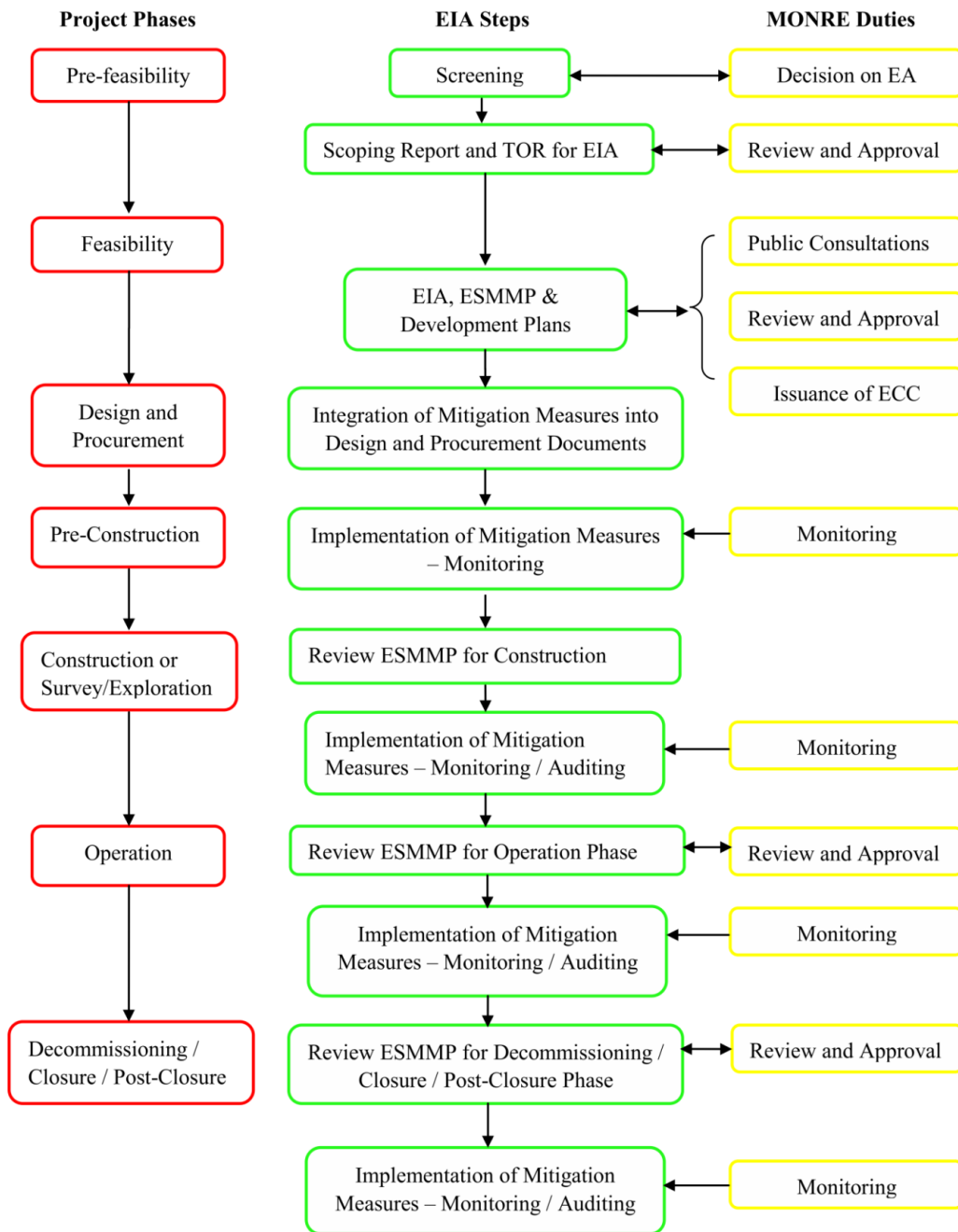


Figure 2-1 ESIA process in Lao PDR (MONRE, 2012)

2.2.2 Governance of Agroforestry

The Ministry of Agriculture and Forestry is responsible for regulating and promoting agroforestry operations. MONRE, Ministry of Planning and Investment and their provincial and district offices provide additional oversight.

Ministry of Agriculture and Forestry (MAF) is the lead agency responsible for the management of natural resources associated with forests and agricultural land, including production forests, conservation forests, and protected areas. MAF is the main agency responsible for the sustainable development and management of the plantation sector and implements relevant policies, laws and regulations related to forestry. MAF participates in approving national and foreign investment projects, including plantation projects in cooperation of the Ministry of Planning and Investment (MPI) and the National Land Management Authority

(NLMA). MAF designates various responsibilities to Provincial Agriculture and Forestry Offices (PAFO) and / or District Agriculture and Forestry Offices (DAFO).

Department of Forestry (DOF), an agency within the MAF provides services related to forest management, protection and development, including: inspecting, monitoring, and evaluating the implementation of laws set forth by the National Assembly, and decrees, decisions, orders, and regulations issued by the government concerning the management, protection, use, and sustainable development of forest resources. The DOF, via its Provincial (PAFO) and District (DAFO) offices also monitor plantation project operations.

Ministry of Natural Resources and Environment (MONRE) is the chief agency responsible for the management of natural resources and environment and social management in the Project area. MONRE and its Provincial Departments (PONRE) will monitor / audit the Project for adherence to environmental standards concerning development activities. MONRE, through the Department of Land Administration, also has the right to approve the lease or concession of degraded forest land for commercial timber activities. The PONRE may approve leases or concessions for not more than 500 ha per one activity. MONRE has the right to approve lease or concession of degraded forest land with an area of more than 500 ha to 2,000 ha per one activity or one investment permit. Central government approval is required for leases / concessions of 2,000 – 50,000 ha, whereas areas of greater than 50,000 ha must be approved by the National Assembly

Ministry of Planning and Investment (MPI) is the responsible agency for promoting domestic and foreign investments and monitoring investment performance. The MPI is also responsible for negotiating land lease or land concession agreements for investment projects in collaboration with its Provincial Departments and MONRE.

Ministry of Finance (MOF) is responsible for the collection of taxes and royalty payments for various laws including the Law on Tax No. 04/NA (2005), and the Decree on Land Tax No. 01/PO (2007). Within the MOF, the **Department of Customs** is the agency tasked with determining and collecting the duties on goods exported for Lao PDR.

2.2.3 Relevant Legislation and Guidelines

Table 2-2 lists the main decrees, laws, regulations and policies relevant to the Agroforestry project in Lao PDR.

Table 2-2 Relevant Lao PDR laws, regulations and policies for the Burapha Agroforestry Project

Title	Year
Laws	
Law on Resolving Public Complaints	2014
Environmental Protection Law	2013
Law on Labour Protection	2013
Law on National Heritage	2013
Law on Hygiene, Disease Prevention and Health Promotion	2012
Law on Investment Promotion	2009
Law on Agriculture	2008
Law on Aquatic and Wildlife	2007
Law on Fire Prevention and Firefighting	2007
Law on Forestry	2007
Land Law	2003
Law on Water and Water Resources	1996
Decisions, Directives, Regulations, and other Legislation	
Decree on Compensation and Resettlement Management in Development Projects	2016
Order of the Prime Minister on Strengthening the Management and Inspection of Logging, Wood Transport and Timber-Related Businesses	2016
Decree on Conservation Forest	2015

Title	Year
Notification from the Ministry of Labour and Social Welfares on Minimum Wage in Lao PDR	2015
Ministerial Instruction on the Process of EIA of the Investment Projects and Activities	2013
Moratorium on Land Concession for Mining, Rubber and Eucalypt Investment Projects	2012
Environmental Impact Assessment Guidelines	2012
Guidelines on Public Involvement in Environmental and Social Impact Assessment	2012
Agreement of the Minister on the Management and Use of Plant Variety	2012
National UXO and Mine Action Standards	2012
Regulation on the Control of Pesticides in Lao PDR	2010
Decree on Protection Forest	2010
Agreement on the National Environmental Standards No. 2734/PM-WREA	2010
Notification of MAF No. 1374/MAF on Development and Promotion of Sustainable Forest Plantation	2010
Guidelines of the Department of Forestry No. 1643/DOF on the Conduct of Economic-Technical Studies for Industrial Tree Plantation and Non-timber Forest Product	2010
Decree on State Land Lease and Concession	2009
Presidential Decree on Land Tax	2007
Order of the Minister on the Promotion of Agro-biodiversity approach in Agriculture and Forestry Development	2005
Prime Minister Decree No. 96/PM on Industrial Tree Plantation and Environmental Protection	2003
Instruction of MAF No. 0115/MAF on Plantation Forest for Wood Processing Factory, Plantation Registration, Plantation Tree Harvest Permit and Export of Planted Timber	2003
Regulation of MAF No. 0196/MAF on Development and Promotion of Sustainable Forest Plantation	2000
Instruction of MAF No. 1849/MAF on Forest Plantation Registration Process	1999
Instruction of the Prime Minister No. 03/PM on the Implementation of Land and Forest Allocation Program	1996
Instruction of MAF No. 0822/MAF on Management of Tree Planting and Planted Forests	1996
Decree on the Establishment of National Forest Reserves	1993

The **Law on Forestry** (2007) sets fundamental principles, regulations and measures on management planning, conservation, and development and utilization of forest resources, promotion of tree plantation and increase forest resources. The Law officially recognises forest plantation development which could be established in production forest areas classified as 'degraded' or 'bare'; and in other appropriate land types:

- Article 30: Recognises forest plantation aiming for supplementing the increased timber demands and forest products on a sustainable basis.
- Article 32: Outlines forest plantation planning for organizations in collaboration with local authorities. The plantation plans shall determine tree species, planting locations and areas, funding as well as key stakeholders involving in plantation activities.
- Article 34: Organizations, private sectors and individuals participating in regeneration of degraded natural forest and young fallow forest are encouraged by the Government. This includes benefits and incentives to be provided by the Government in accordance with the regulations and policies.
- Article 35: Articulates that organizations and individuals are able to establish tree plantation in degraded production forest areas to supply wood materials to processing industries as well as support livelihood development of local communities. The Government would provide incentive policies suitable for domestic and foreign investments including conditions for land lease or concession, fees and taxes, and technical support in accordance with regulations.
- Article 36: Management of tree planting activities shall be undertaken in accordance with regulations and standards set by the Ministry of Agriculture and Forestry and other agencies. Plantation management such as site selection, site preparation, selection of species production of seedlings, planting, plantation maintenance, fire management, pest and diseases controls, and certification of planted forest areas is required to meet technical standards and regulations.

- Article 74: Defines process and requirements for lease or concession for plantation projects in degraded forest areas or barren land. Plantation investors are required to conduct environmental and social impact assessment as well as technical and economic studies on potential plantation areas.
- Article 75: Provincial or Vientiane Capital Administration Authority has the right to approve a lease or concession of degraded forestland of not more than 150 ha per project and with a maximum lease or concession period of not more than 40 years with extensible depending on the case, through a proposal made by the Provincial or Vientiane Capital Land Management Authority based on the agreement of Provincial or Vientiane Capital Agriculture and Forestry Office;

The Government has the right to approve a lease or concession of barren forestland with an area of more than 500 hectares to 30,000 hectares per one project and with a lease or concession period of more than 40 years, but with the maximum period of no more than 60 years with extensible depending on the case, through a proposal made by the National Land Management Authority based on the agreement of the Ministry of Agriculture and Forestry. In the case of more than 30,000 hectares, such parties require the approval from the National Assembly Standing Committee based on the proposal made by the government. In rural and remote areas, the period of lease or concession may be more than 40 years, but with the maximum of the period not more 70 years with extensible depending the cases.

- Article 76: The scope of the right to approve a lease or concession on barren forestland for regenerating forests, planted forests, industrial tree species or NTFPs are follows:

Provincial or Vientiane Capital Administration Authority has the right to approve a lease or concession of barren forestland with an area of not more than 500 hectares per one project and with a maximum lease or concession period of not more than 40 years with extensible depending on the case, through a proposal made by the Provincial or Vientiane Capital Land Management Authority based on the agreement of Provincial or Vientiane Capital Agriculture and Forestry Office;

The government has the right to approve a lease or concession of barren forestland with an area of more than 500 hectares to 30,000 hectares per one project and with a lease or concession period of more than 40 years, but with the maximum period of no more than 60 years with extensible depending on the case, through a proposal made by the National Land Management Authority based on the agreement of the Ministry of Agriculture and Forestry. In the case of more than 30,000 hectares, such parties require the approval from the National Assembly Standing Committee based on the proposal made by the government. In rural and remote areas, the period of lease or concession may be more than 40 years, but with the maximum of the period not more 70 years with extensible depending the cases.

The **Environmental Protection Law (2013)** is the overarching piece of environmental legislation in Lao PDR. The law specifies the principles, rules and measures to manage, protect, monitor and rehabilitate the environment, as well as to contribute to the socio-economic development of the nation and reduce the impacts of climate change (Article 1). Articles 51 and 52 specifically address the rights, duties and obligations of natural resource users:

Article 51: Rights and duties of natural resources users

1. *Persons, individuals and organizations can utilize natural resources in compliance with the related laws and regulations.*

Article 52: Obligations of natural resources users - The obligations of natural resources users are as follows:

1. *To use natural resources in an economic, reasonable, efficient and sustainable way;*
2. *To assess the impact that might occur on social and natural environment from natural resources usage and implement appropriate protection or mitigation of the impacts as defined in the related laws and regulations;*
3. *Do not adversely impact the rights and benefits of others in using the natural resources;*
4. *To solve the impacts and restore areas which are affected from utilization of natural resources;*
5. *To contribute and participate in natural resource protection;*

6. To pay natural resources, eco-system and environmental protection fee as defined in the specific regulations;
7. To compensate for losses that affect the social and natural environment as a result of utilization of natural resources; and
8. To implement other obligations as defined in the laws and regulations.

The **Land Law, 2003**, describes the system of land tenure, with all land recognised as the property of the nation, and remaining under the control of the Government of the Lao PDR. However, the law recognises and protects private land use rights. These rights can be transferred, granted by the State, or inherited provided taxes on the land have been paid. Land is categorised in accordance with the form of use, and various principles are outlined in the legislation for respective land use. This law provides an important framework for any land compensation, as despite the lack of freehold title, the land use rights are a tradeable commodity. The land classification administration is also important for determining the various categories of land use within the Project area. The Land Law, 1997 was amended in 2003 to set out the main institutional responsibilities for land management and administration in Lao PDR and stipulates that the overall responsibility for land administration will, once established, belong to the National Land Management Authority (now part of MONRE).

The **Law on Water and Water Resources, 1996**, outlines a similar approach with all water and water resources remaining the property of the State. If relevant approvals are gained by an applicant seeking to use water resources, individuals or entities may attain water use rights. Article 29 stipulates a range of responsibilities for all water users, including the preservation of water resources, the efficient use of water, and the responsibility to maintain water quality, including the environmental and aesthetic qualities of waterbodies.

2.3 Lao PDR Discharge and Ambient Standards

In developing an environmental and social management and monitoring program for the Project, it will be necessary to consider:

- Discharge / emissions guidelines for off-site releases of water, waste and potential airborne contaminants; and
- Ambient guidelines for the protection of beneficial uses and environmental values (e.g. aquatic fauna / fisheries protection, drinking water protection, etc.).

National discharge standards, from the *Agreement of the National Environmental Standards* (MONRE, 2010) and the *Lao PDR General Industrial Wastewater Discharge Standards* are provided in the Project ESMMP.

2.4 International Policies, Guidelines and Standards

2.4.1 World Bank / IFC Performance Standards

Burapha is committed to developing the Agroforestry Project to an international standard. In addition to compliance with national environmental and social standards and regulations for Lao PDR, Burapha aims to align with the requirements of the IFC *Sustainability Framework* (2012). The IFC Guidelines and Sustainability Framework are summarised below (Table 2-3).

The Sustainability Framework developed by the IFC articulates strategic commitment to sustainable development and is an integral part of its approach to risk management. Originally implemented in April 2006, the Sustainability Framework was subsequently updated in 2011, and became effective on January 2012. The key changes include: the categorisation of financial intermediaries (FI) projects according to risk; a requirement for free prior and informed consent (FPIC) from indigenous peoples in certain situations; the addition of protection for migrant workers; strengthened transparency on greenhouse gas emissions; the disclosure of extractives project contracts; and the promise of more project-level information.

The updated Sustainability Framework reflects the evolution in good practice for sustainability, risk mitigation, and transparency. The Sustainability Framework consists of the revised IFC Policy on Environmental and Social Sustainability, a newly introduced Access to Information Policy and revised Performance Standards.

Table 2-3 IFC Performance Standards (2012)

Performance Standards	Objectives
1 Assessment and Management of Environmental and Social Risks and Impacts	<ul style="list-style-type: none"> ● To identify and evaluate environmental and social risks and impacts of the project; ● To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment; ● To promote improved environmental and social performance of clients through the effective use of management systems; ● To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately; and ● To promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.
2 Labour and Working Conditions	<ul style="list-style-type: none"> ● To promote the fair treatment, non-discrimination, and equal opportunity of workers; ● To establish, maintain, and improve the worker-management relationship; ● To promote compliance with national employment and labour laws; ● To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain; ● To promote safe and healthy working conditions, and the health of workers; and ● To avoid the use of forced labour.
3 Resource Efficiency and Pollution Reduction	<ul style="list-style-type: none"> ● To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities; ● To promote more sustainable use of resources, including energy and water; and ● To reduce project-related GHG emissions.
4 Community Health, Safety and Security	<ul style="list-style-type: none"> ● To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances; and ● To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.
5 Land Acquisition and Involuntary Resettlement	<ul style="list-style-type: none"> ● To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs; ● To avoid forced eviction; ● To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost⁴ and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected; ● To improve, or restore, the livelihoods and standards of living of displaced persons; and ● To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.
6 Biodiversity Conservation and Sustainable Management of Living Natural Resources	<ul style="list-style-type: none"> ● To protect and conserve biodiversity; ● To maintain the benefits from ecosystem services; and ● To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

Performance Standards	Objectives
7 Indigenous Peoples	<ul style="list-style-type: none"> • To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. • To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts. • To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. • To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle. • To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present. • To respect and preserve the culture, knowledge, and practices of Indigenous Peoples.
8 Cultural Heritage	<ul style="list-style-type: none"> • To protect cultural heritage from the adverse impacts of project activities and support its preservation. • To promote the equitable sharing of benefits from the use of cultural heritage.

The IFC EHS Guidelines are technical reference documents that provide guidance for projects in relation to key environmental, health and safety issues and parameters. Key EHS guidelines relevant to the Project include:

- General Environmental Health and Safety Guidelines (2007); and
- EHS Guidelines for Forest Harvesting Operations (2007);

Other IFC guidelines potentially relevant to the social impacts of the Project include:

- Environmental Health and Safety Guidelines for Water and Sanitation (2007);
- Addressing Grievances from Project-Affected Communities (2009);
- Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets (2007);
- A Guide to Biodiversity for the Private Sector (2006); and
- Sections I and II of the World Bank Group Pollution Prevention and Abatement Handbook (PPAH, 1999) (note: Section III was superseded by the revised IFC Environmental, Health and Safety Guidelines in 2007).

International discharge standards applicable for the Project include:

- General EHS Guidelines: Air Emissions and Ambient Air Quality (IFC, 2007);
- EHS Guidelines for Forest Harvesting Operations (2007);
- Ambient Air Quality Guidelines (WHO, 2005);
- Effluent Guideline for Board and Particle Based Products (IFC, 2007);
- Guidelines for Drinking water quality 3rd edition (WHO, 2008); and
- General EHS Guidelines: Noise. (IFC, 2007).

2.4.2 Certification

Burapha will achieve FSC Forest Management and / or Programme for Endorsement of Forest Certification for its agroforestry operations, which requires adherence to the principles and standards of the select certification scheme.

Forest Stewardship Council (FSC) Forest Management

FSC Forest Management certification requires adherence to FSC Principles and Criteria, comprising:

- **Principle 1: Compliance with Laws** – the Company shall comply with all applicable laws, regulations, and nationally ratified international treaties, conventions and agreements;
- **Principle 2: Workers Rights and Employment Conditions** - the Company shall maintain or enhance the social and economic wellbeing of workers;
- **Principle 3: Indigenous Peoples' Rights** - The Company shall identify and uphold indigenous peoples' legal and customary rights of ownership, use and management of land, territories and resources affected by management activities;
- **Principle 4: Community Relations** - the Company shall contribute to maintaining or enhancing the social and economic wellbeing of local communities.
- **Principle 5: Benefits from the Forest** - the Company shall efficiently manage the range of multiple products and services of the Management Unit to maintain or enhance long-term economic viability and the range of environmental and social benefits;
- **Principle 6: Environmental Values and Impacts** - the Company shall maintain, conserve and/or restore ecosystem services and environmental values of the Management Unit, and shall avoid, repair or mitigate negative environmental impacts;
- **Principle 7: Management Planning** - the Company shall have a management plan consistent with its policies and objectives and proportionate to scale, intensity and risks of its management activities. The management plan shall be implemented and kept up to date based on monitoring information in order to promote adaptive management. The associated planning and procedural documentation shall be sufficient to guide staff, inform affected stakeholders and interested stakeholders and to justify management decisions;
- **Principle 8: Monitoring and Assessment** - the Company shall demonstrate that, progress towards achieving the management objectives, the impacts of management activities and the condition of the Management Unit, are monitored and evaluated proportionate to the scale, intensity and risk of management activities, in order to implement adaptive management;
- **Principle 9: High Conservation Values** - the Company shall maintain and/or enhance the High Conservation Values in the Management Unit through applying the precautionary approach; and
- **Principle 10: Implementation of Management Activities** - Management activities conducted by or for the Company for the Management Unit shall be selected and implemented consistent with the Company's economic, environmental and social policies and objectives and in compliance with the Principles and Criteria collectively.

Programme for the Endorsement of Forest Certification

PEFC Sustainable Forest Management certification requires adherence to general and specific requirements set forth in PEFC International Standard – Requirements for certification schemes (PEFC ST 1003:2010), including:

- **Criterion 1:** Maintenance and appropriate enhancement of forest resources and their contribution to the global carbon cycle;
- **Criterion 2:** Maintenance of forest ecosystem health and vitality;
- **Criterion 3:** Maintenance and encouragement of productive functions of forests (wood and non-wood);
- **Criterion 4:** Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems;
- **Criterion 5:** Maintenance and appropriate enhancement of protective functions in forest management (notably soil and water);

- **Criterion 6:** Maintenance of other socio-economic functions and conditions; and
- **Criterion 7:** Compliance with legal requirements.

2.4.3 Other International Standards and Guidelines

The Project will incorporate international best practices and will align with potentially relevant certification requirements that the Company currently adheres to or may prescribe to in the future, including:

- International Association for Impact Assessment (IAIA) Guidelines and Standards;
- International Organisation for Standardisation, environmental and social management systems (ISO 14001);
- Occupational Health and Safety Management Systems (e.g. OHSAS 18001 and / or ISO 45001); and
- Social Accountability International (SA8000).



Chapter 3 | Project Description and Alternatives

Chapter 3 | Project Description

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3 PROJECT DESCRIPTION AND ALTERNATIVES

3.1 Project Overview

Burapha plans to establish an estate of up to 55,000 ha of short-rotation Eucalyptus and Acacia plantations in Central Lao PDR, requiring approximately 68,750 ha of lease area to account for riparian buffers, steep slopes and additional uncleared / unplanted area. Existing Project components include plantation areas, a tree nursery, a sawmill / wood manufacturing facility, and supporting infrastructure. To date, the Company has acquired land use rights to approximately 8,000 ha (gross Project land) across 32 villages in seven districts within the Provinces of Vientiane Prefecture, Vientiane Province, Xayabouly Province, and Saisomboun Province (refer to Table 3-1, Table 3-2, Figure 3-1) and has planted approximately 3,000 ha across 23 villages in six Districts.

Burapha proposes to expand its plantation operations in the coming years by acquiring land leases / concession agreements from communities and / or the Government of Lao PDR (GOL) in the same four Provinces it currently operates in (herein referred to as 'Project Provinces'). Land use rights are currently acquired from village lands, individuals and / or the Lao Government utilising various agreements and tenure categories (refer to Section 3.5). Per the **Burapha Land Acquisition Manual** and **Land Selection Criteria**, the Company will seek to lease additional land with vegetation comprised of fallow forest / recently disturbed by swidden agriculture (refer to Figure 3-2 for land use / forest conditions in the potential expansion area) outside of Protected Areas (refer to Figure 3-3). The Company is also in discussion with the Lao Government regarding the potential utilisation of degraded Production Forest once the new policy relating to use of these areas (in draft) has been finalised.

3.2 Project Area

3.2.1 Concession / Lease Areas

Current concession / lease areas are distributed across seven Districts of the four Project Provinces (refer to Table 3-1 and Figure 3-1). Plantations have been established in 23 villages across six districts in Vientiane Prefecture, Vientiane Province and Xayabouly Province (Table 3-2).

The Project will expand into suitable land within the same four Provinces. Land suitability (discussed in Section 3.3.2) considers the potential for the land to support industrial tree plantations and agricultural activities associated with the agroforestry model, geopolitical designations (forest / land use categorisation), as well as avoidance of key environmental and social sensitivities to avoid respective impacts.

Table 3-1 Current Project Area overview

Province	Planted Area (ha)	Unplanted Area (ha)	Gross land area (ha)
Vientiane Prefecture	684.6	846.5	1,531.1
Vientiane Province	2,007.6	3,726.7	5,734.3
Saisomboun Province	0	93	93
Xayabouly Province	225.9	376.6	602.5
Total	2,986.9	4,974.0	7,960.9

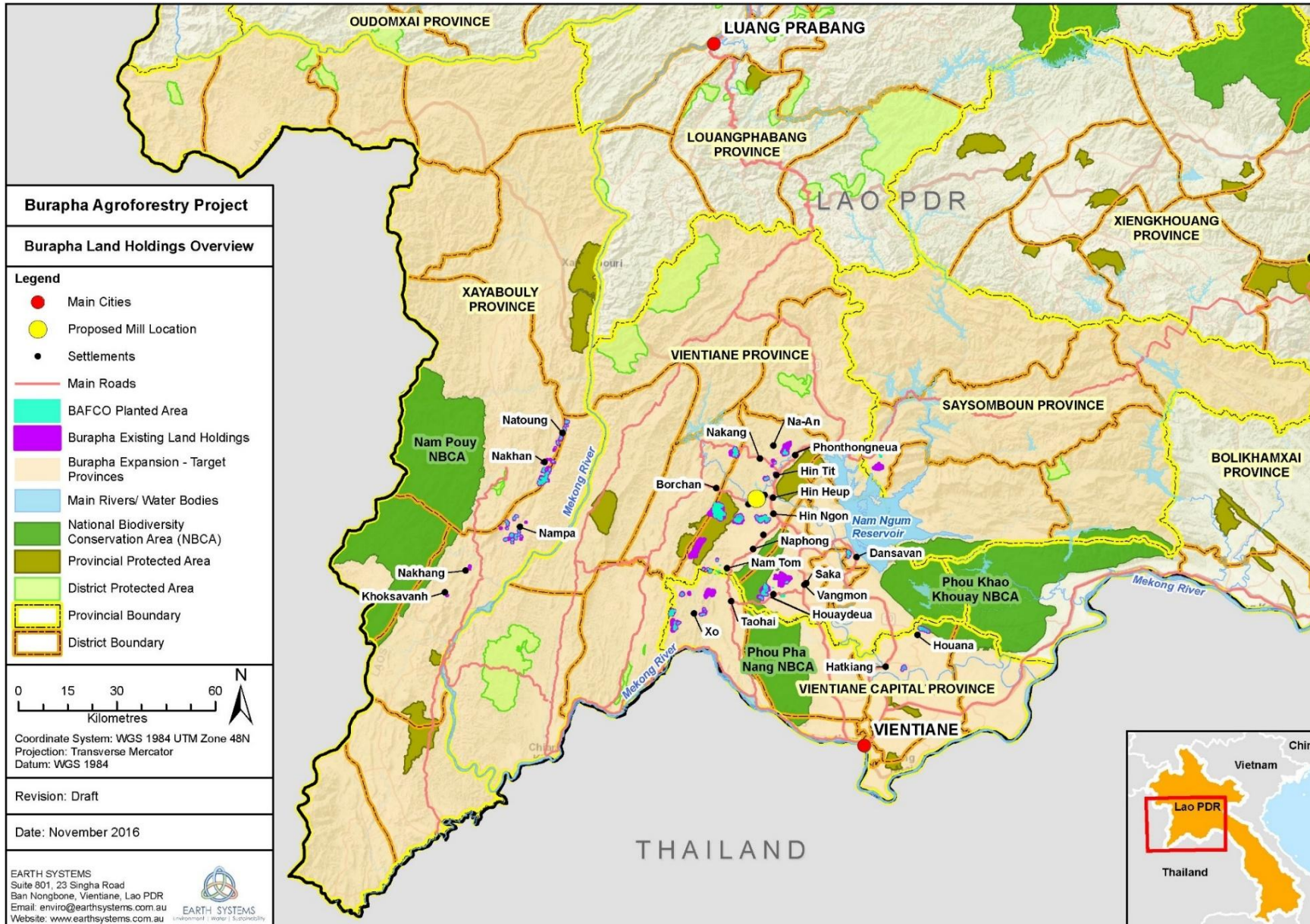
Source: Burapha 2016

Table 3-2 Current Concession / Lease Areas

Village	District	Province	Planted (ha)	Unplanted (ha)	Total (ha)
B.Borchan	Hin Heup	Vientiane	287.0	61.7	348.7
B.Hinngon	Hin Heup	Vientiane	167.9	58.3	226.2
B.Hintit	Hin Heup	Vientiane	75.4	48.1	123.5
B.Khonekeo	Hin Heup	Vientiane	35.0	45.3	80.3

Village	District	Province	Planted (ha)	Unplanted (ha)	Total (ha)
B.Mouangsoum	Annouvong	Saisomboun	0.0	295.5	295.5
B.Na-An	Hin Heup	Vientiane	84.0	347.7	431.7
B.Nakang	Hin Heup	Vientiane	124.6	288.5	413.1
B.Namthom	Hin Heup	Vientiane	37.6	426.7	464.3
B.Naphong	Hin Heup	Vientiane	0.0	468.6	468.6
B.Phonmouang	Hin Heup	Vientiane	605.2	559.7	1164.9
B.Phonngeun	Hin Heup	Vientiane	273.2	153.2	426.4
B.Phonsavan	Hin Heup	Vientiane	0.0	42.5	42.5
B.Phonthong-nuea	Hin Heup	Vientiane	40.0	55.2	95.2
B.Dansavan	Keo-Oudom	Saisomboun	68.8	24.1	93.0
B.Khoksavanh	Paklai	Xayabouly	0.0	3.3	3.3
B.Nakang	Paklai	Xayabouly	0.0	19.6	19.6
B.Nakhan	Paklai	Xayabouly	80.5	231.2	311.6
B.Nampa	Paklai	Xayabouly	111.3	108.0	219.3
B.Natoung	Paklai	Xayabouly	34.1	14.5	48.7
B.Houaydua	Phonhong	Vientiane	270.6	123.5	394.0
B.Nongkhone	Phonhong	Vientiane	0.0	75.2	75.2
B.Phonngeun	Phonhong	Vientiane	0.0	283.7	283.7
B.Saka	Phonhong	Vientiane	7.1	161.1	168.2
B.Vangmon	Phonhong	Vientiane	0.0	232.5	232.5
B.Kouay	Sangthong	Vientiane Prefecture	8.8	91.8	100.6
B.Taohai	Sangthong	Vientiane Prefecture	0.0	138.3	138.3
B.Xo	Sangthong	Vientiane Prefecture	306.8	440.7	747.5
B.Donian	Xaythany	Vientiane Prefecture	7.2	0.0	7.2
B.Hatkiang	Xaythany	Vientiane Prefecture	64.1	4.8	68.9
B.Houana	Xaythany	Vientiane Prefecture	100.3	24.4	124.7
B.Nakhanthoung	Xaythany	Vientiane Prefecture	48.1	34.7	82.7
B.Sean-oudom	Xaythany	Vientiane Prefecture	149.3	111.9	261.2
Total			2986.9	4974.0	7960.9

Source: Burapha 2016



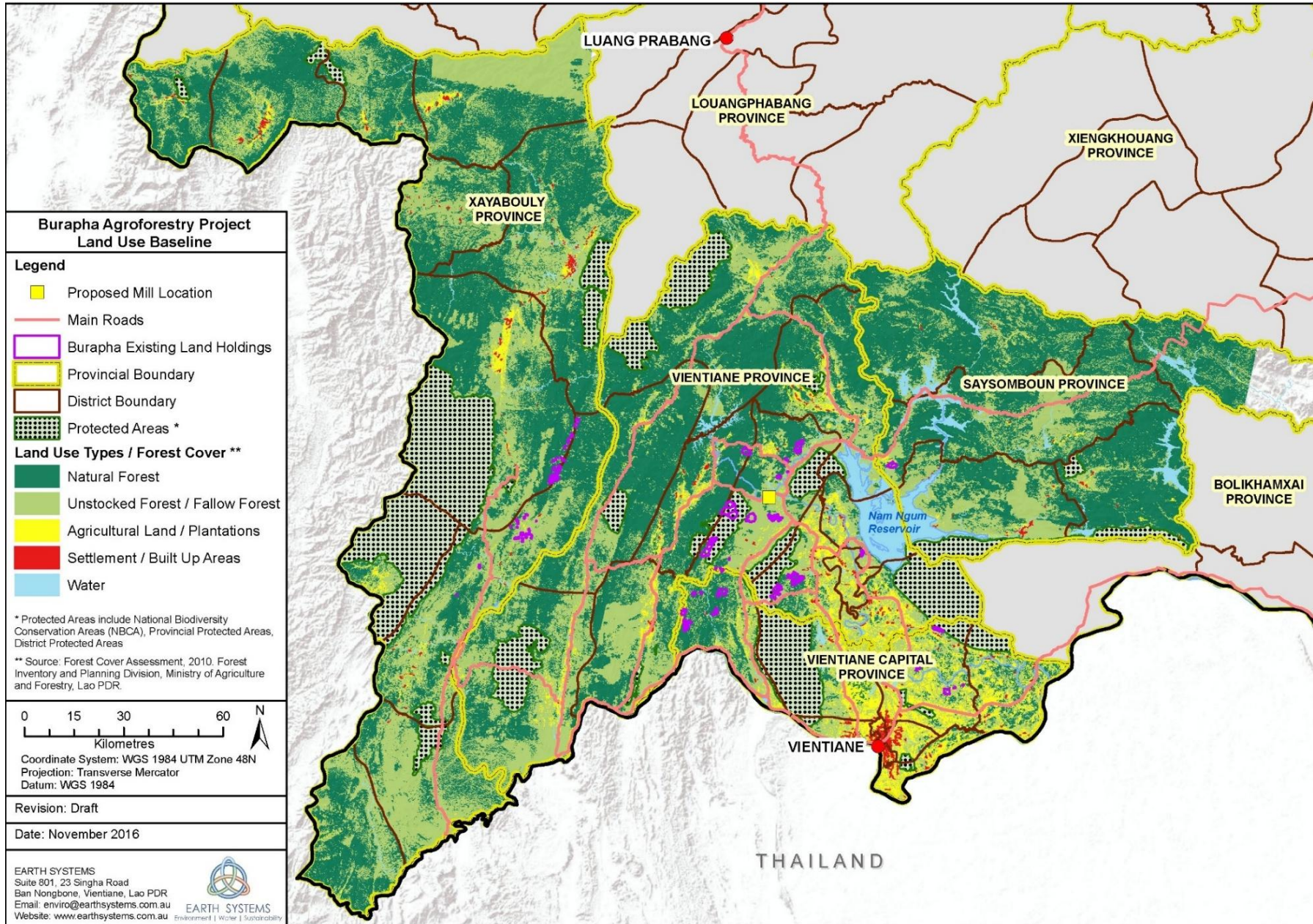


Figure 3-2 Potential Project expansion area (Unstocked / Fallow Forest) by land use

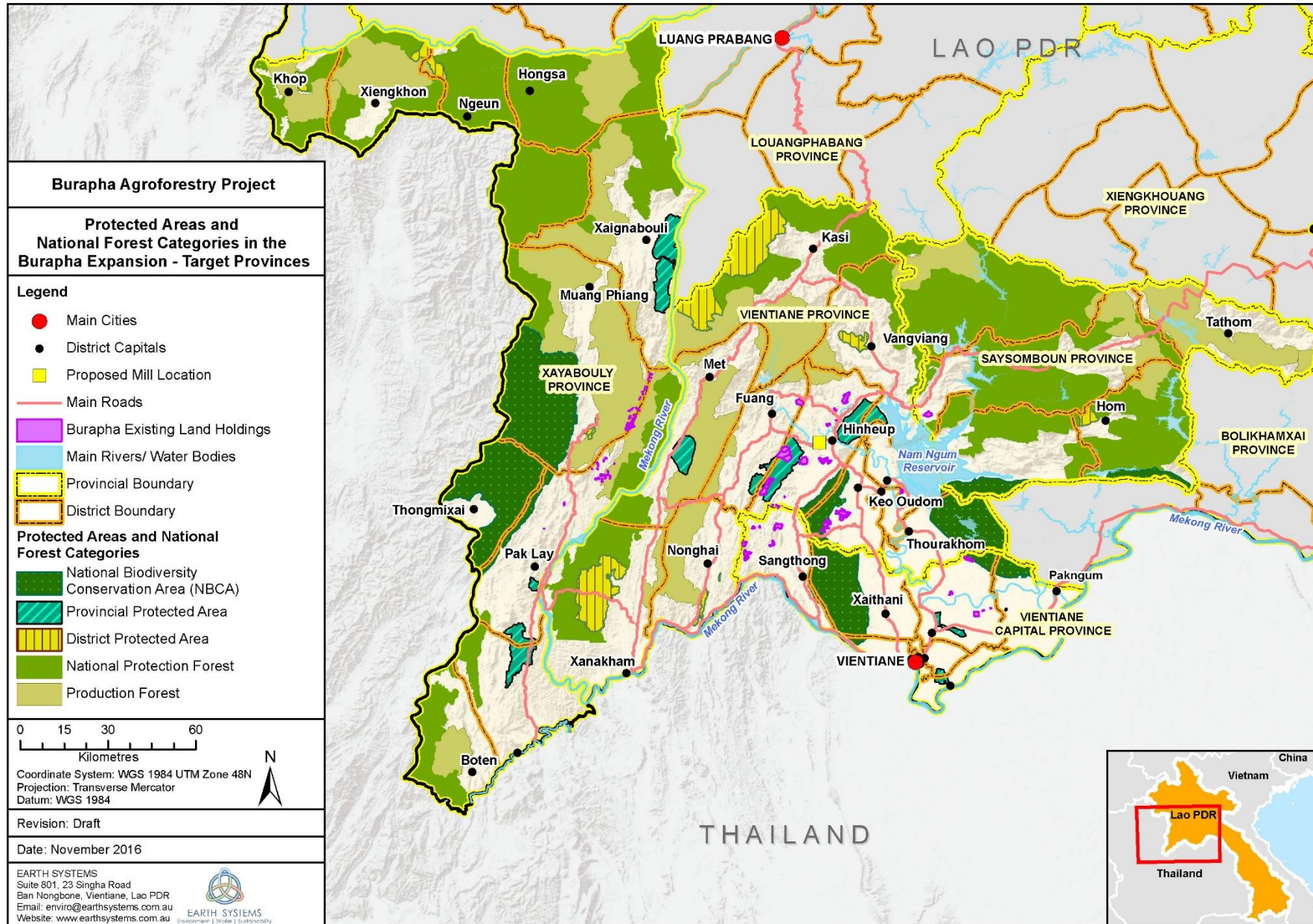


Figure 3-3 National forest categories and Protected Area

3.2.2 Sawmill and Wood Manufacturing Facility

Burapha operates a sawmill and furniture factory at the Nabong Farm in Xaythany District / Vientiane Prefecture to process wood grown in the Company's plantations as well as timber purchased from outside entities (refer to Figure 3-4). Forty-Four Burapha employees currently work at this operation. The sawmill uses primarily domestically grown Eucalyptus, Teak and Acacia purchased from third parties, but is now supplementing this with wood from Burapha plantations and thinning operations.

The facility has a current installed capacity of 15,000 m³ raw input per annum producing approximately 1,500 m³ of ready-made products per year, which services markets in the USA, Scandinavia, Europe, Southeast Asia and the Maldives.



Figure 3-4 Burapha sawmill (north of road) and nursery (south of road) at Nabong Farm

3.2.3 Tree Nursery and Research and Development Facility

Burapha's nursery and research and development (R&D) facility are situated adjacent to the Nabong sawmill and furniture factory in Xaythany District, Vientiane Province (Figure 3-4). The nursery has the current capacity to develop three million cuttings per year (Plate 3-1). Facilities at the nursery include an irrigation system, rooting areas, shade houses, holding areas, mother plant areas and clonal multiplication areas (Figure 3-5). There are also large areas surrounding the nursery for field trials testing a range of tree species for long term suitability to the Lao climate.

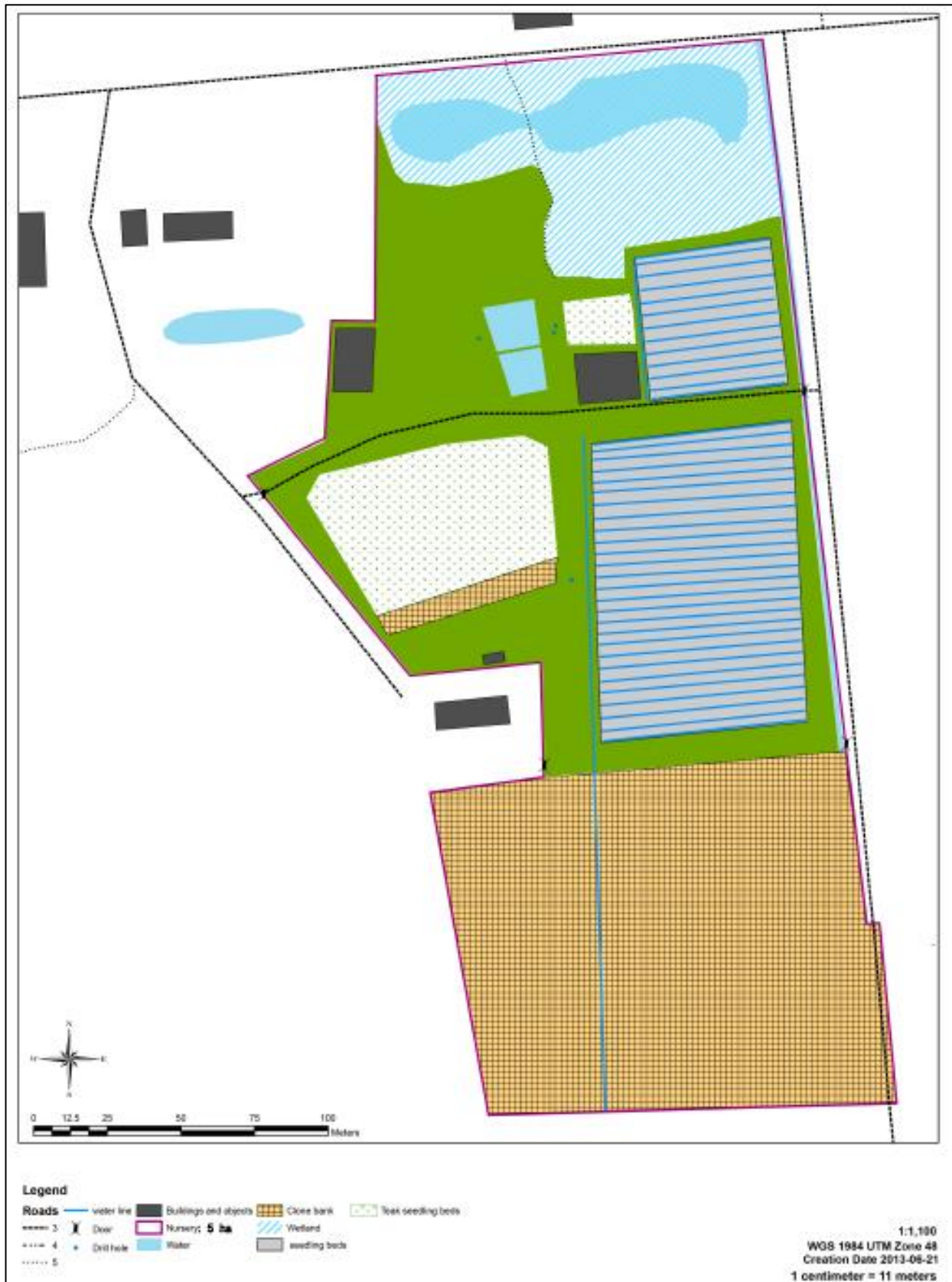


Figure 3-5 Burapha tree nursery layout

3.2.4 Ancillary Facilities

Burapha's main office is in Vientiane and District zonal offices and workers' camps are in Hin Heup District, Phonehong District in Vientiane Province; Sangthong District in Vientiane Capital; and Paklai District in Xayabouly Province.

3.2.5 Outgrower Schemes

The Project will provide opportunities for communities or individuals to establish their own outgrower schemes in collaboration with Burapha. Burapha is committed gradually increasing the involvement of outgrower farmers as the Project matures and is currently working to develop and refine a model or models that best meet community, government, NGO, and Company expectations. The outgrower models proposed below are based upon consultation with communities and shared participation in decision making.

In Lao PDR, relationships between foreign investors and farmers for agricultural commodities are characterised by the allocation of five basic resource elements and a contractual arrangement for a share of the benefits:

- (1) Land: rented or provided;
- (2) Labour: paid or external;
- (3) Capital (initial and working - seedlings, fertiliser);
- (4) Technology: a functional package;
- (5) Access to markets: guaranteed or non-guaranteed.

Burapha is considering implemented versions of what are commonly referred to as the 2+3 model and / or the 1+4 model (with reference to the numbers / elements listed above), with the concepts described below for Model 1 and Model 2. The outgrower scheme is expected to be initiated with trial / pilot programs in one or more village(s), for further expansion utilising the most productive method(s).

A typical 2+3 model generally entails:

- Farmer provides land and labour (2);
- Company provides capital (seedlings, fertiliser etc.) + technology + access to market (3);
- For an agricultural commodity, usually 70% benefit goes to farmer 30% to company. For trees, the farmer might receive all the revenues from the wood, less repayment for the cost of initial seedlings and fertiliser.

A typical 1+4 model generally entails:

- The farmer(s) provide the land (1);
- The Company hires labour (sometimes the farmer partner, sometimes outsiders) and provides capital (seedlings, fertiliser etc.) + technology + access to market (4);
- For an agricultural commodity, typically 30% of the benefits go to the farmer (land owner) and 70% of benefits go to company. For trees, the farmer might receive all the revenues from the wood, less repayment for the cost of initial seedlings and fertiliser.

The two models proposed by Burapha are described as follows (according to email correspondence with Burapha's chief forester, May 2017).

Model 1 – Low intensity / low risk (2+3) models for smallholder engagement - This activity will test pilots for low intensity / low risk models (an interpretation of the GOL 2+3 models) for smallholder engagement for 100 ha in Burapha's area of activity. In a pilot project based around the village of Phone Muong, close to Burapha's planned veneer and plywood mill, it is proposed that Burapha would offer seedlings, fertiliser and advice and plans to offer a viable market for the wood grown after 7 years. Preliminary consultations with the community suggest that this commitment to plant trees might reach 100 hectares equivalent. Using this approach, Burapha will offer a reliable market for wood produced and provide technical advice, seedlings and fertiliser at no cost. The grower will plant the trees in a variety of patterns on their own land (line and boundary plantings, small blocks, intercropping etc.). As part of community engagement, Burapha might consider providing support for registration with the health insurance program if this was attractive (or needed) by the growers (Burapha correspondence, May 2017).

Model 2 – High intensity / low risk (1+4) models for smallholder engagement - This model will test the “high intensity / low risk” approach for smallholder engagement whereby the farmer foregoes the opportunity to share the final harvest in lieu of an annual rent (notionally, the 1+4 model in GOL terminology). The Company might enter into a long-term lease for the farmer’s land (notionally 20 - 30 years) and a nominal 100 ha would be selected by the Company. An annual rent is paid to the farmer (to be determined based upon anticipated wood yields) or a lump sum to cover rent for a set number of years (nominally two rotations) and the Company manages the process and attends to all plantation inputs (future land taxes, site preparation, seedlings, fertiliser, weeding and maintenance and harvesting and transport to the mill). The farmer has opportunities for guaranteed annual rent, paid labour (if desired) and (possibly) an undefined profit-share at wood harvest. A possible variation of these models (requested by the Burapha communities) might include company assistance to pay land tax and gain land use tenure via a Temporary Land Use Certificate (TLUC). This latter refinement requires company and community consultation with District and Provincial authorities (Burapha correspondence, May 2017).

Notably, the models respect the land exclusions according to national law and those which may be imposed by the performance standards of financing agencies such as IFC, including avoidance of: (i) riparian zones, (ii) HCV areas, (iii) steep slopes, (iv) Protected Areas, and (v) land not definitively ‘owned’ by the participating farmer.

Proposed case in a selected village - Legal and administrative (at District and Provincial levels) advice will be sought regarding payment for 3 years of land tax at one time. Assuming a positive outcome (based upon rubber sector precedents), the Burapha team will consult with communities to assess interest, develop selection criteria, conduct interviews and make final a village selection. An independent group (such as VFI) would assist with the development of agreements between the farmers in the selected village(s) and the company, especially regarding appropriate levels of rent. Once land tax has been paid by the company and TLUC issued, the company might use the certificate as security against its contract with the grower which will specify proposed rents which will be established through an independent determination of land value/opportunity cost. Establishment inputs and costs for a notional 100 ha will mirror those for company plantings (Burapha correspondence, May 2017).

3.3 Plantation Development

Plantation management throughout the ESIA and ESMMP have been categorised as follows to better delineate management and mitigation required during specific phases of operation:

- Land Identification and acquisition;
- Plantation establishment;
- Plantation Management / Operations; and
- Decommissioning.

3.3.1 Land Identification and Acquisition

Burapha acquires land use rights for plantation establishment through various land tenure agreements (refer to Table 3-3). Project expansion into new areas is guided by the **Burapha Land Acquisition Manual**, which requires adherence to specific criteria to fulfil Company obligations for environmental and social sustainability (summarised below).

Table 3-3 Burapha Land Lease Agreements

Type	Description	GOL Consultation
Perpetual Land Use Rights	Land with land use rights in a Lao shareholder’s name.	District
Cooperation Agreement with Village	Cooperation Agreements made with villages on land that is state land will be forwarded to relevant government authorities for establishment of Concession Agreements. The agreement period shall be 30 + 20 years.	District, Province / MAF
Cooperation Agreement with individuals	Cooperation Agreements made with individuals can only be made on land for which the individual can prove that their land use rights and related documents are fully in accordance with GOL laws, rules, and	District, Province / MAF

Type	Description	GOL Consultation	
	regulation and that land use tax has been paid for the last 3 years. The agreement period shall be 30 + 20 years.		
Concession Agreement	Concession Agreement shall be made for all land that is state land and the procedure shall follow the laws and the regulations of Lao PDR. The agreed concession period shall be 50 + 25 years.	National Assembly	>10,000ha
		Central	>100 – 10,000ha
		Province	>3 - 100ha
		District	3 ha or less
Joint Venture Agreement (JVA)	Joint Ventures can be made with such entities that can prove that their land use rights and related documents are fully in accordance with GOL' laws rules and regulation. A Joint Venture operation shall, in all aspects, follow the same policies and standards that are applied to the Company's own operations.	District, Province / MAF	

Source: Earth Systems 2016

Suitable plantation areas are assessed for potential cooperation agreement / concession using the Burapha Land Assessment Process (Figure 3-6), comprising:

- **Land Scouting** - Potential plantation areas are identified by Burapha, GOL authorities, or villages. Stakeholders are engaged and communications initiated. Field staff screen potential sites against **Burapha Land Selection Criteria** and develop a Land Contact Report for the Burapha Land Department. Management screen and potentially approve the prospective area for surveys and contact relevant government authorities for notification / approvals regarding an intended reconnaissance survey.
- **Reconnaissance Survey** – Burapha conducts a reconnaissance survey with applicable GOL and Village authorities comprised of a rapid site assessment to collect information on the suitability of the site for plantation establishment; site topography; land use; vegetation; soil quality; and social and environmental restrictions including High Conservation Values (as per FSC requirements) that need to be avoided.
- **Comprehensive Land Survey** – Burapha conducts the following for sites that meet Company / GOL selection criteria following Reconnaissance Survey:
 - » **Information Meeting** – Potentially collaborating villages are introduced to the Company and the agroforestry model. This meeting initiates the Company's free, prior, and informed consent (FPIC) process, informing potential stakeholders of project benefits and potential impacts. Key stakeholders and potential issues are identified for further consultation. Areas for avoidance are preliminarily identified, including sites of archaeological or cultural significance, village conservation and protection areas, high value habitat / vegetation, permanent agricultural areas, important resource collection areas (NTFP and TFP), important water resources, etc.;
 - » **Mapping** – Village Participatory Land Use (PLUP) Maps are used during the Information Meeting to identify potentially suitable areas for plantation establishment and key avoidance areas (per Company Land Selection Criteria and PLUP land use designations). Further avoidance area with respect to environmental and social characteristics are identified and mapped during this exercise;
 - » **Site Survey** – A quantitative and qualitative sampling method is employed around the boundary and along transects through the potential plantation area to verify information collected during the Information Meeting and Reconnaissance Survey. Surveys are used to identify whether (i) the site meets Burapha Land Selection Criteria; (ii) has areas that require avoidance (High Conservation Value Forests / threatened species, sites of cultural / archaeological importance, etc.); (iii) is accessible; (iv) is suitable for agroforestry operations including topography, soil types, vegetation composition and quality, and (v) whether there is potential area for future expansion;
 - » **Village Consultation** – Village consultation is conducted with all adults in the prospective collaborating community, with extensive land use verification, social baseline survey, a focus group discussion regarding potential impacts and needs, a development plan which is annexed to the

potential Cooperation Agreement and consultation regarding village level High Conservation Value Forest, sites of archaeological / cultural significance, etc.

- *Contract Signing and Cooperation Agreement* – Burapha provides villages / individuals with a contract and cooperation agreement that includes a description of work, wages, lease fees, mapping of the plantation area, and conditions of employment for village / individual cooperation agreements which are signed by the Village Chief and Company.

Land Selection Criteria

Suitable land is considered within the four Project Provinces in accordance with the following assessment criteria:

- *Land Use* – Areas with known land use conflicts are avoided, including all environmental and social indicators listed below;
- *Protection Areas* – Burapha avoids establishing plantations in Village, District, Provincial, and National Protection and Conservation Forests;
- *Environmental* – Burapha selects areas with a minimum of 80% of the lot area acceptable for industrial tree plantation establishment. Acceptable planting area includes areas with slope less than 35°; in degraded or barren forest; outside of riparian, High Conservation Value Forests, or sensitive forest areas; and GOL / Village Protection / Conservation Area.
- *Socio-economic* – Burapha does not plant in areas with permanent settlements within its borders; permanent agricultural plots; within 50 m of sites / areas of cultural or archaeological value; area planned for tourism; or in areas of potential land use conflict. The lease requires approval by the Village authority.
- *Suitability for industrial tree plantations* – a number of aspects are registered including topography, land use, vegetation, soil character and all environmental / social criteria listed above.

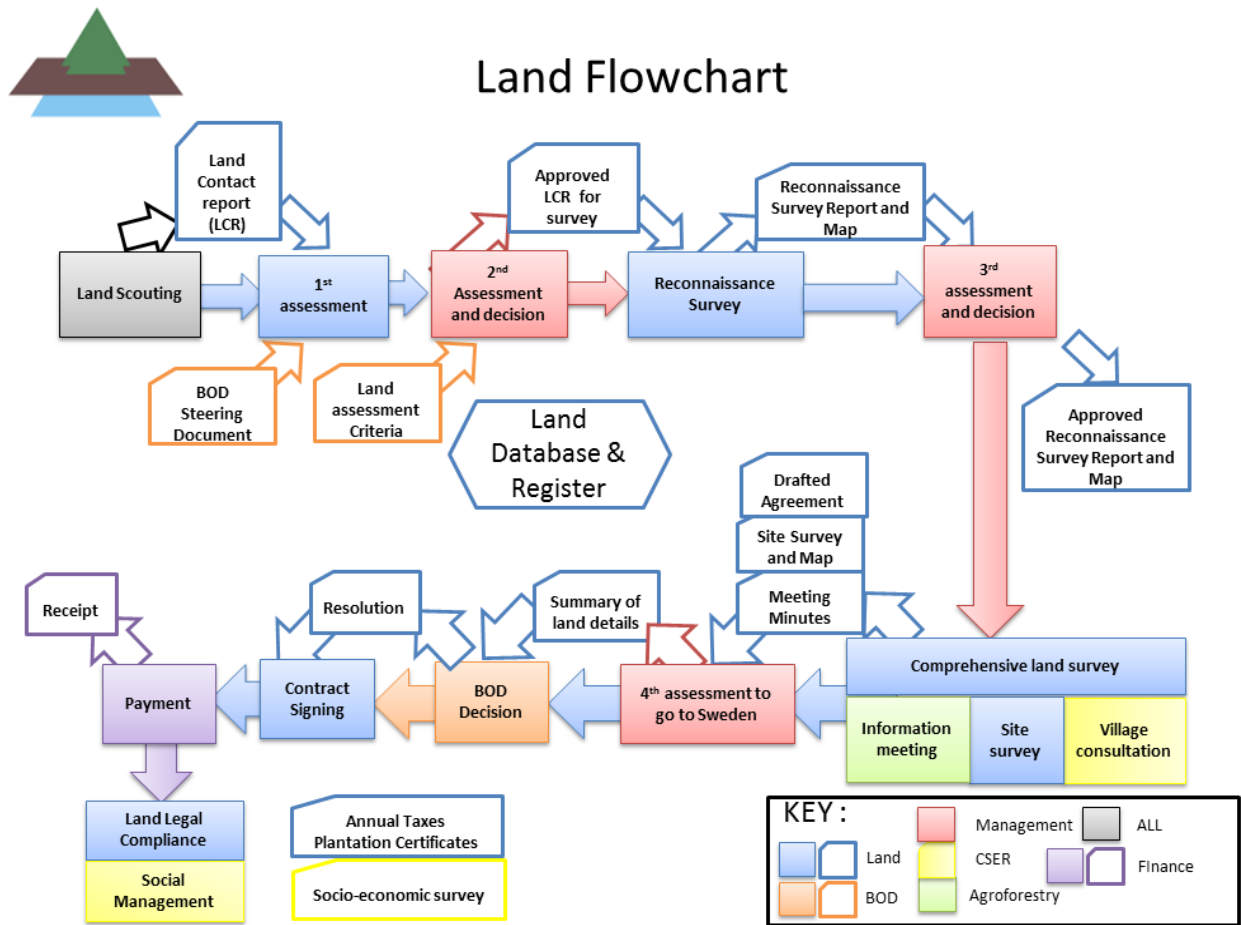


Figure 3-6 Burapha Land Acquisition Process

Source: Burapha 2016

3.3.2 Plantation Establishment

Site Preparation

Site preparation activities are summarised as follows:

Vegetation retention – All areas that will be avoided are clearly demarcated with GPS and flagging prior to vegetation removal activities for ongoing native vegetation retention. These areas include riparian corridors adjacent seasonal and perennial streams; High Conservation Areas defined by a third-party assessor which are deemed critical in supporting environmental and / or social values; areas with slopes > 35°; and strategic areas for fire protection (e.g. ridgelines); each of which are targeted for habitat enhancement and eventual regeneration of a native forest community with multi-canopy structure.

UXO clearance - There are very few known US aerial bombing sites with potential unexploded ordnance (UXOs) within proximity of current Burapha planted areas or land holdings. Most of the recorded bombing sites are located to the east and north-east of the land holdings (refer to Chapters 6 and 9). If the Project expands into these regions, UXO clearance will become a major priority during site preparation. Any new plantation areas that are within recorded bombing sites will be cleared according to national UXO clearance standards. Once plantation areas have been cleared, the Contractor issues a signed UXO Clearing Certificate for the area. No soil preparation or other type of work involving disturbance of the soil are undertaken on land before a signed UXO Clearing Certificate has been issued.

Brush / vegetation and stump removal – Brush / Fallow Forest is cleared manually or with a tractor, pending site conditions. Burapha maximises manual clearing to the extent practicable to increase local job opportunities,

and requires it on steep slopes (>25°). Vegetation is cut to the stump or pulled with roots, where feasible. Burapha then removes stumps on land with slopes of less than 35°. Herbicides (Glyphosate and / or Metsulfuron) are hand sprayed to control invasive plants, per the Burapha *Chemical Application SOP*.

Fire preparation – fire breaks are cleared (and additional fire preparedness measures implemented which are detailed in the Project ESMMP) and slash pulled away from vegetation retention areas / key areas to prevent wildfire or accidental burning of retention areas;

Controlled burns – the slash from brush removal is burned during the dry season prior to the first-rotation planting season. The Company will evaluate the need for controlled burns in subsequent rotations.

Soil Conditioning and Planting

Burapha implements a soil conditioning program to promote tree and crop growth and maintain soil fertility and structure for future rotations. Typical soil preparation activities include:

- Fertilisation: A general fertiliser (NPK and micronutrients) is applied. Pending the results of soil fertility testing, additional fertilisers may be used, including rock phosphate, boron, and dolomite;
- Soil acidity: Dolomite is applied (where necessary) to elevate pH to an acceptable level for tree and crop growth. Dolomite is comprised of calcium and magnesium, which are also provide plant nutrients.
- Agricultural intercropping area: Cropping areas are ploughed using tractor for slopes less than 25°;
- Soil ripping: Soil is ripped to 60 cm depth using a tractor. To prevent soil erosion on land with slopes > 15 degrees, ripping is carried out along the contour line. If this is not possible, the ripping blade is lifted after every 8–10 m to cut the line and thus prevent water from continuing to run down along the line. Manual hole digging takes place (50 x 50 x 50 cm) where ripping is not possible.

Trees are then transported from the nursery to the plantation sites and planted by local villagers (Burapha seasonal workforce). Tree planting is conducted manually and is timed according to the traditional agriculture calendar / precipitation regime. Selection of tree species and the specific clone depend on suitability to site-specific conditions (altitude, soil type, soil humidity, micro-climate etc.).

Tree stocking (density) is approximately 1,100 trees / ha. If farmers want intercropping for two years, 9m x 1m spacing is used. Otherwise, trees will be spaced at 3m x 3m or 4.5m x 2.5m to provide for one year of intercropping.

3.3.3 Plantation Management (Operations)

Burapha plantation management aims to balance stump value and productivity (tree growth) to meet Company processing goals. The silvicultural model has been developed to maximise village agricultural productivity and capability to support livestock grazing. Burapha's *Silviculture SOP* and *Policy on Intercropping* delineate management activities accordingly:

1. Intercropping;
2. Weeding, thinning and fertilising activities;
3. Harvesting of trees for sale;
4. Upgrade of Project Roads, and;
5. Fire management, pest and disease control.

Resources required to implement these steps are described below.

Intercropping Model

The Burapha agroforestry plantation model allows for intercropping of agricultural crops in the plantations during the first year of plantation establishment and grazing land for year's three to seven (refer to Table 3-4). While Burapha leases the entire plantation area, families / individuals are provided user rights to individual

plots to grow crops between the trees at their discretion and may utilise the land for livestock grazing when tree canopies preclude typical crop production.

Though integrated into the agroforestry model, crop production / grazing and associated activities are separate from formal Burapha activities (i.e. user rights are granted, but paid labour is reserved for forestry / cassava operations; Plate 3-2). The family / individual for whom the plot has been assigned is provided user rights for the leased area, undertakes the work at their convenience, and harvests the crops for their own utilisation (consumption or sale). In the case of land leased from villages refer to Section 3.3.4.

Table 3-4 Burapha Agroforestry model labour and intercropping opportunities

Year	1	2	3	4	5	6	7
Company Activity	Site Prep.	Weeding		Thinning			Harvesting
	Planting	Fertilising					
Community Opportunities	Labour (for Company Activities above)						
	Annual Intercropping		Grazing				
	Long Rotation Intercropping (e.g. Rattan)						

Source: Burapha 2016

The agroforestry model will only be implemented in plantations where villagers express an interest in intercropping. Where plantations are far from villagers or where villagers already have sufficient land for agriculture, the intercropping land can be planted with Burapha owned cassava or other crops for the first two years of the plantation cycle.

Key aspects of the model include:

- Tree row spacing allows for village agriculture between the rows (Plate 3-3, Plate 3-4)
- Food and cash crops grown by the farmers in the spaces between the trees belong to them. Each participating family is provided land area dependent on the number of households participating from the village and the total land area;
- Plantations are managed on seven-year rotations. The Company is working toward dividing plantation land into multiple parcels within a given village boundary (as many as seven) to provide agricultural land and labour opportunities on a consistent basis for participating villages;
- Seventy percent of the plantation area will be used for food and cash crop production in the first year of the cycle. Agricultural activity may extend to the second year at the request of the farmer, but this is not typical.. In the third – seventh years of the cycle, no food and cash crops are produced but the plantation area is available for grazing of livestock;
- An agreement for intercropping on land for which the Company has land use rights is signed with each participating village;
- Company staff define which land within the plantation area is for agricultural use and the village is responsible for dividing and allocating this land to individual families. Company staff are not involved in this process;
- The Company provides the farmers who participate in the Plantation Model for the first time with rice seed free of charge;
- The Project will not provide the farmers with the following:
 - » Banana seedlings, tree seedlings (e.g. Yang Bong), or planting material for any other cash crops; and
 - » Fertiliser.
- Crops with a rotation period longer than 12 months are not allowed to be used for intercropping;
- The Project assists farmers with:

- » Technical advice from an agronomist to select best crops to grow and define growth regimes and fertilisation needs; and
- » Market information, especially price and quantity demanded.

Table 3-5 Burapha Agroforestry Project model

Year	Plantation activity	Intercropping
1	<ul style="list-style-type: none"> • Brush clearing (manual clearing via casual workforce or mechanical clearing by Burapha staff, pending site conditions) • Staking & planting • Fertilizing x 2 • Weeding & guarding 	<ul style="list-style-type: none"> • Rice (Rice (owned and managed by individuals) • Other crops (owned and managed by individuals) • Cassava (owned by Burapha, with casual workforce employed to plant, maintain and harvest).
2-4	<ul style="list-style-type: none"> • Weeding & guarding • Singling • Fertilizing 	<ul style="list-style-type: none"> • Rice (for some regions) • Cassava • Other crops
3-4	<ul style="list-style-type: none"> • Weeding & guarding • Thinning 	<ul style="list-style-type: none"> • Pasture for grazing
5-6	<ul style="list-style-type: none"> • Weeding & guarding 	<ul style="list-style-type: none"> • Pasture for grazing
7	<ul style="list-style-type: none"> • Harvesting 	<ul style="list-style-type: none"> • Pasture for grazing

Source: Burapha 2016

Weeding, Thinning and Fertilising Activities

Maintenance of the plantations during their growth cycle involves periodic weeding, thinning and addition of fertiliser. Weeding is normally done manually by villagers, or otherwise by farm tractor using a 16-disc harrow for reduced depth of disturbance. Chemical weeding is used where manual weeding has failed or inadequately controlled invasive plants.

Fertilising activities aim to improve the productive capacity of the soil throughout the plantation rotation, for subsequent rotations, and for post-decommissioning land use. Soils throughout the region are typically acidic often nutrient poor. Burapha applies a general fertiliser (NPK and micronutrients) and additional fertiliser when soil fertility testing indicates deficiencies (including rock phosphate and boron). Dolomite is applied to raise soil pH to a level suitable for tree growth, and provides calcium and magnesium for enhanced soil fertility. Soils are fertilised during the first two years of the rotation.

Fire Control

Firebreaks are constructed and maintained to prevent fire spreading beyond plantation boundaries or encroaching upon boundaries from adjacent areas (in addition to other measures provided in the ESMMP). Firebreaks are kept clean of weeds, vegetation and branches. When plantations have a common border with farmers' land, a firebreak is constructed on the border. Attention is paid to the maintenance of plantation roads, as they form natural firebreaks.

Burapha is considering methodologies to minimise the potential for fire encroachment in vegetation retention areas (refer to ESMMP, Volume D).



Plate 3-1 Seedling production at the Nabong Nursery and Research and Development (R&D) Facility



Plate 3-2 Cattle grazing in between plantation trees



Plate 3-3 Intercropping plantation with cassava



Plate 3-4 Intercropping plantation with upland rice

Workforce

The majority of plantation management tasks will be carried out by local villagers supervised by permanent Project employed staff. The seasonal workforce is contracted to implement the majority of plantation establishment and plantation management tasks, including brush clearing, weeding, fertilising, planting, and tree harvest. Labour is recruited from the participating villages (i.e. communities with plantations within their respective village boundaries) through the village chief, and no "import" of labour from other Districts will take place unless there is a labour shortage.

Subcontractors are used only in cases where work requires specific qualifications and machinery, e.g. rented farm tractors or in the case of labour shortage (i.e. village does not have enough interested individuals to complete the work).

It is expected that the equivalent of 7,860 full time positions (4,393 full time / 10,500 seasonal jobs) will be created through expansion of the Project area.

3.3.4 Project Concession Period

Burapha are implementing their current operations through various land use agreements (refer Table 3-3). Per the Land Law (2003), village cooperation agreements leases are for 30 years with an option for a 20-year extension pending approval by all stakeholders and concession periods are for 50 years with an option for a 25-year extension pending approval by all stakeholders.

Project expansion is expected to utilise similar agreements depending on the preferences of participating local communities.

3.3.5 Decommissioning / Handover

At the end of the Project Concession / Lease period, the Company will either negotiate a new Concession / Lease with local communities and government; hand-over the operation to the GOL or village; or decommission the operation, pending the results of stakeholder consultation. Burapha will consult with the GOL and participating villages to facilitate implementation of measures needed to achieve desired end land uses.

Decommissioning will entail returning the land to a condition that is suitable for agricultural activities or forest regeneration (pending desired end land uses for villages / the GOL). As the Eucalyptus species utilised for operations coppice sprout from stumps following harvest, regeneration of plantation trees will have prohibited to avoid reestablishment and ongoing domination of the canopy by non-native trees. Possible methods for decommissioning include:

- Mechanical stump removal;
- Application of an appropriate herbicide to cut stumps (i.e. surface of stumps of eucalypts are brushed with herbicide immediately after tree felling); or
- “Pocketing” of the stumps (drilling the stump and applying herbicide into the drill holes).

The soil will be of suitable quality to promote reforestation with natural trees (provided that is the end land use determination). This will be accomplished with soil fertility testing to assess nutrient status and deficiencies, with a fertiliser application applied during the dry season following final harvest.

3.4 Project Schedule

A preliminary Project schedule is provided in Table 3-6.

Table 3-6 Preliminary Project Scheduling

Project Phase	Description	Anticipated Timeline
Approvals Process	Decision from Lao Government (GOL) on the Project and associated approvals.	Dec. 2016 – May 2017
Plantation Expansion	Finalise Project funding and work with GOL and local communities to identify and acquire suitable areas for plantation establishment.	May 2017 - Ongoing
Plantation Management	Implement systems to coordinate and manage Company staff, Contractors and community partners for implementation and management of Project plantations.	May 2017 - Ongoing
Extension of Concession / Project Handover / Decommissioning	At the end of the Concession period	End of Concession Period

Source: Burapha 2016

3.5 Project Benefits and Needs

Lao PDR is well placed to capitalise on the large and growing demand for wood products in neighbouring markets such as Vietnam, China and Thailand, through conversion of degraded forest land into sustainable forestry plantations which may invigorate rural economies and support national socio-economic development goals such as the *National Growth and Poverty Eradication Strategy* and the *8th National Socio-Economic Development Plan*.

Burapha has developed an agroforestry model that has provided a range of benefits to local communities including direct and indirect employment, community development initiatives, and land for agriculture within plantations. The Lao government has recognised these benefits and in early 2016 a letter from the Prime Minister's Office endorsed the Company's investment plans to scale-up operations according to its investment plans, thereby spreading the benefits and opportunities that come with their model to the wider population.

Attracting responsible investors utilising international standards (i.e. FSC and IFC) to implement sustainable forest management practices and a commitment to 'shared value' investment outcomes will assist the country in transitioning from a forestry industry which has historically been based on unsustainable logging of natural forests to one based on an internationally competitive plantation forestry sector. A thriving forestry sector will also create new opportunities for Lao PDR in high end manufacturing of innovative and value added wood fibre products which will help to accelerate the Country's transformation from a resource based to a knowledge based economy.

3.5.1 Eucalyptus Plantation Forestry

Eucalyptus species currently account for approximately 26% of global industrial tree plantations internationally. Their widespread success as a commercial species is largely due to their fast growth rates, tolerance to a wide range of soil moisture and soil fertility conditions and relatively low susceptibility to insect / pest attack. Eucalypts provide a range of products including roundwood, wood fibre, pulp, textiles, chemicals, renewable energy and oils.

3.5.2 Benefits to Lao PDR

The Burapha Agroforestry Project is expected to provide a range of benefits to Lao PDR. Direct benefits include government revenue through fees and taxes, increased direct foreign investment in the country and new employment opportunities. Indirect benefits include flow on effects, training / skills development and infrastructure development. Expansion to 68,750 ha (55,000 ha planted) will also make the establishment of a wood and veneer mill and cellulose biorefinery facility viable, which would require a total investment of approximately \$26 million USD and \$750 million - \$1 billion, respectively.

The Project will also contribute to national development goals including the *National Growth and Poverty Eradication Strategy*, the *8th National Socio-Economic Development Plan 2016 – 2020* and the *Forestry Strategy 2030* (under development) which is expected to promote significant expansion of industrial tree plantations in Lao PDR.

Direct Economic Benefits

Current Burapha Agroforestry operations have been well received at the community level. However, the current scale of the Project is such that economic benefit to the greater Lao economy is limited. Expansion of the operation to 55,000 ha of planted area will require significant investment in the country.

Capital and Operating Expenditure

The capital expenditure required to establish the expanded plantation area is expected to be approximately \$26 million. This expenditure will likely result in flow on effects to the Lao PDR national economy. Flow on effects in developing economies are estimated by the World Bank to be as much as 2.5 times the initial input and include the creation of additional employment, small businesses and other opportunities.

Annual operating expenditure for the Project is yet to be determined, but will include salaries, taxes, equipment costs, infrastructure costs, research and development, training and capacity building and community development funds.

Payroll Tax

Payroll tax refers to taxes levied on salaries and other material benefits paid to individual employees. Based on an estimated income tax of 10%, payroll tax is expected to generate considerable revenue over the seven-year plantation cycle.

Income Tax

Income tax is a tax on the year-end net profit (i.e. the difference between gross income and deductible expenses, as listed in the Tax Law). This Project is expected to result in significant additional income tax paid to GOL annually.

Other Government Fees

There are a range of other fees and taxes that will be payable to the government including value added tax, land concession fees (paid on a per hectare basis), log transport and inspection fees, and export tariffs. The fees will cumulatively provide considerable government revenue.

Re-Investment of Revenues

Burapha will re-invest a proportion of income on development in Lao PDR, including investment in the areas of Project expansion, research and development and community development. The Company is also committed to investment in the development of sophisticated processing industries which will promote manufacture of innovative and value added products within the country.

Indirect Benefits

Indirect benefits from the Project include flow on benefits and external effects. Flow on benefits include local business development (i.e. businesses arising to provide goods and services to the Project and to Project employees) and general increased consumption in the local communities resulting from the injection of cash into the local economy. Flow on benefits will generate additional revenue to GOL through taxes paid by businesses and on goods purchased in the new cash economy.

External effects refer to costs or benefits not reflected in price, income or tax revenues. In the case of the Project, these benefits are likely to include skill development, capacity building of GOL representatives, technology transfer, infrastructure development in the Project Area and the surrounding region, and UXO clearance (if needed). Other benefits include the promotion of quality investment demonstrating best practice environmental and social management within the sector, the development of local economies in poor, rural areas where plantations will be established, and reduced logging pressure on natural forests through promotion of a forestry sector based on processing industries supplied by industrial tree plantations. While many of these benefits will be realised at the local level, significant benefits for the Lao PDR economy as a whole are anticipated.

3.5.3 Regional and Local Community Benefits

Burapha has developed and implemented a model for plantation forestry that utilises small concession areas at the contractual consent of community land holders. The model provides lease fees, jobs, community development initiatives, and land for agriculture. Key benefits for local and regional communities from the plantation expansion Project are described below.

Land Leasing

Land lease fees will be paid for individual or communal land acquired for the project in accordance with Burapha's *Land Acquisition Policy*.

Project Employment

The extension of Burapha plantations is expected to create direct employment of approximately 4,366 full time jobs over the 7-year rotation cycle and an additional 1500 jobs in other aspects of operations (e.g. mills). Local

communities will be given first opportunity for employment in plantation operations including plantation establishment, thinning, maintenance and harvesting. The Project will also create spin-off opportunities for suppliers and businesses through local procurement. The associated injection of cash into the local economy through salaries and procurement will have flow-on benefits for local business development and general increased consumption.

Training and Capacity Building

This Project will generate a need for skilled workers capable of operating international standard plantation operations. Burapha will invest in training and capacity building initiatives with Company staff, local communities and the government. The Project will also create a growing need for greater industry investment into advanced research facilities, learning resources, and research skills and expertise which will complement current development initiatives in the forestry sector.

Outgrower Schemes

In accordance with Burapha's *Outgrower Scheme Policy*, the Project will provide opportunities for communities and individuals to establish their own outgrower schemes in collaboration with Burapha (i.e. the 2+3 system), whereby Burapha provides seedlings, technical advice, and potentially an end market for those interested in establishing Eucalypt plantations. In addition, the associated plywood / veneer mill will create a potential market for villagers and communities with existing plantations.

Agriculture

The Burapha agroforestry model which was first introduced in 2006 provides agricultural development opportunities for local communities through plantation design that comprises 30% of land use for tree plantations and 70% for agriculture (of the planted land – e.g. not including riparian buffers, steep slopes, etc.).

Community Development

As part of its current operations, Burapha undertakes development initiatives in partnership with local communities, which may support development of alternative livelihoods or improvement of existing livelihoods. The Project will provide community development funds for participating communities as per the current model which includes annual contributions to Village Development Funds (1 – 3 million Kip / ha), Khum Development Funds (40,000 Kip / ha), and District Development Funds (80,000 Kip / ha). At 68,750 ha, this would equate to approximately \$12 million USD contributed to community development funds, \$300,000 USD to Khum development funds, and \$600,000 USD to District development fund, respectively.

UXO Clearance

Burapha will perform UXO clearance on any land acquired for the project that is affected by UXO. This will provide a lasting benefit for communities by transforming previously dangerous zones into safe, productive land use areas and present agricultural development opportunities for villagers on the cleared land in accordance with Burapha's agroforestry model.

3.6 Consideration of Alternatives

This section outlines the development alternatives available to Burapha. The Project concept presented in this ESIA has been developed recognising that development alternatives have existed for the location and establishment of plantations and key infrastructure associated with the Project. However, Project location is restricted by:

- Topographic, climatic, and geotechnical constraints imposed by the landscape;
- Environmental sensitivities;
- Expectations and concerns of affected communities;
- Availability of land potentially provided by the GOL and / or villages;

- Government laws and regulations;
- Location of Burapha's sawmill; and
- The need to operate the Project profitably.

Therefore, the analysis of alternatives does not focus on regional location within Lao PDR, instead assessing (i) expansion of operations within the current Project Provinces; (ii) utilising traditional plantation forestry silviculture; (iii) developing a plantation forestry or agroforestry project outside of Lao PDR; and (iv) the 'no Project' alternative.

3.6.1 Identification of alternatives

In accordance with the *Environmental Assessment Guidelines (2012)*, an analysis of alternatives has been undertaken considering the following alternatives:

1. Expansion of the current operation to 68,750 ha (55,000 ha planted);
2. Implementing the Project in another country; and
3. The 'No Project' alternative.

Option 1: Expansion of the current agroforestry model and incorporation of traditional plantation forestry

This ESIA assesses the benefits (Section 3.5) and potential physical, environmental, and social impacts (Chapters 7,8, and 9, respectively) of expanding the Burapha agroforestry operations to 68,750 ha (55,000 ha planted), with expansion of operations using a traditional plantation forestry model where there is a shortfall in labour / village land or where villagers are not interested in intercropping. The results are summarised as follows:

Benefits

Project expansion will:

- The success of the agroforestry operation enhancing livelihoods of participating communities is expected to be achievable on a larger scale;
- Provide for a viable industrial tree plantation operation capable of producing the volume of wood required for the Company to achieve operational sustainability;
- Support the development of a Eucalyptus plantation forestry sector in Lao PDR capable of supplying finished products that are increasing in high demand in the region.
- Supply raw material for current and planned manufacturing units, including the sawmill at Nabong Farm, a Veneer and Plywood Mill planned for implementation in Hin Heup District, and potentially a cellulose biorefinery;
- Support national socio-economic development goals such as the *National Growth and Poverty Eradication Strategy* and the *8th National Socio-Economic Development Plan* through extension of community / regional benefits described above to additional communities;
- Provide direct and indirect benefits to Lao PDR (described above) at a significant scale, with flow-on effects expected to benefit the GOL and Central, Provincial, District, and Village Levels;
- Provide significant direct and indirect benefits for regional economies and local communities, including: employment opportunities, community development funding / lease fees, land cleared for agriculture, training and capacity building for the GOL and villagers, and potentially UXO clearance in the northern range of the Project area.

Potential Impacts

Key potential environmental and social impacts associated with Project expansion may include:

- Biological impacts, including conversion of low to moderate value terrestrial habitat to plantations (low quality habitat) and potentially improved access for hunting, fishing, flora harvesting;
- Physical impact, potentially including slight impairment to water quality through increased erosion and sedimentation; localised impacts on surface and groundwater hydrology; and increased potential for wildfire given the volatility of Eucalyptus;
- Social impacts, potentially including resource loss (NFTP and TFP), short term and infrequent nuisance level noise impacts associated with vehicle transit on access roads through villages.

Option 2: Expansion Utilising a Traditional Forestry Model to 68,750 ha

Project expansion utilising a traditional plantation forestry model (3m x 3m or similar spacing) may increase overall yield of eucalyptus using the same seven-year rotation duration. This model could also be structured to provide similar employment and community development opportunities as the agroforestry model. The community agricultural activities and Company cassava production would not be feasible.

Given the removal of swidden agricultural land for plantation establishment, there is some potential for this model to reduce rice production for affected villages. This maybe particularly impactful for those not employed by the Company who may augment lesser agricultural yields with cash generated from plantation work.

Option 3: Location

Silvicapital, the majority owner of Burapha, evaluated more than 100 countries to identify the best location to establish their planned wood processing facilities and associated plantations. After the evaluation, they invested in Lao PDR (Burapha) and Paraguay (SilviPar).

Silvicapital purchased Burapha as the Company has a history in Lao PDR and favours expansion of its current operations provided it can achieve the land area necessary to support planned wood processing facilities. Lao PDR was originally chosen by Burapha due to the potential for the area to support rapid tree growth rates, its low population density, and government stability.

The proximity to Vientiane also provides for skilled labour. The location also provides the requisite infrastructure for transport of products to domestic and international markets.

Option 4: The 'No Project' Alternative

The anticipated benefits and potential impacts of Project expansion are provided in Section 3.5 and Chapters 7-9, respectively. By not proceeding with the Project, none of these benefits would be realised and each of the potential impacts avoided.

In summary, the following benefits associated with Project expansion would not be realised:

- The Company would not have the timber volumes to support the implementation of a veneer and plywood mill and a wood cellulose bio-refinery, depriving plantation owners throughout Lao PDR of viable end markets for their products;
- The Eucalyptus plantation industry in Lao PDR may remain stagnant and likely unviable, as the majority of land acquisition and plantation models of the other large-scale operators has not been widely accepted by communities, NGOs, GOL, and other stakeholders;
- The country would forego foreign direct investment from this Project and the associated veneer and plywood mill (and potentially a planned investment for a Burapha cellulose biorefinery);
- Additional national benefits described above would not be realised, including payroll and income taxes, royalties, other government fees, reinvestment of revenue, flow-on benefits and external effect;
- Regional and community benefits described above would not be realised, including employment opportunities, community development initiatives / lease fees, training and capacity building in communities and for the GOL, and (if applicable) removal of UXO in affected areas;

- Villages will continue to be dependent on agriculture and exploitation of forest products for raising cash income;
- It will be more difficult for the GOL to achieve its objectives relating to the reduction of swidden agriculture as well as broader poverty alleviation goals laid out in the NGPES;
- Women will not benefit from the equal opportunity employment policy implemented by Burapha and may remain vulnerable in some locations throughout the Project area.

In summary, the following potential environmental and social impacts would be avoided:

- Potential environmental impacts associated with conversion of fallow forest to plantations will not occur, including: temporary (long-term) conversion of low to moderate value terrestrial habitat to low quality habitat; increase in erosion and sedimentation; and anticipated minor changes to surface and groundwater hydrology;
- Potential social impacts associated with use of village land will not occur, including: reduction in land availability for agriculture, resource collection (NTFP and TFP), and livestock grazing (years 1-2 of rotation) and minor noise impacts and potential safety issues related to vehicle transport through villages.

Silvicultural Alternatives

Burapha is continually improving their model through research and development to identify the best silvicultural and agricultural methodologies for its operations. Research and development is focused on the best outcomes for timber production, agricultural / livestock productivity in intercropping, including:

- Clonal trials to identify the best stock with respect to growth and form, disease resistance, and compatibility with soils;
- Various grasses for livestock (for years 4-7 of rotation) and planting / seeding methodologies;
- Various crops for years 2-4 of the rotation (rattan, cassava, pineapple, etc.); and
- Various thinning vs non-thinning silvicultural applications.

Crop trials undertaken by the company provide an added benefit for communities in that the company takes on the risk of trialling the new crops. If trials are successful for particular crops, they can be recommended to communities in that locality. Burapha is also planting with tree rows spaced at 4.5 x 2.5m and 3 x 3m. The intent is to plant at reduced spacing in areas that are not utilised for agroforestry (e.g. in GOL Production Forest) or where only one year of rice production is requested by farmers.

3.6.2 The Preferred Alternative

Having undertaken a thorough analysis and careful consideration of the above alternatives, Option 1 (expansion of the current agroforestry model to 68,750 ha) has been selected as the preferred option, as it will provide the scale required for the Company to achieve financial objectives; as benefits to livelihoods and regional economies can be expanded, with national economic benefits realised; and the model promotes environmental and social sustainability that is expected to be achieved throughout operational areas.

However, if there is a shortfall in village land or a shortfall in farmers to conduct agroforestry at this scale, and / or where villagers are not interested in intercropping. Burapha will also implement more traditional plantation forestry pending agreement by GOL / participating villages (i.e. combination of Option 1 and Option 2).



Chapter 4 | Physical Setting

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4 PHYSICAL SETTING

4.1 Landforms

The main landforms of the four provinces that will be considered for Project expansion (Vientiane Province, Vientiane Prefecture, Xayabouly Province, Saysomboun Province) are:

- Plateaus, floodplains / plains:
 - » Vientiane Plain;
 - » Khorat Plateau;
- Rivers, river basins, wetlands and reservoirs:
 - » Mekong River and Basin;
 - » Nam Ngum, Nam Ngum Reservoir and Basin;
 - » Nam Lik and Sub-basin;
 - » Nam Xong and Sub-basin;
- Foothills:
 - » Foothills of the lower slopes of the main ridgelines of the Loei Fold Belt;
- Mountains:
 - » Luang Prabang Range (Xayabouly Province);
 - » Phou Bia and Annamite Range (Saysomboun Province);
 - » Phu Phra Mountain and Range (Vientiane Province).

4.1.1 Topography

Burapha's land acquisition criteria targets foothill areas typically used for swidden agriculture. This strategy for site selection avoids sensitive habitat and productive land (typically floodplains suitable for permanent agriculture) and natural, core habitat for wildlife in the rugged, steep terrain of mountainous areas.

Foothill zones are characterised by a gradual increase in elevation from plains toward the base of mountain ranges, steep hills or other upland area. Foothills therefore represent a transitional zone between plains (floodplains, lowlands) and mountains (Figure 4-1). Plains are typically used for agriculture and settlement, with density of settlement decreasing with increasing elevation and ruggedness. Burapha targets foothill slopes with inclinations of up to 15° (slopes greater than 15° are generally suitable only for manual operations). Slopes of greater than 35° are not regarded to be plantable according to Company policy.

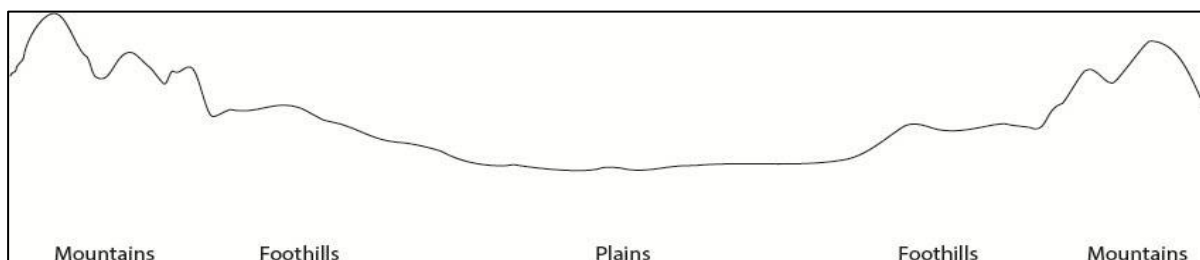


Figure 4-1 Diagrammatic cross-section representation of landforms in the four Project Provinces

The majority of existing Project plantations are located in the southern region of Vientiane Province, where topography, land use and slope meet Project criteria. Landforms become more mountainous in the north and west of the Province associated with the Loei Fold Belt, with peaks greater than 1,000 masl. The north of the Province is typically steeply sloping ($>45^\circ$) with elevations of $\sim 1,600$ masl.

A large proportion of the four Provinces considered for Project expansion lies in the Loei Fold Belt, in which foothills comprise a gently undulating plateau at elevations of 150–500 m above sea level (asl). The dominant landforms within the foothills are low hills and ridges with broad crests and gentle straight slopes of 20–30 m relief separated by broad valleys. Slopes across the four Provinces generally range from 0 to 45° .

The lowlands around Vientiane are generally excluded from Project expansion due to the presence of settlements, agricultural land and low-lying land. The lowlands form part of the Vientiane Plains, an area of fertile alluvial soils along the Mekong River. The Vientiane Plains represent the northern extent of the Khorat Plateau, which covers most of eastern Thailand, with elevations of 100–200 masl.

Xayabouly Province includes a small ridgeline with an elevation of ~ 800 masl forming part of the larger Luang Prabang Range, which extends north along the Loei Fold Belt into Luang Prabang Province. The north-south trending valleys and foothills in Xayabouly Province vary in slope, but are generally inclined by less than 30° .

Saysomboun Province includes the highest mountain in Lao PDR, Phou Bia (2,823 masl). Much of Saysomboun Province is mountainous, with elevations of 900–2,800 masl. Foothills are largely confined to the valleys, and slopes are in many areas too steep for plantations. Project expansion is likely to target areas in the valleys and near to the shores of Nam Ngum Reservoir, where current plantations are situated.

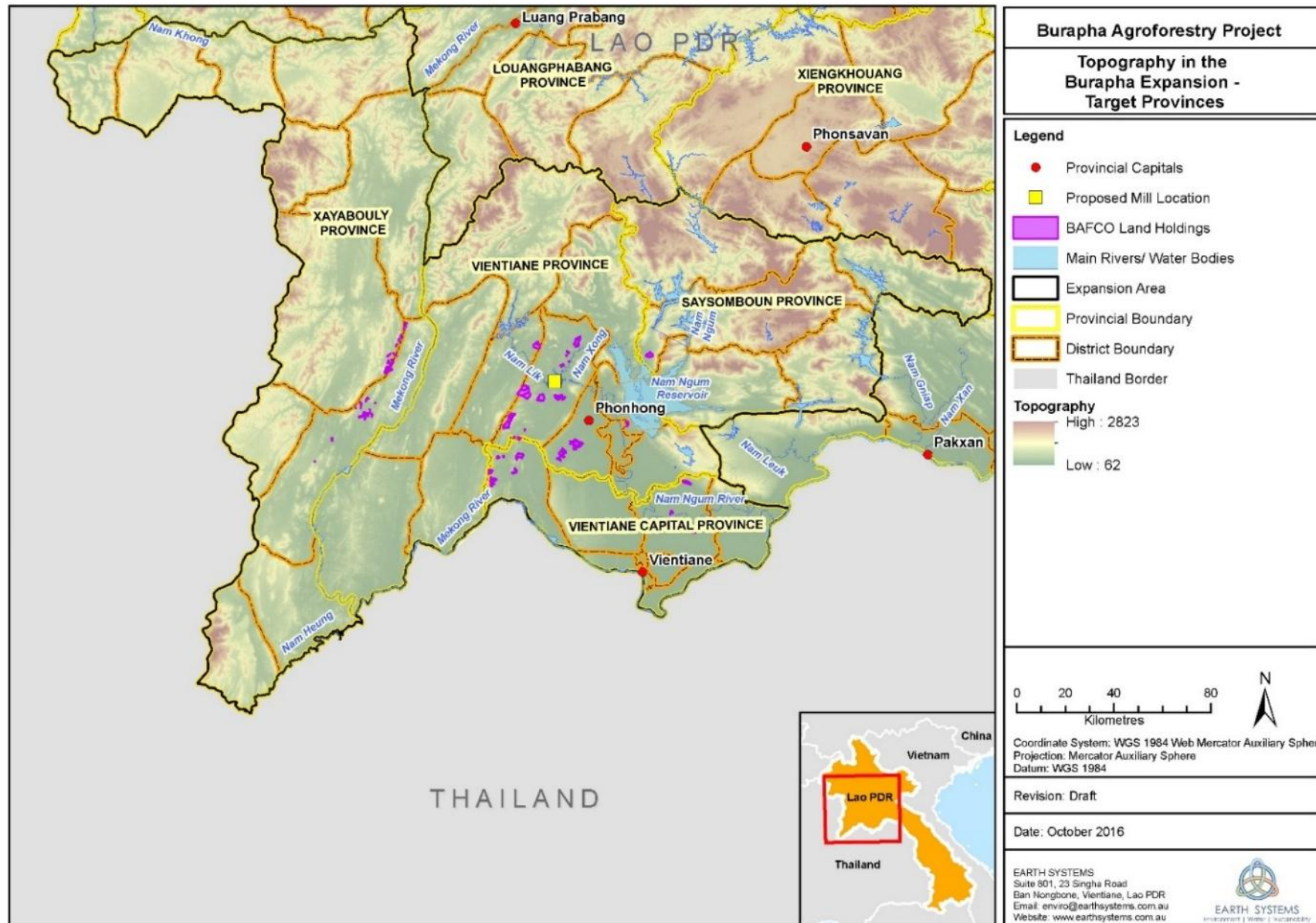


Figure 4-2 Topography across the four Provinces targeted for the Burapha Agroforestry Project

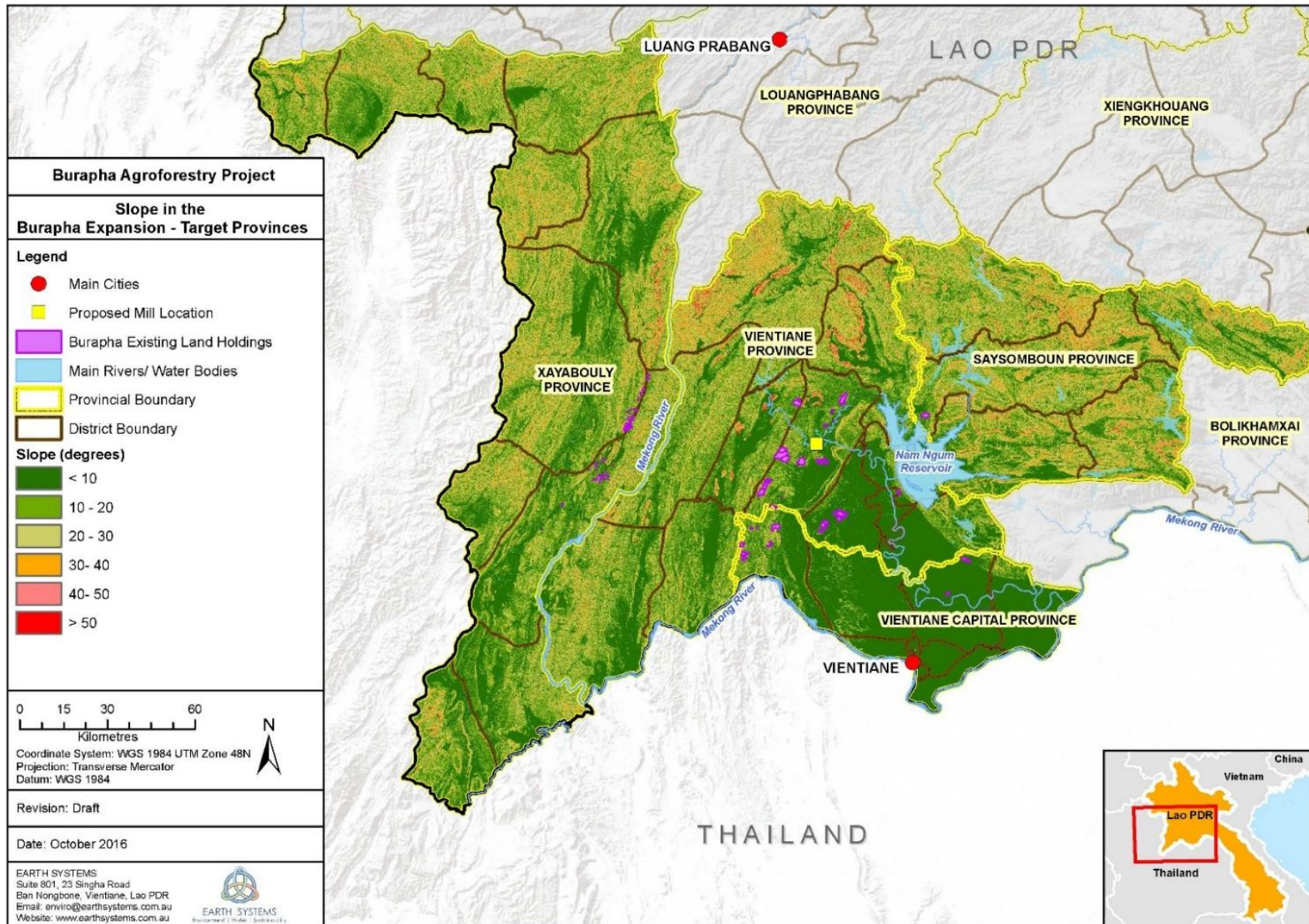


Figure 4-3 Slope variation across the four target Provinces for Project expansion

4.1.2 Geology

Two geological sequences occur in the four Provinces considered for Project expansion:

- Loei Fold Belt, consisting of Palaeozoic to Early Mesozoic sedimentary-volcano-plutonic suites; and
- Khorat Plateau, consisting of a thick sequence of Mesozoic sediments.

The main sediments (shallow to deep marine) of the Loei Fold Belt were deposited during the Silurian and Devonian Periods (440–360 Ma). The deposition continued into the Carboniferous Period, extending into the Permian (360–250 Ma). During deposition, the Loei Fold Belt was intruded by plutonic rocks, particularly during an extensive igneous event in the late Carboniferous to early Permian (310–270 Ma; Phommakaysone, 2012). In some areas, the sediments are dominated by a volcanic-sedimentary sequence with feldspar-phyric and crystal-rich breccia units (Manaka *et al.*, 2008). From the Late Permian to the Jurassic, the belt was subject to eastward subduction, folding the belt to create a north-south trending magmatic and metallogenic zone (Kamvong *et al.*, 2014).

The Khorat Plateau consists of a thick sequence of Mesozoic rocks that were deposited across northeast Thailand, neighbouring parts of Laos and Cambodia (Racey, 2009). Shallow marine and non-marine deposits were deposited during the Triassic and Cretaceous Periods (250–65 Ma), with the majority being limestone, clay, red sand and conglomerate (Phommakaysone, 2012). Some uplift has occurred along the western and southern edges of the Khorat Plateau, predominantly in central Thailand and Vietnam (Racey, 2009).

The landforms across the foothills vary in association with geology, comprising igneous intrusions forming mountains and sedimentary and alluvial stratigraphy forming the plains. The less weathered and harder igneous intrusions result in steeper terrains, while the more readily weathered sedimentary sequences are characterised by more gentle relief.

4.1.3 Soils

Soils across the four Provinces are typically derived from siliceous sedimentary formations, and are often mildly acidic, leached of nutrients including boron, and relatively enriched in aluminium (Eswaran *et al.*, 2005). Topsoils have relatively low clay content, subsoils (Cambisols) have low base saturation, resulting in low nutrient and water holding capacity. Soils are generally well leached by rainfall and in some areas, have been limed for agriculture.

Foothill soils are generally a combination of dystic Cambisols, ferric Acrisols, and haplic Acrisols (refer to Figure 4-4).

Acrisols are characterised by a shallow argic soil horizon starting less than 1 m from the surface. The transition is marked by an increase in soil texture, structure, and illuvial clay. This lower sub soil horizon is generally more dispersive and thus represents an erosion risk if exposed by removal of topsoil through development or erosion. Foothill subsoils generally have low fertility and do not provide a suitable substrate for plant growth, and thus extensive agricultural use is rare.

Ferric Acrisols have been subject to laterisation by tropical rains and are distinguished by reddish to blackish concretions or nodules, coarse mottles, and typical accumulations of iron and manganese oxides. This soil characteristic is a common feature of tropical sandy soils and the soils typically possess excellent drainage characteristics.

Cambisols are characterised by a slightly higher texture and structure when compared with the underlying soils. The texture class of this horizon is a sandy loam or finer sand with a distinct lack of rock structure in >50% of the fine earth fraction. The cambic horizon is typically found between 25–50 cm below surface level. Cambisols may also display a rich dark, deep surface horizon with higher soil organic matter. The soils have a saturation index of below 50%, thus these sandy soils are less able to reduce acidity. This lower acid buffering capacity may introduce crop vulnerabilities associated with lower pH and plant nutrient availability and the finer textures increases the risk of erosion.

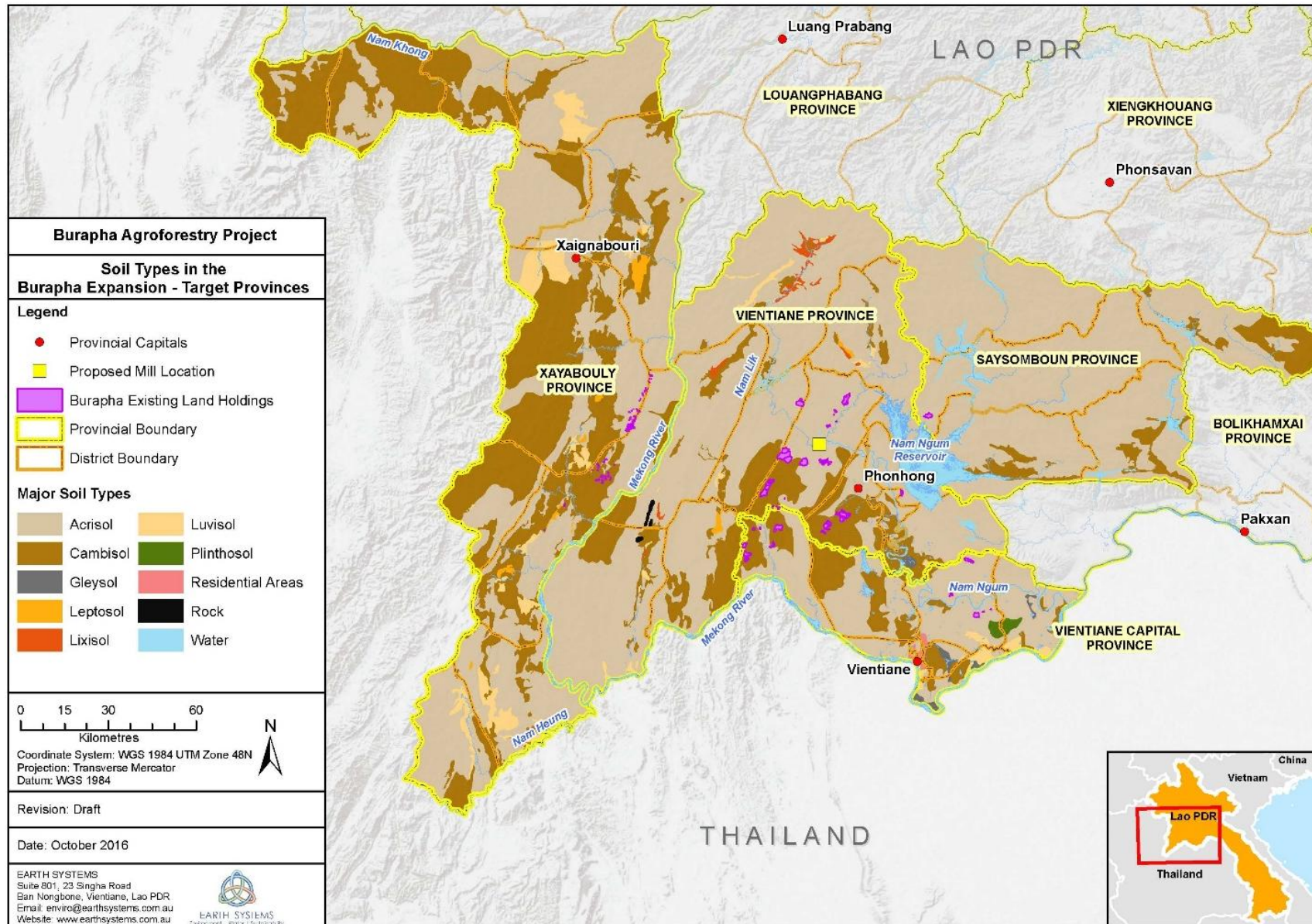


Figure 4-4 Soil types across the four Provinces

Previous swidden agricultural land practices in the foothills have resulted in soil degradation. These degraded soils often suffer from poor structural qualities, such as surface crusting, and poor nutrient load due to the loss of organic matter, calcium, magnesium and potassium. Areas of extreme acidity due to land degradation may only support adapted native vegetation regrowth (e.g. degraded forest).

The practice of swidden agriculture has degraded topsoil in two ways. The practice of prolonged clearing and burning of vegetation has exposed bare soil to wind erosion during the dry summer months. During wetter periods, rains and surface waters can transport finer clays, humus and nutrients towards the valley bottoms and floodplains. The process continues until all fine particles and nutrients suspended or dissolved in runoff are subsequently lost to larger regional river systems or have been dispersed by atmospheric systems. The remaining heavy larger sand to gravel size fractions have limited capacity to support plant growth.

In contrast to the foothills, the Khorat Plateau predominantly consists of sandstone and shale beds of Triassic age. The bedrock has extensively weathered to form a good quality agricultural loam with good proportions of clay, silt and sand. Soils are well draining and highly leached from tropical rains across Vientiane Plain. Soil structure and nutrient quality are spatially variable across plantation sites and depend on many different environmental variables, such as previous agricultural practices, pedological processes and parent rock, vegetation communities, topography and geology.

Soils in the four Provinces are susceptible to significant erosion due to various factors, in particular:

- Rainfall levels, for example there is an increased risk of erosion in the wet season;
- Soil type and character;
- Slope angle;
- Land use, e.g. length of fallow period; and
- Levels of vegetation cover.

4.2 Climate

There are minor climate variations between the mountains, foothills and plains. Plains are generally hotter, while the foothills and mountains are cooler but more humid. The foothills across the four Project Provinces experience a pronounced tropical monsoon cycle. The area is strongly influenced by the cool and dry season from November to February, a humid and hot season from March to April and a hot and wet season from May to October.

The meteorological station at Vientiane has the most reliable data for the four Provinces. The station at Phonehong has less reliable data but is more centrally located with respect to existing plantations. Therefore, most data was acquired for Vientiane, supplemented by data from Phonehong as well as Hin Heup in the north of the four Provinces.

4.2.1 Temperature and Rainfall

Mean temperatures in Vientiane are in the range 23–29 °C, with an annual peak in April. The air temperature at Vientiane and Phonehong is relatively uniform and predictable throughout the year (Figure 4-5). Monthly minima and maxima range from 16 °C in January/December to 34 °C in April. Temperatures have exceeded 40 °C in March and April, but this is rare (Table 4-1). Vientiane temperatures did not fall below 0 °C between 1951 and 2000.

Mean monthly temperatures between Vientiane and Phonehong are very similar, with little variation over the year (± 2 °C; Figure 4-5). Phonehong is approximately 60 km north of, and 50 m higher than, Vientiane.

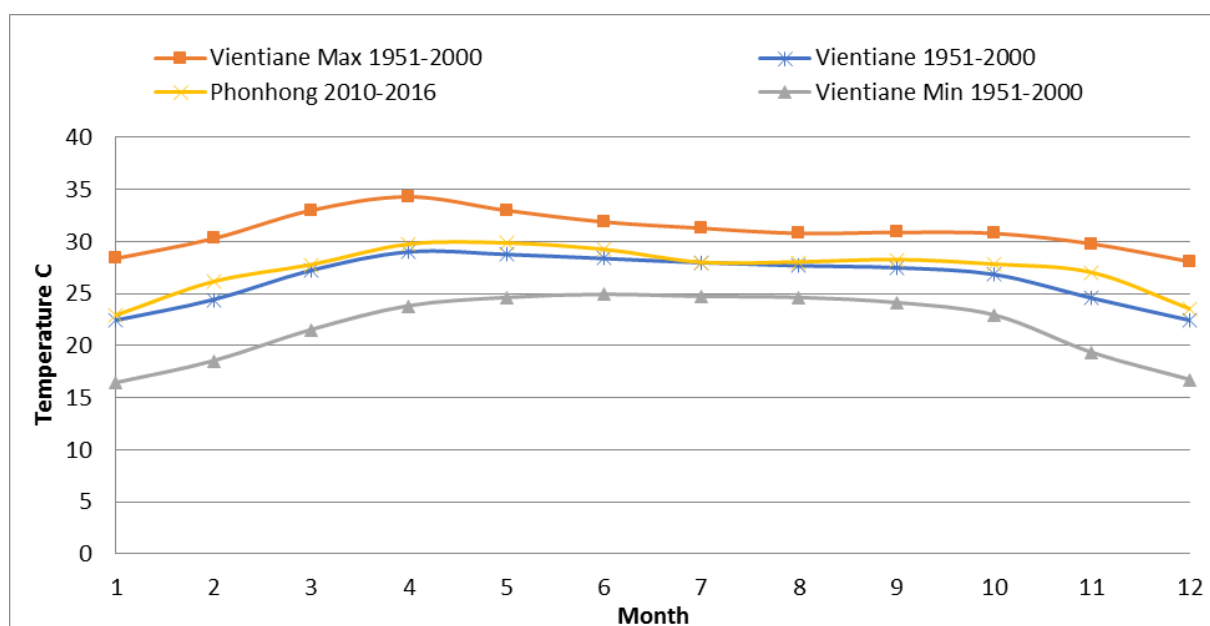


Figure 4-5 Average monthly temperatures (°C) at Vientiane (1951-2000) and Phonehong, including maximum and minimum mean temperature per month for Vientiane (TuTiempo, USGS, 2016)

Annual average rainfall across the four Provinces varies from 1,300 to 2,700 mm (IUCN, 2013, Liu *et al.*, 2015, Claridge 1996). The highest rainfall occurs between May and September, and wet season rains can constitute 84 to 94% of the total annual precipitation (Kallio, 2014, Liu *et al.*, 2015). Annual rainfall at Vientiane ranges from 1,142 mm (1977) to 2,374 mm (2011; Table 4-1, Table 4-2, Figure 4-6, Figure 4-7), and mean monthly rainfall is typically greater than 250 mm in the wet season.

August is typically the wettest month, with a mean total rainfall of more than 300 mm in the plains of Vientiane (Table 4-1). Vientiane has received as much as 216 mm of rain in one day. Although rainfall peaks in August, other months can be nearly as wet, including September, July and June. The number of rain days typically mirrors rainfall patterns, peaking in August.

Mean humidity mirrors rainfall trends, and is highest in August (Table 4-1). Mean monthly humidity ranged from 66 to 84% between 1951 and 2000, with a mean annual humidity of 75%. It is assumed that humidity would be similar for much of the four Provinces.

Table 4-1 Climatology information from Vientiane weather station based on monthly averages over the 50-year period 1951-2000 (World Meteorological Organization, 2016)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Total Rainfall (mm)	7.5	13.0	33.7	84.9	245.8	279.8	272.3	334.6	297.3	78.0	11.1	2.5
Mean Rainy Days	1	2	4	8	15	18	20	21	17	9	2	1
Max. °C	35.6	37.8	40.0	41.1	38.9	37.8	36.1	37.2	38.9	38.9	34.4	33.4
Min. °C	0.0	7.6	12.1	17.1	20.0	21.1	21.2	21.1	21.2	12.9	8.9	5.0
Mean Daily Max. °C	28.4	30.3	33	34.3	33	31.9	31.3	30.8	30.9	30.8	29.8	28.1
Mean Daily Min. °C	16.4	18.5	21.5	23.8	24.6	24.9	24.7	24.6	24.1	22.9	19.3	16.7
Mean Humidity %	70	68	66	69	78	82	82	84	83	78	72	70

Table 4-2 Climatology averages or totals from Vientiane weather station based on monthly averages over the 50-year period 1951-2000 (World Meteorological Organization, 2016)

Parameter	Value
Total Rainfall	1661 mm
Total Number of Rainy Days	118
Yearly Maximum Temperature	41.1 °C
Yearly Minimum Temperature	0.0 °C
Mean Daily Maximum Temperature	34.3 °C
Mean Daily Minimum Temperature	16.4 °C
Mean Annual Relative Humidity	75%

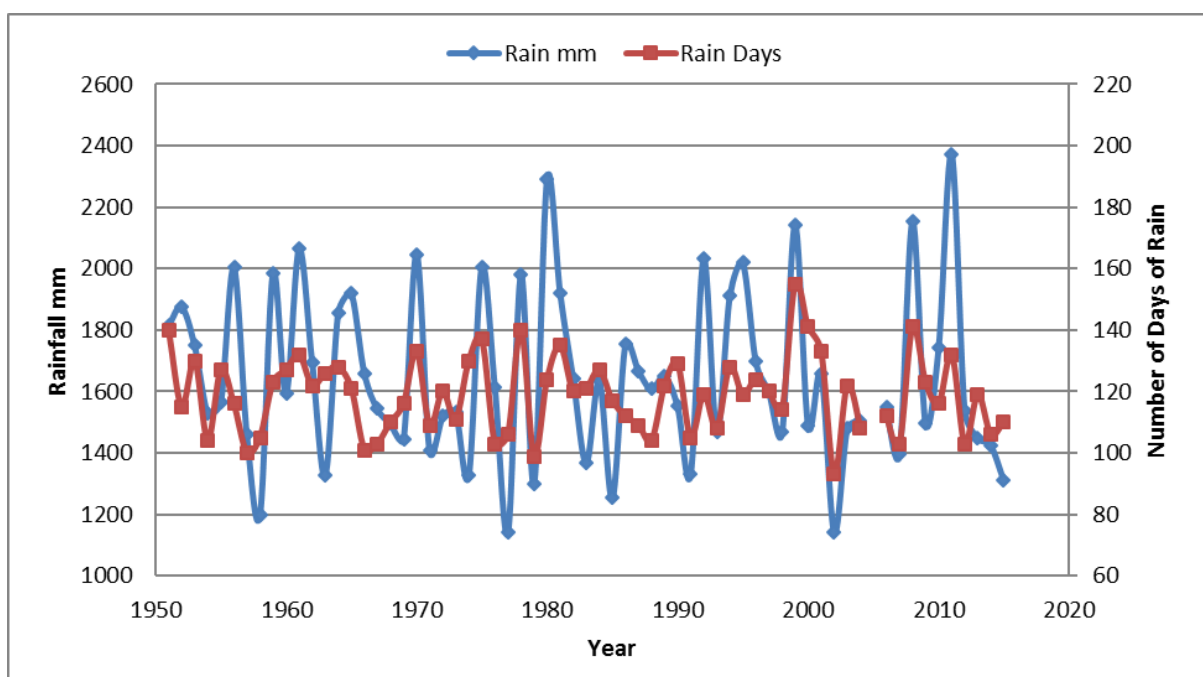


Figure 4-6 Rainfall and number of rain days per year in Vientiane 1951-2015 (based on DMH data)

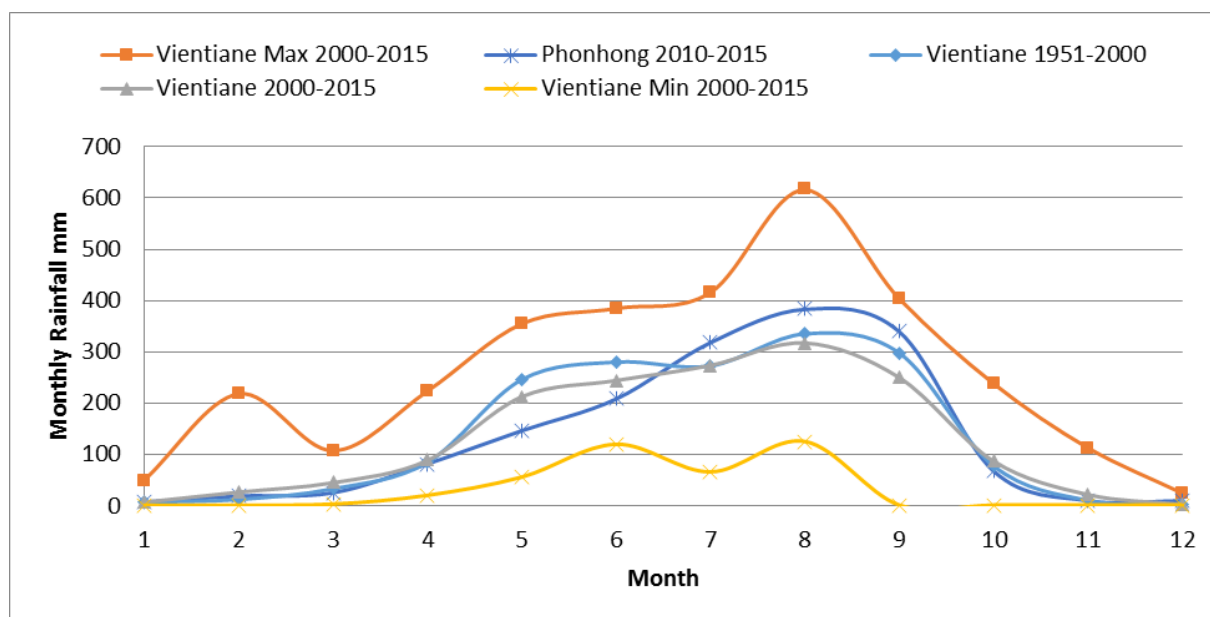


Figure 4-7 Average, minimum, and monthly rainfall in Vientiane (1951-2000 and 2000-2015) and mean monthly rainfall in Phonhong (TuTiempo, USGS, 2016)

4.2.2 Evaporation and Wind Direction

Mean monthly evaporation for Vientiane in the latter part of the last century ranges from 115 mm in January to 156 mm in April (Table 4-3) and generally follows air temperature.

Table 4-3 Mean monthly evaporation at Vientiane in mm (NOAA 1961-1990)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
115.2	116.8	140.7	156.1	138.9	118.9	116.7	148.5	114.3	127.6	125.5	116.8	1,536.0

The prevailing wind direction across the four Provinces is governed by the Asian Monsoon, with easterly winds in the dry season and south-easterly and south-westerly winds in the wet season. Modelling at Hin Heup, and available data at Vientiane and Phonhong in the central and southern areas, suggest that wind direction is fairly uniform across the four Provinces (Table 4-4).

Table 4-4 Monthly mean prevailing wind direction and modelling (TAPM), from sites in the north (Hin Heup), south (Vientiane) and central (Phonhong) of the four Provinces

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hin Heup	E	ESE	ESE	SE	SSE	SSW	WSW	SSW	SSE	E	E	E
Vientiane	SE	SE	SE	S	SW	SW	S	S	SSW	S	S	SSE
Phonhong	S	SSW	SSW	SW	SSW	SSW	SSW	SSW	SSW	SSW	SSW	SW

4.3 Hydrology and Hydrogeology

4.3.1 Hydrology

The main drainage systems within the four Provinces are the Mekong River, Nam Ngum River and Reservoir, Nam Lik and Nam Xong, and their tributaries and basins (**Error! Reference source not found.**). Nam Lik and Nam Xong are tributaries of Nam Ngum, while the Nam Ngum is a primary tributary of the Mekong River.

The Mekong River is characterised by massive gorges with vertical bedrock, broken boulders and sandy beaches.

A dominant feature of the four Provinces is the Nam Ngum Reservoir. The Nam Ngum has been dammed for electricity generation, creating the Nam Ngum Reservoir. The Nam Ngum is a main tributary of the Mekong River, which it joins over 100 km south of the reservoir. The Nam Ngum is approximately 350 km long and the catchment area is 16,841 km² (Kallio, 2014). Most of Burapha’s current landholdings are to the west of the Nam Ngum reservoir, with one exception, Maung Xuom, to the north of the reservoir.

The Nam Ngum originates in Xiangkhoang Province and flows south through Vientiane Province. The Nam Ngum retains water throughout the year, with levels peaking over the wet season (July to September). Historical data indicate that mean monthly water levels range from 4 to 13 m, while maximums can reach 18 m. The Nam Ngum can range from a low of 100 m³/s discharge to 4,500 m³/s discharge during the wet season (Figure 4-8). The Nam Ngum discharges 21 billion m³ into the Mekong annually.

The Nam Lik sub-basin is part of the Nam Ngum Basin. The Nam Lik originates approximately 150 km upstream of the confluence with the Nam Ngum. The drainage area within the Nam Lik sub-basin near this confluence is approximately 5,120 km² (Liu et al., 2015). The Nam Lik typically retains water throughout the year even during drought. In extremely rainy years the river can reach a depth of nearly 15 m and discharge of 3,500 m³/s at the Ban Hin Heup gauging station (Figure 4-9; Figure 4-10). Mean annual streamflow at Ban Hin Heup between 1987 and 1990 was 236 m³/s (Goteti and Lettenmaier, 2001). The Nam Lik flow is now partially regulated due to the presence of a hydropower dam (Nam Lik 2 Hydropower Project) approximately 25 km downstream of its origin.

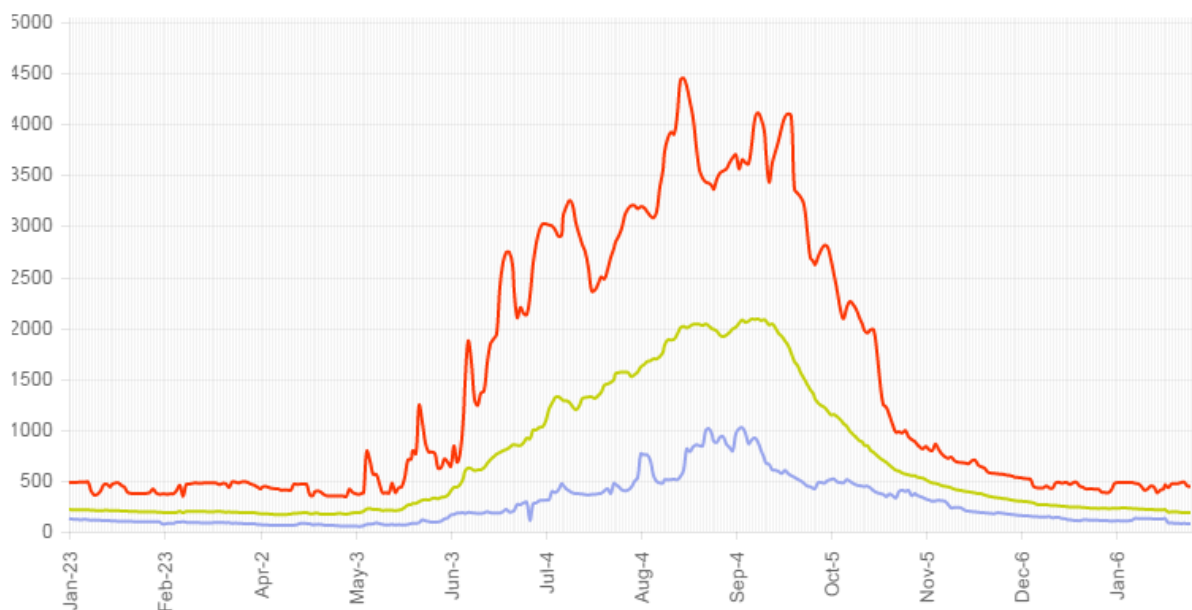


Figure 4-8 Monthly maximum (red), minimum (blue) and average (green) discharge (m³/s) within the Nam Ngum at Ban Tha Ngon between 1960 and 2009 (MRC, 2016)

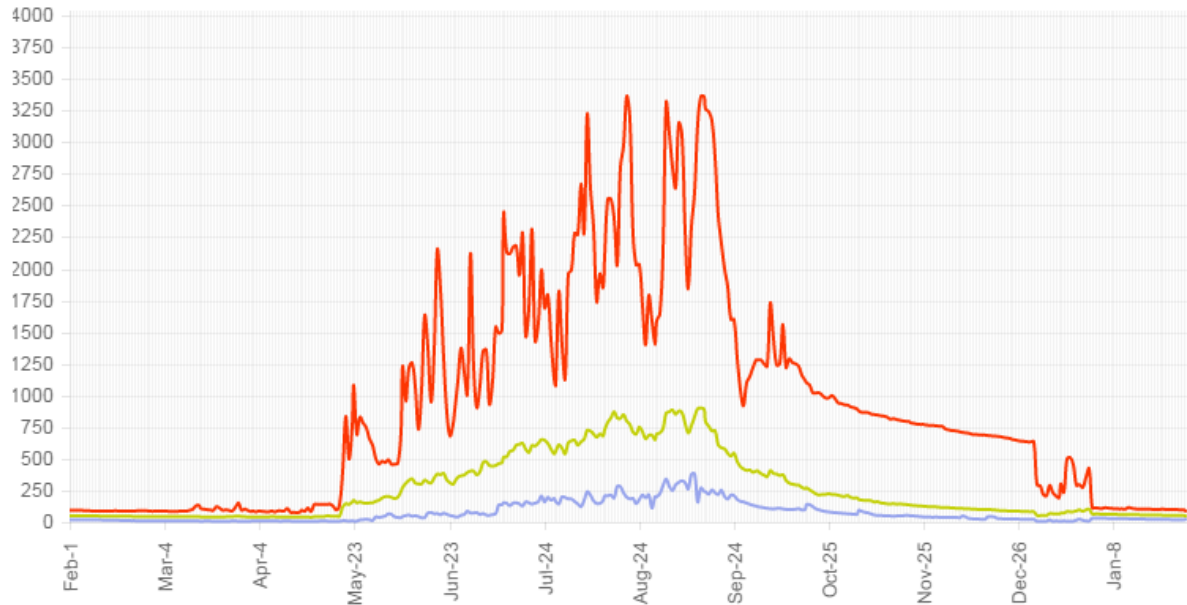


Figure 4-9 Monthly maximum (red), minimum (blue) and mean (green) discharge (m³/s) within the Nam Lik at Ban Hin Heup between 1960 and 2009 (MRC, 2016)

In addition to the main rivers, drainage systems range from lowland to upland streams and rivers, with a few smaller montane streams. There are nearby wetlands¹, lakes and ponds, some of which are human-made. For example, the Nakhanthoung Irrigation Dam is approximately 400 m downstream of a current plantation and is the result of damming a natural stream. Minor rivers, streams and waterbodies are more likely to intersect potential Project expansion areas in the foothills, rather than the main rivers.

The hydrology of the foothills is highly influenced by rainfall patterns. Monsoonal rainfall (see section above) particularly affects the flow and presence of intermittent and ephemeral streams. These intermittent and ephemeral streams are generally first or second order tributaries to the large perennial rivers that dissect the four Provinces. Seasonal rain is important for flow volumes in foothill streams and is generally highest during the wet season, between May and September/October.

Current Burapha plantations typically have a number of intersecting ephemeral streams, which discharge to perennial streams in or near plantation areas. These generally flow through villages and provide an important water source for these villages.

¹ Minor wetlands, not related to Ramsar classification of wetlands of international importance

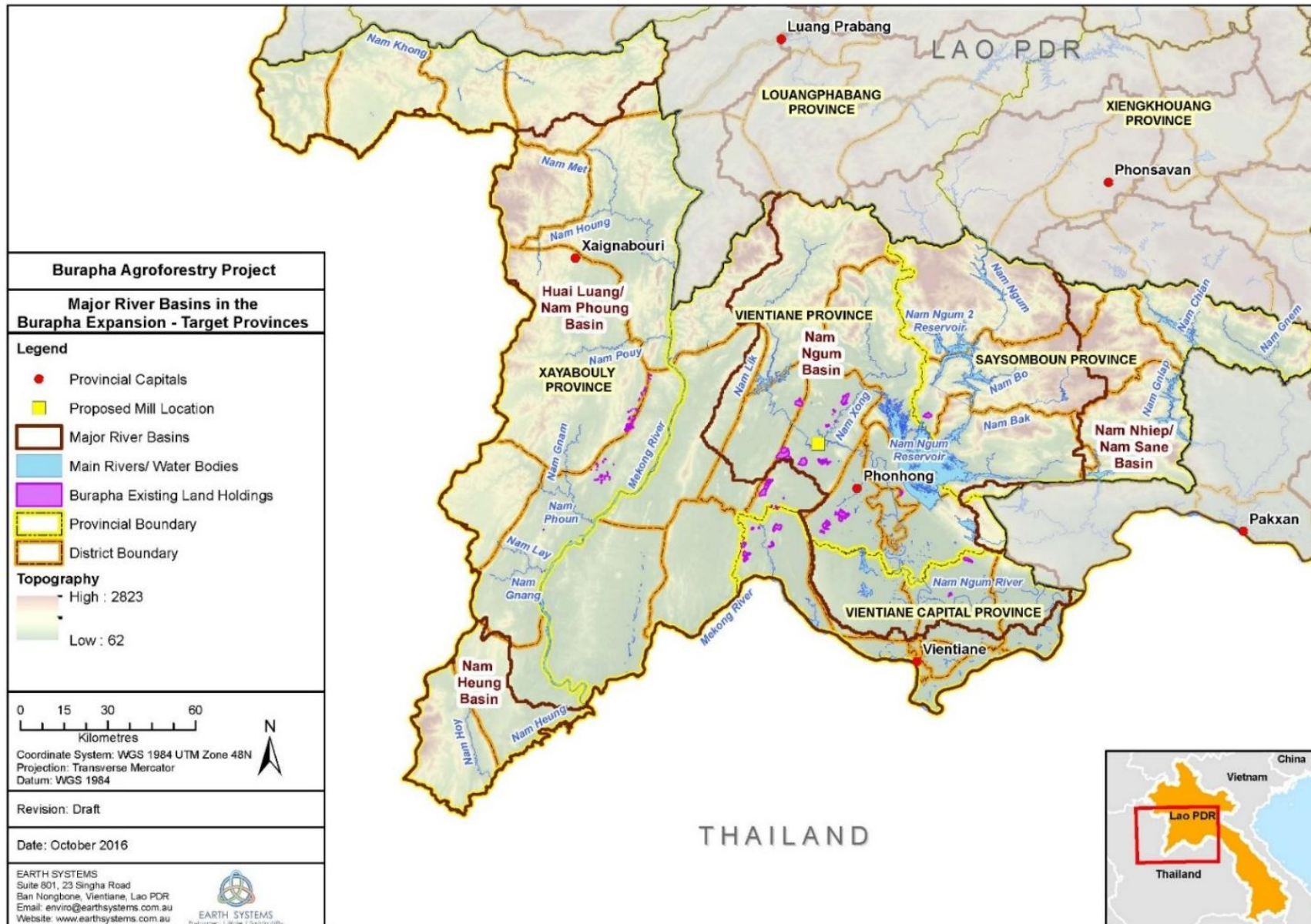


Figure 4-10 Major river basins and rivers within the four Provinces



Plate 4-1 Nam Lik near Hin Heup

4.3.2 Hydrogeology

There is little information available on groundwater within the four Provinces, although it is known that karstic formations in the region can lead to complex groundwater systems. The primary aquifer of four Provinces has a consolidated groundwater potential yield of $<5 \text{ m}^3/\text{hr}$ (Seebacher, 2014). Hydrological modelling shows that there is a reasonable likelihood of groundwater-dependent ecosystems being present along streams, such as permanent or semi-permanent pools and springs. Groundwater wells are also commonly used by communities.

4.4 Water Quality

4.4.1 Surface Water

Surface water quality within the main drainages of the four Provinces is generally relatively good. Turbidity is generally higher in the wet season due to high rainfall eroding soil entering drainage systems. It is assumed that streams in the foothills have a similar seasonal water quality trend, with wet season rains causing turbidity and increased runoff of pollutants from nearby agricultural, residential or other altered land. Foothill streams in areas with less soil/land disturbance are likely to have better water quality than downstream main rivers (e.g. Nam Lik, Nam Ngum).

Monitoring over the last 15 years suggests that water quality in the Nam Ngum River Basin has generally been good and has not been significantly affected by human activities (Komany, 2008). Limited data available for the Nam Lik suggests that water quality at Phonesoung is of good quality with little apparent impact from industry in the region (Earth Systems, 2016). Nam Lik water samples were very clear (low

turbidity and total suspended sediment) with near neutral pH, and temperature typical of the region (Table 4-5). A moderate dissolved oxygen concentration (6.15 ppm), low nutrient concentration, and an absence of measured pollutants indicate that the water quality is suitable for a range of aquatic biodiversity and water uses. Total coliform levels were found to be high (exceeding the detection limit of 2300 MPN / 100 mL), which is typical in Lao PDR near villages / livestock.

Water quality samples taken for the Nam Ngiep Hydropower Project in Saysomboun and nearby Bolikhamxay Provinces show some similarities to the Nam Lik samples (ERM, 2014). Conductivity, salinity and hardness are typically within acceptable ranges for surface water quality for freshwater. Turbidity values were low in the dry season, but became higher in the rainy season. The average suspended sediment concentration was 17 ppm in the dry season and 83 ppm in the rainy season. Dissolved oxygen concentrations in Nam Ngiep samples were high, ranging from 7 to 10 mg/L. Nitrate concentrations in the dry season were higher than in the rainy season but below the acceptable standard for surface waters (<5 mg/L). The increase in nitrate concentrations during the rainy season could have been caused by runoff discharged from residential communities and riverside livestock.

Table 4-5 Water quality parameters from the Nam Lik at Phonesoung in March (Earth Systems, 2016)

Parameter	Nam Lik	Lao Ambient WQ Guideline#
Temperature (°C)	23.6	-
pH	7.32	5 to 9
Dissolved oxygen (ppm)	6.15	> 6
Chemical oxygen demand (mg/L)	ND <5.0	5 ml/L
Biochemical oxygen demand (BOD5: mg/L)	0.88	1.5
Total suspended solids (mg/L)	ND	-
Total dissolved solids (mg/L)	131	-
Turbidity (NTU)	1.6	-
Conductivity (µ/cm)	173.8	-
Ammonia (NH ₃ : mg/L)	0.13	0.2
Fat, oil, grease (mg/L)	ND <1	2
Formaldehyde (mg/L)	ND <0.05	-
Phenolic substances (mg/L)	0.047	0.005
Total coliform group (MPN/100 ml)	>2300	<5000

Key: ND – Not Detected

Agreement on the National Environmental Standard, Lao PDR 2009

4.4.2 Groundwater

Groundwater is generally good quality across the four Provinces. Groundwater quality is likely to be better in areas remote from industrial discharges (e.g. Vientiane industry). Groundwater available from village bores is of variable quality due to impact from local pollutants in some circumstances. Local residents generally extract groundwater for livestock, crops and other non-potable purposes.

4.5 Air Quality

Air quality across the four Provinces is generally good and likely to be within national ambient air quality guidelines, except during periods of widespread biomass burning. Anticipated sources of air emissions in the foothills near like Project expansion sites include:

- Vehicular traffic along dirt tracks;

- Dust carried on prevailing winds;
- Open cooking using firewood or fossil fuels;
- Industrial activity near urban areas, particularly Vientiane;
- Motorised logging equipment;
- Biomass burning, particularly for agricultural site preparation in February/ March; and
- Biogenic emissions from soil and lightning.

The road network in most of the foothills is generally unsealed, and particulates from the unsealed roads have mostly a nuisance impact.

Baseline concentrations of airborne particulates were found to be above international air quality guidelines at two sites in the north (Hin Heup - foothills) and south-east (Nabong - plains) of the four Provinces (Table 4-6). Air quality parameters were likely to exceed guideline levels due to windblown smoke and ash from regional burning of vegetation (NASA 2016). TSP levels are within Lao guidelines over a 24-hour period, but can exceed the 24-hour guideline for short intervals.

Baseline particulate concentrations in the wet season are anticipated to be generally low due to natural suppression by regular rainfall and the lack of biomass burning during this period. Combustion gases (sulphur dioxide (SO₂), carbon monoxide (CO) and nitrogen oxides (NO_x)) are assumed to be low to negligible under normal conditions. Existing vehicle emissions (SO₂, NO_x, CO and particulates) from nearby roads are estimated to be negligible due to low traffic volumes in the foothills.

Table 4-6 24-hour baseline particulate concentrations during dry season (2016) biomass burning (µg/m³)

Parameters	Hin Heup Mean	Nabong Mean	Laos Criteria	WHO Criteria
Total Suspended Particulates (TSP)	191	230	330	n/a
Particulate Matter <10 microns (PM ₁₀)	190	228	120	50
Particulate Matter <2.5 microns (PM _{2.5})	185	199	n/a ¹	25

¹ Inhalable fine particulate matter smaller than 2.5 microns (PM_{2.5}) is not ascribed a guideline within Laos, but is considered one of the most important contributors to acute respiratory infections and other issues by the World Health Organization (WHO 2013)

4.6 Noise

The foothills in the four Provinces are generally remote rural areas located distal to the settlements of the plains and the associated elevated noise levels. Communities and villages are more spatially dispersed and agricultural land is less common than in the plains. Sources of baseline anthropogenic noise emissions in the foothills are include:

- Vehicles on roads and pathways (mostly low-powered motorcycles);
- Agroforestry operation emissions (e.g. chainsaws, machinery);
- Agricultural activities (e.g. cows, goats, machinery);
- Village activities.

4.7 Archaeology

The landforms and soil within Project expansion areas have been disturbed by land clearing, swidden agriculture and ploughing. This disturbance has likely resulted in the removal or destruction of archaeological sites or artefacts that may have been present. Burapha's land acquisition criteria provide for

the avoidance of any known archaeology and surveys and management measures to determine presence and avoid unknown sites and artefacts.

In the broader landscape, the north-west of Lao has a long history of human habitation. The Mekong Basin is thought to have been an ancient route to people, technology and culture (White et al., 2009). In particular, the Basin near Luang Prabang appears to be rich in archaeological evidence from the Holocene and into the late Pleistocene (Sayavongkhamdy et al., 2000). Two cave sites at Tam Hua Pu (near Ban Tin Hong) and Tam Nang An (near Ban Som) were first occupied during the Hoabinhian period and then used in the Iron Age for burials (6,000 to 2,000 years before present (BP)). These caves are within the foothills, approximately 100 m above the plains (Sayavongkhamdy et al., 2000). Recent excavations suggest there are at least 38 caves and/or rockshelters near the former two caves. Human remains have been found throughout these sites (White et al., 2009). The city of Luang Prabang was also the capital of the Lane Xang Kingdom during the 13th to 16th centuries and has been listed as an UNESCO World Heritage site.

A site of early human habitation in Vientiane Province is at Lao Pako on the shores of the Nam Ngum, approximately 9 km northeast of Nabong (Kallen, 2000). Radiocarbon dating suggests the site was occupied and potentially used for agriculture as early as 4,000 BP (Sayavongkhamdy et al., 2000). The site (now part of an eco-resort) on the southern bank of the Nam Ngum also has remains of pottery, pebble tools and iron knives from a settlement during the 4th to 6th centuries AD. Lao Pako is highly significant for investigating Iron Age and prehistoric archaeology in Lao PDR.

These sites link to other prehistoric sites in the greater landscape. To the north-east are the stone jars in the Plain of Jars near Phonsavan (Xieng Khuang Province). The megalith monuments were made of local rock and hollowed out with iron chisels (Sayavongkhamdy et al., 2000). In the centre of the Plain of Jars is a limestone hill and cave. The cave was enlarged by humans and used as a crematorium. Radiocarbon dating on a piece of human skull suggests that funerary activity began in the Plain of Jars approximately 3,000 BP. The mortuary practice appears to have been centred on the jars, which may have been used to contain a body/bones and family members were interred around the stone jar (Sayavongkhamdy et al., 2000).

Archaeological studies and excavations are ongoing and are managed by archaeologists and the Department of Heritage. Due to the potential for archaeology across the four Provinces in undisturbed areas (e.g. un-cultivated/ploughed), archaeological excavations are undertaken prior to soil disturbance. Known sites of archaeological and cultural heritage significance in the four provinces are shown in Figure 4-11.

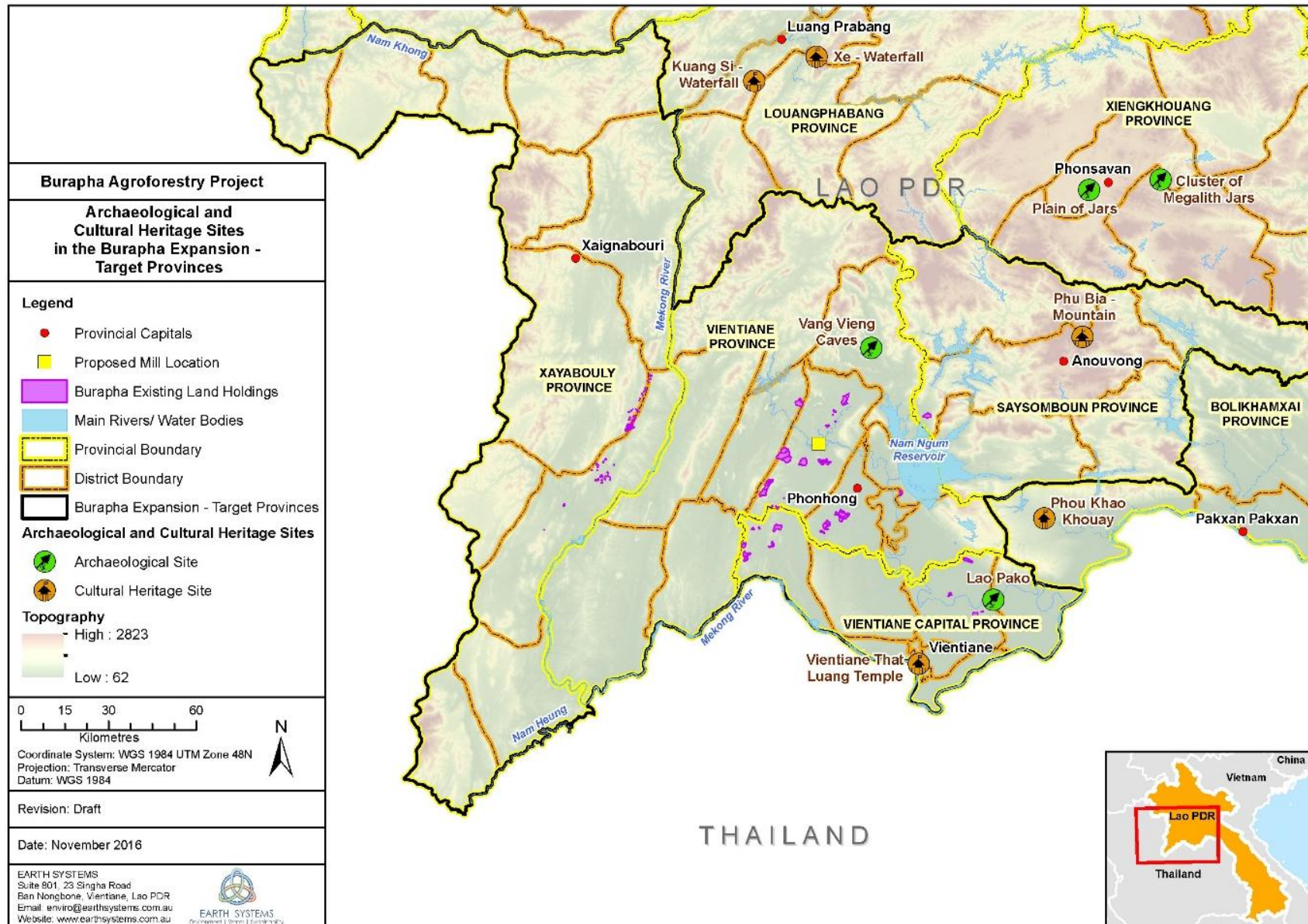


Figure 4-11 Known archaeological sites in the four provinces

4.8 Natural Hazards

4.8.1 Storms and Flooding

Tropical storms with winds of 60–120 km/hr can affect all parts of the four provinces (UNDP, 2010). Severe and super typhoons are infrequent, unlike in tropical coastal areas where they occur multiple times each year (Table 4-7). However, there have been several typhoons and tropical storms that have caused flooding in the region. For example, floods and landslides in Vientiane in August 2008 were caused by the typhoon Kamuri, while typhoon Haima caused considerable damage and deaths in two of the four provinces (Table 4-8).

The frequency of floods and droughts in Lao PDR is related to the typically seven-year alternating cycle of El Niño (warm) and La Niña (cool) conditions in the Pacific Ocean. Droughts occur in South-East Asia as part of the El Niño cycle due to reduced rainfall during the wet season. This results in decreased vegetation growth and increased soil erosion and airborne dust, resulting in poor air quality. There have been four major droughts in the past 30 years, while less extensive dry events have been more common, including delayed onset of the wet season (JICA, 2015). Saysomboun Province has been more susceptible to periodic drought than the other Provinces.

The middle reaches of the Mekong along the Vientiane Plains are particularly flood-prone following storms. Any low-lying areas in the Nam Ngum River Basin are highly susceptible to flooding during high rainfall events. Other major flooding events may occur along the Nam Lik. Low-lying areas along the Nam Ngum, Nam Lik and other tributaries are most vulnerable to flooding and flash flooding. It has been estimated that on average 1.5 severe floods occur every year in Lao PDR (GFDRR, 2011), thus it is anticipated that regional severe flood occurrence would be less than one per year. Flooding can impact communities through direct casualties as well as indirectly through disease outbreaks and/or significant infrastructure damage.

The foothills are not as susceptible to flooding due to their elevation. Flooding can occur locally due to high rainfall events in the mountains and upstream of the foothills. Foothill streams are more likely to flood if they are in areas with cleared or disturbed land, as the rain is not absorbed by the soil and flows quickly downstream. Highly localised storm rainfall can cause flash flooding.

Table 4-7 Classification of storms according to sustained wind speed (based on Japan Meteorological Agency classification for Western Pacific Ocean)

Classification	Sustained Wind Speed
Super typhoon	>190 km/hr
Severe typhoon	>150 km/hr
Typhoon	>120 km/hr
Severe tropical storm	>90 km/hr
Tropical storm	>60 km/hr
Tropical depression	<60 km/hr

Table 4-8 Number of areas and people affected by typhoon Haima in June 2011 (JICA, 2015)

Province	Districts	Villages	Families	Population	Deaths
Xayabouly	9	78	6,490	32,816	2
Vientiane	11	-	2,613	10,464	5

4.8.2 Fire

It is estimated that 90% of forest fires in the four provinces originate from the slash-and-burn cultivation practices of upland farmers. However, there is no distinction between fires due to careless shifting

cultivation and forest fires. Escaped fires for hunting or clearing permanent agricultural plots may cause more damage than shifting cultivation. Fires are more common during March, April and May, during the hot and dry season (London, 2001). Other causes of fire include arson, residential fire spread and electrical faults.

Present initiatives in Lao PDR related to forest fire management are primarily led by government or donor-initiated projects and focus on fire prevention and preparedness. As forest fires are not seen as a major threat in the country, few projects are based solely on forest fire management (except for the Cooperazione e Sviluppo [CESVI] project in Xayabouly Province), but rather are part of larger forest management initiatives (London, 2001).

4.8.3 Climate Change

Temperatures across the four Provinces have increased on average 0.1 to 0.3 °C per decade over the last 60 years (World Bank, 2011). Based on these trends, regional temperatures may increase by 1.4 °C to 4.3 °C by the end of the century (World Bank, 2011, ICEM, 2013).

Rainfall may also increase in the four provinces with climate change. Recent studies have estimated that the annual precipitation for the Mekong Basin may increase by 13.5% from the historical mean of 1,509 mm to 1,712 by 2030 (World Bank, 2011, ICEM, 2013). This increase is anticipated to be mostly confined to the wet season. It is possible that there will be a decrease in dry season precipitation by up to 25% from historic levels (UNISDR, 2012). Other predictions have been calculated as a 22% increase in dry season rain (Eastham *et al.*, 2008).

One of the main hydrological features of the four provinces, the Nam Ngum river, is predicted to experience a 7% increase in discharge during the wet season if CO₂ increases to 540 ppm (from 360 ppm baseline, AIACC, 2006). An increase to 720 ppm of CO₂ is predicted to increase the discharge from Nam Ngum by 12%.



Chapter 5 | Biological Setting



Chapter 5 | Biological Setting

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5 BIOLOGICAL SETTING

Burapha establishes plantations in degraded vegetative landscapes that have typically been used for swidden agriculture, primarily in foothill positions that avoid sensitive habitat and productive land in the floodplains and native forest in mountainous areas. The Company will expand its plantation area in four Provinces of Central Lao (Project Provinces) that occur within the Indo-Malay Tropical and Subtropical Broadleaf Forests Biome (WWF, 2016).

The biological setting for the Project is provided for the following sections to facilitate understanding of the biological setting within and surrounding the potential Project area:

- Current Project area – biological setting in the land currently leased by Burapha (2017);
- Project expansion area – biological setting in land within the four target Provinces that has the physical / biological character suited for plantation expansion; and
- Surrounding habitat – biological setting in land contiguous or surrounding potential expansion areas that may be indirectly or directly affected by plantation establishment.

There are a variety of natural and modified¹ habitat types across the Project Provinces (Table 5-1), including:

- Modified:
 - » Fallow forest;
 - » Barren land;
 - » Deciduous/evergreen plantation;
 - » Agricultural cropland;
 - » Rice paddy; and
 - » Settlement / built up areas.
- Natural:
 - » Bamboo;
 - » Coniferous forest;
 - » Dry dipterocarp forest;
 - » Deciduous forest;
 - » Evergreen forest;
 - » Grassland;
 - » Mixed coniferous / broadleaf forest;
 - » Gallery (riparian) forest; and
 - » Waterways / aquatic habitat.

Forests in Lao PDR are classified into five categories (Forestry Law):

¹ According to IFC definitions:

Modified - contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition and may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands

Natural - areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.

- **Production Forests** – provide sustainable-use timber and other forest products for people’s livelihoods and national economic and social development requirements.
- **Conservation Forests** – protect and conserve animal and plant species, natural habitats and historical, cultural, tourism, environmental, educational or scientific values.
- **Protection Forests** – protect watershed areas and prevent soil erosion. They also include areas of forestland with national security significance, areas for protecting against natural disaster and areas for protection of the environment.
- **Regeneration Forests** – young or fallow areas allowed to regenerate and maintain forest cover to generate natural forest cover as trees mature.
- **Degraded Forests** – heavily damaged forests, to the extent they are without forest or barren, that are classified for tree planting and/or allocation to individuals or organizations for tree planting, permanent agriculture and livestock production or other purposes in accordance with national economic development plans.

According to Lao PDR’s Forestry Strategy to 2020, 41.5% of the Country’s total land area has more than 20% canopy density, with the forest area rapidly declining. One of the aims of Lao PDR’s Forestry Strategy to 2020 is to decrease the rate of forest loss and changes in species assemblage.

The Company will expand its operations via planting the remainder of its concession / leased land (where suitable) in non-sensitive areas and will acquire new land use rights in the same four Provinces. Acceptable areas for plantation implementation include:

- Degraded forest or cleared land (e.g. fallow forest) in the foothill upslope from productive paddy agricultural land;
- Areas outside of intact forests, riparian area, High Conservation Value (HCV) Forests, or otherwise sensitive forest areas;
- Areas outside of Village, District, Provincial, and National Protection and Conservation Forests and their buffers.

Table 5-1 Land use and vegetative community area within the Project Provinces

Province	Vientiane	Vientiane Cap.	Xayabouly	Saisomboun	Grand Total
Land Use/ Habitat	Area km ²	Area km ²	Area km ²	Area km ²	Area km ²
Evergreen forest	1289.24	15.17	1659.51	1590.58	4554.51
Dry dipterocarp forest	42.21	-	33.08	-	75.29
Deciduous forest	4105.43	985.85	7382.05	2671.97	15145.30
Old fallow forest	2572.81	490.58	3815.84	1203.53	8082.76
Young fallow forest	1897.62	844.81	1663.06	712.36	5117.85
Bamboo	290.90	28.71	196.34	416.43	932.39
Grassland	0.94	-	1.32	84.98	87.25
Swamp	13.53	22.69	-	-	36.22
Rice paddy	550.47	898.45	258.39	63.93	1771.24
Slash and burn land	743.01	165.65	658.54	188.66	1755.85
Other agriculture area	-	-	8.20	-	8.20
Urban area	8.78	48.36	5.18	7.71	70.02
Other land	-	-	1.40	-	1.40
Barren land	-	-	0.33	-	0.33
Water	492.11	90.29	104.51	244.24	931.16
Total	12007.05	3590.56	15787.76	7184.40	38569.76

5.1 Habitat and Biodiversity

5.1.1 Current Project Area

Evergreen Plantation

Burapha has established evergreen plantations, with *Eucalyptus cumadulensis* (or cross with *E. urophylla*, *E. pellita*, or *E. grandis*) and / or *Acacia auriculiformis*. These trees form a uniform canopy within approximately three years, with low species richness beneath.

Flora Biodiversity

All species identified in surveyed plantations (not including plantation trees) are common and widespread within the region and Lao PDR (refer to Table 5-2). Native plants were found to be a subset of those identified during literature reviews and surveys for fallow forest.

Two known invasive flora species were identified: *Chromolaena odorata* (Siam weed), a perennial shrub native to South and Central America, and *Imperata cylindrica*, a native grass to Asia that has spread far beyond its original distribution and abundance (ISSG, 2016).

The fast-growing *C. odorata* weed forms dense stands/bushes often preventing the establishment of other flora species (GISD, 2016a). *Chromolaena odorata* is particularly problematic in agricultural areas, plantations, road margins, or anywhere with disturbed vegetation and soil with adequate sunlight.

Imperata cylindrica is a highly invasive weed that develops an extensive root/rhizome system, can grow in poor soils, is drought tolerant, can adapt to fire regimes and appears to have genetic plasticity (GISD, 2016b). Thus, the grass has been able to grow in harsh and highly disturbed conditions. Additionally, the grass can invade minimally degraded habitats, out-competing native grasses and plants. The grass has become particularly problematic in agricultural and plantation areas where slash and burn practices are undertaken.



Plate 5-1 Mature Eucalypt plantation



Plate 5-2 Young Eucalypt plantation

Table 5-2 Common species within the structural layers of Burapha *Eucalyptus* and *Acacia* plantations

Strata	Scientific Name	Family	Habit
Canopy 5 m – 6 m	<i>Eucalyptus</i> sp.	Myrtaceae	Planted tree
	<i>Acacia auriculiformis</i>	Leguminosae	Planted tree
Mid-storey 1 m – 4 m	<i>Alstonia scholaris</i>	Apocynaceae	Tree
	<i>Artocarpus chaplasha</i>	Moraceae	Tree
	<i>Baccaurea ramiflora</i>	Phyllanthaceae	Tree
	<i>Cephalostachyum virgatum</i>	Poaceae	Bamboo
	<i>Croton laevigatus</i>	Euphorbiaceae	Small tree
	<i>Dillenia kerrii</i>	Dilleniaceae	Tree
	<i>Ficus hispida</i>	Moraceae	Small tree
	<i>Fernandoa adenophylla</i>	Bignoniaceae	Tree
	<i>Gonocaryum lobbianum</i>	Cardiopteridaceae	Small tree
	<i>Macaranga denticulata</i>	Euphorbiaceae	Small tree
	<i>Mallotus barbatus</i>	Euphorbiaceae	Small tree
	<i>Mallotus paniculatus</i>	Euphorbiaceae	Small tree
	<i>Microcos paniculata</i>	Tiliaceae	Tree
	<i>Musa acuminata</i>	Musaceae	Herb
	<i>Ormosia cambodiana</i>	Leguminosae	Tree
	<i>Pterospermum semisagittatum</i>	Malvaceae	Tree
	<i>Rhapis micrantha</i>	Arecaceae	Herb
	<i>Saraca declinata</i>	Fabaceae	Tree
<i>Xerospermum noronhianum</i>	Sapindaceae	Tree	
Understorey < 1 m	<i>Acacia pennata</i>	Leguminosae	Climber
	<i>Catimbium bracteatum</i>	Zingiberaceae	Herb
	<i>Chromolaena odorata</i> #	Asteraceae	Herb
	<i>Croton laevigatus</i>	Euphorbiaceae	Small tree
	<i>Curculigo orchioides</i>	Hypoxidaceae	Herb
	<i>Halopogon blumei</i>	Maranthaceae	Herb
	<i>Hedyotis verticillata</i>	Rubiaceae	Herb
	<i>Homalomena pendula</i>	Araceae	Herb
	<i>Imperata cylindrica</i> #	Poaceae	Herb
	<i>Lentinus squarrosulus</i>	Polyporaceae	Mushroom
	<i>Lygodium flexuosum</i>	Lygodiaceae	Fern
	<i>Manihot esculenta</i>	Euphorbiaceae	Shrub
	<i>Paederia tomentosa</i>	Rubiaceae	Climber
	<i>Panicum</i> sp.	Poaceae	Grass
	<i>Paspalum commersonii</i>	Gramineae	Grass
	<i>Rhapis micrantha</i>	Arecaceae	Herb
	<i>Rinorea boissieu</i>	Violaceae	Shrub
	<i>Saccharum spontaneum</i>	Gramineae	Grass
	<i>Sida acuta</i>	Elaeocarpaceae	Herb
	<i>Thysanolaena maxima</i>	Poaceae	Grass

KEY: # - Known invasive species

Fauna Biodiversity

Fauna biodiversity is generally poor and limited to common, widespread and disturbance-tolerant species. Some of the species that are common to fallow forests, including the Asiatic brush-tailed porcupine, hoary bamboo rat and house mouse may inhabit plantations. Larger mammals are unlikely to occur in plantations due to the lack of canopy and mid-storey cover.

A wide variety of bird taxa occur within plantations and are common and widespread regionally and in Lao PDR. Asiatic reticulated pythons and Bengal monitor lizards have a wide habitat tolerance and may hunt rodents in the undergrowth. Species that have been identified by residents living near plantations² include spotted dove (*Stigmatopelia chinensis*), Javan frogmouth (*Batrachostomus javensis*), Emma Gray's forest lizard (*Calotes emma*), radiated ratsnake (*Elaphe radiata*), Chinese edible frog (*Hoplobatrachus rugulosus*) and common green frog (*Hylarana erythraea*).

5.1.2 Project Expansion Area

The Project will expand into degraded vegetative communities that are generally defined as fallow forest. Species assemblage and structural composition is sourced from data collated from previous surveys for development projects across the Project Provinces³. Species presence data was also collected during botanical surveys of potential Project expansion areas and through local knowledge surveys in nearby villages.

Fallow Forest

Fallow forest is a regenerating vegetative community that is re-establishing, generally after clearance for shifting / swidden cultivation. Swidden agriculture is a common land use in Lao PDR, though the number of people practising this method of agriculture has decreased in recent decades (Rerkasem et al., 2009) however it cannot be confirmed for this study whether total land area utilised for swidden agriculture has increased or decreased in recent years.

Fallow forest develops through primary succession dominated by herbaceous flora, while secondary succession is dominated by woody vegetation that range from shrubs to tall trees (Rerkasem et al., 2009). This forest type is divided into two categories (for this study) based on structural composition: (i) young fallow (<5 years) is generally comprised of one or two strata of vegetation and (ii) fallow (5+ years) may have three strata (MacNamara et al., 2012).

The fallow phase between cycles of swidden agriculture allows for some restoration of soil fertility and the provision of non-timber forest products (NTFPs), timber forest products (TFPs) and other ecosystem services (e.g. carbon sequestration, water filtration, erosion control) and habitat for native flora and fauna (Ziegler et al., 2009; Brunn et al., 2009).

Young fallow is dominated by the mid-storey and understorey strata, with only fast-growing species exceeding 2 to 3 m height (Table 5-, Plate 5-). Despite the relatively high species richness in both structural layers, the floristic composition differs considerably from the natural forest types it has replaced and is thus considered modified habitat. MacNamara et al., (2012) found that primary forest species can occur in frequently and infrequently cleared/disturbed sites, suggesting resilience in some species to regenerate after disturbance and recolonise agricultural areas. The older fallow has a more natural vegetative structure but species richness is reduced compared to the natural forest floristic assemblage (Table 5-).

² During local knowledge surveys and focus group discussions

³ Conducted by Dr Pheng Phengsintham, Botanist, PhD / MSc / B.Sc

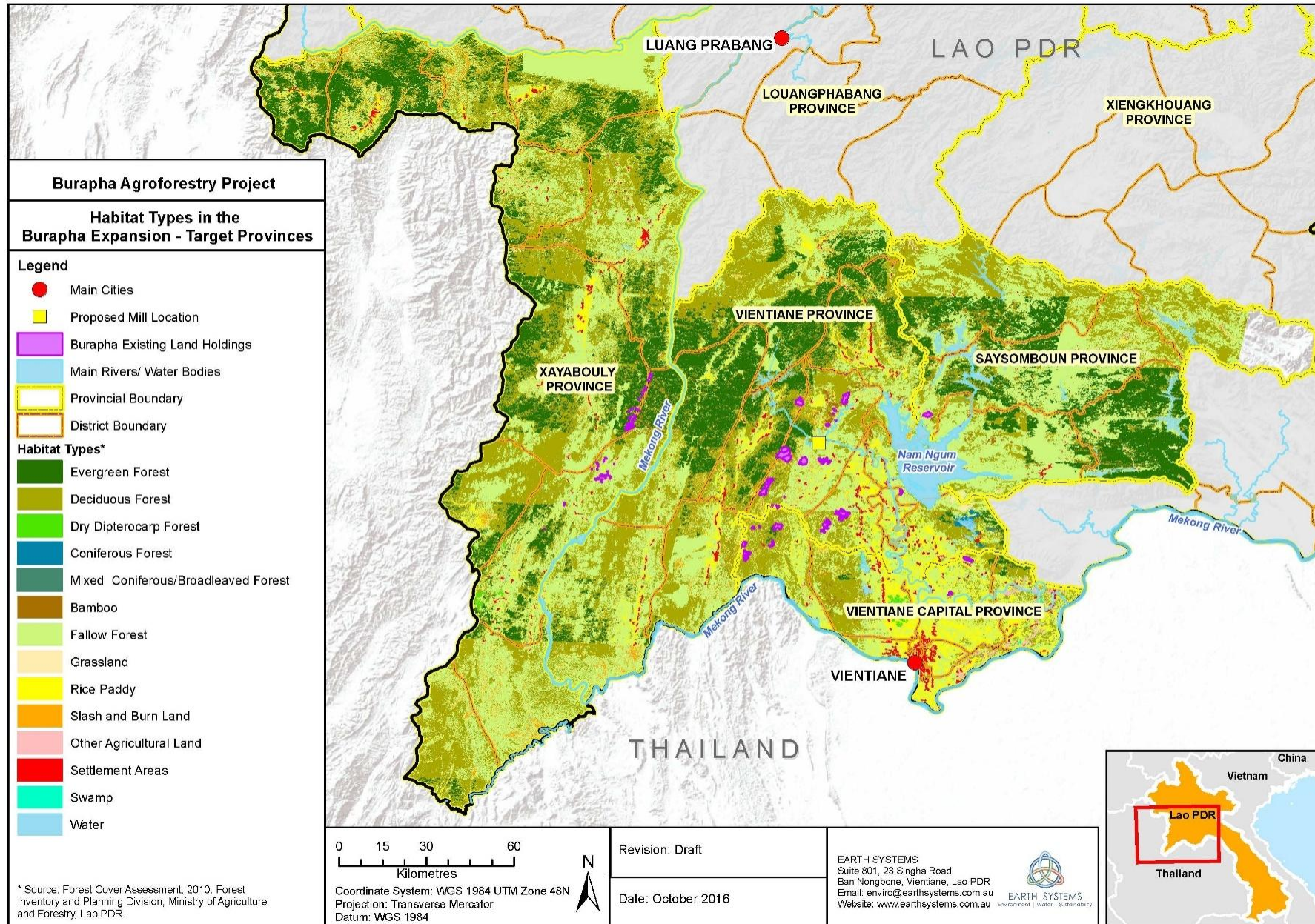


Figure 5-1 Project Province habitat types

Flora Biodiversity

Fallow forest may have a high species diversity (refer to Tables 5-3 and 5-4), with a high proportion of rapidly growing pioneer species (Rerkasem et al., 2009). Most flora species in fallow forests are native and common to the region (refer to Tables 5-3 and 5-4). Many of these species are important TFPs (construction timber, firewood, etc.) or NTFPs, including several species of bamboo, mushroom, rattan and hardwoods. Non-native species are common in fallow forest, including three globally significant invasive plants: *Chromolaena odorata*, *Imperata cylindrica* and *Mimosa pudica* (ISSG, 2016).

Table 5-3 Common species within young fallow forest

Strata	Scientific Name	Family	Habit
Upper Canopy (5 – 10m)	Absent		
Mid-storey (1.3 – 4m)	<i>Aporosa polystachya</i>	Phyllanthaceae	Small tree
	<i>Aporosa villosa</i>	Phyllanthaceae	Small tree
	<i>Aporosa ficifolia</i>	Phyllanthaceae	Small tree
	<i>Aporosa macrostachyus</i>	Phyllanthaceae	Small tree
	<i>Aporosa polystachya</i>	Phyllanthaceae	Small tree
	<i>Casearia grewiaefolia</i>	Salicaceae	Small tree
	<i>Cratoxylum formosum</i>	Guttiferae	Tree
	<i>Cratoxylum formosum var. prunifolium</i>	Guttiferae	Tree
	<i>Croton laevigatus</i>	Euphorbiaceae	Small tree
	<i>Macaranga denticulata</i>	Euphorbiaceae	Small tree
	<i>Maesa ramentacea</i>	Primulaceae	Small tree
	<i>Mallotus barbatus</i>	Euphorbiaceae	Small tree
	<i>Mallotus paniculatus</i>	Euphorbiaceae	Small tree
	<i>Ormosia pinnata</i>	Fabaceae	Tree
	<i>Oxytenanthera albociliata</i>	Poaceae	Bamboo
	<i>Peltophorum dasyrrhachis</i>	Fabaceae	Tree
	<i>Sapium discolor</i>	Euphorbiaceae	Tree
<i>Trema orientalis</i>	Cannabaceae	Small tree	
Understorey (< 1.3m)	<i>Aralia armata</i>	Araliaceae	Small tree
	<i>Chromolaena odorata</i> #	Asteraceae	Herb
	<i>Clausena anisata</i>	Rutaceae	Shrub
	<i>Clerodendrum colebrookianum</i>	Lamiaceae	Herb
	<i>Conyza sumatrensis</i>	Asteraceae	Herb
	<i>Cyclea peltata</i>	Menispermaceae	Climber
	<i>Dioscorea alata</i>	Dioscoreaceae	Climber
	<i>Dioscorea triphylla</i>	Dioscoreaceae	Climber
	<i>Embelia ribes</i>	Primulaceae	Climber
	<i>Erechtites valerianifolia</i>	Asteraceae	Herb
	<i>Helicteres viscida</i>	Malvaceae	Herb
	<i>Lepisanthes tetraphylla</i>	Sapindaceae	Small tree
	<i>Mallotus thorelii</i>	Euphorbiaceae	Small tree
<i>Mimosa pudica</i> #	Fabaceae	Herb	

Strata	Scientific Name	Family	Habit
	<i>Oxytenanthera albociliata</i>	Poaceae	Bamboo
	<i>Panicum sp.</i>	Poaceae	Grass
	<i>Scleria terrestris</i>	Cyperaceae	Herb

KEY: # - Known invasive species

Table 5-4 Common species in fallow forest

Strata	Scientific Name	Family	Habit
Upper Canopy 5 m – 20 m	<i>Alstonia scholaris</i>	Apocynaceae	Tree
	<i>Anisoptera costata</i>	Dipterocarpaceae	Tree
	<i>Bombax anceps</i>	Bombacaceae	Tree
	<i>Cratoxylum formosum</i>	Guttiferae	Tree
	<i>Cratoxylum formosum var. prunifolium</i>	Guttiferae	Tree
	<i>Crypteronia paniculata</i>	Crypteroniaceae	Tree
	<i>Garcinia oliveri</i>	Clusiaceae	Tree
	<i>Grewia paniculata</i>	Malvaceae	Tree
	<i>Irvingia malayana</i>	Irvingiaceae	Tree
	<i>Lagerstroemia sp.</i>	Lythraceae	Tree
	<i>Ormosia cambodiana</i>	Leguminosae	Tree
	<i>Ormosia pinnata</i>	Fabaceae	Tree
	<i>Peltophorum dasyrrhachis</i>	Fabaceae	Tree
	<i>Pterocarpus macrocarpus</i>	Fabaceae	Tree
	<i>Sapium discolor</i>	Euphorbiaceae	Tree
<i>Schima wallichii</i>	Theaceae	Tree	
Mid-storey 1.3 m – 4 m	<i>Aporosa ficifolia</i>	Phyllanthaceae	Small tree
	<i>Aporosa polystachya</i>	Phyllanthaceae	Small tree
	<i>Cratoxylum formosum</i>	Guttiferae	Tree
	<i>Cratoxylum formosum var. prunifolium</i>	Guttiferae	Tree
	<i>Ficus hispida</i>	Moraceae	Small tree
	<i>Mallotus barbatus</i>	Euphorbiaceae	Small tree
	<i>Mallotus paniculatus</i>	Euphorbiaceae	Small tree
	<i>Micromelum minutum</i>	Rutaceae	Small tree
	<i>Oroxylum indicum</i>	Bignoniaceae	Small tree
Understorey < 1.3 m	<i>Ancistrocladus tectorius</i>	Ancistrocladaceae	Climber
	<i>Catimbium bracteatum</i>	Zingiberaceae	Herb
	<i>Chromolaena odorata</i> #	Asteraceae	Herb
	<i>Cnestis palala</i>	Connaraceae	Shrub
	<i>Eurycoma longifolia</i>	Simaroubaceae	Small tree
	<i>Imperata cylindrica</i> #	Poaceae	Grass
	<i>Oxytenanthera albociliata</i>	Poaceae	Grass
	<i>Panicum sp.</i>	Poaceae	Grass
	<i>Scleria terrestris</i>	Cyperaceae	Herb

KEY: # - Known invasive species

Fauna Biodiversity

Large mammals are typically uncommon or transient in fallow forest, with the lack of canopy structure to provide cover for refuge. Mid-sized mammals that inhabit fallow forest include wild boar (*Sus scrofa*), red muntjac (*Muntiacus muntjak*) and spotted linsang (*Prionodon pardicolor*). It has been reported that the globally Endangered Sunda pangolin (*Manis javanica*) occasionally occurs in fallow and other disturbed habitats. Rodents are common to fallow forests, such as the Asiatic brush-tailed porcupine (*Atherurus macrourus*), Indochinese ground squirrel (*Menetes berdmorei*) and hoary bamboo rat (*Rhizomys pruinosus*; Aplin and Singleton, 2003)⁵.

A wide variety of bird taxa may occur within fallow forest. Most birds that inhabit fallow are common and widespread regionally. Birds are capable of moving through fallow into nearby natural habitat. Species commonly observed in regional fallow forest include lesser coucal (*Centropus bengalensis*), changeable hawk-eagle (*Nisaetus cirrhatus*) and large-billed crow (*Corvus macrorhynchos*).

Frogs and toads may occur in more humid fallow forests. Frogs and toads require pooled or flowing water at some point during their life cycle and thus dry fallow forests are unlikely to be inhabited by a wide variety of species. If frogs and toads are present, they are likely to be common and disturbance-tolerant species.

A wide range of reptiles inhabit fallow forest including monitors, snakes and geckos. These reptiles are common and widespread in the region. Key reptile species common within fallow forest are Asiatic reticulated python (*Python reticulatus*), Bengal monitor lizard (*Varanus bengalensis*) and common water monitor (*Varanus salvator*). These species are highly disturbance-tolerant and can inhabit a wide range of habitats. Two threatened species that have a wide habitat tolerance, including within fallow forest are the black and white spitting cobra (*Naja siamensis* VU⁶) and king cobra (*Ophiophagus hannah* VU; IUCN, 2016).



Plate 5-3 Fallow forest along Burapha plantation access road

⁵ Includes surveys conducted for other major development projects, e.g. Phonsavan Copper-Gold Project, Nam Ngiep Hydropower

⁶ IUCN Red List of Threatened Species - Vulnerable

5.1.3 Surrounding Habitat

In the wider landscape of the target Provinces, the dominant habitat types are (Figure 5-1):

- Natural:
 - » Bamboo;
 - » Coniferous forest;
 - » Dry dipterocarp forest;
 - » Mixed deciduous forest;
 - » Evergreen forest;
 - » Mixed coniferous / broadleaf forest;
 - » Grassland;
 - » Gallery (riparian) forest; and
 - » Waterways / aquatic habitat.
- Modified:
 - » Agricultural cropland;
 - » Deciduous/evergreen plantation;
 - » Rice paddy;
 - » Settlement / built up areas.

Information regarding habitat structure and species assemblage has been sourced from the literature, data collated from previous surveys for development projects, surveys of Project expansion areas and local knowledge surveys in nearby villages.

Bamboo Forest

Bamboo forest is widely distributed across the Provinces. Bamboo forest can be a natural habitat or modified, depending on its level of previous disturbance regime. Areas classified as bamboo forest have at least 80% composition of bamboo species with bamboo heights of up to 15 m.

Flora Biodiversity

Characteristic species of bamboo forest are *Bombax anceps* and *Oxytenanthera albociliata*, while *B. anceps* is dominant in the canopy (Inthakoun and Delang, 2008). Other common species include trees, small trees and herbs (refer to Table 5-5). Threatened species are rare in disturbed bamboo forests, but *Shorea roxburghii* (white meranti, EN) may occur in primary forest (IUCN, 2016).

Table 5-5 Common species within the strata of bamboo forest

Strata	Scientific Name	Family	Habit
Canopy trees 5 m - 50 m	<i>Bombax anceps</i> *	Bombacaceae	Tree
	<i>Lagerstroemia sp.</i>	Lythraceae	Tree
	<i>Pterocarpus macrocarpus</i>	Fabaceae	Tree
	<i>Vitex limonifolia</i>	Lamiaceae	Tree
Mid-storey 2 m – 5 m	<i>Antidesma ghaesembilla</i>	Phyllanthaceae	Small tree
	<i>Ficus hispida</i>	Moraceae	Small tree
	<i>Memecylon edule</i>	Melastomataceae	Small tree
	<i>Microcos paniculata</i>	Tiliaceae	Small tree
	<i>Oxytenanthera albociliata</i> *	Poaceae	Bamboo

Strata	Scientific Name	Family	Habit
	<i>Zizyphus oenoplia</i>	Rhamnaceae	Shrub
Understorey < 2 m	<i>Chromolaena odorata</i>	Asteraceae	Herb
	<i>Clerodendrum colebrookianum</i>	Lamiaceae	Herb
	<i>Conyza sumatrensis</i>	Asteraceae	Herb
	<i>Curcuma sp.</i>	Zingiberaceae	Herb
	<i>Dioscorea hispida</i>	Dioscoreaceae	Climber
	<i>Erechtites valerianifolia</i>	Asteraceae	Herb
	<i>Saccharum spontaneum</i>	Gramineae	Herb
	<i>Scleria terrestris</i>	Cyperaceae	Herb

*Key bamboo species

Fauna Biodiversity

The fauna biodiversity of bamboo forest is dependent on the level of disturbance. Primary bamboo forest will have a moderate species diversity, while disturbed forests are likely to have few species. Small mammals (e.g. rodents) and passerines are common in bamboo forests. Globally threatened species that occur in bamboo forest include sambar deer (*Rusa unicolor*, VU), Chinese pangolin (EN), Phayre's leaf monkey (EN) and black and white spitting cobra (VU; IUCN, 2016). These species are capable of inhabiting disturbed habitats.

Coniferous Forest

Coniferous forest has an open canopy dominated by conifers, while the young growth often forms a dense mid-storey (Table 5-6). This forest type occurs in higher elevations (200 to 2,000 masl) with a relatively cooler climate. Remnant coniferous forest occurs mainly on steep hillsides in stands of 10 to 50 trees but may occur across foothills (Yamane and Chanthirath, 2000).

Flora Biodiversity

The characteristic species of this habitat type are *Pinus kesiya* and *Keteleeria evelyniana*, with other tree species occurring in lower numbers (; Rundel, 1999). The understory can be very sparse with some patches of grass and herbs due to the carpet of pine needles. Other species of conifer recorded in Lao coniferous montane forests are *Calocedrus macrolepis*, *Cunninghamia konishii*, *Dacrycarpus imbricatus*, *Dacrydium elatum*, *Fokienia hodginsii*, *Nageia wallichiana*, *P. merkusii*, *P. dalatensis* and *Podocarpus neriifolius* (Thomas et al., 2007). *Dacrydium elatum* has been found in Phou Khao Khoay NPA. *Keteleeria evelyniana* is a globally Vulnerable species as it is highly value timber species used for construction, firewood and wooden drums are often carved from the trunks (IUCN, 2016).

Table 5-6 Dominant species recorded in each forest layer of coniferous forest

Strata	Scientific Name	Family	Habit
Canopy 10 - 20 m	<i>Engelhardtia spicata</i>	Juglandaceae	Tree
	<i>Keteleeria evelyniana</i>	Pinaceae	Tree
	<i>Lithocarpus truncatus</i>	Fagaceae	Tree
	<i>Pinus kesiya</i>	Pinaceae	Tree
	<i>Schima wallichii</i>	Theaceae	Tree
Mid-storey 2 - 10 m	<i>Aporosa villosa</i>	Euphorbiaceae	Small tree
	<i>Phyllanthus emblica</i>	Euphorbiaceae	Small tree
	<i>Rhus chinensis</i>	Anacardiaceae	Small tree

Strata	Scientific Name	Family	Habit
	<i>Sapium discolor</i>	Euphorbiaceae	Tree
	<i>Wendlandia thorelii</i>	Rubiaceae	Small tree
Understorey < 2 m	<i>Lygodium polystachyum</i>	Schizeaceae	Fern
	<i>Melastoma normale</i>	Melastomataceae	Herb
	<i>Thysanolaena latifolia</i>	Poaceae	Grass

Fauna Biodiversity

Coniferous forests host a range of mammals, reptiles and birds, including common species such as common cuckoo (*Cuculus canorus*), northern treeshrew (*Tupaia belangeri*) and red-collared woodpecker (*Picus rabieri*). Species richness is poorer than other forests, but there can be a specialised assemblage. Characteristic bird species include grey-crowned pygmy woodpecker (*Dendrocopos canicapillus*) and greater necklaced laughingthrush (*Garrulax pectoralis*; Duckworth et al., 2002). Arboreal species are common in the conifer dominated canopy. Binturong (*Arctictis binturong*, VU), sambar deer (VU) and Chinese pangolin (EN) use secondary or primary coniferous forest.



Plate 5-4 Coniferous forest with relatively sparse canopy and little undergrowth



Plate 5-5 Mixed deciduous forest with dense canopy, mid-storey and understorey

Dry Dipterocarp Forest

Dry dipterocarp forest forms a moderately open stand of mid-sized trees (Rundel, 1999). Canopy cover ranges from nearly closed to open, similar to woodland or tree savannah. Trees typically grow to a maximum of 25 to 30 m, with small canopy trees ranging between 8 to 10 m. A mid-storey is often less distinctive in dry dipterocarp forests than other forest types (Rundel, 1999). This type of forest is normally found in places with shallow soil (Inthakoun and Delang, 2008). Trees rarely exceed 10 m on the poorest and shallowest soils. Dry dipterocarp forest is also referred to as deciduous dipterocarp forest.

Flora Biodiversity

Vidal (1960) found 207 species of vascular plants during early botanical surveys, of dry dipterocarp forest with the majority of tree species being deciduous. There are many characteristic species of dry dipterocarp forests, such as *Dipterocarpus intricatus*, *Shorea obtusa*, *Dipterocarpus obtusifolius*, *Terminalia tomentosa* and *Shorea siamensis* and have a thick bark and are fire resistant. Other species include *Syzygium gratum*, *Tristaniopsis burmanica* and *T. merguensis* (Souladeth and Meesawat, 2012). Grass and herbs are species rich in the understorey of open stands, while climbers/lianas are less diverse (Rundel, 1999).

Threatened dipterocarps common to primary forest include *Dipterocarpus costatus* (EN) and *Dipterocarpus alatus* (CR)⁷ but have been over-exploited for their timber and are threatened by habitat loss (IUCN, 2016).

Fauna Biodiversity

Fauna species diversity is high within primary dry dipterocarp forests, particularly with a high number of birds. Canopy species include ashy woodswallows (*Artamus fuscus*), bay woodpeckers (*Blythipicus pyrrhotis*) and ashy drongos (*Dicrurus leucophaeus*; IUCN, 2016). Mid-storey and understorey species include rodents, reptiles, ground-dwelling birds and some larger mammals such as large Indian civets (*Viverra zibetha*) and Chinese serows (*Capricornis milneedwardsii*).

Dry dipterocarp forest is inhabited by a wide array of threatened species, particularly protected, contiguous and large tracts of forest (Duckworth et al., 1999). Green peafowls (*Pavo muticus*, EN), great slaty woodpeckers (*Mulleripicus pulverulentus*, VU), binturong (VU), large-spotted civets (*Viverra megaspila*, VU), gaur (*Bos gaurus*, VU), sambar deer (VU), Asian elephants (*Elephas maximus*, EN) and king cobra (VU) are known to inhabit primary and secondary dry dipterocarp forests. More remote and inaccessible mountainous areas are more likely to be refuges for these species, but their home ranges can occur across multiple habitats.

Mixed Deciduous Forest

Mixed deciduous forest generally has a dense canopy (70-90%), with deciduous trees providing more than 50% of the canopy (Rundel, 1999). The mid-storey of young trees often forms a similarly dense layer (40 – 70%). Due to the dense canopy, light is filtered and rarely reaches the forest floor. This creates a microclimate for herbs, fungi and ferns. In secondary forests with more open canopies, the understorey can form up to 60% cover.

Flora Biodiversity

Mixed deciduous forest has a high species diversity (Table 5-7). Common tree species in the canopy reach 35 m and include: *Ailanthus fauveliana*, *Duabanga grandiflora* and *Toxicodendron succedaneum*. Small trees, herbs and vines dominate the mid and understorey, but understorey species are less diverse than other forest types due to the dense canopy.

Primary forest provides sufficient cover and environmental conditions for several threatened species such as *Dalbergia cochinchinensis* (Siamese rosewood, VU), *Dipterocarpus alatus* (CR), *Dipterocarpus costatus* (EN), *Dipterocarpus turbinatus* (CR) and *Shorea roxburghii* (EN; IUCN, 2016; Vidal, 1960).

Table 5-7 Common species within the three strata of mixed deciduous forest

Strata	Scientific Name	Family	Habit
Canopy 10 - 40 m	<i>Ailanthus fauveliana</i>	Simaroubaceae	Tree
	<i>Anisoptera costata</i>	Dipterocarpaceae	Tree
	<i>Bombax anceps</i>	Bombacaceae	Tree
	<i>Cratoxylum formosum</i>	Guttiferae	Tree
	<i>Cratoxylum formosum var. prunifolium</i>	Guttiferae	Tree
	<i>Dipterocarpus alatus</i>	Dipterocarpaceae	Tree
	<i>Dipterocarpus costatus</i>	Dipterocarpaceae	Tree
	<i>Duabanga grandiflora</i>	Lythraceae	Tree
	<i>Garcinia oliveri</i>	Clusiaceae	Small tree
	<i>Grewia paniculata</i>	Malvaceae	Tree
	<i>Irvingia malayana</i>	Irvingiaceae	Tree

⁷ IUCN Critically Endangered

Strata	Scientific Name	Family	Habit
	<i>Lagerstroemia calyculata</i>	Lythraceae	Tree
	<i>Lagerstroemia sp.</i>	Lythraceae	Tree
	<i>Lithocarpus polystachyus</i>	Fagaceae	Tree
	<i>Lithocarpus sp.</i>	Fagaceae	Tree
	<i>Mesua ferrea</i>	Calophyllaceae	Tree
	<i>Ormosia pinnata</i>	Fabaceae	Tree
	<i>Parkia sumatrana</i>	Fabaceae	Tree
	<i>Pterocarpus macrocarpus</i>	Fabaceae	Tree
	<i>Sapium discolor</i>	Euphorbiaceae	Tree
	<i>Schima wallichii</i>	Theaceae	Tree
	<i>Sindora siamensis var. siamensis</i>	Leguminosae	Tree
	<i>Syzygium cumini</i>	Myrtaceae	Tree
	<i>Tetrameles nudiflora</i>	Datisceae	Tree
	<i>Toxicodendron succedaneum</i>	Anacardiaceae	Tree
	<i>Vatica cinerea</i>	Dipterocarpaceae	Tree
Mid-storey 2 - 10 m	<i>Capparis micrantha</i>	Capparaceae	Shrub
	<i>Casearia grewiaefolia</i>	Salicaceae	Small tree
	<i>Cinnamomum iners</i>	Lauraceae	Tree
	<i>Cratoxylum formosum var. prunifolium</i>	Guttiferae	Tree
	<i>Croton argyratus</i>	Euphorbiaceae	Small tree
	<i>Croton laevigatus</i>	Euphorbiaceae	Small tree
	<i>Croton oblongifolia</i>	Euphorbiaceae	Small tree
	<i>Gonocaryum lobbianum</i>	Cardiopteridaceae	Small tree
	<i>Grewia paniculata</i>	Malvaceae	Tree
	<i>Mallotus barbatus</i>	Euphorbiaceae	Small tree
	<i>Mallotus paniculatus</i>	Euphorbiaceae	Small tree
	<i>Memecylon fruticosum</i>	Melastomataceae	Small tree
	<i>Oxytenanthera albociliata</i>	Poaceae	Herb
	<i>Wrightia arborea</i>	Apocynaceae	Tree
Understorey < 2 m	<i>Ardisia crispa</i>	Myrsinaceae	Shrub
	<i>Ardisia elliptica</i>	Primulaceae	Shrub
	<i>Aspidistra sp.</i>	Asparagaceae	Herb
	<i>Calamus javensis</i>	Arecaceae	Climber
	<i>Catimbiium bracteatum</i>	Zingiberaceae	Herb
	<i>Chromolaena odorata</i>	Asteraceae	Herb
	<i>Clausena anisata</i>	Rutaceae	Small tree
	<i>Dracaena angustifolia</i>	Liliaceae	Herb
	<i>Eurycoma longifolia</i>	Simaroubaceae	Shrub
	<i>Melastoma normale</i>	Melastomataceae	Herb
	<i>Mimosa pudica</i>	Fabaceae	Herb
	<i>Oxytenanthera albociliata</i>	Poaceae	Herb
	<i>Pandanus tectorius</i>	Pandanaceae	Herb
	<i>Rhapis micrantha</i>	Arecaceae	Herb
<i>Scleria terrestris</i>	Cyperaceae	Herb	

Strata	Scientific Name	Family	Habit
	<i>Urena lobata</i>	Malvaceae	Herb
	<i>Uvaria macrophylla</i>	Annonaceae	Climber

Fauna Biodiversity

Inaccessible, contiguous and primary mixed deciduous forest is home to a wide variety of species including Oriental bay-owl (*Phodilus badius*), red-collared woodpecker (*Picus rabieri*), Alexandrine parakeet (*Psittacula eupatria*), Pallas's squirrel (*Callosciurus erythraeus*), pompadour green-pigeon (*Treron pompadora*) and Gairdner's shrewmouse (*Mus pahari*). These undisturbed areas are known to be inhabited by the following globally threatened species (IUCN, 2016):

- Dhole (*Cuon alpinus* EN);
- Sun bear (*Helarctos malayanus* VU);
- Asiatic black bear (*Ursus thibetanus* VU);
- Binturong (VU);
- Large-spotted civet (*Viverra megaspila* VU);
- Gaur (*Bos gaurus* VU);
- Stump-tailed macaque (*Macaca arctoides* VU);
- Northern pig-tailed macaque (*Macaca leonina* VU);
- Phayre's leaf monkey (EN);
- Lar gibbon (*Hylobates lar* EN);
- Bengal slow loris (*Nycticebus bengalensis* VU);
- Pygmy slow loris (*N. pygmaeus* VU);
- Asian elephant (EN);
- King cobra (VU).

Threatened species will range across this habitat within protected areas and into adjacent habitats, such as evergreen, mixed coniferous/broadleaf and gallery forest (Sukumar, 2006). Secondary and degraded forest provides sufficient habitat for a variety of common and threatened species, but species diversity is more likely to be high in areas that do not experience hunting, logging and other significant threats (Duckworth et al., 1999).

Evergreen Forest

Evergreen forest canopies are composed of 50% to 80% evergreen tree species (Inthakoun and Delang, 2008). Although deciduous species can be more species rich, canopy cover and lower strata are dominated by evergreen species (Rundel, 1999). Tree heights in the canopy usually exceed 30 m and can form a dense layer (>70% cover). Tree density in the canopy and mid-storey prevents most sunlight from penetrating to the ground, creating dark and often humid conditions for the undergrowth. Evergreen forests grow in deep and fertile soil. This forest type is divided into 'upper' (> 200 masl) and 'lower' (< 200 masl) dry evergreen forest.

Flora Biodiversity

Flora species richness is generally high in evergreen forests, but two to three species tend to dominate. Characteristic canopy trees are *Hopea* spp., *Pterocarpus pedatus*, *Dipterocarpus alatus* and *Anisoptera* spp. (Rundel, 1999). Many canopy trees are deciduous. Due to the tree density and protection from direct sunlight, the mid-storey includes a diverse array of climbers and lichens on tree stems. Bamboo is usually not found except where the canopy has been opened. Early botanical studies found 88 tree, 53 shrub, 29

herb, 39 climber and eight epiphyte / parasite species in dry evergreen forest on alluvial soils near Vientiane, Pakse and Savannakhet (Vidal, 1960).

Transitional communities of humid evergreen forest occur at about 800 m elevation, with *Dipterocarpus turbinatus* and *Toxicodendron succedanea* as the dominant canopy trees (Inthakoun and Delang, 2008). Secondary characteristic species are a variety of palms including *Arenga saccharifera*, *Caryota*, and *Calamus* spp.

Threatened species that were historically common were *Dalbergia cochinchinensis* (VU), *Dipterocarpus retusus* (VU), *Dipterocarpus turbinatus* (CR), *Fokienia hodginsii* (Fujian cypress) VU, *Hopea pierrei* (EN), *Shorea roxburghii* (EN) and *Shorea thorelii* (CR). These species are generally restricted to protected and remote tracts of evergreen forest.

Fauna Biodiversity

Similar to mixed deciduous, fauna species diversity is generally high in evergreen forest, with common species including green Imperial-pigeon (*Ducula aenea*), black drongo (*Dicrurus macrocercus*), red-breasted parakeet (*Psittacula alexandri*), Sunda flying lemur (*Galeopterus variegatus*) and large Indian civet (*Viverra zibetha*). Globally threatened species found in protected and primary evergreen forest include (IUCN, 2016):

- Rhacophorus kio (a frog, VU);
- Dhole (EN);
- Sun bear (VU);
- Asiatic black bear (VU);
- Binturong (VU);
- Large-spotted civet (VU);
- Gaur (VU);
- Sambar deer (VU);
- Stump-tailed macaque (VU);
- Northern pig-tailed macaque (VU);
- Phayre's leaf monkey (EN);
- Lar gibbon (EN);
- Northern white-cheeked gibbon (*Nomascus leucogenys* CR);
- Bengal slow loris (VU);
- Pygmy slow loris (VU);
- Asian elephant (EN).

Mixed Coniferous / Broadleaf Forest

Mixed coniferous and broadleaf forest generally has only one canopy layer. The canopy is quite open and sparse; however, a highly dense mid-storey of young-growth tree species can occasionally occur below the canopy (Inthakoun and Delang, 2008). These forests occur from approximately 200 to 2,000 masl. Mixed coniferous / broadleaf forests constitute a transitional forest type between coniferous and broadleaf forests. Broadleaf forests can either be deciduous or evergreen forests. Transitional zones between the different forest types can be difficult to delineate, hence the categorisation of a mixed coniferous / broadleaf forest.

Flora Biodiversity

A diverse canopy of coniferous tree species is found together with either deciduous or evergreen species. Dominant species are two pines (*Pinus kesiya* and *Pinus merkusii*), but other coniferous trees such as

Cunninghamia spp. may be abundant (Rundel, 1999). Since the forest is a transition between other forest types, flora species diversity is often high. Threatened species that are known to occur in this transitional mosaic include *Dalbergia bariensis* (EN).

Fauna Biodiversity

Along with species that occur in the forests that form this transitional habitat, orange-breasted pigeons (*Treron bicinctus*) and blue magpies (*Urocissa erythrorhyncha*) are generalist species that can occur across habitats. Threatened species known to occur across mosaic and transitional habitats are sun bears (VU), Asiatic black bears (VU), binturongs (VU), large-spotted civets (VU), sambar deer (VU), Chinese pangolins (EN), northern pig-tailed macaques (VU) and Asian elephants (EN; IUCN, 2016).

Gallery (Riparian) Forest

Gallery forests are situated within riparian zones along waterways. These forests may be evergreen or deciduous (Inthakoun and Delang, 2008). Gallery forests may develop a secondary stand along the streams' or rivers' lower bank of both perennial and intermittent waterways. This secondary stand forms a long band of forest in lowland areas and near floodplains where streams and rivers are likely to frequently overflow. Remnant patches of gallery forest are common and degraded gallery forest are common as the land is often of high agricultural value. Gallery forest is often retained as it occurs along waterways and thus provides water filtration and erosion/sedimentation protection.

Flora Biodiversity

Flora diversity is generally high in primary gallery forests (Table 5-8), while degraded and secondary forests often retain good species diversity as surrounding habitats are removed (Inthakoun and Delang, 2008). Threatened species are known in gallery forest, particularly in protected areas and adjacent to primary and secondary natural habitat. Key threatened species include *Hopea odorata* (VU) and *Dipterocarpus alatus* (CR; IUCN 2016).

Table 5-8 Common species that grow within gallery forest

Strata	Scientific Name	Family	Habit
Canopy 5 m - 15 m	<i>Albizia odoratissima</i>	Leguminosae	Tree
	<i>Bischofia javanica</i>	Phyllanthaceae	Tree
	<i>Castanopsis hystrix</i>	Fagaceae	Tree
	<i>Elaeocarpus floribundus</i>	Elaeocarpaceae	Tree
	<i>Ficus semicordata</i>	Moraceae	Tree
	<i>Macaranga denticulata</i>	Euphorbiaceae	Tree
Mid-storey 2 m - 5 m	<i>Chromolaena odorata</i> #	Asteraceae	Herb
	<i>Maesa ramentacea</i>	Myrsinaceae	Small tree
	<i>Mallotus barbatus</i>	Euphorbiaceae	Small tree
	<i>Solanum torvum</i>	Solanaceae	Herb
	<i>Tithonia diversifolia</i>	Asteraceae	Herb
Understorey < 2 m	<i>Colocasia antiquorum</i>	Araceae	Herb
	<i>Diplazium esculentum</i>	Woodsiaceae	Fern
	<i>Equisetum sp.</i>	Equisetaceae	Herb
	<i>Erechites valerianifolia</i>	Asteraceae	Herb
	<i>Rubus obcordatus</i>	Rosaceae	Herb
	<i>Saccharum spontaneum</i>	Poaceae	Grass

Fauna Biodiversity

Species common to gallery forest or its edge include river lapwing (*Vanellus duvaucelii*), tawny fish-owl (*Ketupa flavipes*), Asian common toad (*Duttaphrynus melanostictus*), Burmese squat frog (*Calluella guttulata*), Limborg's frog (*Limnonectes limborgi*) and beautiful pygmy frog (*Microhyla pulchra*). Great cormorant (*Phalacrocorax carbo*), great thick-knee (*Esacus recurvirostris*), pied kingfisher (*Ceryle rudis*), blue-tailed bee-eater (*Merops philippinus*) and large-billed crow (*Corvus macrorhynchos*) occur in small numbers (Duckworth et al., 2002).

Primary gallery forest is also inhabited by fishing cats (*Prionailurus viverrinus*, EN), sambar deer (VU), northern pig-tailed macaques (VU), Asian elephants (EN), Chinese cobras (VU), king cobras (VU) and Burmese pythons (VU; IUCN, 2016). Primary and secondary gallery forest is often used by these species, and those that inhabit nearby habitats, as wildlife corridors, particularly remnant patches along main waterways.



Plate 5-6 Gallery forest along a fast-flowing river



Plate 5-7 Degraded riparian habitat, Nam Ngum



Plate 5-1 Seasonal stream



Plate 5-9 Nam Lik and stands of gallery forest

Grassland

This community refers to naturally occurring grasslands areas that are nearly devoid of trees. Small scattered shrubs/young trees occur in some areas forming a distinct shrub layer or mid-storey (Table 5-9).

Flora Biodiversity

Grassland is generally dominated by a few of the grass species identified in Table 5-9.

Table 5-9 Common grassland species in Central Lao

Strata	Scientific Name	Family	Habit
Mid-storey 0.5 m - 2 m	<i>Aporosa villosa</i>	Euphorbiaceae	Small tree
	<i>Ficus hispida</i>	Moraceae	Small tree
	<i>Phyllanthus emblica</i>	Euphorbiaceae	Small tree
	<i>Tithonia diversifolia</i>	Asteraceae	Herb
	<i>Wendlandia thorelii</i>	Rubiaceae	Small tree
Understorey < 0.5 m	<i>Chromolaena odorata</i> #	Asteraceae	Herb
	<i>Elephantopus scaber</i>	Asteraceae	Herb
	<i>Imperata cylindrica</i> #	Poaceae	Grass
	<i>Eularia phaeothrix</i>	Poaceae	Grass
	<i>Sorghum nitidum</i>	Gramineae	Grass
	<i>Sporobolus indicus</i>	Gramineae	Grass
	<i>Themeda triandra</i>	Poaceae	Grass
	<i>Thysanolaena latifolia</i>	Poaceae	Grass

Invasive species

Fauna Biodiversity

Several species of passerine use grasslands including the striated grassbird (*Megalurus palustris*), while rabbits and hares are common (Burmese hare *Lepus peguensis*; Duckworth et al., 1999). Burmese hares are also known to occur in cropland and seasonally inundated areas and will avoid areas where they have been hunted in the past. Threatened species known to use grasslands include yellow-breasted bunting (EN), Chinese pangolins (EN), Asian elephants (EN) and king cobra (VU)

Waterways / Aquatic Habitat

The main aquatic ecosystems and habitat within the four Provinces are the Mekong River, Nam Ngum River and reservoirs, Nam Lik and reservoir, and Nam Xong, and their tributaries (Rundel, 1999). The habitat ranges from lowland to upland streams and rivers, with a few smaller montane streams. There are nearby wetlands, lakes and ponds, some of which are human-made. For example, the Nakhanthoung Irrigation Dam is approximately 400 m downstream of a current plantation.

There are three main riparian zones within rivers: aquatic; beach, mudflat and bedrock; and strand.

Flora Biodiversity

The aquatic zones of smaller / slower moving streams are typically dominated by herbaceous plants (refer to Table 5-10). Floating aquatic flora within these watercourses and waterbodies include Asian watermoss (*Salvinia cucullata*), mosquito fern (*Azolla pinnata*), water-snowflake (*Nymphoides indica*) and tropical duckweed (*Pistis stratiotes*). Submersed aquatic flora common to the four Provinces include *Blyxa echinosperma*, rigid hornwort (*Ceratophyllum demersum*), water-thyme (*Hydrilla verticillata*) and bladderwort (*Utricularia australis*; Gangstad et al., 1972).

While marginal and wetland species in the beach and strand include (Gangstad et al., 1972):

- *Amaranthus spinosus*;
- Giant reed (*Arundo donax*);

- *Coix aquatica*;
- Sedges *Cyperus difformis* and *C. rotundus*;
- Water chestnut (*Eleocharis dulcis*);
- Wrinkle duck beak (*Ischaemum rugosum*);
- *Ludwigia hyssopifolia*;
- Petterwort (*Marsilea crenata*);
- *Meliolotus suaveolens*;
- Heartshape false pickerelweed (*Monochoria vaginalis*);
- Common reed (*Phragmites australis*);
- *Polygonum plebeium*; and
- Greater club rush (*Scirpus grossus*).

Invasive species are common, particularly the waterhyacinth (*Eichhornia crassipes*) and lesser bulrush (*Typha angustifolia*), even in relatively undisturbed habitat.

Table 5-10 Common species within wetlands and marginal aquatic habitat

Strata	Scientific Name	Family	Habit
Mid-storey 2 m - 5 m	<i>Breynia angustifolia</i>	Phyllanthaceae	Small tree
Understorey <2 m	<i>Alternanthera sessilis</i>	Amaranthaceae	Herb
	<i>Colocasia antiquorum</i>	Araceae	Herb
	<i>Cyperus procerus</i>	Cyperaceae	Herb
	<i>Digitaria sp.</i>	Poaceae	Grass
	<i>Eichhornia crassipes</i> #	Pontederiaceae	Herb
	<i>Leersia hexanora</i>	Poaceae	Grass
	<i>Marsilea crenata</i>	Marsileaceae	Herb
	<i>Miscanthus sinensis</i>	Poaceae	Grass
	<i>Typha angustifolia</i> #	Typhaceae	Herb

invasive species

Fauna Biodiversity

Species diversity is high in good quality aquatic habitat. Common terrestrial species that frequent this habitat type include grey heron (*Ardea cinerea*), purple heron (*Ardea purpurea*), pied kingfisher (*Ceryle rudis*), Limnonectes frog (*Limnonectes gyldenstolpei*), sapgren stream frog (*Hylarana nigrovittata*) and common coot (*Fulica atra*). Waterbirds are particularly common along waterways (Duckworth et al., 1998). Threatened terrestrial species that rely on these aquatic habitats include wood snipe (*Gallinago nemoricola*, VU), fishing cat (*Prionailurus viverrinus*, EN), Asian small-clawed otter (*Aonyx cinerea*, VU) and smooth-coated otter (*Lutrogale perspicillata* VU; IUCN, 2016).

Siamese crocodiles (*Crocodylus siamensis*, CR) are thought to be largely restricted to the Mekong River (Bezuijen et al., 2006). Other semi-aquatic reptiles that inhabit the watercourses include the common water monitor, diamond-backed water snake, Asiatic reticulated python and Burmese python.

There are several freshwater turtles that inhabit the rivers and streams across the four Provinces, with higher quality watercourses having higher species richness (IUCN, 2013). The majority of turtles are globally threatened due to habitat destruction and over-exploitation for meat and traditional medicine. For example, the big-headed turtle (*Platysternon megacephalum*, EN) elongated tortoise (*Indotestudo elongata*

EN) impressed tortoise (*Manouria impressa*, VU) and Southeast Asian softshell turtle (*Amyda cartilaginea*, VU) were once common in the four Provinces (IUCN, 2016).

There are two turtles that have been introduced into the watercourses, the Chinese softshell turtle (*Pelodiscus sinensis*, VU) and the red-eared slider turtle (*Trachemys scripta elegans*; IUCN, 2016). The red-eared slider is native to Alabama (USA) and Mexico and has been commercially farmed for the pet trade, entering Laos watercourses as escapees. Red-eared slider turtles are included on the IUCN/SSC Invasive Species Specialist Group's 100 Worst Invasive List (ISSG, 2016).

Over 30 species of amphibians are known to occur in the watercourses across the four Provinces. The majority of species' populations are globally secure (IUCN, 2013).

More than 100 species of fish are known to occur within the watercourses and waterbodies of the four Provinces (IUCN, 2013). These fish species are from nine orders, 27 families and 68 genera. Cypriniformes, ray-finned fish, appear to be the most species rich order with 55 species. Many of these Cypriniformes are carps.

Fish that are sold at a high price and in high demand in villagers include *Hemibagrus wyckioides*, *H. nemurus*, *Micronema apogon*, *Pangasius bocourti*, *Hemisilurus mekongensis*, *Oxyeleotris marmorata*, *Hypsibarbus lagleri*, *Helicophagus lepthorhynchus*, *Bagarius yarrelli* and *Probarbus jullieni* (IUCN, 2013). Many of these species are globally threatened or regionally declining.

Recent studies suggest that there are at least 19 orders and 105 families of aquatic invertebrates in the watercourses and waterbodies of the four Provinces (IUCN, 2013). Insects are the most diverse taxa. It is assumed that many more aquatic invertebrates inhabit the watercourses and waterbodies, but aquatic invertebrate taxa knowledge in the area is limited.

Agricultural Cropland

Flora Biodiversity

Flora assemblage is determined by the crop type, rotation cycle and weeding frequency (Plate 5-). Some native species are cultivated such as cardamom (*Amomum* spp. Foppes and Ketphanh, 2000). Other native species that have been domesticated include bamboos (*Bambusa nana* and *B. blumeana*) and rattan (*Calamus* sp. aff. *C. tenuis*; Rerkasem et al., 2009). Domesticated species used as crops across the four Provinces include coffee and banana. The most popular cultivated crops are corn, sesame and cassava (based on social surveys for this Project; refer to Chapter 6, Social Settings).

Fauna Biodiversity

The house mouse, black rat (*Rattus rattus*), brown rat (*Rattus norvegicus*) and house sparrow (*Passer domesticus*) are common species that inhabit agricultural croplands. Fauna species diversity is generally low, with non-native and invasive species dominating the disturbed habitat (alongside domestic species). Buffalo and cattle commonly graze throughout village lands and pigs, goats, chickens, ducks and geese often roam freely around the villages.

Several globally threatened fauna species have been reported as tolerating and using agricultural areas including Sunda pangolin (EN), Chinese pangolin (*Manis pentadactyla*, EN), Phayre's leaf monkey (*Trachypithecus phayrei*, EN), black and white spitting cobra (*Naja siamensis*, VU) and king cobra (*Ophiophagus hannah*, VU; IUCN, 2016). It is considered unlikely that these species use the habitat as their primarily breeding and foraging habitat, but as agricultural areas expand into undisturbed areas these species have had to adapt.

Deciduous Plantations

Like evergreen plantations, cultivated species form a uniform canopy, with low species richness in the layers beneath. Typically, lower strata are cleared to maximise cultivated species growth.

Flora Biodiversity

Several deciduous species are cultivated in the four Provinces, both native and non-native. Pines (*Pinus kesiya*, *P. merkusii*), teak (*Tectona grandis*) and *Wrightia arborea* are natives that have been, and are, used (Phongoudome and Mounlamai, 2004).

Fauna Biodiversity

Fauna diversity is similar to evergreen plantations, except where several native species are grown and understoreys are allowed to establish. These conditions allow more native species to inhabit.

Rice Paddy

Flora Biodiversity

Rice paddies are generally devoid of vegetation, other than the cultivated rice (*Oryza sativa*;). The majority of households in sample villages (refer to Chapter 6, Social Settings) practice rain-fed rice paddy cultivation and / or upland rice cultivation. Only a small percentage of households practice irrigated rice cultivation (8%).

Fauna Biodiversity

The rice crop can provide cover for a variety of invertebrate and vertebrate species. Paddyfield warblers (*Acrocephalus agricola*), paddyfield pipits (*Anthus rufulus*), common mynas (*Acridotheres tristis*), cattle egrets (*Bubulcus ibis*) and other wetland-type species are common within and near rice paddies. A few globally threatened species have been able to use rice paddies including yellow-breasted bunting (*Emberiza aureola*, EN), Asian small-clawed otter (*Aonyx cinerea*, VU), smooth-coated otter (*Lutrogale perspicillata*, VU) and black and white spitting cobra (VU; IUCN, 2016). Rice paddies resemble their natural habitats by providing wetland-type conditions, prey and can be connected to natural wetlands, streams and rivers.

Rice paddies hydraulically connected to watercourses with overbank flooding are known to provide high value breeding ground for migratory fish.

Settlement / Built Up Areas

Settlement and built up areas generally lack a vegetative structure, except for gardens and green wedges.

Flora Biodiversity

Flora biodiversity is poor and dominated by cultivated, planted species such as fruit trees and ornamental plants.

Fauna Biodiversity

Fauna species diversity is generally poor, with non-native and invasive species common and often dominant. House swifts (*Apus nipalensis*), house sparrows, Oriental turtle-doves (*Streptopelia orientalis*) and house shrews (*Suncus murinus*) are common inhabitants. Sunda pangolin (EN) have been reported in settlement areas, particularly in the absence of hunting (IUCN, 2016).

5.2 Protected Areas

5.2.1 Current Project Area

The Burapha Land Acquisition Manual has been refined to prohibit plantation establishment within National, Provincial, District, and Village Protection and Conservation Areas. Due to discrepancies in protected area boundaries and / or inadequate consultation activities, some existing plantations have encroached upon protection / conservation area, covering approximately 890 ha of protected area land (refer to Table 5-11 and Chapter 7).

Table 5-11 Current concession areas overlapping with published Protected Area (PA) borders (NAFRI)

Name	Protected Area Type	Province	District	Concession Area within PA (ha)
Phou Khao Khoay	NPA	Vientiane Capital	Xaythany	0.002
Phou Pha Nang	NPA	Vientiane Capital	Phonehong	22.09
Phouinthin	Provincial	Vientiane	Hin Heup / Feuang	661.44
Namsang	District	Capital	Santhong	129.76
Phou Xang	District	Xayabouly	Paklai	3.56
Ban Keo	District	Xayabouly	Paklai / Phiang	0.71
Phou Ngan / Phou Kham	District	Vientiane	Meuan	1.65
Total				890.14

5.2.2 Project Expansion Area

The Project will not encroach upon protection areas during Project expansion. The Burapha Land Acquisition Manual requires avoidance of National, Provincial, District, and Village Protection and Conservation Areas during land acquisition for plantation establishment, with potential for plantation establishment in Watershed Reserves with formal consent from the GOL.

5.2.3 Surrounding Habitat

International Protected Areas

There are no Internationally Protected Areas (e.g. World Heritage natural sites, Ramsar wetlands) in the Project expansion area. The closest World Heritage site is the outstanding example of traditional architecture in Luang Prabang (i.e. cultural protection), over 100 km north of the currently planned expansion of plantations.

National Biodiversity Conservation Areas

There are three Nationally Protected Areas within the four Provinces (refer to Figure 5-2). These areas are the Nam Pouy National Biodiversity Conservation Area (NPA), Phou Phanang NPA and Phou Khao Khoay NPA. The three NPAs are recognised by international bodies as “protected areas with sustainable use of natural resources” (IUCN Category VI). NPAs are “forests and forest land that have been approved by Prime Minister” and are “classified as such for the purpose of preserving animal species, plant varieties, the nature and other objects of biological, historic, cultural, tourism, environmental, educational, research and experimental value” (MAF Regulation No. 360, 2003).

Nam Pouy NPA (also known as Nam Phouy) is 191,200 ha and encompasses dry evergreen and mixed deciduous forest. The NPA is located in the forested Luang Prabang mountain range, near the Thailand border. Nam Pouy is inhabited by Asian elephants, but unfortunately populations are declining due to high intensity poaching and human-elephant conflict (McWilliam et al., 2010). Thus, the NPA is a priority for elephant conservation.

Phou Phanang NPA is situated within 10 km of the capital, Vientiane. Phou Phanang is predominantly covered by degraded forests with patches of evergreen forest. The NPA is over 70,000 ha. Shifting cultivation and logging are common in the NPA (Fujita, 2004).

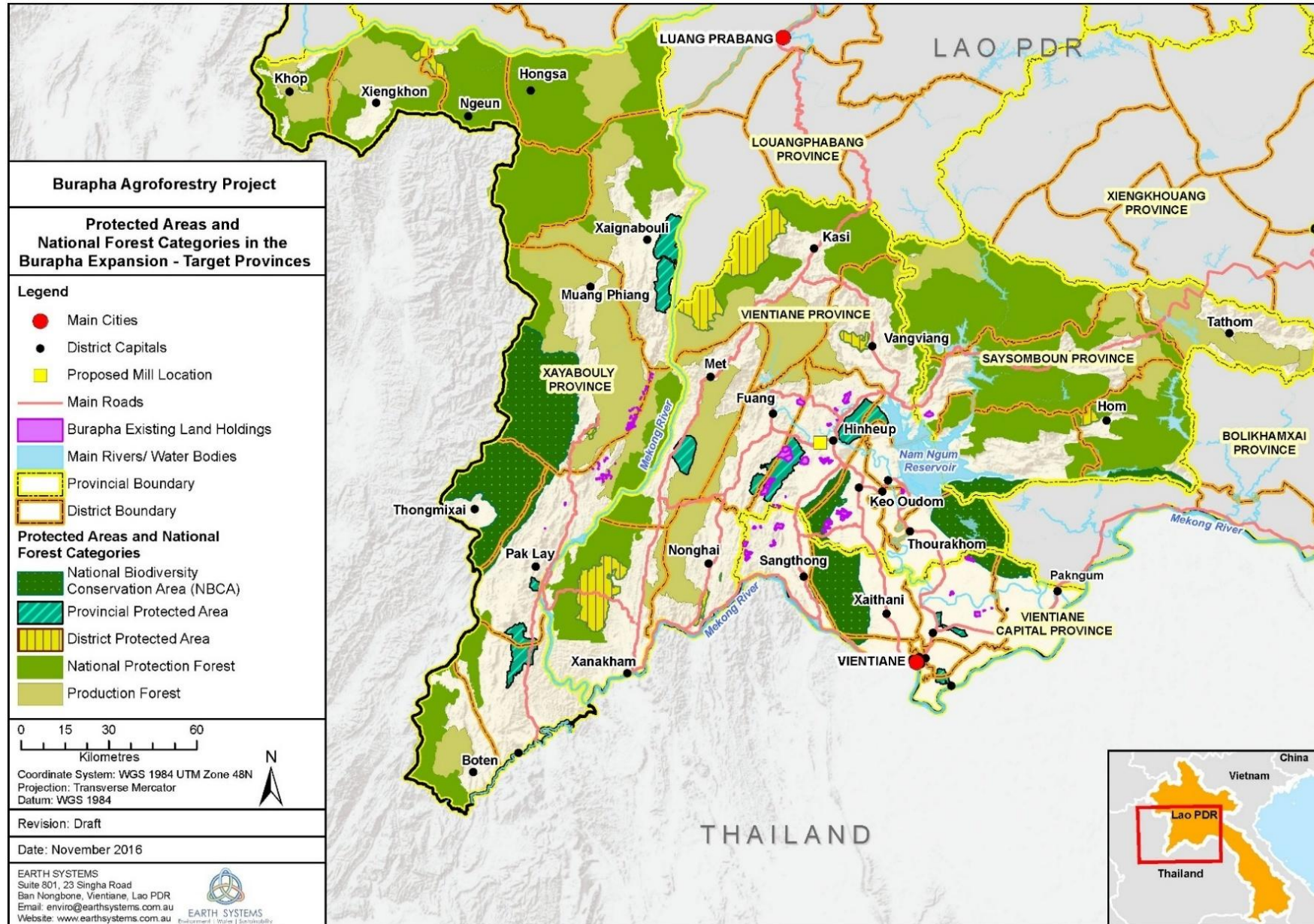


Figure 5-2 Protected areas across the Project Provinces

Phou Khao Khoay NPA is located approximately 40 km northeast of Vientiane and spans three provinces. The protected area covers 200,000 ha and contains a mosaic of evergreen, mixed deciduous, dry dipterocarp and coniferous forests. This habitat supports several flora and wildlife species that are of international and national conservation concern (Vongkhamheng, 2015, Soukhavong et al., 2013). The NPA has been inhabited by Asian elephants, Asiatic black bears, sun bears, dholes, primates, civets, otters and green peafowls, while the status of populations is uncertain.

Provincial and District Protected Areas

Provincial protected areas have been designated for conservation or protection as they provide locally significant watershed or conservation value (ICEM, 2003). Provincial forests in the broader region of the plantations include Phouking Provincial Forest, Dongbanxay Provincial Forest and Phoumeut Provincial Forest. While other protected areas include Dongpatae District Forest, Houysadot District Forest and Phoukaisou District Protected Forest.

Watershed Protection Areas

Watershed Reserves have been established to protect catchments and other important areas to prevent significant erosion and protection of water sources. For example, there are the considerably large Nam Ngum and Nam Xong Watershed Reserves that feed into the Nam Ngum Reservoir and Nam Xong / Lik. Other large Watershed Reserves are west of Vientiane and are the Nam Ton and Nam Sang.

Other Conservation Areas

There is one Important Bird and Biodiversity Area (IBA) within the four Provinces, the Mekong River from Luang Prabang to Vientiane (18,230 ha). The site covers an approximately 300 km section of the Mekong River upstream of Vientiane, the lower section forming the international border with Thailand. The IBA qualifies under criteria A3 and A4i because it supports species restricted to the Indo-Gangetic Plains (Duckworth et al., 2002) and is known or thought to regularly hold >1% of a biogeographic population of a congregatory waterbird species (BirdLife International, 2016). This IBA is also considered as a Key Biodiversity Area (KBA, Tordoff et al., 2012). There are two other KBAs in the region, which are the Nam Pouy and Phou Khao Khoay NPAs. There are no Endemic Bird Areas (EBAs).

5.3 Threatened Species and Important Values

5.3.1 Current Project Area

No threatened species or other important values were identified during surveys of current plantations. Threatened species are invariably difficult to detect and may not be identified during a short-term survey. Therefore, species identified in Section 5.3 are considered potential candidates for inhabiting plantations.

5.3.2 Project Expansion Area

A Threatened Species and Ecosystems Assessment was undertaken to analyse the potential presence of internationally and nationally threatened ecosystems, species of conservation concern and critical habitat. Species that may be of regional importance were also considered.

Threatened species are invariably difficult to detect and may not be identified during a snap-shot survey. The potential presence of these values is based on literature and database review, direct surveys, village consultation, and species biology to indicate which species are more likely to be present. Absolute presence would need to be confirmed by direct or indirect fauna surveys conducted by zoologists, potentially intensive and over multiple seasons.

Critical Habitat

The presence of Critical Habitat is dependent on the presence of threatened, restricted-range, and migratory species; highly unique or rare ecosystems; and key evolutionary processes. Critical Habitat is comparable to FSC / HCVRN High Conservation Values (HCVs). The IFC considers that many of the biodiversity values to be protected as per Performance Standard 6 can also be classified according to international definitions of HCVs (refer to Table 5-12). An HCV assessment has been undertaken and will be submitted to FSC for Project certification.

Table 5-12 High Conservation Value (HCV) types compared to IFC Performance Standards (adapted from IFC PS6 Guidance Notes)

HCV Type	Performance Standards
HCV 1: Areas containing globally, regionally or nationally significant concentrations of biodiversity values	Critical habitat in most cases
HCV 1.1: Protected areas	
HCV 1.2: Rare, threatened or endangered species	
HCV 1.3: Endemic species	
HCV 1.4: Seasonal concentrations of species	
HCV 2: Globally, regionally or nationally significant large landscape-level areas where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance	Natural habitat, and may be critical habitat if areas contain high biodiversity values as identified in paragraph 16 of Performance Standard 6
HCV 3: Areas that are in or contain rare threatened or endangered ecosystems	Critical habitat
HCV 4: Areas that provide basic ecosystem services in critical situations	Priority ecosystem services as defined by paragraph 24 of Performance Standard 6
HCV 4.1: Areas critical to water catchments	
HCV 4.2: Areas critical to erosion control	
HCV 4.3: Areas providing critical barriers to destructive fire	
HCV 5: Areas fundamental to meeting basic needs of local communities	Priority ecosystem services as defined by paragraph 24 of Performance Standard 6. Client requirements defined in Performance Standard 5 are also applicable
HCV 6: Areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities)	Priority ecosystem services as defined by paragraph 24 of Performance Standard 6. Client requirements defined in Performance Standard 8 are also applicable

Ecosystems and Habitat

Since the Project will establish plantations within fallow forest, the likelihood of unique and/or threatened ecosystems (and Critical Habitat) in these areas is negligible as these are highly modified and degraded habitats.

Flora

No threatened flora was identified during botanical surveys of fallow forest and local knowledge surveys for Project expansion. Based on species biology, it is considered unlikely that threatened flora will occur in significant numbers in degraded habitat. Threatened flora are typically highly valuable timber and non-timber products and thus would have been removed prior to the clearing event that caused the land to regenerate to fallow.

Fauna

Four globally threatened mammals and two globally threatened reptiles may inhabit fallow forest in the expansion area (; IUCN, 2016), particularly for sites that are:

- Adjacent or are very close to protected areas and high quality habitat;
- Distant from villages and hunting / capture probability in the area is very low; and
- Have adequate mid-storey and understorey cover.

Residents of several villages in the Project area have confirmed the presence of Chinese pangolin (*Manis pentadactyla* EN⁸), northern pig-tailed macaque (*Macaca leonina* VU⁹) and king cobra in forests surrounding their villages. Although these species may occasionally use the habitat within established plantations, plantations are unlikely to provide important foraging habitat and highly unlikely to provide breeding habitat (i.e. Eucalypt monoculture). Established plantations are unlikely to provide habitat of significance for any of the globally threatened species and may simply provide a corridor through the area.

Sites that are distant from high value habitat, protected areas and are in areas dominated by agricultural and residential land use will not provide sufficient habitat and connectivity for the presence of the globally threatened mammals and reptiles.

Several nationally important mammals, birds and reptiles may use the habitat within the current or future plantations (; IUCN, 2016; Duckworth et al., 1999). Most birds and mammals (bats) can move freely through the area and thus are of less importance for management or conservation. These species can avoid any disturbance or dangers within plantations or fallow forest. Regionally important mammals, birds and reptiles have a wider habitat and human disturbance tolerance and thus are more likely to use and reside in fallow forest and plantations.

Of the globally threatened and nationally important fauna that inhabit the four Provinces, most mammal and bird species are unlikely to occur within plantations or fallow forest (upon Project expansion) as follows:

- Many of these species have specific habitat requirements and fallow forest or plantations would not provide food or breeding habitat;
- Most species have been hunted in these areas in the past and populations have not recovered, especially of long-lived, low fecund species, restricting species to high quality habitat in protected areas; and
- The species are intolerant of anthropogenic sources of disturbance.

The four globally threatened mammals and two globally threatened reptiles (refer to Table 5-13) that may occur in fallow forest are more likely to be transient, using disturbed areas as corridors, hunting grounds or occasional refuges, particularly in proximity to protected areas and high quality habitat.

Table 5-13 Globally threatened and regionally important fauna in potential expansion area

Taxa / Significance	Species and Threatened Status (International & National)
Globally Threatened Mammals	Sunda pangolin <i>Manis javanica</i> EN ARL / C
	Chinese pangolin <i>Manis pentadactyla</i> EN ARL
	Northern pig-tailed macaque <i>Macaca leonina</i> VU PARL / C
	Lar gibbon <i>Hylobates lar</i> EN ARL / R
Globally Threatened Reptiles and Amphibians	Black and white spitting cobra <i>Naja siamensis</i> VU PARL
	King cobra <i>Ophiophagus hannah</i> VU PARL / R
Regionally Important Mammals	Wild boar <i>Sus scrofa</i> LC LKL
	Horsfield's leaf-nosed bat <i>Hipposideros larvatus</i> LC PARL
	Dawn bat <i>Eonycteris spelaea</i> LC PARL
	Geoffroy's rousette <i>Rousettus amplexicaudatus</i> LC PARL
	Leschenault's rousette <i>Rousettus leschenaultii</i> LC PARL

⁸ IUCN Red List of Threatened Species Endangered status

⁹ IUNC Vulnerable

Taxa / Significance	Species and Threatened Status (International & National)
	Intermediate horseshoe bat <i>Rhinolophus affinis</i> LC PARL
	Malayan horseshoe bat <i>Rhinolophus malayanus</i> LC PARL
	Inornate squirrel <i>Callosciurus inornatus</i> LC LKL
	Large brown flying squirrel <i>Petaurista philippensis</i> LC R
	Malayan porcupine <i>Hystrix brachyuran</i> LC C
Regionally Important Birds	Small pratincole <i>Glareola lactea</i> LC ¹⁰ PARL
	Green imperial-pigeon <i>Ducula aenea</i> LC ARL
	Little cuckoo-dove <i>Macropygia ruficeps</i> LC PARL
	Orange-breasted green-pigeon <i>Treron bicinctus</i> LC PARL
	Yellow-footed green-pigeon <i>Treron phoenicopterus</i> LC ARL
	Pompadour green-pigeon <i>Treron pompadora</i> LC ARL
	Oriental pied hornbill <i>Anthracoceros albirostris</i> LC C
	Austen's brown hornbill <i>Anorrhinus austeni</i> NT PARL
	Black-billed magpie <i>Pica</i> LC LKL
	Golden-crested myna <i>Ampeliceps coronatus</i> LC PARL
	Asian pied starling <i>Sturnus contra</i> LC LKL
	Chestnut-tailed starling <i>Sturnus malabaricus</i> LC ¹¹
	Alexandrine parakeet <i>Psittacula eupatria</i> NT ARL
	Blossom-headed parakeet <i>Psittacula roseata</i> NT PARL
	Tawny fish-owl <i>Ketupa flavipes</i> LC LKL
	Buffy fish-owl <i>Ketupa ketupu</i> LC LKL
	Brown fish-owl <i>Ketupa zeylonensis</i> LC PARL
	Brown wood-owl <i>Strix leptogrammica</i> LC R
	Barn owl <i>Tyto alba</i> LC LKL
Siamese fireback <i>Lophura diardi</i> LC PARL / R	
Regionally Important Reptiles	Monocled cobra <i>Naja kaouthia</i> LC PARL
	Asiatic reticulated python <i>reticulatus</i> N/A PARL / R
	Bengal monitor lizard <i>Varanus bengalensis</i> LC PARL
	Common water monitor <i>Varanus salvator</i> LC PARL / C

KEY: CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; DD – Data Deficient; LR – Lower Risk; LC – Least Concern; N/A – Not Assessed; Duckworth et al. 1999 national threatened status: ARL – At Risk in Lao; CARL – Conditionally At Risk in Lao; LKL – Little Known in Lao; PARL – Potentially At Risk in Lao; MAF 360 / 2003 Regulation: R – Restricted; C – Controlled

5.3.3 Surrounding Habitat

Protected Areas

All internationally and nationally protected areas can be classified as Critical Habitat according to the IFC definition and are considered High Conservation Value by the FSC. Critical Habitat are areas with high biodiversity value with i) habitat of significant importance to Critically Endangered and/or Endangered species; ii) habitat of significant importance to endemic and/or restricted-range; iii) habitat supporting globally significant concentrations of migratory and/or congregatory species; and/or v) areas associated with key

¹⁰ IBA trigger species: A4i

¹¹ IBA trigger species / Biome-restricted species: A3

evolutionary processes (IFC, 2012). Internationally and nationally protected areas have been delineated because they fulfil one or multiple criteria.

The specific biodiversity conservation value of Watershed Reserves, Provincial and District protected areas is less clear than NPAs and internationally protected areas, since much of these areas have been used for forestry, development and other human activities. However, Provincial and District protected areas may encompass Critical Habitat as they provide essential ecosystem services.

Nationally protected areas will be the most important Critical Habitat for the Project to avoid during Project expansion. Watershed Reserves, Provincial and District Forests will be of importance, but with less likelihood of Critical Habitat within their boundaries.

Terrestrial Ecosystems

The IUCN has not listed any threatened ecosystems in Lao PDR as none have been assessed by the IUCN. The GOL, in association with the UNDP and GEF, have recognised that the dry dipterocarp ecosystems of Savannakhet Province are of global importance. Since there has been no country-wide assessment of ecosystem importance/rarity it is assumed that similar to Savannakhet Province, dipterocarp and other forest types in the four Provinces may be part of regionally threatened or unique ecosystems.

The Northern Khorat Plateau moist deciduous forest ecoregion that occurs across portions of the four Provinces may be considered Critical/Endangered (WWF, 2016). The ecoregion has been assigned the Critical/Endangered status based on most large bird and mammal species populations being greatly reduced or extirpated. Similarly, the Luang Prabang montane rain forests ecoregion has been classified as Vulnerable (other ecoregion across the four Provinces; WWF, 2016). Much of the forest and natural habitat within these ecoregions have been converted, increasing the likelihood of remaining threatened and/or unique ecosystems being rare and qualifying as Critical Habitat (IFC, 2012). This will include any patches / areas delineated as:

- Coniferous forest;
- Mixed deciduous forest;
- Evergreen forest;
- Dry dipterocarp forest;
- Riparian / gallery forest;
- Mixed broadleaf and coniferous forest;
- Bamboo forest (original - not bamboo dominated fallow forest); and
- Grassland.

These habitats/ecosystems may be partially degraded, significantly degraded, or pristine. Critical Habitat may be mosaics (of the above) or transitional zones between types (IFC, 2012). Contiguous areas of habitat should be considered high priority for the Project, but small remnant patches (>0.25 ha) should also be regarded as important. Remnant linear patches along roads and watercourses are also important corridors for wildlife and for connectivity between larger patches. Much of these natural habitat patches and ecosystems exist within protected areas.

Terrestrial Flora

Threatened species may grow naturally or for cultivation purposes (as threatened species are generally high value timber or NTFP species). The presence of Critically Endangered and/or Endangered species in surrounding areas may indicate the presence of Critical Habitat, but would require further clarification under IFC criteria (i.e. tier thresholds).

There are several threatened flora species that grow in natural habitat identified in sections above. Based on habitat requirements and species biology, the globally and nationally threatened species that are most likely to grow in surrounding habitat (of plantations – current and future) include:

- *Azelia xylocarpa* (EN, nationally VU¹²);
- *Anisoptera costata* (EN);
- *Aquilaria crassna* (Eagle wood, CR, EN);
- *Dalbergia bariensis* (Burmese rosewood, EN);
- *Dalbergia cochinchinensis* (Siamese rosewood, VU);
- *Dipterocarpus alatus* (EN, VU);
- *Dipterocarpus retusus* (VU, DD);
- *Diospyros mun* (Ebony, CR, Data Deficient (DD));
- *Hopea chinensis* (CR, VU);
- *Hopea odorata* (VU, Lower Risk / Conservation Dependent / Near Threatened (LR/CD/NT));
- *Hydnocarpus annamensis* (VU);
- *Melientha suavis* (Not Assessed (N/A), VU);
- *Pometia pinnata* (N/A, VU);
- *Pterocarpus macrocarpus* (Burma padauk, N/A, VU);
- *Shorea henryana* (White meranti, EN, VU);
- *Shorea roxburghii* (EN, LR/CD/NT);
- *Shorea thorelii* (CR, VU); and
- *Sindora siamensis* (LR/LC, VU).

Terrestrial Fauna

The majority of threatened fauna known to the region are unlikely to inhabit surrounding vegetative communities given the accessibility and lack of high quality contiguous forest, as would be found in the centre of protected areas (refer to Table 5-14). Several globally threatened mammals and one globally threatened bird may occur in surrounding habitat provided moderately good quality habitat exists adjacent future sites, such as near NPAs (Duckworth et al., 1999). Residents from several villages near Project plantations have confirmed the presence of dholes, binturongs, Asiatic black bears, fishing cats, northern white-cheeked gibbon and sambar deer in the higher value habitat within or adjacent their villages. The presence of the Endangered species would likely classify the habitat as Critical (i.e. dependent on criteria/tier thresholds).

The likely presence of threatened species will increase if plantation sites are:

- In proximity to protected areas, providing a source population;
- Close to good, high quality habitat (~1-5 km);
- Far from settlements, roads and other sources of disturbance and hunting; and / or
- Close to large, good quality waterways, wetlands and the Mekong River (~1-5 km).

Some species are likely to be restricted to the interior of protected areas in good quality habitat (e.g. Asian elephants, gaur). These species may sporadically occur in surrounding habitat, but the likelihood is very low.

Table 5-12 Globally threatened and regionally important fauna that may inhabit surrounding habitat

Taxa / Significance	Species and Threatened Status
Globally Threatened Mammals	Sunda pangolin <i>Manis javanica</i> EN ARL / C
	Chinese pangolin <i>Manis pentadactyla</i> EN ARL
	Northern pig-tailed macaque <i>Macaca leonina</i> VU PARL / C
	Lar gibbon <i>Hylobates lar</i> EN ARL / R

¹² Nationally threatened according to NAFRI assessment (Phongoudome and Mounlamai 2004)

Taxa / Significance	Species and Threatened Status	
	Dhole <i>Cuon alpinus</i> EN ARL	
	Fishing cat <i>Prionailurus viverrinus</i> EN LKL	
	Asiatic black bear <i>Ursus thibetanus</i> VU ARL / R	
	Binturong <i>Arctictis binturong</i> VU ARL	
	Large-spotted civet <i>Viverra megaspila</i> VU PARL	
	Sambar deer <i>Rusa unicolor</i> VU PARL / C	
	Northern white-cheeked gibbon <i>Nomascus leucogenys</i> CR PARL / R	
Globally Threatened Birds	Yellow-breasted bunting <i>Emberiza aureola</i> EN	
Globally Threatened Reptiles and Amphibians	Black and white spitting cobra <i>Naja siamensis</i> VU PARL	
	King cobra <i>Ophiophagus hannah</i> VU PARL / R	
Regionally Important Mammals	Wild boar <i>Sus scrofa</i> LC LKL	
	Horsfield's leaf-nosed bat <i>Hipposideros larvatus</i> LC PARL	
	Dawn bat <i>Eonycteris spelaea</i> LC PARL	
	Geoffroy's rousette <i>Rousettus amplexicaudatus</i> LC PARL	
	Leschenault's rousette <i>Rousettus leschenaultii</i> LC PARL	
	Intermediate horseshoe bat <i>Rhinolophus affinis</i> LC PARL	
	Malayan horseshoe bat <i>Rhinolophus malayanus</i> LC PARL	
	Inornate squirrel <i>Callosciurus inornatus</i> LC LKL	
	Large brown flying squirrel <i>Petaurista philippensis</i> LC R	
	Malayan porcupine <i>Hystrix brachyuran</i> LC C	
	Leopard <i>Panthera pardus</i> NT ARL / R	
	Hog badger <i>Arctonyx collaris</i> NT LKL	
	Small-toothed ferret-badger <i>Melogale moschata</i> LC LKL	
	Large-toothed ferret-badger <i>Melogale personata</i> DD LKL	
	Spotted linsang <i>Prionodon pardicolor</i> LC LKL	
	Great woolly horseshoe bat <i>Rhinolophus luctus</i> LC PARL	
	Big-eared horseshoe bat <i>Rhinolophus macrotis</i> LC PARL	
	Marshall's horseshoe bat <i>Rhinolophus marshalli</i> LC PARL	
	Bouret's horseshoe bat <i>Rhinolophus paradoxolophus</i> LC PARL	
	Least horseshoe bat <i>Rhinolophus pusillus</i> LC PARL	
	Shamel's horseshoe bat <i>Rhinolophus shameli</i> LC PARL	
	Thai horseshoe bat <i>Rhinolophus siamensis</i> LC PARL	
	Lesser brown horseshoe bat <i>Rhinolophus stheno</i> LC PARL	
	Thomas's horseshoe bat <i>Rhinolophus thomasi</i> LC PARL	
	Small long-fingered bat <i>Miniopterus pusillus</i> LC PARL	
	Himalayan whiskered bat <i>Myotis siligorensis</i> LC PARL	
	Cadorna's pipistrelle <i>Pipistrellus cadornae</i> LC LKL	
	Chinese pipistrelle <i>Pipistrellus pulveratus</i> LC LKL	
	Rhesus monkey <i>Macaca mulatta</i> LC PARL	
	Regionally Important Birds	Small pratincole <i>Glareola lactea</i> LC ¹³ PARL
		Green imperial-pigeon <i>Ducula aenea</i> LC ARL

¹³ IBA trigger species: A4i

Taxa / Significance	Species and Threatened Status
	Little cuckoo-dove <i>Macropygia ruficeps</i> LC PARL
	Orange-breasted green-pigeon <i>Treron bicinctus</i> LC PARL
	Yellow-footed green-pigeon <i>Treron phoenicopterus</i> LC ARL
	Pompador green-pigeon <i>Treron pompadora</i> LC ARL
	Yellow-bellied flowerpecker <i>Dicaeum melanoxanthum</i> LC LKL
	Grey-headed fish-eagle <i>Icthyophaga ichthyaetus</i> NT ARL
	Japanese quail <i>Coturnix japonica</i> NT LKL
	Wire-tailed swallow <i>Hirundo smithii</i> LC PARL
	Oriental pied hornbill <i>Anthracoceros albirostris</i> LC C
	Austen's brown hornbill <i>Anorrhinus austeni</i> NT PARL
	Black-billed magpie <i>Pica</i> LC LKL
	Golden-crested myna <i>Ampeliceps coronatus</i> LC PARL
	Asian pied starling <i>Sturnus contra</i> LC LKL
	Chestnut-tailed starling <i>Sturnus malabaricus</i> LC ¹⁴
	Alexandrine parakeet <i>Psittacula eupatria</i> NT ARL
	Blossom-headed parakeet <i>Psittacula roseata</i> NT PARL
	Tawny fish-owl <i>Ketupa flavipes</i> LC LKL
	Buffy fish-owl <i>Ketupa ketupu</i> LC LKL
	Brown fish-owl <i>Ketupa zeylonensis</i> LC PARL
	Brown wood-owl <i>Strix leptogrammica</i> LC R
Barn owl <i>Tyto alba</i> LC LKL	
Siamese fireback <i>Lophura diardi</i> LC PARL / R	
Regionally Important Reptiles	Monocled cobra <i>Naja kaouthia</i> LC PARL
	Asiatic reticulated python <i>reticulatus</i> N/A PARL / R
	Bengal monitor lizard <i>Varanus bengalensis</i> LC PARL
	Common water monitor <i>Varanus salvator</i> LC PARL / C

KEY: CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; DD – Data Deficient; LR – Lower Risk; LC – Least Concern; N/A – Not Assessed; Duckworth et al. 1999 national threatened status: ARL – At Risk in Lao; CARL – Conditionally At Risk in Lao; LKL – Little Known in Lao; PARL – Potentially At Risk in Lao; MAF 360 / 2003 Regulation: R – Restricted; C – Controlled

Aquatic Ecosystems

The Mekong River is an important and unique ecosystem as are its primary and secondary tributaries. The Mekong River from Luang Prabang to Vientiane is also an IBA and thus is likely to be Critical Habitat for many migratory and congregatory species (among other criteria; IUCN, 2013). All natural watercourses within the four Provinces should be considered important aquatic habitat, and as part of the larger freshwater ecosystem. This will include:

- Perennial, ephemeral and intermittent watercourses;
- Ponds, lakes and other waterbodies;
- Deep pools and rapids (as many species are reliant on rapids for spawning and migration); and
- Wetlands, marshes, swamps and floodplains; and

¹⁴ IBA trigger species / Biome-restricted species: A3

- Peatlands (considered as important in South-east Asia; GEF / ASEAN).

Key aquatic ecosystems within and surrounding the four Provinces are the Mekong River, Nam Ngum River and Reservoir, Nam Lik and Nam Xong, and their primary tributaries. These aquatic ecosystems are likely to fulfil one or multiple Critical Habitat criteria.

Fish

Fish are the only aquatic fauna taxon with sufficient information available for the current assessment within the watercourses of the Project Provinces (e.g. IUCN, 2013; IUCN, 2016; Kottelat 2000; Kottelat, 2016). Additional threatened aquatic species may include crustaceans, zooplankton and gastropods. As there is insufficient information regarding these fauna, the likelihood and subsequent protection of good quality habitat and threatened fish can be used as proxies for other aquatic fauna. Fish species have not been assessed by authorities for their regional or national importance, but their global threatened and endemic status will also serve as regional importance.

Fourteen globally threatened fish have the potential to inhabit watercourses that flow within or near to current or future plantation sites (refer to Table 5-15 and Appendix C). Most these fish are more likely to be found within the Nam Lik, Nam Ngum and Nam Xong rivers, with a few venturing into the primary tributaries of these rivers (Kottelat, 2000; Kottelat, 2001; Kottelat, 2011; Kottelat, 2016). Four globally Vulnerable species that may be found in the primary tributaries and streams near the Project are *Bangana behri*, *Hypsibarbus lagleri*, endemic *Rhinogobius albimaculatus* and *Serpenticobitis cingulata* (Kottelat et al., 2012).

The presence of the 14 threatened fish species in waterways near the Project will be dependent on:

- Size and flow of watercourses within sites;
- Water quality, with greater water quality equalling greater likelihood of threatened species;
- Distance to extensively used fishing grounds (i.e. over-exploitation); and
- Intactness of riparian vegetation and absence of significant bank erosion and development.

Table 5-15 Globally threatened fish that may inhabit watercourses in the region

Common Name	Scientific Name	IUCN Red List Status	Likely Watercourse Habitat (if present)
Mekong giant salmon carp	<i>Aptosyax grypus</i>	CR	Large and medium rivers
	<i>Bangana behri</i>	VU	Ranges from large rivers to smaller streams
Giant carp	<i>Catlocarpio siamensis</i>	CR	Large rivers and floodplains
Small scaled mud carp	<i>Cirrhinus microlepis</i>	VU	Large rivers, floodplains and flooded forest
	<i>Hypsibarbus lagleri</i>	VU	Ranges from large rivers to smaller streams and flooded forest
Flying minnow	<i>Laubuca caeruleostigmata</i>	EN	Large and medium rivers
Elephant ear gourami	<i>Osphronemus exodon</i>	VU	Large rivers and flooded forest
	<i>Oxygaster pointoni</i>	VU	Medium rivers
Striped catfish	<i>Pangasianodon hypophthalmus</i>	EN	Large rivers, floodplains and marshes
Giant pangasius	<i>Pangasius sanitwongsei</i>	CR	Large rivers and pools in forests
Jullien's golden carp	<i>Probarbus jullieni</i>	EN	Large and medium rivers
	<i>Pseudohemiculter dispar</i>	VU	Large and medium rivers
	<i>Rhinogobius albimaculatus</i>	VU*	Ranges from large rivers to smaller streams
	<i>Serpenticobitis cingulata</i>	VU	Ranges from large rivers to smaller streams

Key: CR – Critically Endangered; EN – Endangered; VU – Vulnerable; * – Endemic

A woman wearing a camouflage hat with "YOUR LIFE" written on it, a patterned scarf, a blue patterned jacket, and floral-patterned pants is working in a field. She is holding a wooden stake and a small sapling. In the foreground, there is a black plastic nursery tray containing several young plants. The background shows a dirt field with some sparse vegetation.

Chapter 6 | Socio-economic and Cultural Setting

Chapter 6 | Socio-Economic and Cultural Setting

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6 SOCIO-ECONOMIC AND CULTURAL SETTING

For the purpose of this baseline and *Chapter 9 Potential Social Impacts and Proposed Management and Mitigation Measures* (Volume B, ESIA Main Report), the socio-economic and cultural setting of the Project includes the target areas for plantation development within Vientiane Capital, Vientiane Province, Xayabouly Province and Saysomboun Province (hereafter 'the Project Provinces' or 'the Project Region'). This includes both existing Burapha lease areas and areas potentially suitable for plantation expansion within the target Provinces (based on Burapha's Land Acquisition Criteria 2015).

Where possible, the socio-economic and cultural setting for the Project focuses on the suitable plantation areas (i.e. fallow / unstocked degraded forest) within the four target Provinces. The baseline in villages currently participating in the Agroforestry Project (hereafter 'current Project villages') provide a case study for future expansion.

This chapter presents government and other data collected from secondary sources (e.g. District, Provincial and National socio-economic data). Data for the recently formed Saysomboun Province was used where possible, though in some cases it was not readily available. The chapter also presents primary information collected during socio-economic survey exercises conducted in current Project villages. These include:

- Socio-economic surveys in a total of 26 Project villages (both with and without established plantations) conducted in 2016;
- Household Surveys in 583 households for 17 villages conducted in 2016;
- Additional livelihood and employment surveys conducted in 19 villages in 2017.

6.1.1 Project Setting

Target Provinces and current lease areas are presented in Figure 6-1.

Project Region

Vientiane Capital (Province)

Vientiane Capital is the smallest Province in Lao PDR in geographical area (3,920 km²). It is located along the Mekong River and borders with Thailand in the south and Vientiane Province in the north. In population terms, Vientiane Capital is the most populated Province in the country with a population of 820,900 people and a population density of 209 persons per square kilometre (PHC, 2015). The Province is divided into 9 Districts and has a total of 485 villages and 165,400 households, with an average household size of 4.7 people. The average land area of each village in Vientiane Capital is 8 km².

Vientiane Province

Vientiane Province is the second largest Province in Lao PDR in geographical area (18,526 km²) and is located approximately 85 km from Vientiane City. The Province shares a border with Luang Prabang and Xieng Khoung in the north and north east, Bolikhamxay to the east, Vientiane Capital to the south, Xayabouly to the west and Thailand in the south west. In population terms, Vientiane Province has the fourth largest population in the country, at 419,100 people and a population density of 27 persons per square kilometre (PHC, 2015). The Province is divided into 11 Districts and has a total of 434 villages and 80,000 households. Average household size is 5.1 people and the average land area of each village is 42 km².

Xayabouly Province

Xayabouly Province is situated in the northern region of Lao PDR and shares a border with Vientiane and Luang Prabang Provinces in the east and Thailand in the west. In terms of land area and population, it is a

medium Province, with a total area of 16,389 km² and a population of 381,300 people (population density of 23 persons per square kilometre (PHC, 2015). The Province has 11 Districts, with 432 villages and 75,800 households. The average household size is 4.9 people and the average village land area is 37.9 km².

Saysomboun Province

Saysomboun Province is the second smallest in Lao PDR in geographical area (4,506 km²). The Province was established in 2013 as the 18th Province of the country. Located in the central region, approximately 230 km from Vientiane City, it is bounded by Xieng Khouang Province to the north and the east, Bolikhamxay Province to the south and Vientiane Province to the west. It is the least populated Province in the country with 85,200 people and a population density of just 10 persons per square kilometre (PHC, 2015). The Province is divided into 5 Districts, with 96 villages and 13,900 households. Average household size is 5.7 people and the average village land area is 46.9 km².

Current Lease Areas

The Country's Land Law 2003 and PM Decree 88/2008 identifies all land in Lao PDR under the ownership of the national community and managed by the State; and provides the State with various instruments to recognise the customary land use rights of individuals, organizations, or village communities. Burapha acquires land via concession agreements for State land and leases for privately owned land; lease agreements with villages/individuals for lands with communal / individual users; and purchased land. At the village level, leases are generally for communally owned land (refer to Chapter 4).

There are 32 current Project villages (23 of which have plantations) located in 7 Districts across the Project Region including:

- Xaythany, Vientiane Capital;
- Sangthong, Vientiane Capital;
- Phonghong, Vientiane Province;
- Keo Oudom, Vientiane Province;
- Hin Heup, Vientiane Province;
- Pak Lai, Xayabouly Province;
- Anouvong, Saysomboun Province.

This includes both planted and unplanted lease areas. To date, plantations have been established in 23 villages. Further details on current Project villages is presented in Table 6-2.

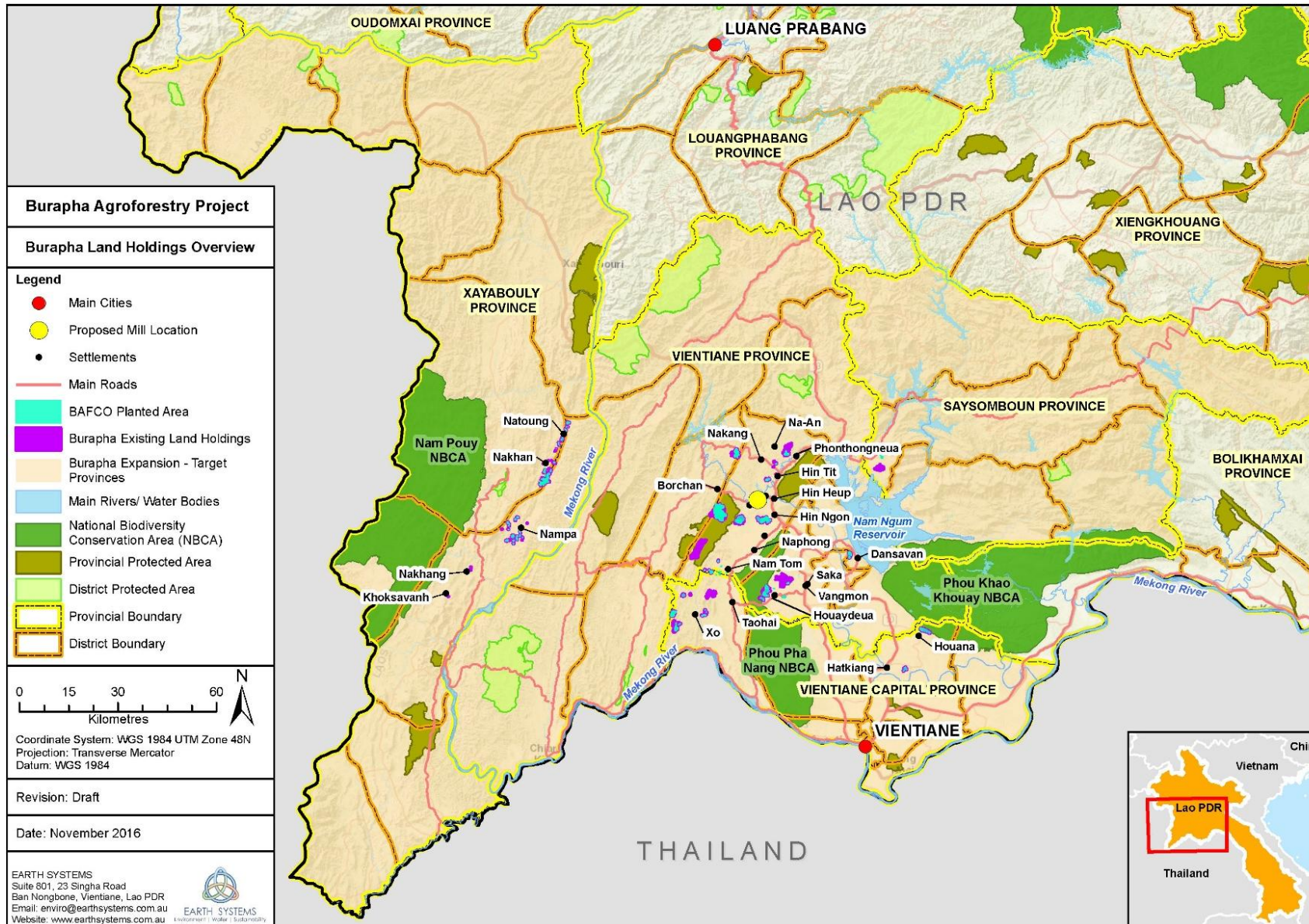


Figure 6-1 Target Provinces and current lease areas

6.2 Demographics

6.2.1 Basic Demographics

Project Region

There are a total of 1.7 million people living in the four (4) target Provinces with population size, density and distribution varying across the region (refer Figure 6-2). The majority of the region has low to medium population densities, with pockets of higher densities around the Vientiane Provincial capital, the Nam Ngum Reservoir region and the urban Capital of Vientiane City and nearby Districts.

Vientiane Capital is the most populous Province, with a total population of 820,900 (NSC 2015), living in 9 Districts. Due to limited land and high internal migration rates, population density is relatively high at 209 people / km². Most of the population is concentrated in Vientiane City and surrounding Districts, with lower population densities in the rural outer Districts, such as Sangthong District where current lease areas are located.

The other target Provinces including Vientiane, Xayabouly and Saysomboun have significantly lower populations, with the majority living in rural areas with much lower population densities. Vientiane Province has a total population of 419,000 living in 11 Districts. Average population density is 27 people per km². Most Districts in which current lease areas are located largely rural populations, except for Keo Odoum (50% urban) and Viengkham (95% urban). Xayabouly Province has a total population of 381,300 people across 11 Districts with a population density of 23 people per km². Pak Lai District where current lease areas are located, has low population density, though is more populated than the midland and highland areas of Xayabouly Province. The recently formed Saysomboun Province is the least populated of the target Provinces, with a total population of 85,200 people. Population density is amongst the lowest in the country at 10 people / km².

Current Lease Areas

The majority of current Project lease areas are in Vientiane Province, followed by Xayabouly Province and Vientiane Capital, with the lowest number in Saysomboun Province (refer Figure 6-1).

Lease areas are generally located in villages having low to medium population density, distant from District capitals (Figure 6-2). Surveyed Project villages vary in population size, ranging from 182 people in Ban Borchan (Hin Heup District, Vientiane Province) to 1,989 people in Ban Xor, (Sangthong District, Vientiane Capital), with an average village size of 1,113 people. Average household size is 5.5 persons per household and overall sex ratio is 1.05 (female to male).

Further information on demographic indicators in the target Provinces is presented in Table 6-1, Table 6-2 and Figure 6-2.

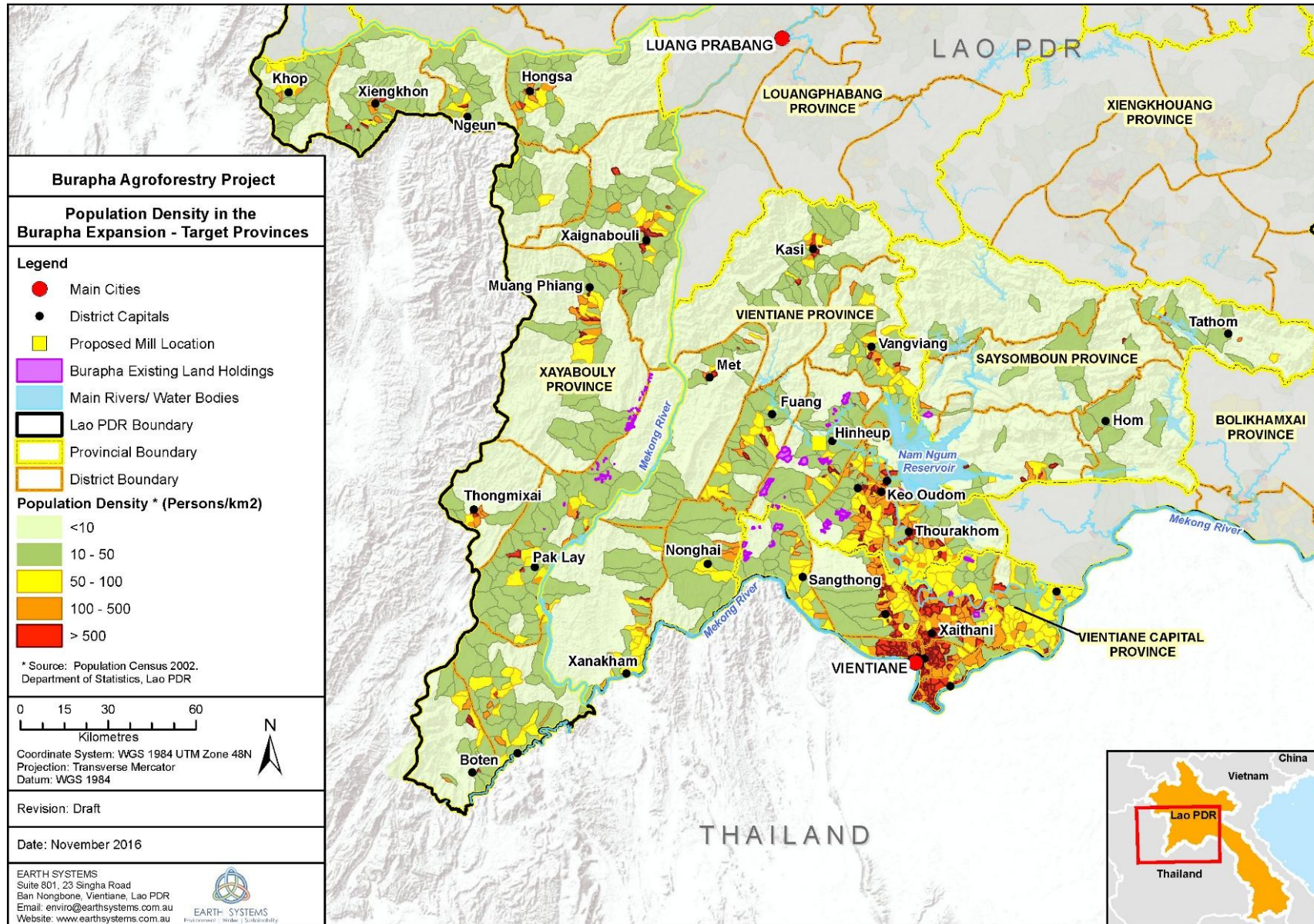


Figure 6-2 Population density in the target Provinces

Table 6-1 National and regional demographic indicators in the four Provinces

Province	No. Districts	No. Villages	No. HHs	Population			Pop. Growth (2005 – 2015)	Avg. HH Size	Sex Ratio	Avg. Pop. Density
				Total	Urban	Rural				
<i>National</i>	141	8,507	952,386	6,492,400	2,137,800	4,354,600		5.3	100	27
Vientiane Capital	9	485	165,400	820,900	639,600	181,300	1.6	4.7	0.99	209
Vientiane Province	11	434	80,000	419,100	139,800	279,300	1.5	5.1	1.02	27
Xayabouly Province	11	432	75,800	381,300	152,200	229,100	2.8	4.9	1.05	23
Saysomboun Province	5	96	13,900	85,200	29,600	55,600	1.2	5.7	1.1	10

Source: NSC 2015

Table 6-2 Demographic indicators of surveyed Project villages

No	District	Villages	Stage	No. Households	No. Families	Population		Avg. HH size	Sex Ratio (males to females)	Ethnicity (% of people)				Religion (% of people)			
						Total	Females			Lao	Khmu	Hmong	Phou Noy	Buddhist	Animist	Christian	Catholic
Vientiane Capital				1,593	1,545	7,786	3,797	4.9	1.05	90	7	3	0	84	14	1	0
1	Sangthong	Kouay	Planted	158	150	666	328	4.2	1.03	97	3	0	0	97	2	0	0
2		Taohai	Unplanted	174	163	740	358	4.3	1.07	100	0	0	0	100	0	0	0
3		Xor	Planted	417	430	1,989	915	4.8	1.17	60	40	0	0	60	40	0	0
4	Xaythany	Hatkiang	Planted	238	243	1,498	745	6.3	1.01	80	0	20	0	73	21	6	0
5		Houana	Planted	180	174	885	424	4.9	1.09	100	0	0	0	100	0	0	0
6		Nakhanthoun	Planted	265	229	1,127	573	4.3	0.97	98	1	0	1	100	0	0	0
7		Saen Udom	Planted	161	156	881	454	5.5	0.94	98	2	0	0	100	0	0	0
Vientiane Province				2,427	2,798	13,900	7,022	5.7	0.98	40	58	2	0	50	30	6	2
8	Hin Heup	Borchan	Planted	29	48	182	91	6.3	1.00	69	7	24	0	69	31	0	0
9		Hingon	Planted	138	165	735	361	5.3	1.04	57	43	0	0	57	43	0	0
10		Khonekeo	Planted	238	308	1,480	738	6.2	1.01	2	98	0	0	0	90	1	9
11		Na-An	Planted	226	246	1,526	845	6.8	0.81	35	65	0	0	0	0	0	0
12		Namthom	Planted	210	247	1,148	538	5.5	1.13	3	97	0	0	64	0	36	0
13		Naphong	Unplanted	271	321	1,742	947	6.4	0.84	10	90	0	0	46	46	7	0

No	District	Villages	Stage	No. Households	No. Families	Population		Avg. HH size	Sex Ratio (males to females)	Ethnicity (% of people)				Religion (% of people)			
						Total	Females			Lao	Khmu	Hmong	Phou Noy	Buddhist	Animist	Christian	Catholic
14		Phon Ngeun	Planted	105	126	625	324	6.0	0.93	4	96	0	0	4	96	0	0
15		Phonmouang	Planted	127	147	701	352	5.5	0.99	5	95	0	0	7	87	6	0
16		Phonsavanh	Unplanted	42	48	259	128	6.2	1.02	0	100	0	0	0	100	0	0
17	Keo	Dansavanh	Planted	86	96	455	233	5.3	0.95	98	2	0	0	100	0	0	0
18	Phonehong	Houaydeua	Planted	241	240	1,257	619	5.2	1.03	63	37	0	0	90	0	7	3
19		Nongkhone	Unplanted	308	374	1,585	758	5.1	1.09	90	10	0	0	90	10	0	0
20		Phon Ngeun	Unplanted	150	128	848	410	5.7	1.07	30	70	0	0	54	4	22	20
21		Vangmon	Planted	256	304	1,359	678	5.3	1.00	100	0	0	0	100	0	0	0
Xayabouly Province				1,065	1,078	6,205	2,868	5.5	1.02	85.7	0	0	0	14.2	85.7	14.2	0
22	Paklai	Nakang	Unplanted	265	265	1779	678	5.5	1.02	100	0	0	0	0	100	0	0
23		Nakhan	Planted	128	139	609	283	5.5	1.02	100	0	0	0	0	100	0	0
24		Meuang Pa	Planted	542	542	3092	1549	5.5	1.02	43	0	0	0	57	43	57	0
25		Natoung	Planted	130	132	725	358	5.5	1.02	100	0	0	0	0	100	0	
Saysomboun Province				210	236	1,061	515	5.1	1.06	100	0	0	0	100	0	0	0
26	Annouvong	Mouangxoum	Unplanted	210	236	1,061	515	5.1	1.06	100	0	0	0	100	0	0	0
Surveyed villages – planted (19 villages)				2,895	3,135	15,62	7,794	5.4	1.01	58	39	3	0	59	26	4	1
Surveyed villages – unplanted (7 villages)				1,335	1,444	7,120	3,540	5.3	1.01	61	39	0	0	76	18	4	2
All surveyed villages				4,230	4,579	22,74	11,334	5.4	1.01	59	39	2	0	64	23	4	2

Source: ES Village Survey (2016)

6.2.2 Population Growth and Migration

Project Region

According to the 2015 Census, Vientiane Prefecture, Vientiane Province and Saysomboun Province have experienced annual population growth rates that exceed the national annual average (1.4%) over the last decade (refer Table 6-1). Saysomboun Province has experienced the highest (2.8%) and Xayabouly Province, the lowest (1.2%) average annual population growth.

Migration trends in the region have been greatly affected by the two Indochinese wars (late 1950's to early 1960's and late 1960's to the early 1970's) and subsequent centralization, collectivisation and administrative, and territorial restructuring before the 1980's. Recent migration trends have seen increases in young migration and rural to urban migration (particularly to Vientiane Capital) driven by social and economic factors (e.g. people moving to be with family or for jobs or education). Resettlement because of large development (i.e. hydropower) has also increased.

Of the four target Provinces, only Vientiane Province and Vientiane Capital have experienced positive net migration rates. Net migration to Vientiane Capital has increased sharply over the last two decades compared to other Provinces, which has contributed to the high population densities in the Province. Most immigrants were reported to originate from the central part of Vientiane Province, Xienghuang and Huaphan Province in search of better employment, healthcare and education in the capital city. Positive net migration rates in Vientiane Province are mainly due to its proximity to Vientiane Capital. Xayabouly and Saysomboun Provinces experience low negative net migration rates.

Higher negative net migration rates are generally found in highland areas, as people move to live close to the major roads and rivers in the lowland areas to improve their living conditions or find agricultural land to cultivate paddy rice. The economic gap between highland and lowland areas is a key driver for migration into the lowlands, major urban areas or small towns and rural areas near larger centres (Phouxay, 2010).

Current Lease Areas

Current Project villages have experienced a natural population growth of 0.8% over the past 12 months, with some variation between villages (refer Table 6-3). The overall crude birth rate was 1.3% and the overall crude death rate was 0.5%. Crude birth rates were highest in Vientiane Province and Vientiane Capital, whilst crude death rates were highest in Xayabouly Province.

Table 6-3 Natural population characteristics of surveyed current Project villages

Province	No. Surveyed Villages	Population	No. of Live Births in Past 12 Months	Crude Birth Rate (%)	No. of Deaths in Past 12 Months	Crude Death Rate (%)	Natural growth Rate (%)
Vientiane Capital	7	7,786	118	1.5	33	0.4	1.1
Vientiane Province	14	13,902	206	1.5	65	0.5	1.0
Xayabouly Province	4	6,205	48	0.8	49	0.8	0.0
Saysomboun Province	1	1,061	14	1.3	0	0.0	1.3
Total	26	28,954	386	1.3	147	0.5	0.8

Source: ES Village Survey (2016)

Migration over the past 12 months varies within surveyed villages and are broadly reflective of regional trends, with a higher number of in-migrants into villages in Vientiane Province. Information on the history of surveyed current Project villages indicates that:

- Twelve villages are very old, having been established 200 – 700 years ago;

- Five villages were involved in movements during and following the Indochina war (1960s and 1970s);
- Several villages were involved in resettlements of the 1990s and 2000s as part of the Government's internal resettlement program;
- Several villages were consolidated with other villages in the last 10 years as part of the Government's efforts to streamline village level administration and services.

Table 6-4 Migration in surveyed Project villages over the past 12 months

Province	No. of Surveyed Villages	Population	In-migration		Out-migration		Net Migration Rate (No. People)
			No. Families	No. People	No. Families	No. People	
Vientiane Capital	7	7,786	5	64	13	66	-2
Vientiane Province	14	13,902	18	101	13	52	49
Xayabouly Province	4	6,205	16	28	2	5	23
Saysomboun Province	1	1,061	0	0	0	0	0
Total	26	22,749	23	165	26	118	70

Source: ES Village Survey (2016)

6.3 Ethnicity and Religion

Project Region

Lao PDR is a multi-ethnic country with 49 ethnic groups divided into four main language family groups including Lao-Tai, Mon-Khmer, Sino-Tibetan and Hmong-Mien. Lao Tai speaking people account for approximately 60% of the population. Other family groups are generally considered 'ethnic minority' groups. The largest include Mon-khmer and Hmong-Mien making up 35% and 10% of the population respectively.

Typically, the Lao-Tai reside in the agriculturally productive lowland areas around the Vientiane Plains and are also primary residents of urban areas. The Mon-Khmer traditionally live in midland rural areas, whilst the Hmong-Mien are generally found in the upland and highland mountains in the north. Further information on ethno-linguistic families is presented in Table 6-5.

Table 6-5 Summary of the main ethno-linguistic groups in the Project region

Language Family	Description
Lao Tai	Lao-Tai groups (often referred to as Lao Loum) traditionally reside in lowland areas and for the most part cultivate paddy fields, practice Buddhism and are integrated into the national economy. This linguistic family includes the Lao, the dominant group, and various related ethnic groups such as Tai Dam, Tai Daeng, Tai Khao, Tai Lue and Tai Phuan.
Mon-Khmer	The Mon-Khmer (often referred to as Lao Theung) traditionally live in the middle hill areas, are animist, tend to practice swidden agriculture, utilise forest products and are relatively isolated from the dominant lowland culture - although there has been assimilation and integration for centuries. This linguistic family includes the Khmu, the Phong and the Phouak ethnic subgroups. Their language links them to the Mon (Menam Region) and the Khmer (Cambodia).
Hmong-Mien	The Hmong-Mien migrated from China to Laos in the 19th century and include several ethnic groups: Hmong Ntsoua, Hmong Daw, Lu Mien and Kim Mun. They generally inhabit highland regions, are animist and practice shifting cultivation.

Source: Chazee 1999 and NSC 2005

The distribution of ethno-linguistic groups in the Project region is presented in Figure 6-3. In general the Lao-Tai are the dominant ethnic group in Vientiane Capital, Vientiane Province and Xayabouly Province, whilst Saysomboun Province is dominated by Mon-Khmer and Hmong-Mien ethnic groups.

Current Lease Areas

The geographical spread of ethnic groups across the surveyed current Project villages is reflective of the broader regional trends (refer in Figure 6-3).

The majority (63%) of the population in these villages are Lao (Lao-Tai), specifically in villages in Vientiane Capital. The remaining population consists of ethnic minority groups including the Khmu (33%) and small numbers of Hmong (2%) (Hmong-Mien). Over seven (7) villages in the target Provinces have predominately Khmu populations, mainly in Vientiane Province. These villages are now sited in the lowlands (because of resettlement activities) and the Khmu population (typically 'middle upland' communities) have integrated with Lao-Tai ethnic groups.

Approximately 66% of people in surveyed villages practice Buddhism, and 24% practice Animism (mainly the Khmu population). In multi-ethnic villages, a mix of both religions is common. Smaller groups of households in Vientiane Capital and Vientiane Province have converted to Christianity (3%).

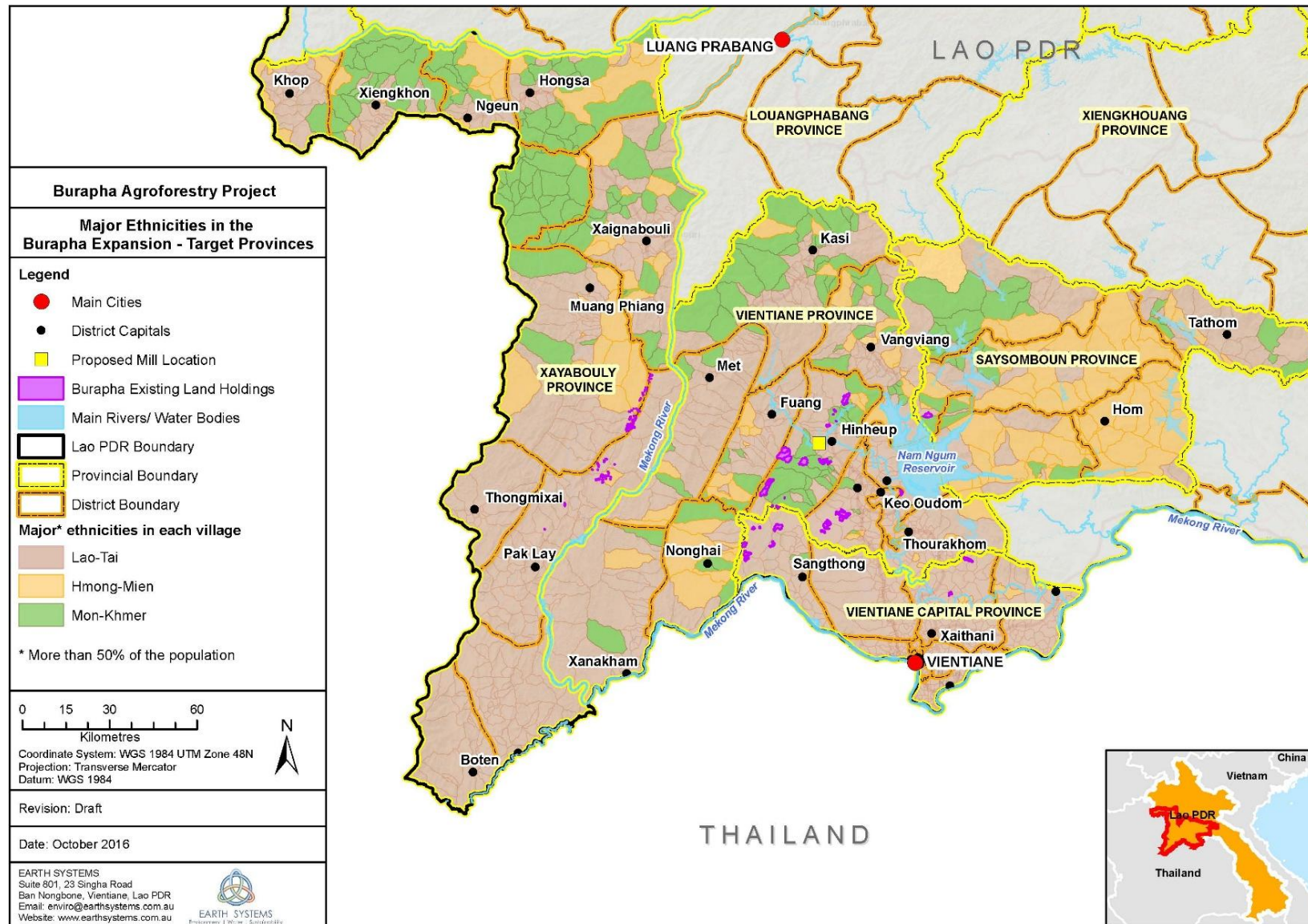


Figure 6-3 Distribution of ethno-linguistic groups within target Provinces (Source: Census 2015)

6.4 Wealth, Poverty and Vulnerable Groups

6.4.1 Wealth and Poverty

Project Region

The national poverty rate in Lao PDR has declined over the past decade from 33.5% to 23.2% (Table 6-6), allowing Lao PDR to reach its MDG target of reducing poverty to below 24% by 2015 (World Bank, 2015). Both rural and urban areas saw declines in poverty to 10.0% and 28.6% respectively. The national poverty lines (i.e. the minimum level of income deemed adequate) for Lao PDR is 203,613 LAK (USD 25.5) per month or 6,694 LAK (USD 0.84) per day (Table 6-7). Income inequality (as measured by the GINI index) has risen nationally from 33.5 in 2002-2003 to 36.1 in 2012 – 2013. This was mainly driven by a widening rural-urban gap and rising inequality in urban areas within and across Provinces (SODA, 2015).

Information on poverty and income inequality in the target Provinces are presented in Figure 6-4, Table 6-6, and Table 6-7.

Whilst provincial poverty rates in the Project region are generally low (<30%), District poverty rates vary widely, ranging from <10% in Districts around Vientiane City and the Nam Ngum Reservoir to 31-40% in small pockets of Vientiane, Xayabouly, and Saysomboun Provinces (World Bank, 2015).

Poverty incidence is closely associated with geography and terrain (refer to Table 6-6). Poverty incidence tends to be lowest in the lowlands and highest in highland areas. Higher incidences of poverty are reported in remote rural areas, without road access, in upland areas and in areas with steep slopes. Reflective of this, poverty rates are higher in Hmong Mien and Mon Khmer groups who generally reside in highland and midland areas respectively (WFP, 2013).

Table 6-6 Incidents of poverty and income inequality in Lao PDR along administrative, ethnic and geographical lines

Area	Poverty Rate (%)			Income Inequality (GINI)		
	2002-2003	2007-2008	2012-2013	2002-2003	2007-2008	2012-2013
National	33.5	27.6	23.2	0.33	0.35	0.36
Urban	19.7	17.4	10.0	0.34	0.36	0.375
Rural	37.7	31.7	28.6	0.30	0.33	0.32
Administrative						
Vientiane Capital	16.7	15.2	8.5	0.36	0.38	0.38
Vientiane Province	19.0	27.8	16.5	0.32	0.32	0.31
Xayabouly Province	25	15.7	20.2	0.35	0.42	0.34
Saysomboun Province	-	-	23.2	-	-	-
Ethnicity						
Lao-Tai	15.7	18.4	15.4	0.32	-	-
Mon-Khmer	33.6	47.3	42.3	0.30	-	-
Chino-Tibetan	31.9	42.2	16.4	-	-	-
Hmong Mien	35.2	43.7	39.8	0.30	-	-
Agro-ecological Zones						
Vientiane Plain	15.6	-	-	0.31	-	-
Northern Lowlands	27.5	-	-	0.31	-	-
Northern Midlands	46.2	-	-	0.31	-	-

Area	Poverty Rate (%)			Income Inequality (GINI)		
	2002-2003	2007-2008	2012-2013	2002-2003	2007-2008	2012-2013
Northern Highlands	42.4	-	-	0.31	-	-

Source: LECS 5; NCCR and IFPRI, 2010; World Bank, 2015

Table 6-7 National poverty lines in Lao PDR

Category	Poverty Line (per person per month) 2008		Poverty Line (per person per month) 2012/2013	
	LAK	USD	LAK	USD
National	192,000	24.0	203,613	25.5
Urban	240,000	30.0	221,391	27.7
Rural	180,000	22.5	196,412	24.6

Source: World Bank, based on PMO 2009 and LECS5, 2013

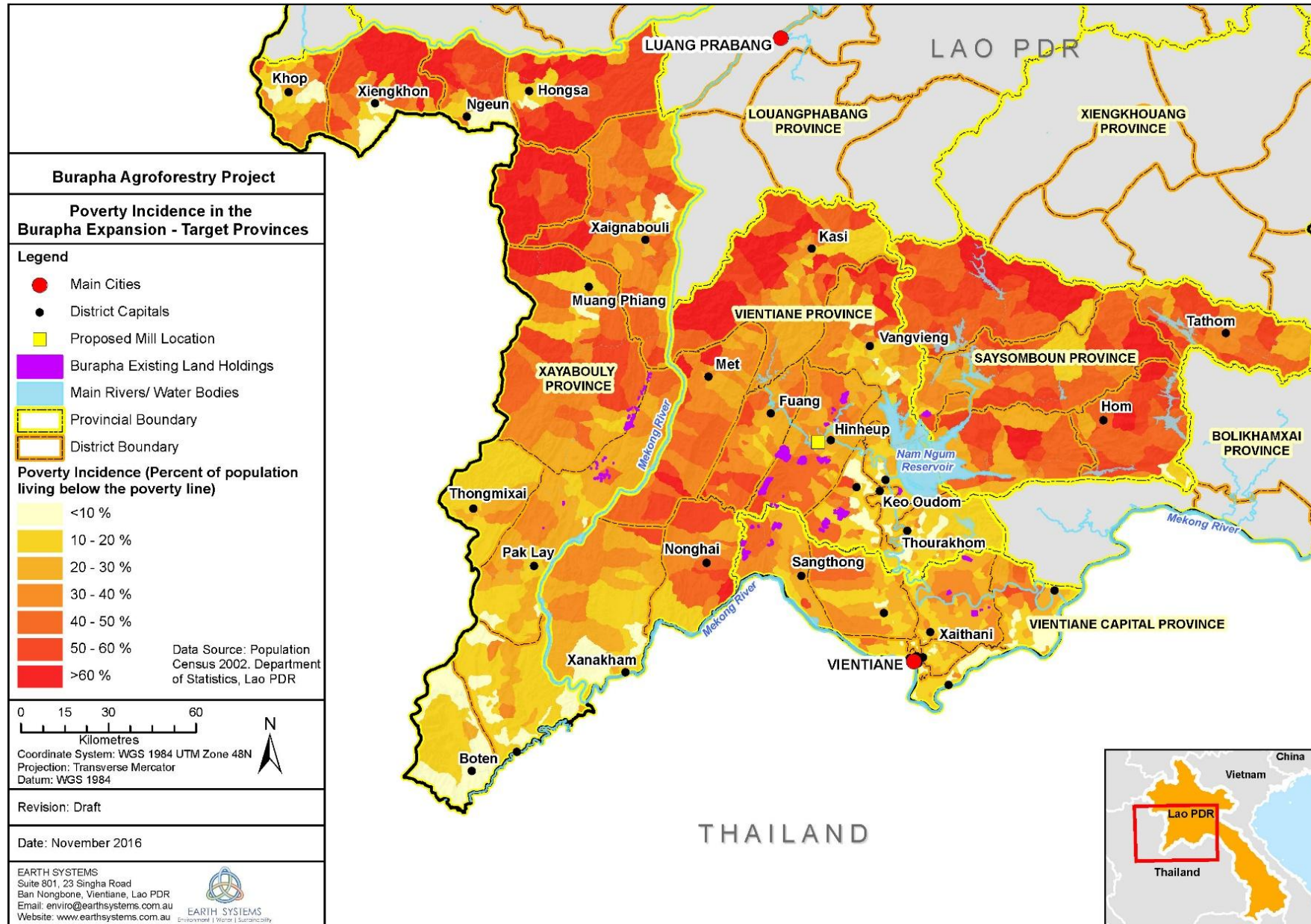


Figure 6-4 Incidence of poverty within target Provinces

Current Lease Areas

Poverty Incidence

The majority of current Project lease areas lie in areas with moderate rates of poverty (refer to Figure 6-4). Observations on District poverty incidence include:

- Sangthong District, where the majority of current lease areas are located in Vientiane Capital, has a higher poverty rate (12%) compared to the Provincial average (8.5%);
- Poverty rates in Hin Heup (17%), Fueng (21%) and Vangvieng (16%) Districts are higher than the Provincial average (16.5%), whilst in Keo Oudom, Phonehong and Viengham District poverty rates are well below the Provincial average, at less than 10%;
- Southern Districts in Xayabouly Province such as Pak Lai have lower District poverty rates (16%) compared to northern Districts in the midland and highland regions such as Hongsa and Ngeun Districts (20 – 30%). and
- Annouvong has one of the poverty rates of Districts in Saysomboun Province.

Perceptions of Wealth

During village level surveying, village chiefs were asked to group families into four (4) categories – very well off, sufficiently well off, poor with land and poor with no land; and then estimate the average annual income of families in those categories.

Results from this exercise (refer Table 6-8) indicate varying perceptions of wealth and poverty in each village and Province. Approximately 22% of families were viewed as ‘very well off’ and earning annual household incomes ranging from LAK 34 million (USD 4,250) to LAK 90 million (USD 11,250). Most families (67%) were considered ‘sufficiently well off’ with average incomes ranging from LAK 23 million (USD 2,875) to LAK 54 million (USD 6,750.) A very small number of families (0.8%) in Vientiane Capital and Vientiane Province were identified as poor with average annual incomes ranging from LAK 9.5 million (USD 1,187) to 17 million (USD 2,125).

Only 16 families in two villages, Ban Hoana in Xaythany District (Vientiane Capital) and Ban Houaydeua in Hin Heup District (Vientiane Province) were reportedly landless poor households.

Table 6-8 Perceptions of wealth in surveyed current Project villages

Province	No. Surveyed Villages	Very Well-Off		Sufficiently Well-Off		Poor with Some Land		Poor with No Land	
		% of families	Avg. family p. a. income (mill kip)	% of families	Avg. family p. a. income (mill kip)	% of families	Avg. family p. a. income (mill kip)	% of families	Avg. family p. a. income (mill kip)
Vientiane Capital	7	13	90	73	30	13	17.2	1	1.8
Vientiane Province	14	19	74	70	23	7	9.5	0	3.0
Xayabouly Province	4	46	34	42	26	11	10.5	0	0
Saysomboun Province	1	0	0	100	54	0	0	0	0
Total	26	22	71	67	27	9	11.4	0.3	0.8

Source: ES Village Survey (2016)

6.4.2 Vulnerable Groups

Vulnerable groups are people who by virtue of gender, ethnicity, age, physical or mental disability, economic disadvantage, or social status may be limited in their ability to claim or take advantage of development benefits. Disadvantaged or vulnerable households in Lao PDR include the following:

- Households with persons falling under the poverty line or without land;
- Divorced or widowed female headed households with dependents and low income;
- Households with no labour;
- Elderly households with infirm or elderly persons;
- Households with physical or mental disabled persons.

These are described in further detail below.

Poor Households

Poor households are considered vulnerable as they lack savings or assets that can assist in coping with hardships, and therefore are particularly vulnerable to changes such as loss of land or livelihoods. Poor households are more likely to resort to marginal activities, sell vital assets, or incur debt. Lower income households also tend to be large, have a greater number of dependents, and lack access to education.

Female Headed Households

Women are typically more vulnerable to livelihood changes due to fewer available education, employment and training opportunities and a higher reliance on agricultural activities. Women tend to be employed in less lucrative economic sectors and have substantially less access to inputs such as land, agricultural advice, seed and credit. Gender may limit women's access to resources, opportunities, and public services necessary to improve the standard of living for themselves and their families.

Landless Households

Landless or near landless households are another vulnerable group not only in terms of income, but also in terms of the challenges they face. Living in rural areas without land can pose difficulties in sustaining livelihoods, particularly where non-farm employment is limited and where labour market conditions are less favourable.

Households with Disabled or Elderly Members

Disabled or elderly people face economic and social constraints which place them in a vulnerable position. In addition, these groups face other constraints as they may not be able to sustain their livelihoods during difficult periods or take advantage of development opportunities such as labour and employment due to their disabilities or age.

Households with no Labour

Households with no labour or a high number of dependents are at greater risk of poverty since its members are not able to productively contribute to household income. In addition, these households may be at risk of not being able to benefit from available labour and employment opportunities associated with development projects, either due to the high number of dependents they need to care for, or the lack of people physically able to work.

Project Region

Government data on the Provincial vulnerability indicators in the Project Region is presented in Table 6-9.

Table 6-9 Vulnerability of households in Project Region

Province	Vulnerability Indicators				
	Poverty rate (% of population, 2012-13)	Single Female Headed households	Elderly Infirm (no labour)	Landless households	Prevalence of disability (in population 5 and over)
Vientiane Capital	8.5	ND	ND	5%	2.2
Vientiane Province	16.5	ND	ND	0.16%	2.9
Xayabouly Province	20.2	ND	ND	1.1%	2.9
Saysomboun Province	23.2	ND	ND	ND	4
National	23.2	ND	ND	<1%	2.8

Source: NSC, 2015; MAF, 2011

Current Lease Areas

Village surveying indicated that levels of vulnerability in surveyed Project villages were fairly low, with 9% of households identified as being vulnerable. Of these, 6% of households were headed by single females, 1% had elderly and infirmed people, 1% include disabled household members and 1% of households had no land (Table 6-10).

Table 6-10 Vulnerability of surveyed current Project villages

Province	No. of Villages Surveyed	Vulnerability Indicators (% of households in village)				
		Single Female Head	Elderly Infirm (no labour)	Landless	Disabled	Total
Vientiane Capital	7	7	1	1	1	10
Vientiane Province	14	7	1	1	1	10
Xayabouly Province	4	5	0	0	1	6
Saysomboun Province	1	0	0	0	1	1
Total	26	6	1	1	1	9

Source: ES Village Survey (2016)

Other vulnerable household groups include farmers with limited activity in fishing and hunting, unskilled labourers, households engaged in upland farming on steep slopes, those living in remote villages with little infrastructure, and those from non-Lao-Tai ethnic groups. Agriculture shocks (i.e. food price changes and loss of land) and health shocks are the main drivers of household vulnerability.

6.5 Regional and Local Economies

6.5.1 Economic Activity

Project Region

Average GDP for the Project region in 2014-2015 was LAK 9,767 billion (USD 1.2 Billion). The majority of the region's economic activity takes place in Vientiane Capital (64%) followed by Vientiane Province (20%) and Xayabouly (14%; Table 6-11). Saysomboun Province has the lowest share of economic activity in the region (2%). GDP growth rates reflect a similar pattern with extremely high growth in Vientiane Capital (12.5%) and relatively low growth in Saysomboun (5.5%). Key sectors include agriculture (35.0%), industry (35.7%), services (29.3%).

Table 6-11 Economic activity across the Project Region

Province	GDP (Bill. LAK)	GDP / Person / Year (Mill. LAK)	GDP Growth (%)	Sector Contribution		
				Agriculture	Industry	Service
Saysomboun Province	645	7.9	5.5	47.7	26.4	25.9
Xayabouly Province	5,622	19.2	9.0	34.0	33.0	33.0
Vientiane Capital	24,981	29.9	12.5	17.1	48.8	34.2
Vientiane Province	7,819	10.2	9.8	41.3	34.5	24.3
Mean	9,767	16.8	9.2	35.0	35.7	29.3

Source Provincial SEDPs 2014-2015

A summary of main economic activities of the population in the target Provinces is provided in Table 6-12. Populations in Vientiane and Xayabouly Provinces spend most their working hours in self-employed farm activities, with some off-farm activities and a smaller proportion of paid employment. In contrast, the population in Vientiane Capital are mostly engaged in off-farm activities and paid employment. In both Vientiane Capital and Vientiane Province, the proportion of the population engaged farm activities has decreased in the last five years, with off farm activities and paid employment becoming more common.

Table 6-12 Main economic activities for population aged 10+ working (2012-2013)

Aspect	National	Vientiane Capital	Vientiane Province	Xayabouly Province	Saysomboun Province*
Percentage (%) of population 10+ working					
Female	73	64	80	81	-
Male	78	70	83	87	-
Total	75	67	81	84	-
Main activity last 7 days, % of total hours worked:					
Paid employee	14	41	20	18	-
Self-employed non-farm activity	20	46	23	18	-
Self-employed farm activity	66	12	56	63	-

LECS5; NSC, 2015 * Data for Saysomboun Province not available

Local Economies

Local economies in participating villages are still predominately agriculture based however are transitioning to market-based economies. Key activities include a mixture of subsistence and cash-income agriculture, natural resource harvesting and cottage industry including handicrafts and charcoal production.

Livelihoods in Vientiane Capital and Vientiane Province are more diversified, with more off-farm activities reported such as paid employment, factory work, government services, and building and construction work. The four Project associated villages in Pak Lai District, Xayabouly Province are very reliant on agriculture and natural resource based livelihoods, supplemented by labour work.

Many of the surveyed villages, particularly in Vientiane Province, are now sited in lowland positions (a result of resettlement activities) and many of the predominately Khmu villages (typically 'middle upland' communities) have integrated with Lao-Tai ethnic groups. This has led to the adoption of some lowland livelihood practices (i.e. paddy rice cultivation). The remainder of villages in these Provinces are located in upland areas where upland rice cultivation and NTFP / TFP collection are common.

6.5.2 Income and Income Generating Activities

Project Region

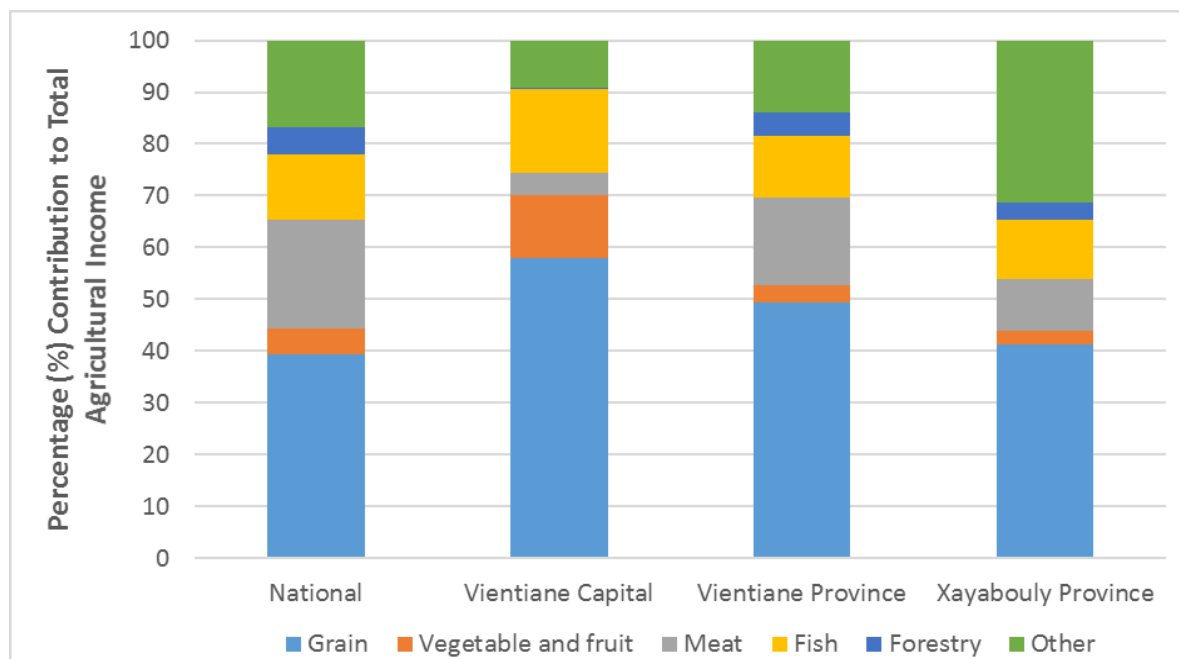
Data on key livelihood and income generating activities in rural households across the target Provinces is presented in Table 6-13 with data sourced from the World Food Program Risk and Vulnerability Analysis for Lao PDR (WFP, 2013). Rice production is practiced by 87-93% of rural households. The capture of fish / aquatic resources and the collection of NTFP products are livelihood activities practiced by the majority of households – although the numbers are significantly lower in Vientiane Capital. An average of 38% of households across the Project region sell agricultural produce; 24% rear and sell cattle and an average of 29% source their main household income from the sale of forest products.

Table 6-13 Key livelihoods and income generating activities in the Project region.

Activity	Percentage (%) of Farming Households			
	Vientiane Capital	Vientiane Province	Xayabouly Province	Saysomboun Province*
Rice production	87	93	92	-
Sale of agricultural produce	30	31	54	-
Capture fishing	48	74	74	-
Sale of capture fish (main income)	0.8	4	<1	-
Collection of forest products	26	67	77	-
Sale of forest product (main income)	27	31	30	-
Rearing cattle	11	36	27	-

Source WFP, 2013, MAF, 2011* Data for Saysomboun Province not available

Figure 6-5 provides information on relative incomes from agricultural production across the target Provinces (LECS5, 2013). The sale of grain constitutes the largest source of agricultural income in the Project region, contributing to over 8.5 million kip per annum in each Province, much higher than the national average (6.7 million kip). The sale of meat is a larger source of income in Vientiane Province and Xayabouly Province.



LECS5, 2013. NB data for Saysomboun Province was not available

Figure 6-5 Relative income from agricultural production by Province 2012-2013

Current Lease Areas

Data on average annual household income in current Project villages is presented in Table 6-14. Average household income is LAK 22 million (USD 2,744) per annum. Household incomes are highly correlated with the distance of villages from Vientiane Capital city. Households in the current Project villages in Vientiane Capital have the highest per annum incomes (26.7 Million / USD 3,338) whilst those in Saysomboun have the lowest (LAK 15.4 / USD 1,926).

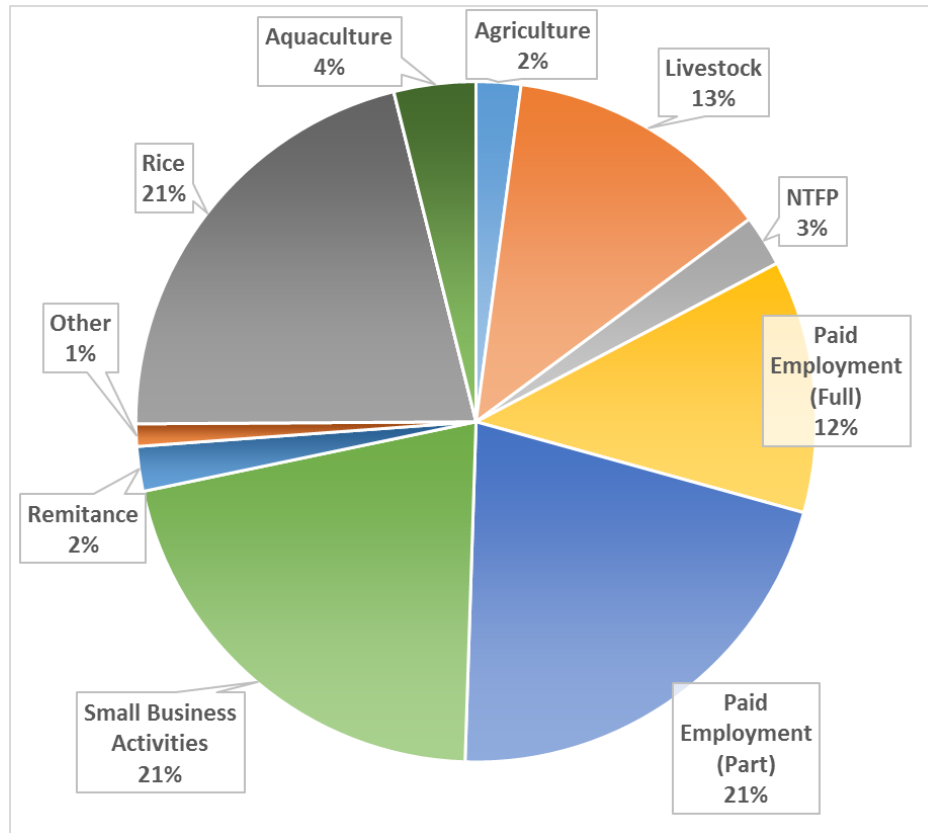
Table 6-14 Incomes in surveyed households within current lease areas

Province	Number of Households Surveyed	Average Household Income (Mill LAK)	Average Annual Household Income (UDS)
Vientiane Capital	140	25.4	3,175
Vientiane Province	347	26.7	3,338
Xayabouly Province	82	20.3	2,537
Saysomboun Province	14	15.4	1,926
Total / Average	583	22.0	2,744

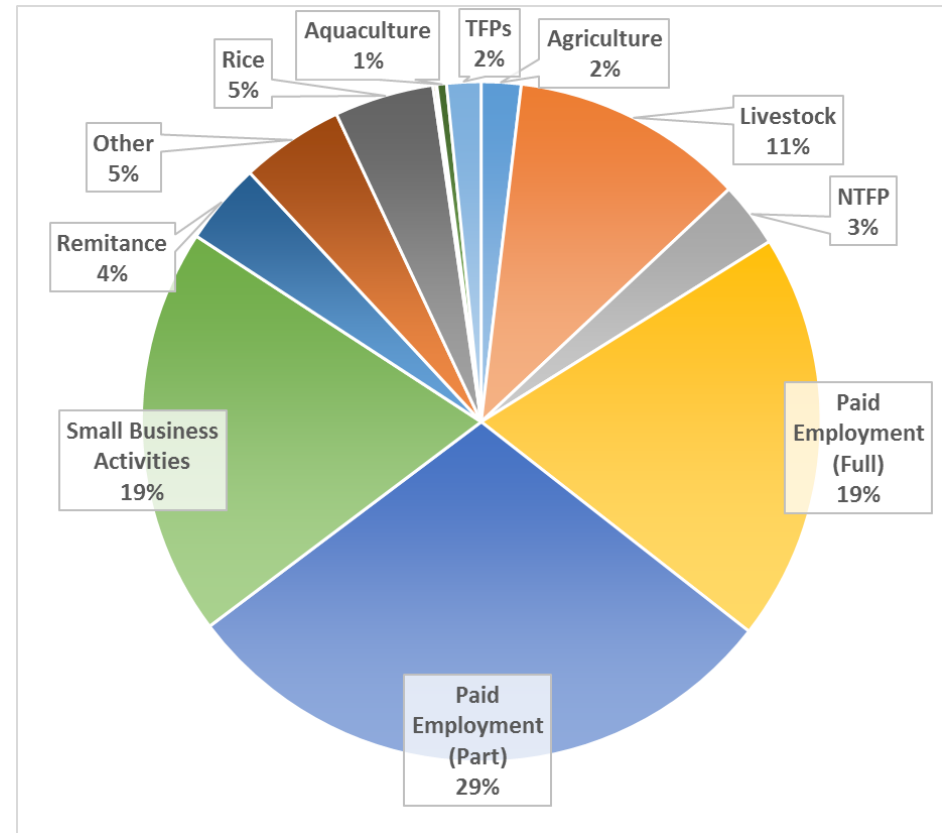
Source: ES Household Survey, 2016

Distribution of income generating activities for households in current Project villages is presented in Figure 6-6 and Figure 6-7. These results present some interesting variations across the Project region.

The main sources of income for households in Vientiane Capital are small business activities (21%), sale of NTFPs (21%) part time employment (21%) and full time employment (12%) and sale of livestock (13%). In Vientiane Province, key income generating activities include part time employment (30%), full time employment (30%), small business (20%) and livestock trade (12%). In Xayabouly Province, households in current Project villages generate the majority of their income from the sale of agricultural produce (47%), sale of rice (29%). While in Saysomboun, household incomes are generated from part time employment (37%), sale of rice (19%), small business activities (13% and livestock trade (12%).

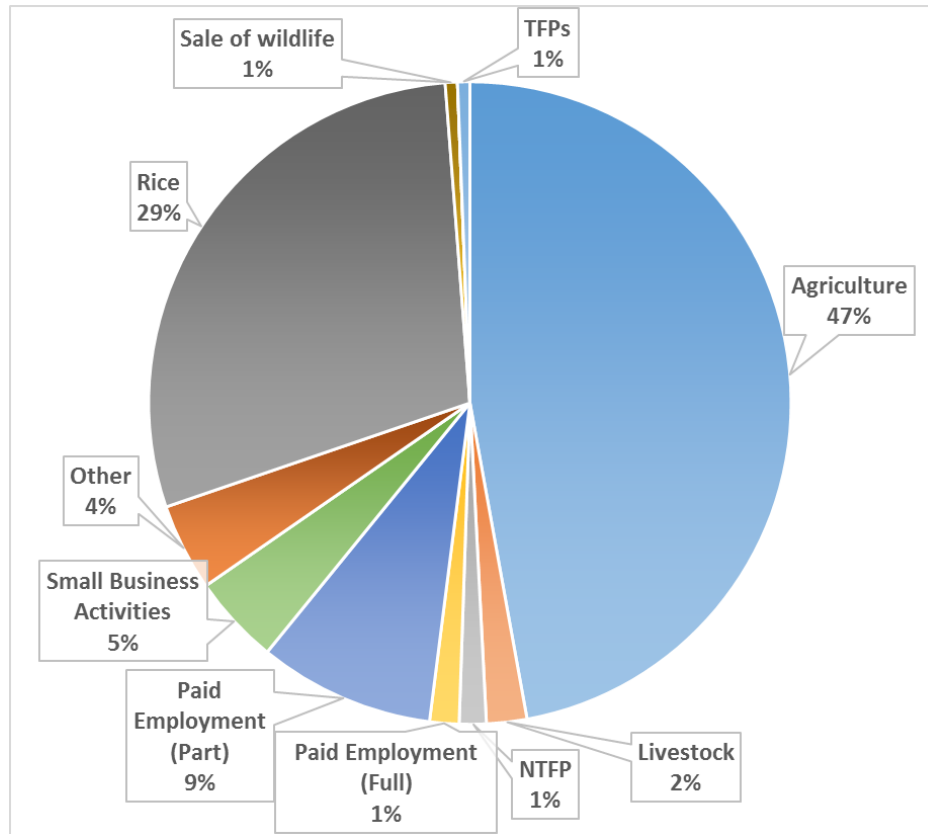


Vientiane Capital

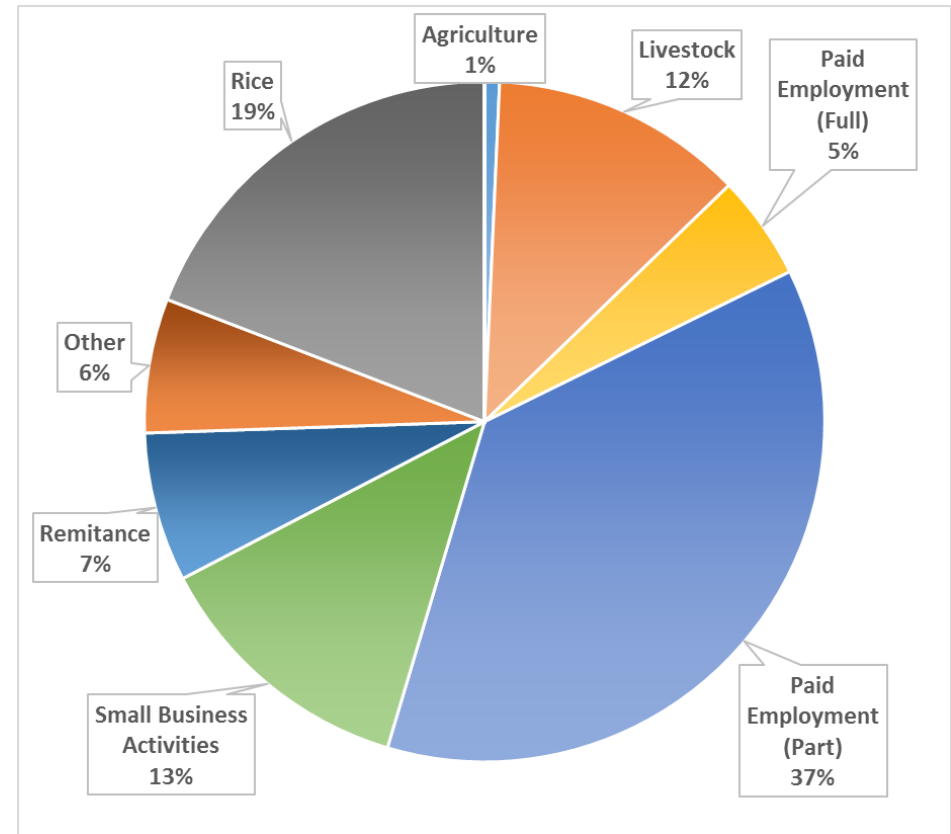


Vientiane Province

Figure 6-6 Distribution of income generating activities in surveyed households in current lease areas in Vientiane Capital and Vientiane Province



Xayabouly Province



Saysomboun Province

Figure 6-7 Distribution of income generating activities in surveyed households in current lease areas in Xayabouly and Saysomboun Provinces

The Project provides a source of income for a number of households in participating villages. Direct employment includes work on brush clearing; fertilizing; plantation maintenance; thinning, and harvesting of trees (skilled labour only) for processing and sale. The work is seasonal and dependent on the stage of the plantation cycle. The Company pays for casual labour by one of two primary methods: (i) a daily rate of 50,000 kip; or (ii) per unit achieved (e.g. area planted, weeded, fertilised, etc.). Burapha rates exceed the Lao minimum wage requirements of 34,000 kip/day. Plantation establishment is typically done during the wet season, with approximately 74 man days per ha required. Plantation management, typically conducted during the dry season and includes 12 man-days for weeding over the 7-year cycle and approximately 88 man-days per ha during harvesting.

Household level socio-economic surveying conducted in 17 villages participating in the Project (ES, 2017) indicates that approximately 506 households were involved in the establishment of 2,464 ha of plantations and approximately 187 households were involved in the management of these plantations (ES, 2017). No data on household employment was collected for the remaining five villages with plantations (thus the number of households employed by Project is greater). The Project is estimated to have provided approximately \$1.4 million to the local economy since the establishment of the first plantation (refer to Table 6-15). The Project has also contributed to the diversification of employment opportunities available to villages.

The level of household participation varied throughout the surveyed villages, ranging from a high level of employment opportunities with over 100 households employed (e.g. Ban Phonmouang) to a medium level of employment opportunities (20 – 50 households), low level (<20 households) or no households employed (e.g. Ban Borchan, Ban Nakhathoung). Higher Project related employment generally correlated to larger plantation size. In Ban Phonmouang, more than 100 households have been employed to establish and / or maintain 600 ha of plantations established since 2013. Villagers also reported that the number of households interested in obtaining employment with the Project increased in 2016 after observing the benefits achieved for those participating in the initial plantations.

Lower levels of employment in participating villages were generally influenced by such factors as: other employment opportunities; villagers preferring to focus on their agricultural activities or unable to divert labour away to plantation work; low awareness of potential employment opportunities, or the distance of plantations from the main village area. In some cases, there has also been a trend towards contractor led, mechanised clearance.

Table 6-15 Labour and income within surveyed villages participating in the Project

District	Villages	No. Households	Total Project Land (ha)	Total Planted (Ha)	Year planted / Amount planted								Estimated Labour-Days	Estimated Income (USD)	Participating Households		Outside Contractor (Establishment Only)		Contractor and HH (Establishment)
					2005	2010	2011	2012	2013	2014	2015	2016			Total	Total	Establishment	Management	
Hin Heup	Borchan	29	349	287	-	-	-	-	-	-	-	287	21,238	\$132,738	0	0	0		-
Keo Oudom	Dansavanh	86	93	69	12	-	-	-	-	-	56	-	5,379	\$33,617	0	0	69		-
	Donian	ND	7	7	-	-	-	-	-	-	-	7	518	\$3,238	ND	ND	ND		
Xaythany	Hatkiang	238	69	64	-	-	-	34	30	-	-	-	5,199	\$32,495	ND	ND	ND		
Hin Heup	Hinngon	138	226	168	-	-	-	-	88	73	7	-	13,257	\$82,859	36	46	-		168
Hin Heup	Hintit	ND	124	75	-	-	-	-	-	-	-	75	5,550	\$34,688	ND	ND	ND		ND
Xaythany	Houana	180	125	100	-	-	-	58	42	-	-	-	8,141	\$50,880	ND	ND	ND		
Phonehong	Houay Deua	241	394	271	-	-	-	100	108	24	9	29	21,588	\$134,924	70	10	30		140
Hin Heup	Khonekeo	238	80	35	-	-	-	-	-	-	-	35	2,590	\$16,188	55	1	0		-
Sangthong	Kouay	158	101	3	-	-	-	-	3	-	-	-	256	\$1,597	65	-	0		-
Paklai	Meuang Pa	542	219	111	-	-	-	-	-	111	-	-	8,683	\$54,267	ND	ND	ND		
Hin Heup	Na-An	226	432	84	-	-	-	-	-	-	-	84	6,216	\$38,850	30	1	60		-
Paklai	Nakhan	128	312	80	-	-	-	-	-	80	-	-	6,276	\$39,223	15	1	65		-
Xaythany	Nakhanthoung	265	83	48	-	-	-	25	23	-	-	-	3,895	\$24,346	0	0	145		-
Hin Heup	Namthom	210	464	38	-	-	-	-	-	21	9	7	2,916	\$18,222	20	22	0		-
Paklai	Natoung	130	49	34	-	-	-	-	-	34	-	-	2,663	\$16,643	ND	ND	30		
Hin Heup	Phon Ngeun	105	426	273	-	-	-	-	58	44	-	171	2,0743	\$129,645	37	5	40		-

District	Villages	No. Households	Total Project Land (ha)	Total Planted (Ha)	Year planted / Amount planted								Estimated Labour-Days	Estimated Income (USD)	Participating Households		Outside Contractor (Establishment Only)		Contractor and HH (Establishment)
					2005	2010	2011	2012	2013	2014	2015	2016			Total	Total	Establishment	Management	
Hin Heup	Phonmouang	127	1165	605	-	-	-	-	67	332	76	131	4,6512	\$290,699	100	100	5		-
Hin Heup	Phonthong-neua	ND	95	40	-	-	-	-	-	-	-	40	2,960	\$18,500	19	ND	10		-
Phonehong	Saka	ND	168	7	-	-	-	-	-	-	-	7	518	\$3,238	4	0			-
Xaythany	Saen Udom	161	261	149	-	2	5	27	109	6	-	-	11,977	\$74,855	25	ND			160
Sangthong	Xor	417	748	307	-	-	-	64	21	-	80	142	23,499	\$146,866	30	1	128		-
Total		4,230	7,960	2,981	12	2	5	309	549	726	295	1,083	229,936	\$1,437,101	506	187			7,960

6.6 Land Allocation, Ownership and Use

6.6.1 Land Allocation and Ownership

Project Region

According to the Land Law 2003, land is owned by the national community and the State is charged with its management. The Government has a range of instruments with which it can allocate land rights and ownership of land and forests to villages and individuals (refer to Table 6-16). These instruments provide varying rights to holders. Most relevant to the Burapha Project are community land tenure and the Village Land and Forest Management Agreements (VLFMA). Through these agreements, the Lao Government recognises the rights of villages to protect, use, benefit from, inherit and to be compensated for land within the village boundary.

In urban and peri-urban areas, permanent land use rights are granted through the Land Titling Program, whilst the LFAP is applicable to rural areas and zones land for communities. The LFAP recognises the customary land use rights of villages over the utilisation of resources. Under LFAP, temporary land use rights for agricultural and forest use are provided in the form of temporary land-use certificates (TLUCs) distributed by the State.

Villagers have the right to use this land for their daily livelihood activities, particularly for agriculture practices and NTFP collection. For land use relating to agriculture practices, villagers must pay annual land use tax to the government. Villagers often regard this tax as their only proof of usage of the land, which becomes important in relation to compensation claims.

Table 6-16 Land use documents under the Land Law and corresponding user rights

Type of Documents	Term of Use	Rights	Type of Lands	Owner/ User
Land title issued by the Provincial or Municipal Land Management authority	Permanent land use right	1. Right to protect; 2. Right to use; 3. Right to benefit; 4. Right to transfer, 5. right to inherit; 6. right to compensation	Construction land, Permanent agricultural land, rice field, fruit garden	Villagers
Land Map Sheet registered at Land Management Agency of the Province/ City or of the District/ Capital	Permanent land use right	1. Right to protect; 2. Right to use; 3. Right to benefit; 4. Right to transfer, 5. Right to inherit; 6. right to compensation	Construction land, permanent agricultural land, rice field, fruit garden	Villagers
Temporary Land Use Certificate (through the land use planning and land allocation process and request by villager); Issued by the District government.	Land use deed for 3 years and then can apply for the land title	1. Right to protect; 2. Right to use; 3. Right to benefit (no collateral), 4. Right to inherit; 5. right to compensation	Temporary production land: slash and burn cultivation areas; degraded forest use for regeneration of forest and tree planting.	Villages
Certificate for Original Acquisition of Land issued by the agriculture and forestry sector	Permanent land use right	Show the historical evolution of the protection and use of the land	Temporary production land: slash and burn cultivation areas; degraded forest use for regeneration of forest and tree planting.	Villagers

Type of Documents	Term of Use	Rights	Type of Lands	Owner/ User
Land Development Attestation issued by the agriculture and forestry sector	Permanent land use right	Attest that the concerned parcel has already been developed. Required for forming the land file for applying for land registration.	Temporary production land: slash and burn cultivation areas; degraded forest use for regeneration of forest and tree planting.	Villagers
Village Land and Forest Management Agreement (through the land use planning and land allocation process), issued by the District government.	Considered on a case by case basis.	1. Right to protect; 2. Right to use; 3. Right to benefit, 4. Right to inherit; 5. right to compensation	Forest land within the village's administrative boundaries.	Villagers
Land Lease Contract	Not more than 30 years	Right to use, right to enjoy mutual interests.	Degraded forest land and barren land.	Lao citizen

Source: Department of Forestry 2007

The Land and Forestry Allocation Program

The Land and Forest Allocation Program (LFAPP) led by the Ministry of Agriculture and Forestry was introduced to conserve forests, restrict shifting cultivation, reform natural resource management, and to transfer much of the decision making regarding the use of communal land back to the village level. The program aimed to allocate rights to households for potential agricultural land and degraded forests for use in agricultural production and tree planting respectively. Village land was also to be classified and zoned into management categories. The LFAP policy was one of the main programs to recognise the customary land use rights of villages over the utilisation of resources. Under LFAP, temporary land use rights for agricultural and forest use was provided in the form of temporary land-use certificates (TLUCs) distributed by the State.

Participatory Land Use Planning

Participatory Land Use Planning (PLUP) was introduced in 2009 by MAF and NLMA, to improve the previous process of land allocation in rural areas. The PLUP process encourages greater participation with all stakeholders in planning and zoning at the local level and seeks to improve the previous land use planning process, whilst also incorporating procedures for land allocation that have been affected by new legislation (MAF-NLMA, 2009). Whilst a smaller number of villages in Lao PDR have undergone the improved PULP process, this is likely to be relevant for Burapha plantation areas in the future.

Under the PULP process, temporary land use certificates are longer be issued. Instead, land titles are granted when possible to strengthen tenure security. Communal land is also further recognised and registered. Villages can identify land that would be eligible for communal title such as village sacred areas, village forest use zones and village common grazing land.

Current Lease Areas

Village surveying (ES, 2016) indicates that 22 of the surveyed Project villages have undergone government land allocation programs through the LFAP during the period 1997 – 2015. Land allocation and zoning for current Project villages is presented in Figure 6-10. The primary land use types allocated in the villages include production forest, swidden agriculture land / degraded forest or grazing land, protection forest and conservation / spirit forest.

Individual land ownership arrangements vary across current Project villages. In Vientiane Prefecture and Vientiane Province, land use certificates are the most common form of land use document for upland and lowland agricultural land. Some villages had stronger tenure security for their agricultural land through

land titles such as Ban Saen Udom and Ban Hatkiang in Xaythany District (Vientiane Capital); Ban Vangmon, Ban Phon Ngeun, and Ban Nongkhone in Phonehong District, and Ban Dansavanh in Keoudom District (Vientiane Province). In Xayabouly and Saysomboun Provinces, land tax documents are the most common form of proof of ownership as further governmental land titling programs had not been undertaken in those villages (ES, 2016). The majority of land use documents across surveyed villages are generally held conjugally, between the husband and wife.

6.6.2 Land Use

Project Region

Forest and Land Resources

Analysis of the Government's Forest Inventory Plantation Division (FIPD) land use data (2010) and ground truthing were undertaken to identify the current use of land resources within the Project region (refer Figure 6-8). Land cover types were classified using manual interpretation of the FIPD data at a scale of approximately 1:50,000. The classifications used were primarily based on the GOL classifications used by the government to conduct periodic land cover mapping in Lao PDR.

The main land use cover type in the Project region is forest area, comprising natural forest (e.g. deciduous forest) and modified forest such as young and old fallow forest. Deciduous forest is defined as forest dominated by deciduous tree species which is located at an altitude above 200 m. This forest type is typically quite open. Fallow forest is regenerating vegetation after the land has been cleared or highly disturbed. Generally, land has been cleared for shifting / swidden cultivation Vientiane Province and Xayabouly Province have the largest amount of young and old fallow forest land and slash and burn land in the target region. Xayabouly Province also has the largest area of natural forests.

The amount of land suitable for agriculture varies across the Project region. Rice paddies and shifting cultivation are the most common agricultural production land uses within the Project region. Vientiane Capital has the largest area under rice paddy cultivation, followed by Vientiane Province.

Agro-ecological Zones

Analysis of the World Food Program's data on agro-ecological zones identifies four (4) zones in the Project region including the Vientiane Plain, Northern Lowlands, Northern Midlands and Northern Highlands (refer Table 6-17).

Table 6-17 Agro-ecological zones across the four targeted Provinces

Agro-ecological Zone	Description
Vientiane Plain	This area extends over parts of Vientiane Capital and Vientiane Province. Altitude ranges from 0-200 metres. Landforms consists of fertile lowland flood plains and adjacent rolling hilly landscapes
Northern Lowlands	This area comprises parts of Vientiane, Xayabouly and Saysomboun Provinces Altitude ranges from 201-500 meters. Landforms consist of plains and lower slopes.
Northern Midlands	This area comprises parts of Vientiane, Xayabouly and Saysomboun Provinces Altitude ranges from 501-900 meters. Landforms consist of higher upland plains and lower mountainous slopes.
Northern Highlands	This area comprises parts of Vientiane, Xayabouly and Saysomboun Provinces Altitude is greater than 900 meters. Landforms consist high mountainous land areas

Adapted from WFP (2013)

The majority of current lease areas are situated within the Northern Lowlands Agro-Ecological Zone (refer Figure 6-1). Much of the land in this zone comprises of the foothills, and land that is suitable for dryland cultivation. The original natural forests have been removed and remaining forests are largely shaped by shifting cultivation, rapid expansion of cash cropping (particularly maize) and livestock grazing (WPF, 2013).

A few existing lease areas (e.g. in Xaythany District, Vientiane Capital) are also located in the Vientiane Plains Agro-Ecological Zone. Based on the Land Selection Criteria, Burapha will avoid the floodplains areas of permanent agriculture, so most of the Vientiane Plains agro-ecological zone is unlikely to be suitable for expansion. The Vientiane Plains zone includes the fertile lowland flood plains of lower Nam Ngum River and adjacent rolling hilly landscape. Natural forests still exist but have been affected by shifting cultivation. Much of the agricultural productive lowland areas, including wetland paddies are found in this zone, although upland rice cultivation is also another key activity and most cash crops are grown in this area.

Current Lease Areas

Land allocations of current Project villages are presented in Figure 6-10. Village land area within the surveyed villages ranges from 427 –11,943 ha with an average of 4,463 ha.

Burapha lease areas range from 31 ha in Ban Nathom, Hin Heup District (Vientiane Province) to 480 ha in Ban Natoung, Pak Lai District (Xayabouly Province). Lease areas generally account for between 1 -14% of villages, average of 10%. However, lease areas in two villages, Ban Khonekeo, Hin Heup District and Ban Phon Ngeun, Phonhong District account for nearly 60% of village land area, mainly due to the very small village size (672 ha and 427 ha respectively; ,).

The amount of swidden / degraded forest land ranges in surveyed villages across the Project region ranges from 0-3,423 ha per village, with an average of 743 ha. Land use within swidden / degraded forest land varies, with some villages depending on swidden agriculture and other villages having stopped this practice due to government policy and low agricultural productivity. Most villages still collect forest resources from these areas. Further details on livelihoods associated with this land use is presented in Section 6.7.



Plate 6-1 Land allocation in Ban Borchan, Hin Heup District



Plate 6-2 Land allocation in Ban Phon Ngeun Hin Heup District

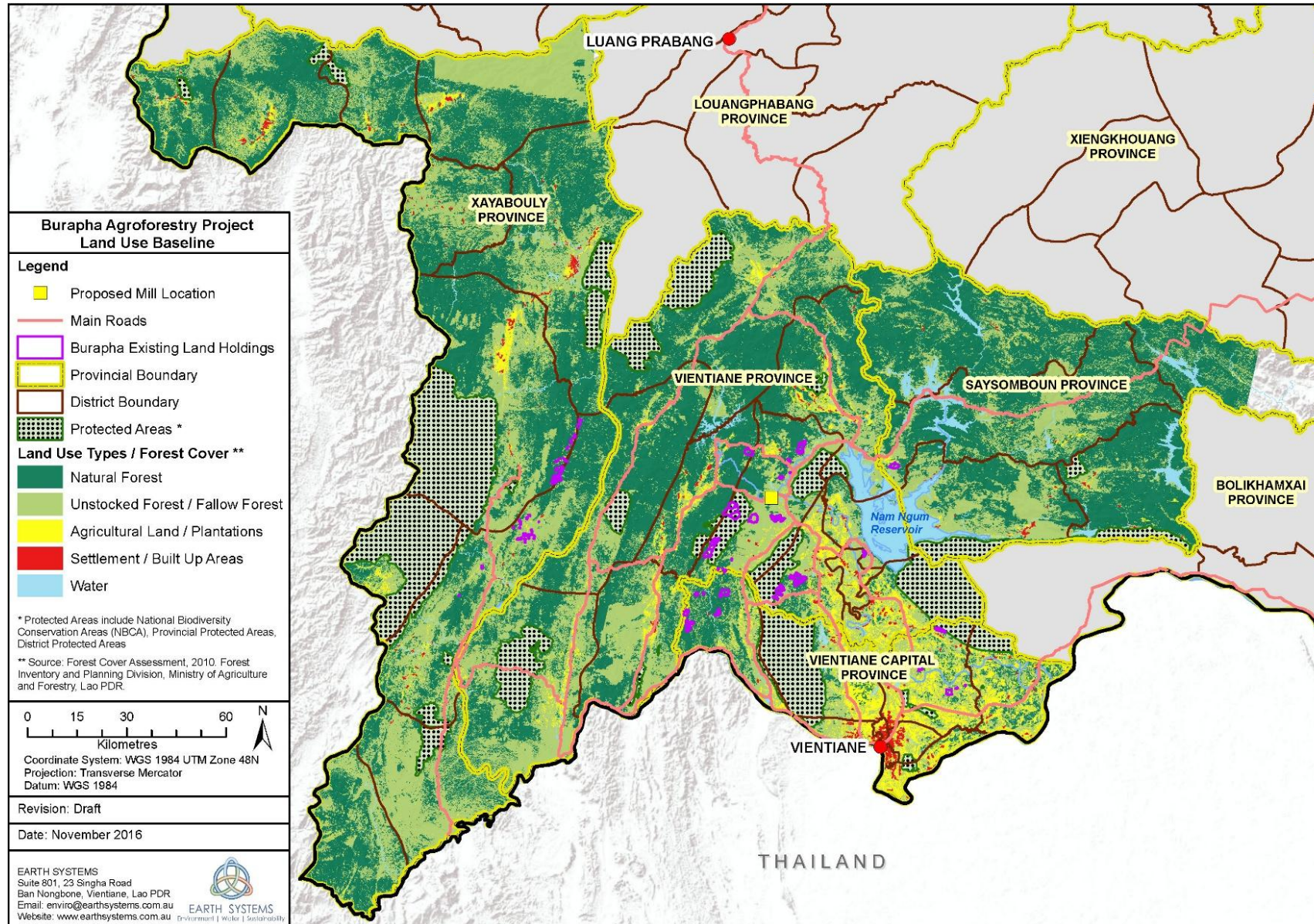


Figure 6-8 Land use in potential expansion areas within target Provinces

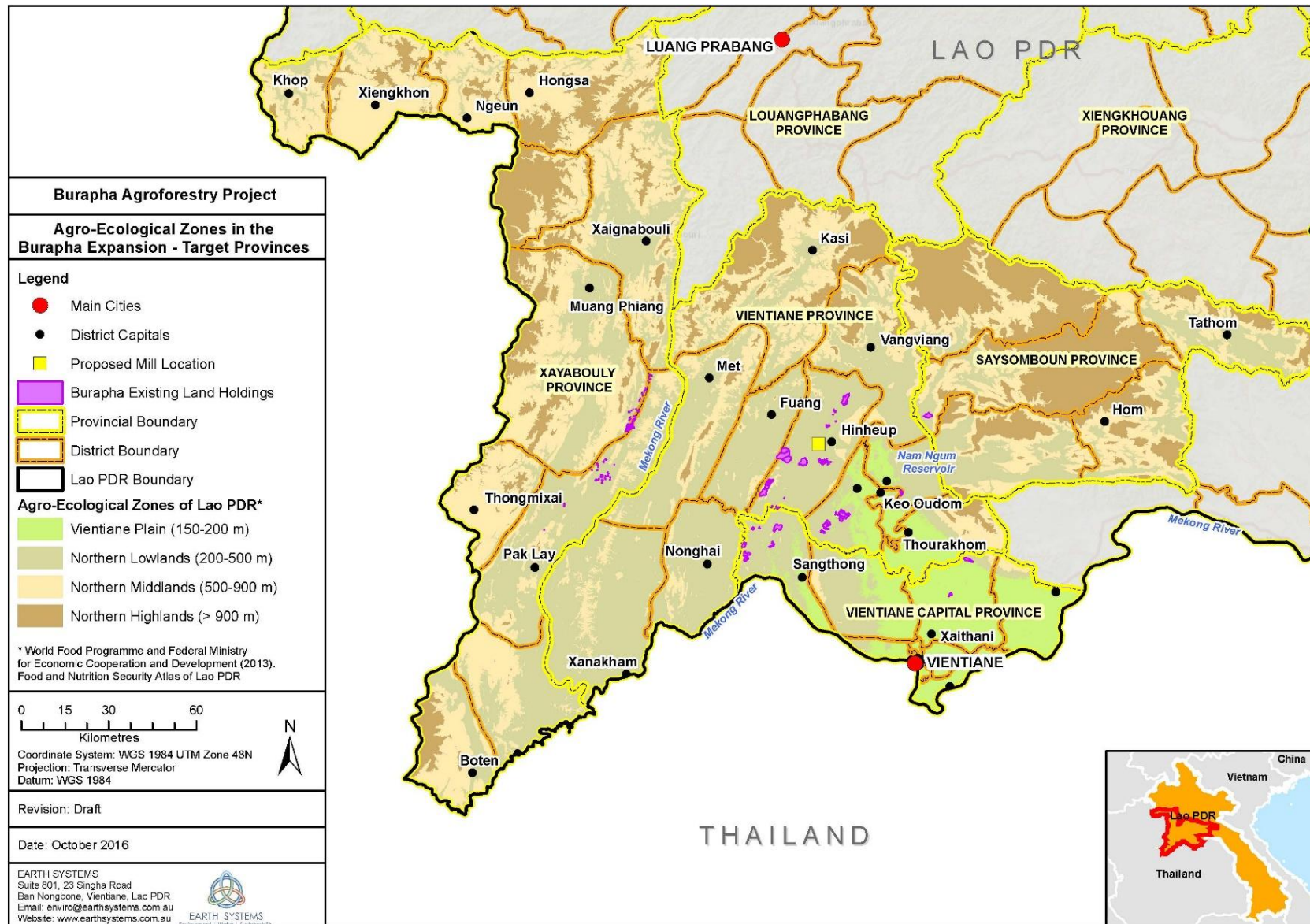


Figure 6-9 Agro-ecological zones across the targeted Provinces for Project expansion

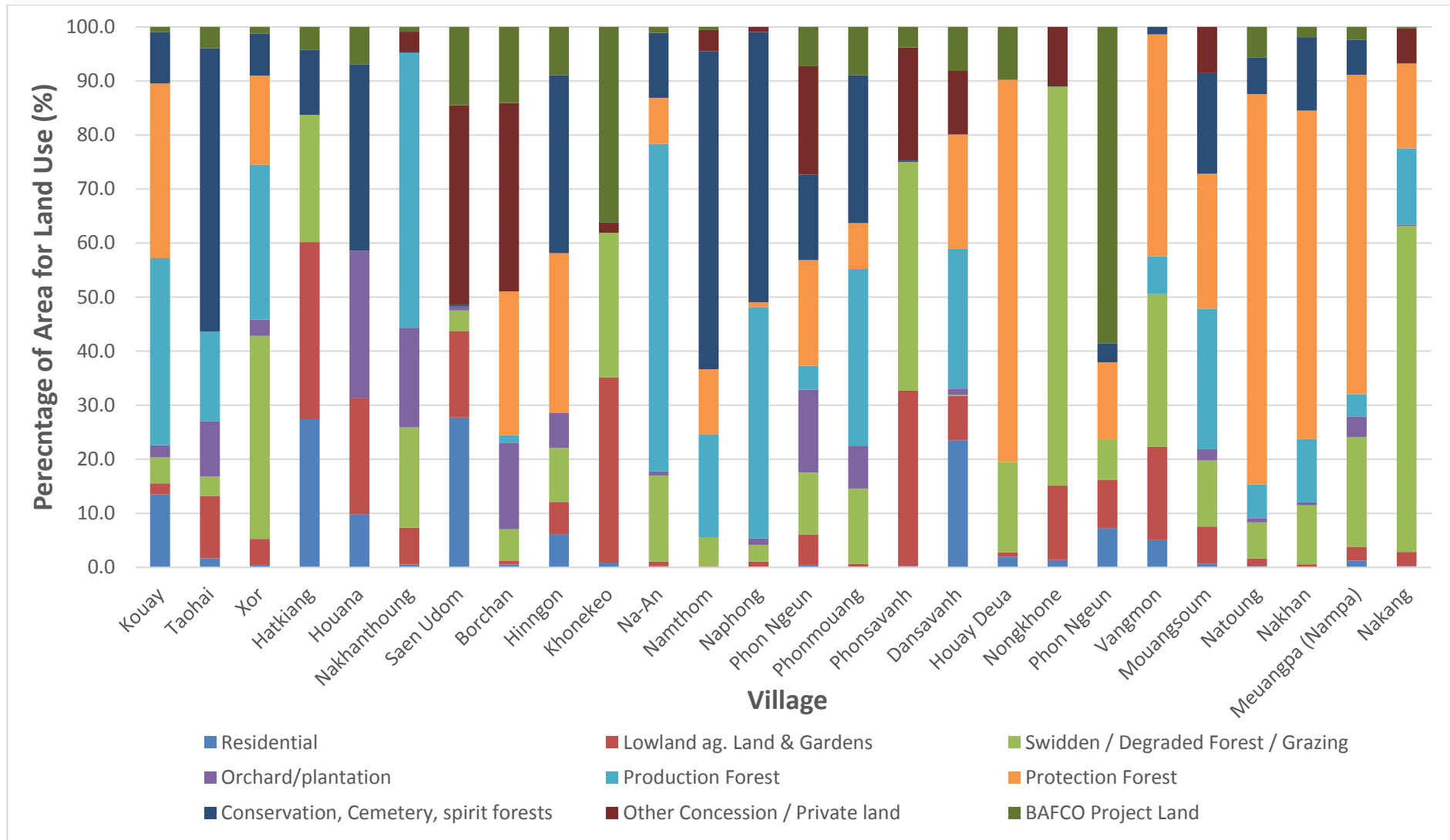


Figure 6-10 Land use in current Project villages in the target Provinces

6.7 Agricultural Land Use and Activity

6.7.1 Crop Cultivation

Project Region

Data on agricultural activity across the Project region is presented in Table 6-5. On average, 73% of households in rural areas across the target Provinces are classified as ‘farming households’ and average agricultural land holdings are 2.6 ha per household.

Vientiane Capital and Vientiane Province have large areas of rice cultivation whilst Saysomboun’s total rice cultivation areas are relatively small. A large percentage of rice areas in all target Provinces are lowland rice paddies - irrigated rice cultivation is most prevalent in Vientiane Capital and Vientiane Province. Much smaller areas of upland rice cultivation exist across the Project region – all in Vientiane, Xayabouly and Saysomboun Provinces. Although official data on this type of cultivation is typically restricted to permanent plots, whilst swidden rice production is under reported (i.e. many households do not pay tax on this land). This is supported by the high percentages of households reportedly engaged in swidden agriculture across the region.

Table 6-18 Agricultural indicators across the target region

Aspect	National	Vientiane Capital	Vientiane Province	Xayabouly Province	Saysomboun Province*
Number of agricultural holdings	776.7	41	62.6	172	ND
Total proportion of farm households (%)	76	32	77	92	ND
Urban (%)		34	21	27	ND
Rural (%)		66	79	73	ND
Average area of agricultural holdings (ha)	2.4	2.39	2.63	2.75	ND
Total land area		392,000	1,852,600	1,638,900	450,600
Total area for all type of rice paddy (ha)	984,932	71,230	66,771	46,992	12,363
Area of rainfed lowland paddy (ha)	769,193	54,064	51,816	32,236	7,320
Area irrigated dry season lowland paddy (ha)	99,019	17166	9,090	2,657	8
Area of rainfed upland rice (ha)	116,720	-	5,865	12,099	5,035
Villages using shifting cultivation methods (% Households)	86.9	98	94.4	100	ND

Source: LEC5, 2012-2013; MAF, 2011; 2015 agriculture statistics *some data for Saysomboun not available

Households across the target region are engaged in a mix of production systems.

Lowland rice cultivation is the dominant agricultural land use type in the target region (refer Table 6-18). The majority of this is rainfed fields, located in productive and fertile areas of the Vientiane Plains agro-ecological zone which covers Vientiane Capital and extends to parts of Vientiane Province. Both these Provinces have contributed significantly to the total increase in national rice production in the last decade.

The information on upland rice cultivation indicates the area in the Project region is fairly limited – and presumably does not include shifting cultivation areas which a high percentage of households are still involved in to some degree. Vientiane Province has the greatest proportion (41%) of household engaged in upland rice production. In Xayabouly Province, lowland rice production is more common among farming households, although one third of households still produce upland rice (WFP, 2013).

Shifting cultivation is largely based on the cyclical use of secondary vegetation. Over the last few decades, fallow periods have becoming critically shorter, mainly due to population increases, competing land uses and agricultural policies. Rotational cycles for villages proximal to current lease areas who reportedly

engaged shifting cultivation were either shorter, from 3 – 4 years, or longer and closer to 7 years. Some villages reported eradicating slash and burn practices in line with government policies.

Secondary crops are also widely grown by households in the target region either for subsistence use or for sale. In lowland environments, vegetable cultivation and maize are more common, whilst in upland environments maize, cassava and job's tears are commonly grown. Maize is becoming of increasing importance in the Northern Agro-ecological Zone, especially in the northern Provinces. Xayabouly Province is the largest maize-producing Province in the country, with approximately 44% of households engaged in this activity (WFP, 2013) Other common secondary crops in the Province include bean, tobacco, sesame, job's tears, sugarcane, starchy roots, and vegetables. Common secondary crops in Vientiane Province include Chinese cabbage and chill, as well as Job's tears which together account for 16% of the Provinces' total temporary land use. Fruit production is also common, with key products including mango, coconut, and tamarind.

Current Lease Area

Lowland Rice Cultivation

All 26 surveyed villages (having Burapha lease areas) practice rainfed rice cultivation, with the majority of households (68%) managing approximately 3,856 ha (average of 148 ha per village). Most of the land under rainfed rice cultivation is located in Vientiane Capital (190 – 400 ha), although a few villages in other Provinces also had relatively large areas (e.g. Ban Vangmon in Vientiane Province, Ban Meaungpa in Xayabouly Province and Ban Mouangsoum in Saisomboun Province). Only six villages practice irrigated rice cultivation on approximately 121 ha, with 4% of households in surveyed villages engaged in this activity. Average reported yields for rainfed rice and irrigated rice were 3 and 2.95 tonnes / ha respectively in 2015-16. However, rainfed rice cultivation in the four surveyed villages in Pak Lai District was very productive with average harvest yields ranging from 3-6 ton/ha.

Upland Cultivation

Village surveying (ES, 2016) indicated mixed results regarding the household practice of upland agriculture in Project villages. In six of the 26 surveyed villages located in the lowland areas of Vientiane Prefecture and Vientiane Province, no upland agricultural activity is reportedly undertaken. Instead these villages rely on lowland rainfed rice cultivation.

Upland shifting cultivation for rice production was reported in 12 of the surveyed villages. Approximately 33% of households (just over 950 households) in these villages reportedly manage more than 1,110 ha of swidden rice area. The number households in these villages engaged in swidden rice production varied from 20% (e.g. in Ban Khone Keo) to 80% and 97% (in Ban Na-an and Ban Kouay respectively). The average area of cultivated land per village is 100 ha, with average yields of 2 tonnes per hectare. In some of these villages (e.g. Ban Kouay, Ban Meaungpa, Ban Houaydeua), swidden rice is also intercropped with secondary crops such as cassava, maize and jobs tear (ES, 2016). Upland agriculture was found to be particularly important in Ban Hingnong, Ban Namthom, Ban Na-An and Ban Phonmouang in Vientiane Province and Ban Natoung, Ban Nakhan, Ban Meaungpa in Xayabouly Province.

Over the last few decades, fallow periods for upland shifting cultivation have become critically shorter (to as little as 3 to 5 years), mainly due to population increases, competing land uses and agricultural policies (World Bank, 2006). Village focus group discussions (ES, 2016) indicate that rotational cycles for Project villages who reportedly engaged shifting cultivation range from three to seven years. Two villages (Phonngoun in Phonhong District and Naphong in Hin Heup District) reported eliminating swidden agriculture due to its low productivity and the government objective to end the practice of shifting cultivation (ES, 2016).

Five of the surveyed villages practice permanent upland production of non-rice crops and reportedly do not conduct upland shifting cultivation for rice production. In these villages, approximately 48% of households manage 1,440 ha of land. The most common crops also include maize, cassava and jobs tear.

Glutinous rice is the main crop (Plate 6-4; Plate 6-6; Plate 6-7). A variety of other crops are cultivated including corn, cassava, job's tears (*Coix lacryma-jobi*; Plate 6-3), sesame, and sweet potato. Corn and cassava are commonly used for household consumption and animal feed (Plate 6-5). A number of fruits are also grown including bananas, pineapple, makdeua (fig) and rambutan. Corn, cassava, sesame, job's tear are popular in Pak Lai District, which are also grown in the four surveyed villages, mostly for export to Thailand.

Table 6-19 Proportion of households in surveyed villages and agricultural systems employed

Province	Lowland rainfed rice	Irrigated rice	Upland rice	Other upland cultivation
Vientiane Capital	80%	0%	0%	12%
Vientiane Province	67%	1%	12%	10%
Xayabouly	89%	5%	12%	70%
Saisomboun	70%	0%	0%	0%

ES Village Survey, 2016

Intercropping in Burapha plantations

The agroforestry plantation model allows for intercropping of agricultural crops during the first year of plantation establishment (potentially within 100% of the plantation areas, with approximately 70% of the land for rice cultivation and 30% for tree cropping) and grazing land for year's three to seven). Information on permanent agriculture within Burapha plantation areas is presented in Table 6-20.

Families / individuals are provided user rights to individual plots to grow crops between the trees at their discretion. Crop production and associated activities are separate from formal Burapha activities (i.e. user rights are granted, but paid labour is reserved for forestry operations). The family / individual for whom the plot has been assigned is provided user rights for the leased area, undertakes the work at their convenience, and harvests the crops for their own utilisation (consumption or sale). In the case of land leased from villages the plots are generally allocated by the applicable village chief or Burapha employed khum operator, whereas land leased from individuals would be designated for agricultural production for that individual / family (refer to Chapter 4 – Project Description).

In the 23 villages with plantations (2,928 ha), approximately 1,829 ha of plantation land is intercropped with either village intercropping (1,412 ha) or Burapha owned cassava (418 ha) (Burapha, 2017). The size of village intercropping areas ranges from less than 20 ha to more than 100 ha for larger plantations. Twenty of the 23 villages have intercropping areas within the plantations and 10 villages have areas intercropped with Burapha owned cassava.

The level of household participation in village intercropping activities varies significantly. High levels of household participation were reported in two villages in particular – Ban Hingnon, where over 70 households are involved and Ban Phonmuang where over 100 households are engaged (ES, 2017). However, the majority of the 23 villages have moderate to low levels of household participation in intercropping regardless of the plantation size. Household engagement in intercropping ranged from no households (3 villages), to under 10 households (5 villages), between 10 to 20 households (4 villages) and moderate levels between 40 – 50 households (2 villages). Focus Group Discussions (ES, 2017) with participating villages indicated several factors that have influenced household participation in intercropping, including: villagers having sufficient rice production through lowland cultivation, land not being suitable for intercropping, poor topsoil after mechanical vegetation clearance, and ineffective communication regarding intercropping opportunities).

Based on Focus Group Discussions, grazing in the 3rd Year was only conducted in a few villages mostly due to the distance of plantations from settlement areas or the grass in plantation areas not being suitable. One village, Ban Houay deua however, reported that 60 to 70 households used plantation areas for livestock grazing.

Table 6-20 Intercropping Areas in Project Villages

District	Villages	No. HH	Total Project Land (ha)	Total Planted (Ha)	Year planted / Amount planted								Total Planted Area with intercropping (Ha) -Village Intercropping								Total Planted Area with intercropping (Ha)			Level of HH participation*
					2005	2010	2011	2012	2013	2014	2015	2016	2005	2010	2011	2012	2013	2014	2015	2016	Total (BAFCO+ Farmer)	Total - Farmer	Total BAFCO	
Hin Heup	Borchan	29	349	287	-	-	-	-	-	-	-	287	-	-	-	-	-	-	172	195	172	23	None	
Keo Oudom	Dansavanh	86	93	69	12	-	-	-	-	-	56	-	-	-	-	-	-	11	0	38	11	27	None	
	Donian	ND	7	7	-	-	-	-	-	-	-	7	-	-	-	-	80	60	7	0	147	147	0	ND
Xaythany	Hatkiang	238	69	64	-	-	-	34	30	-	-	-	-	-	-	-	-	-	0	33	0	33	ND	
Hin Heup	Hinngon	138	226	168	-	-	-	-	88	73	7	-	-	-	-	-	40	3	-	111	43	68	Very High	
Hin Heup	Hintit	ND	124	141	-	-	-	-	10	53	3	75	-	-	-	20	10	-	5	11	67	46	21	Low
Xaythany	Houana	180	125	100	-	-	-	58	42	-	-	-	-	-	-	5	-	-	0	56	5	51	ND	
Phonehong	Houay Deua	241	394	271	-	-	-	100	108	24	9	29	-	-	-	20	5	-	5	0	92	30	62	Low
Hin Heup	Khonekeo	238	80	35	-	-	-	-	-	-	-	35	-	-	-	4	3	-	-	7	7	0	ND	
Sangthong	Kouay	158	101	9	-	-	-	6	3	-	-	-	-	-	-	4	3	-	-	7	7	0	Very Low	
Paklai	Meuang Pa	542	219	111	-	-	-	-	-	111	-	-	-	-	-	-	-	50	0	50	50	0	ND	
Hin Heup	Na-An	226	432	84	-	-	-	-	-	-	-	84	-	-	-	-	-	25	15	40	40	0	Very Low	
Xaythani	Nabong												-	-	-	-	-	-	-	65	0	65	ND	
Paklai	Nakhan	128	312	80	-	-	-	-	-	80	-	-	-	-	-	-	-	30	9	0	39	39	0	Very Low
Xaythany	Nakhanthoung	265	83	48	-	-	-	25	23	-	-	-	-	-	-	-	-	-	-	0	0	0	None	
Hin Heup	Namthom	210	464	38	-	-	-	-	-	21	9	7	-	-	-	-	30	270	30	7	336.5	336.5	0	Low
Paklai	Natoung	130	49	34	-	-	-	-	-	34	-	-	-	-	-	-	20	-	-	20	20	0	Moderate	
Hin Heup	Phon Ngeun	105	426	273	-	-	-	-	58	44	-	171	-	-	-	23	-	-	-	0	0	0	Low	
Hin Heup	Phonmuang	127	1165	605	-	-	-	-	67	332	76	131	-	-	-	-	15	-	-	146	214	161	53	Very High

District	Villages	No. HH	Total Project Land (ha)	Total Planted (Ha)	Year planted / Amount planted								Total Planted Area with intercropping (Ha) -Village Intercropping								Total Planted Area with intercropping (Ha)			Level of HH participation*
					2005	2010	2011	2012	2013	2014	2015	2016	2005	2010	2011	2012	2013	2014	2015	2016	Total (BAFCO+ Farmer)	Total - Farmer	Total BAFCO	
Hin Heup	Phonthong-neua	ND	95	40	-	-	-	-	-	-	-	40	-	-	-	-	-	-	-	30	30	30	0	Low
Phonehong	Saka	ND	168	7	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	7	7	7	0	Very Low
Xaythany	Saen Udom	161	261	149	-	2	5	27	109	6	-	-	1	4	-	-	-	-	0	5	5	0	0	Very Low
Sangthong	Xor	417	748	307	-	-	-	64	21	-	80	142	0	0	0	75	4	-	80	96	270	255	15	Moderate
		3,619	5,989	2,928	12	2	5	315	559	779	241	1,015	0	1	4	146	155	470	175	678	2184	1,412	418	

Source: Burapha, 2017 data; ES survey (2017)

*Household participation: Very High=50+ households, Moderate =20 - 40 HH, Low =10 - 20 HH, Very Low <10.



Plate 6-3 Large-scale job's tears (*Coix lacryma-jobi*) plantation in Ban Natoung, Pak Lai District



Plate 6-4 Upland rice cultivation in Ban Nakhan, Pak Lai District



Plate 6-5 Agricultural land in Ban Na-An, Hin Heup District



Plate 6-6 Rice paddies in Ban Nakang, Pak Lai District



Plate 6-7 Rice paddies, Ban Nakhathoung, Xaythany District



Plate 6-8 Mushroom farming in Ban Houana, Xaythani District

Vegetable Cultivation

Most households (over 75%) in surveyed villages engage in vegetable production (Plate 6-9). Vegetables are primarily cultivated in household gardens and on the banks and low-lying areas adjacent waterways. Most villagers cultivate household garden during dry season (October – April) as an alternative agriculture activity after rice harvest. Typically, each household establish small plots of garden, primarily for domestic consumption. These commonly include green vegetables and chilli, with some also producing pumpkin, beans and cucumbers. Villages with lower household participation rates in vegetable cultivation include Ban Phon Ngeun (25% of total households) in Phonehong District, Ban Saen Udom (50% of total households) in Xaythany District, and Ban Meuangpa (50% of total households) in Pak Lai District.



Plate 6-9 Vegetable gardens in Ban Xor (left) and Ban Namthom (right)

6.7.2 Animal Husbandry

Project Region

Animal husbandry activities are conducted by the vast majority of households across the Project region, primarily for household consumption. Pig husbandry is conducted by 26% of households which much larger participation in Xayabouly Province (51%) and very little in Vientiane Capital (3%). Most households (78%) raise chickens (and other poultry; Table 6-21).

Approximately 33% of households raise cattle and production is becoming more market orientated in some areas, especially in the Northern Lowlands and the Vientiane Plains (WFP 2013). The percentage of households engaged in cattle husbandry has increased from 20% over the last decade

Table 6-21 Proportion of households in the Project Region owning at least one animal species

Province	Livestock			
	Cattle	Buffalo	Pigs	Chicken
Vientiane Capital	34.1%	10.7%	3%	78.3%
Vientiane Province	35.4%	12.9%	26.4%	81.2%
Xayabouly Province	32%	21%	51%	74%
Saysomboun Province*	-	-	-	-

Source: WFP, 2013; *Data unavailable

Current Lease Area

Most households in the surveyed villages practice animal husbandry and had various levels of animal holdings. Approximately 41% of households manage approximately 489 head of cows and 7.5% of households manage 344 buffalos (Table 6-22; Plate 6-10; Plate 6-11), and more than 98% of households keep poultry (chicken and ducks). Livestock graze in degraded forests, around agricultural lands, and residential lands. Over.

Based on Focus Group Discussions, grazing in the 3rd Year was only conducted in a few villages mostly due to the distance of plantations from settlement areas or the grass in plantation areas not being suitable. One village, Ban Houaydeua however, reported that 60 to 70 households used plantation areas for livestock grazing.



Plate 6-10 Livestock in Ban Hatkiang, Xaythani District



Plate 6-11 Livestock in Ban Kouay, Sangthong District

Table 6-22 Livestock ownership in surveyed villages in current lease areas

Province	No. of Villages Surveyed	Livestock														
		Buffalo			Cow			Goat			Pig			Poultry		
		% HH	Ave. Head / Village	Ave. Head / HH	% HH	Ave. Head / Village	Ave. Head / HH	% HH	Ave. Head / Village	Ave. Head / HH	% HH	Ave. Head / Village	Ave. Head / HH	% HH	Ave. Head / Village	Ave. Head / HH
Vientiane Capital	7	6%	81.7	8.2	51%	392.1	9.2	4%	64.3	8.9	6%	83.7	4.8	94%	3969.1	18.3
Vientiane Province	14	11%	61.3	4.2	45%	365.3	5.9	8%	96.6	8.4	48%	296.1	3.4	99%	2430.9	13.5
Xayabouly Province	4	61%	545.0	3.7	12%	621.3	5.9	0%	12.5	1.3	83%	327.5	1.4	100%	3972.5	13.3
Saysomboun Province	1	24%	687.0	13.7	57%	577.0	4.8	1%	27.0	9.0	5%	52.0	5.2	100%	2500.0	11.2
Total / Mean	26	26%	343.8	7.5	41%	488.9	6.4	3%	50.1	6.9	35%	189.8	3.7	98%	3218.1	14.1

6.7.3 Plantation Forestry

Project Region

Information on plantation forestry across the four (4) target Provinces is limited. The following data was sourced from the most recently socio-economic development plans:

- A total of 213,302 ha of rubber have been established, including 188,143 ha (Vientiane Capital), 18,324 ha (Vientiane Province) and 6,835 (Xayabouly Province). Only a small amount of this resource is currently mature and being harvested
- There are small-scale commercial wood plantations dotted across the Project region. Data on plantation size and production is limited however according to Vientiane Province's SEDP (2015), the resource totalled 6,676 ha and production included 820,000 m³ of teak and 20,000 m³ of mai tieu.

Current Lease Area

Burapha has approximately 2,986 ha of plantations in 23 villages across the current lease / lease area. These plantations provide income generating opportunities for local communities.

In general, a small number of households across 15 of the surveyed villages are developing small-holder commercial tree plantations. However, approximately 50 households in Ban Meuangpa in Pak Lai District planted approximately 100 ha of teak and 25 households planted 50 ha of rubber. Several households in Ban Naphong also planted Mai Dou (*Pterocarpus macrocarpus*) and Mai Tae Kha (*Azelia xylocarpa*) for 60 ha as part of Nam Ton Integrated Watershed Management Project under MONRE/GIZ support. Common tree species planted in the surveyed villages include teak (259 ha), eucalyptus (17 ha) and rubber (459 ha). Most of these plantations are yet to reach maturity and provide income generation for households involved.

6.8 Forest Resource Use

Importance of NTFPs to Rural Households

NTFPs including edible and non-edible products play an important role in meeting subsistence and cash income needs of many rural households across Lao PDR - especially disadvantaged groups such as women and ethnic minorities (SNV, 2006). NTFPs also contribute directly to food security through consumption of forest products in addition to rice consumption and indirectly through the sale of NTFPs to buy rice in times of shortage (Foppes, 2011).

Subsistence Value of NTFPs

The most important use of NTFPs may be for subsistence. Rural households often rely on forest products for food and shelter. More than 450 edible NTFPs have been recorded in Lao PDR (Foppes and Ketphanh, 2004). Edible NTFPs such as bamboo shoots, fish, vegetables, and wildlife are considered as some of the most important forest products for local populations. On average, NTFPs are said to contribute to approximately 44% of subsistence value for rural households (Foppes and Ketphanh 2000). Examples of important edible NTFPs include (Foppes and Ketphanh, 1997):

- **Bamboo or rattan shoots** - eaten cooked or raw as a side dish to rice. Common bamboo species eaten for their shoots are "nolai" (*Gigantochloa albociliata*), "mai phai pa" (*Bambusa arundinaria*), "mai sang phai" (*Bambusa nana*) and "mai bong" (*Bambusa tulda*). Two common rattan species eaten for their shoots ("nyod vai") are "nyeh" (*Calamus sp.*), "boun" (*Daemonorops schmidtiana*), a medium sized rattan, and "san" (*Raphis sp.*) a small palm tree.
- **Vegetables** - Some 40 types of leaves from trees, shrubs and herbs are eaten fresh or cooked. These are commonly referred to as "phak". Tubers (*Dioscorea spp.*) are eaten as a substitute for rice in times of hunger. Mushrooms are important in the rainy season. Various flowers ("dok") and forest fruits ("mak") are also gathered and eaten.

- **Fish and other aquatic faunae** - including frogs, shrimps, soft-shelled turtles, crabs and molluscs may be the most important source of protein in the diet of rural households in most of Lao PDR.
- **Wildlife** – some 31 mammal species, 24 bird species and 13 reptile species were recorded as being regularly eaten in some areas (Foppes & Ketphanh, 1997).

Non-edible NTFPs used for house construction and handicrafts include bamboo “mai”, rattan “vai”, pandanus, broom grass and paper mulberry. Others are used for traditional medicine, livestock fodder and pasture (NAFRI, 2006; Foppes & Ketphanh, 2010). Examples include:

- Bamboo species used for house construction: "mai hia" (*Cephalostachyum virgatum*), "mai sod", (*Oxythenanthera parvifolia*), "mai bong" (*Bambusa tulda*), "mai phai" (*Bambusa blumeana*), "mai kasen" (*Neuhouzea mekkhonnensis*);
- Rattan species used for construction - "vai hang nou" (*Calamus javanensis*), "vai boun" (*Daemonorops schmidtiana*) are most commonly mentioned. Vai thoun (*Calamus sp.*), is also exported to Vietnam;
- Mats and ropes - Pandan, "toei" (*Pandanus sp.*) used to make mats and various vines e.g "po piet" (*Pueraria phaseoloides*) are used by some ethnic groups to make bags.

Contribution of NTFPs to Food Security and Nutrition

Forest products, including aquatic fauna and smaller land animals (birds, rodents) are an important source of food in rural Lao diets. NTFPs an important source of dietary diversity in terms of macro and micronutrients (Foppes et al 2011). Forest foods are estimated to contribute between 61-79% of non-rice food consumption by weight, and provide an average of 4% of energy intake, 40% of calcium, 25% of iron and 40% of vitamins A and C (Clendon 2001). Wild fish and animals are the largest source of protein (WFP, 2013) in local diets. At the national level, nearly 32% of animal protein in the average diet is sourced from the wild, as is nearly 9% of vegetables (WFP, 2013).

Contribution of NTFPs to Cash Income

In some studies, NTFPs are estimated to contribute 40-50% of rural households' cash income – which is important, given that income from the sale of NTFPs are used to buy rice in times of shortages, indirectly contributing to household food security (Foppes, 2011).

The degree to which the sale of NTFPs contribute to household income is also dependant on household livelihood strategies. Households with 'coping strategies' are generally poor subsistence orientated households in which income from the sale of NTFPs is the main or even the only source of income. These households have limited opportunities for other employment, working mainly as subsistence farmers. The sale of NTFPs provides an importance source of income, but generally not enough to alleviate poverty. Households with a more diversified livelihood strategy earn most of their income from agriculture or off-farm labour and trading, supplemented with the sale of NTFPs. These are either harvested from the wild or cultivated on agricultural lands. Other households 'specialising' in the sale of NTFPs earn a high proportion of their cash income from this activity and are highly integrated in the cash economy. This includes the cultivation and management of high value NTFPs such as mushrooms, Brazil nuts, fruits—and medicinal products, some of which are traded internationally (Kusters and Belcher, 2004).

Trade of NTFPs

The most traded or exported NTFPs include benzoin, honey and wax, cardamom, rattan, bamboo and sugar palm. Medicinal plants are also an important portion of this trade and are harvested regularly. Bamboo shoots, greens, fish, wild tubers, and invertebrates (such as snails and insect larvae) are some of the NTFPs important for food security and local source of protein. Most taxa of wild vertebrates are used by at least some ethnic groups, either for food, medicine or trade (World Bank, 2005). Examples of typical NTFPs found in fallow forests which are traded are presented in Table 6-23 below.

Table 6-23 Typical NTFPs found in fallow forests which are exported from Lao PDR

NFTP	Scientific Name	Export Destination
Broom grass	<i>Thysanolaema maxima</i>	Thailand to make brooms, 200 ton/ year
Sweet palm fruits	<i>Arenga westerhoutii</i>	Thailand to make sweets, 600ton/ year
Paper mulberry	<i>Broussonetia papyrifera</i>	Thailand to make paper, 500 ton/ year
Benzoin	<i>Styrax tonkinensis</i>	France for the perfume industry, 50 tons/year
Peuak meuak	<i>Boehmeria malabarica</i>	China for glue and joss-sticks, 700 ton/year
Eaglewood	<i>Aquilaria sp.</i>	Middle East as incense, 20 ton/year
Bitter bamboo	<i>Indosasa chinensis</i>	China as fresh edible shoots, 200 ton/year
Cardamom	<i>Amomum sp.</i>	China as medicine, 500 ton/year

Source: Foppes & Ketphanh, 2010

Collection of NTFPs

Many NTFPs are collected from the mosaic of vegetation types (fallow forests and forests in various stages of regeneration) created by shifting cultivation systems. Table 6-24 presents examples of typical vegetation and NTFPs collected and presents typical NTFPs found in fallow forests. Further information on vegetation cover in the target Provinces, including fallow forests is presented in *Chapter 5 – Biological Settings*.

Table 6-24 Typical vegetation in upland areas and products obtained

Vegetation Type	Age of Vegetation	Products Collected
Upland rice field	0-1 years	7,000 or so rice varieties, 40 – 60 other crops
Young herbaceous fallow	1 – 4 years	Vegetables, grass for livestock grazing, grass or thatch
Permanent grassland	5 years and older	Grass for livestock grazing
Young secondary forest	5 – 15 years	Cardamom, tout, tiang bark, mak kha fruits
Bamboo forest	5 years and older	Edible bamboo shoots, bamboo canes
Old secondary forest	Over 15 years	Timber, rattan

Source: Foppes & Ketphanh, 2010

Different forest resource use rights apply in different forest categories. For example, only non-prohibited NFTP species can be collected from Village Production and Protection Forests, whilst any species can be collected in degraded forests and Village Conservation Forests (though only based on village tradition for the latter) (Moizo, 2005).

Timber Forest Products

Timber forest products are also important to rural livelihoods in Lao PDR, and are used for fuel, construction and handicrafts. Approximately 85% of domestic energy consumption for cooking is from fuel wood and charcoal. The estimated use of fuel wood and charcoal by local communities is between 4 and 5 million m³/year, most which is collected directly from forests (World Bank, 2005).

Project Region

Data from the 2011 Agricultural Census on the proportion of farming households who collect and use TFPs and NTFPs in the Project region is presented in Table 6-25.

Table 6-25 Proportion of farming households using forest products in the Project region (NTFPs and TFPs)

Province	No. of Farm HH using Forest Products	Type of Product (% of HH use)						% HH using Forest Products
		Timber	Fuel Wood	Bamboo	Mushroom	Fruit and Vegetables	Other	
Vientiane Capital	11,000	4	82	46	75	53	48	27
Vientiane Province	41,800	1	91	70	63	65	54	31
Xayabouly Province	48,800	6	92	79	82	79	49	30

NB – data on the newly formed Saysomboun Province was not available in the agricultural census

Source: MAF, 2011

Current Lease Areas

Non-timber Forest Product (NTFP)

Consistent with regional trends, NTFPs are major sources of both food and family cash income in all surveyed villages. Approximately 95% of households collect NTFPs, primarily for consumption (ES Household Survey, 2016). The Local Knowledge Survey (ES and Pheng, 2016) identified at least 51 NFTP species being used by local communities in a sub-sample of 8 Project Villages.

Most of the common NFTP species collected and consumed are bamboo/rattan shoots, variety of vegetables, mushrooms, wild fruits and herbs. Bamboo shoots, vegetables and mushrooms were generally ranked in the top three most important NTFPs collected by surveyed villages (ES Village Survey 2016). Based on the household survey, edible shoots, tubers and vegetable were the most commonly collected types of NTFPs (collected by nearly 60% of households), followed by firewood (23%) (Figure 6-11).

Broom grass (*Thysanolaena latifolia*) is harvested in several villages including Ban Hin Ngon, Ban Na-An, Ban Khonekeo (Hin Heup District), Ban Kouay (Sangthong District) Ban Natoung and Ban Nakhon (Paklai District) for making handicrafts (brooms) for sale. Approximately 30 households in Ban Na-An also collect turpentine and rosin in Conservation and riparian forests for sale. In general, NTFPs are collected from degraded forests, production and conservation forests, agricultural land, and riparian forest areas depending on types and species of NTFPs. Several surveyed villages in Sangthong, Phonehong and Hin Heup Districts harvest large quantities of bamboo for sale. It was reported that the price of dried bamboo sticks in these villages was 400,000 kip/tonne (\$48/tonne). Mature bamboo is generally harvested in degraded and production forests within the village boundaries.

It was reported that NTFPs have been declining significantly in many surveyed villages due to a reduction in forest resources and over-exploitation because of population increase. The villages experiencing NTFPs decline are those located relatively close to District centres or semi-urban areas whereas land is becoming more competitive for development projects and activities.

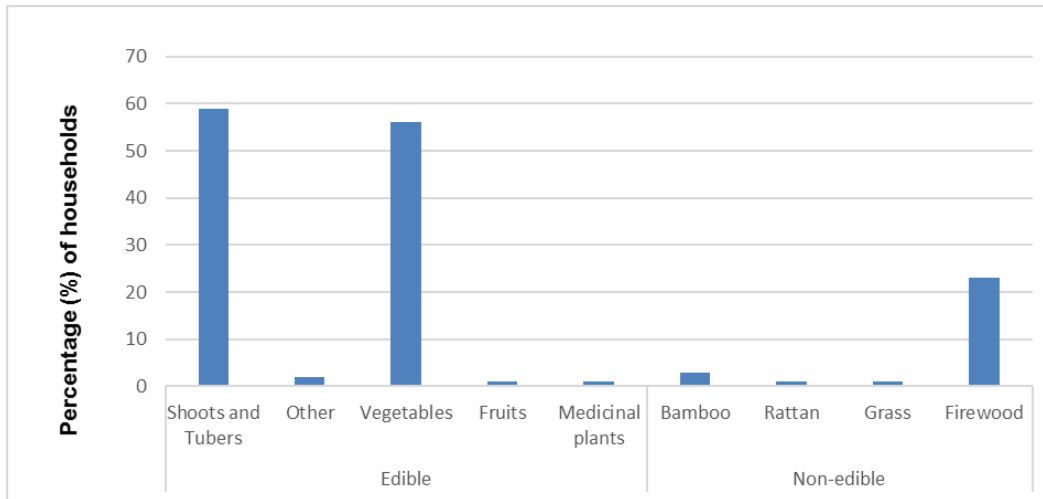


Figure 6-11 Household collection of NTFPs in Project Villages

Source: (ES Household Survey, 2016), n=583 households.

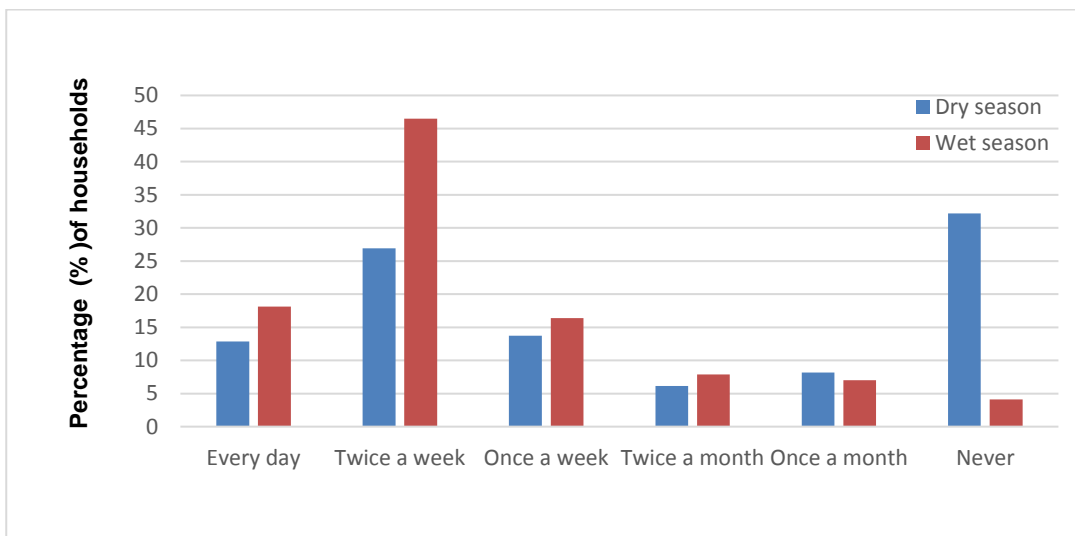


Figure 6-12 Frequency of edible shoots and tuber collection (percentage of surveyed households)

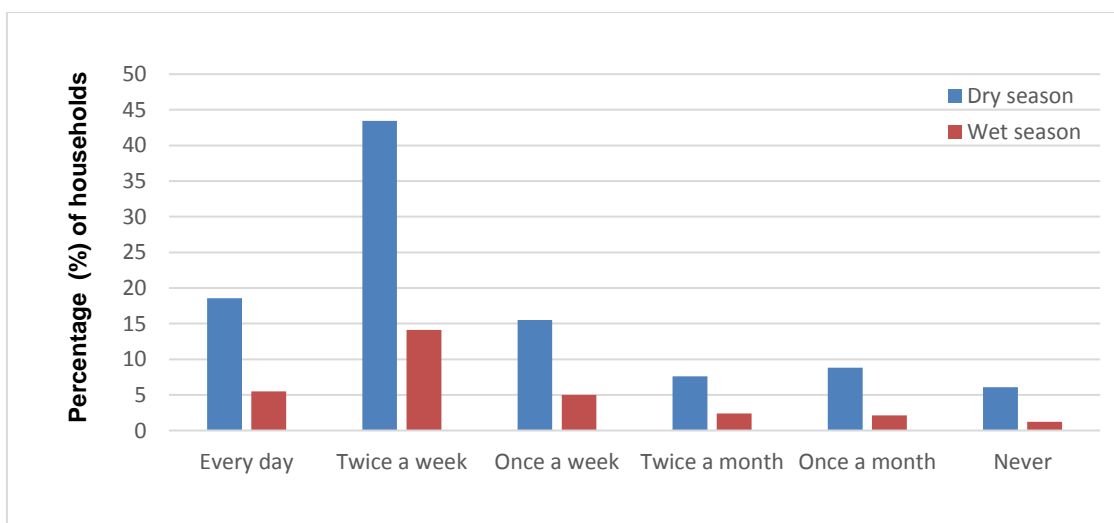


Figure 6-13 Frequency of edible vegetable collection (percentage of surveyed households)

Frequency of NTFP (vegetable and bamboo shoot) collection is provided in Figure 6-12 and Figure 6-13. Collection of edible shoots and tubers is seasonal, with some 60% of surveyed households reported collection on a bi-weekly to weekly basis in the wet season - while close to 35% reported never collecting them in the dry season. In contrast, the collection of forest vegetables is mainly in the dry season, with the majority of households collecting them on a bi-weekly basis (45%).

Table 6-26. Species of NTFPs identified in the Local Knowledge Survey (sub-sample of 8 Project Villages)

Scientific Name	Lao Name	English Name	Frequency	Use
<i>Oxytenanthera albociliata</i>	Nor mai lai	Bamboo shoot	Monthly	Food
<i>Dendrocalamus logifimbriatus</i>	Nor mai phang	Bamboo shoot	Monthly	Food, house construction
<i>Oxytenanthera parvifolia</i>	Nor mai sod	Bamboo shoot	Monthly	Food, house construction
<i>Cephalostachyum virgatum</i>	Nor mai hia	Bamboo shoot	Monthly	Food, house construction
<i>Dawmonorops jenkinsiana</i>	Nor boune	Rattan	Daily	Food
<i>Plectocomia pierreana</i>	Nor wai lao	Rattan	Daily	Food, house construction
<i>Caryota mitis</i>	Tao hang	Caryota	Daily	Food
<i>Calamus flegellum</i>	Wai nam leuang	Rattan	Daily	Food
<i>Centella asiatica</i>	Phak nork	Centella	Daily	Food
<i>Cratoxylum formosum</i>	Phak tew	Cratoxylum	Daily	Food, house construction
<i>Lasia spinosa</i>	Phak narm	Lasia	Daily	Food
<i>Careya sphaerica</i>	Phak ka don	Careya	Daily	Food
<i>Diplazium esculentum</i>	Phak kout	Fern	Daily	Food
<i>Alpinia galanga</i>	Nor kha	Alpinia	Daily	Food
<i>Termitomyces</i>	Hed puak	Mushroom	Monthly	Food
<i>Lentinus squarrosulus</i>	Hed khao	Mushroom	Monthly	Food
<i>Melientha sauis</i>	Phak wan pa	Melientha	Monthly	Food
<i>Syzygium zeylanica</i>	Phak sa meak	Syzygium	Daily	Food
<i>Cosciniium fenestratum</i>	Khuey haem	Cosciniium	Daily	Medicine
<i>Morinda sp.</i>	Lueng jam ten	Morinda	Daily	Medicine
<i>Imperata cylindrica</i>	Hark yaiy kha	Impera grass	Daily	Medicine
<i>Lentinus polychrous</i>	Hed ka dang/Hed bob	Mushroom	Monthly	Food
<i>Schizophyllum commune</i>	Hed bi	Mushroom	Monthly	Food
<i>Auricularia polytricha</i>	Hed hou nou	Mushroom	Monthly	Food
<i>Marsilea crenata</i>	Phak vaen	Marsilea	Daily	Food
<i>Solanum torvum</i>	Mak kheng	Solanum	Daily	Food
<i>Tinospora crispa</i>	Khuey khao hor	Tinospora	Daily	Medicine
<i>Ipomoea aquatica</i>	Phak bong	Ipomoea	Daily	Food
<i>Limnocharis flava</i>	Phak kan jong	Limnocharis	Daily	Food
<i>Piper lolot</i>	Phak ei lerd	Piper	Daily	Food
<i>Tiliacora triandra</i>	Ya nang	Tiliacora	Daily	Food
<i>Acacia pennata var. insuavis</i>	Phak kha	Acacia	Daily	Food
<i>Eleusine indica</i>	Phak yaiy khuay	Eleusine	Daily	Food
<i>Hydrolea zeylanica</i>	Phak be eian	Hydrolea	Daily	Food
<i>Passiflora foetida</i>	Phak yun hang	Passiflora	Daily	Food
<i>Sauropus androgynus</i>	Phak van ban	Sauropus	Daily	Food

Scientific Name	Lao Name	English Name	Frequency	Use
<i>Musa acuminata</i>	Mark pee	Musa	Monthly	Food
<i>Calamus poilanei</i>	Nor wai toun/Toun	Rattan	Daily	Food, house construction
<i>Calamus</i>	Nor wai na	Rattan	Daily	Food
<i>Calamus solitarius</i>	Nor wai tork	Rattan	Daily	Food, house construction
<i>Tacca integrifolia</i>	Phak phon mem	Tacca	Daily	Food
<i>Spilanthes paniculata</i>	Phak khard	Spilanthes	Daily	Food
<i>Smilax</i> sp.	Ya hua	Smilax	Daily	Medicine, sale
<i>Polyporus</i> sp.	Hed zen	Mushroom	Monthly	Food
<i>Trichostoma crassum</i>	Hed tee head	Mushroom	Monthly	Food
<i>Bambusa tulda</i>	Nor mai bong	Bamboo shoot	Monthly	Food, house construction
<i>Bambusa bambos</i>	Nor mai zang	Bamboo shoot	M	Food
<i>Erechtites vailianifolia</i>	Phak huey bin	Erechtites	Daily	Food
<i>Amaranthus viridis</i>	Phak hom	Amaranthus	Daily	Food
<i>Calamus tenuis</i>	Wai yae khew	Rattan	Daily	Food
<i>Calocasia antiquorum</i>	Bone	Colocasia	Daily	Food

Source: Local Knowledge Survey, 2016

Timber Forest Products

All households in the surveyed villages collect wood from village forest land primarily for house construction, firewood and sale. The Local Knowledge Survey identified at least 35 timber species being used by local communities in a sub sample of 8 Project villages. Villagers generally harvest timber from degraded forest and production forest within village boundaries.

Trees harvested for construction such as Mai Puey (*Lagerstroemia* sp.), Mai Khaen Heua (*Hopea odorata*), Mai Bark (*Anisoptera costata*), Mai Zee (*Shorea thorelii*), and Mai Yang Song (*Calophyllum polyanthum*) are declining significantly especially villages in Xaythany District as most of the village land was allocated to individuals where it was then developed into agriculture or other purposes. High value species such as Mai Dou (*Pterocarpus macrocarpus*), Mai Tae Kha (*Azelia xylocarpa*) and Mai Yang Muak (*Dipterocarpus alatus*) are not very common in surveyed villages.

The most common tree species harvested by the villagers including Mai Tew (*Cratoxylum formosum*), Mai Khorm (*Microcos paniculata*), Mai Phang (*Dendrocalamus* sp.), Mai Por Hou (*Trema orientalis*), and Mai Khor Laen (*Schleichera oleosa*) which are typically used for firewood or making wood charcoal.

Hunting

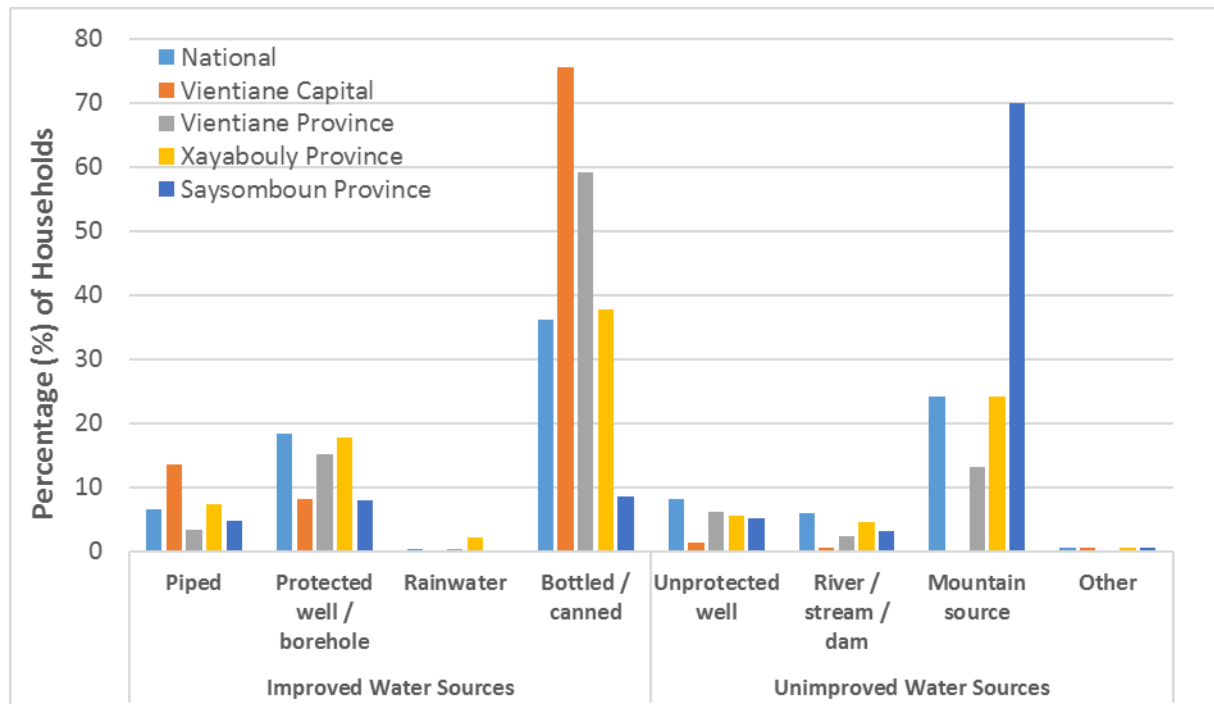
Information from village surveying indicates that approximately 39% of households engage in hunting for domestic consumption. It was also reported that all households in Ban Phonmouang and Ban Naphong in Hin Heup District, and Ban Natoung in Paklai District occasionally engage in hunting activities as the villages are close to forests which provide habitats for wild animals. Many households in Ban Khonekeo and Ban Na-An in Hin Heup District hunt. The most common wild animal species hunted include squirrels, rats, birds, rabbits, wild chicken, wild pigs, bats, and snakes. Wealthier households tend to purchase meat or fish from the market rather than engage in hunting activities.

6.9 Water Resource Use

Project Region

Local surface and ground water resources (rivers, streams, lakes, wetlands, aquifers etc.) play a significant role in the day to day lives of people living in rural areas. Across the Project region, household access to improved water sources is above the national average (61%) except for Saysomboun Province where only 21% of households had access to improved water source (Table 6-11).

Many households also depend on nearby water resources for drinking, washing, bathing, swimming and collection of aquatic resources. For households without access to improved water sources, mountain water sources were most commonly accessed, especially in Saysomboun Province.



NSC, 2015

Figure 6-14 Proportion of households with improved and unimproved water sources in the Project region

Current Lease Area

Surveyed villagers utilise water from a wide variety of sources including rivers (e.g. Nam Ngum, Nam Lik and Nam Song) and their tributaries and streams; ground water wells, gravity flow water systems; and freshwater springs (Table 6-27; Plate 6-12 to Plate 6-15). These sources are utilised for drinking, fishing, laundry, cooking, and bathing. All surveyed villages have an improved water source for drinking water (bottled water), apart from Ban Nakhan, Pak Lai District (Xayabouly Province). Residents in four villages also drink water from wells or bores (after boiling it first).

Table 6-27 Water use in Project villages

Province /District	Village	Drinking		Bathing Washing				Fishing				
		Bottled Water	Open / Closed Bore	Open/ Closed Bore	Nam Lin	Stream / River	Name of Water Body	Stream	River	Pond	Marsh	Name of Water Body
Vientiane Capital												
Sangthong	Kouay	✓	-	✓	✓	✓		✓	✓	✓	-	
Sangthong	Taohai	✓	-	✓	-	-		✓	✓	-	-	Nam Ton, Houay Nam Poon
Sangthong	Xor	✓	-	✓	-	✓	Nam Sang	✓	-	✓	✓	Nam Sang
Xaythany	Hatkiang	✓	-	✓	-	✓	Nam Ngum	-	✓	-	-	Nam Ngum
Xaythany	Houana	✓	-	✓	-	-		✓	-	-	-	Houay Tha, Houay Khang Barn
Xaythany	Nakhanthoung	✓	-	✓	-	-		✓	-	✓	-	
Xaythany	Nakhounthoung	✓	-	✓	-	-		✓	-	-	✓	
Xaythany	Sae Udom	✓	-	✓	-	-		✓	-	✓	✓	
Vientiane Province												
Hin Heup	Borchan	✓	-		✓	✓		✓	-	-	-	Houay Khanxang, Houay Kork
Hin Heup	Hinngon	✓	-	✓	-	-		✓	-	-	✓	Nam Sad, Houay Hinngon, Houay Nam Poon, Houay Tard
Hin Heup	Khonekeo	✓	✓	✓	-	✓		✓	✓	-	-	Houay Hin Herp, Houay Lek Faiy, Nam Ppon, Nam Sad
Hin Heup	Na-An	✓	-	✓	✓	-		✓	-	-	-	
Hin Heup	Namthom	✓	-	✓	-	✓	Nam Tone	✓	-	-	✓	Nam Nga, Nam Thon
Hin Heup	Naphong	✓	✓	✓	-	-		✓	✓	-	-	Nam Ton, Nam Saideaen, Houay Yen
Hin Heup	Phon Ngeun	✓	-	✓	-	✓		✓	-	-	✓	
Hin Heup	Phonmouang	✓	✓	✓	-	✓	Nam Lik, Huay Pang, Huay Sa Ngarn	✓	-	-	-	
Hin Heup	Phonsavanh	✓	-	✓	-	-		-	✓	-	-	Nam Sad Noi and Nam Sad Yai

Province /District	Village	Drinking		Bathing Washing				Fishing				
		Bottled Water	Open / Closed Bore	Open/ Closed Bore	Nam Lin	Stream / River	Name of Water Body	Stream	River	Pond	Marsh	Name of Water Body
Keoudom	Dansavanh	✓	-	✓	-	✓		✓	-	-	-	
Phonehong	Houaydeua	✓	-	✓	-	✓		-	✓	-	-	Nam Cheng, Nam Houay Deua
Phonehong	Nongkhone	✓	-	✓	✓	✓		✓	-	-	-	Nam Cheng, Nam Pha Naiy
Phonehong	Nongkhone	✓	-	✓	-	✓		✓	-	-	-	Nam Cheng, Nam Pha Naiy
Phonehong	Phonngoun	✓	-	✓	-	✓		-	✓	-	-	Nam Cheng
Phonehong	Vangmon	✓	-	✓	-	-		-	✓	✓	-	Nong Sanghai, Nam Tha Nai
Xayabouly Province												
Paklai	Natoung	✓	-	-	✓	✓		✓	✓	-	-	Nam Toung, Nam Sing, Houay Som Poy
Paklai	Nakhan	-	-	-	-	✓	Namkhan, Nam Mouk, Nam Mai	-	✓	-	-	Nam Farn, Nam Khan
Paklai	Meaungpa	✓	✓	✓	-	✓		✓	-	-	-	
Paklai	Nakang	✓	-	✓	-	✓		✓	✓	-	-	
Saysomboun Province												
Anouvong	Mouangsoum	✓	-	✓	-	-		✓	-	-	-	Nam Ngum Reservoir

Source: Earth Systems Village Survey (2016)



Plate 6-12 Water well in Ban Muang Soum, Annouvong District



Plate 6-13 Water pump in Ban Houay Deua, Phonehong District



Plate 6-14 Fishing in Ban Khonkeo, Hin Heup District



Plate 6-15 A water resource in Ban Hatkiang, Xaythany District

6.9.1 Aquatic Resource Use

Project Region

Fish and other aquatic resources play a key role in the lives and livelihoods of rural households in the Project region and are a primary source of animal protein for local people. Most households (>70%) in Vientiane Province and Xayabouly Province engage in some form of capture fishing mainly for their own consumption, although this is lower in Vientiane Capital (48%). Consistent with national trends, very few households sell fish as their main source of income. However, the sale of fish contributes to at least 10% of the total agricultural income at the provincial level.

Fishing for income is primarily undertaken by men, typically using cast nets in rapids sections, directional traps close to the banks and large mesh gill nets in deeper pools. In smaller streams and standing water, scoop nets, fence traps, bamboo traps and hook and line fishing poles are used. Women and children are typically responsible for gathering aquatic resources in these smaller streams and pools, to eat or to use in handicraft-making. These products become especially important in times of rice shortage (MWBP 2006). Women are also especially engaged in the management of fishponds.

Current Lease Area

Surveys in current Project villages indicate that approximately 77% of households are involved in collection of aquatic resources, primarily for own consumption, using traditional fishing gear.

Consistent with regional trends, fishing was more important in Xayabouly Province where the majority of households in the four surveyed villages in Pak Lai District are engaged in this activity. In Vientiane Capital and Vientiane Province, approximately two thirds of households are engaged in this activity.

Fishing and the collection of other aquatic resources occurs mainly in both perennial and seasonal natural streams, rivers, lakes, and swamps. Several households in Ban Saen Udom and Ban Nakhanthoung in Xaythany District; and Ban Meuangpa in Pak Lai District also own fishponds and / or are located near larger water reservoirs thus have an alternative for aquaculture activities.

Common aquatic species caught by local villages include walking catfish (*Clarias batrachus*), snakehead fish (*Channa striata*), a variety of small carps (*Cyprinidae*, and *Clupeidae*), eels, frogs, shrimp, crabs, and snails. Availability of fish and aquatic resources has been declining significantly over the past years across the surveyed villages due to population increases, overfishing, and degradation of aquatic habitats.

In some villages, fishing and the collection of aquatic resources was not very common due to the lack of natural water resources and aquatic habitats. These include Ban Hatkiang (4% of households engaged in fishing) in Xaythany District; Ban Hin Ngon (4%) in Hin Heup District; Ban Dansavanh (6%) in Keoudom District; and Ban Phon Ngeun (2%) in Phonehong District.

6.10 Community Infrastructure

Project Region

Over the last decade, the Government has more than doubled the percentage of villages with critical infrastructure across the country - including grid electricity, water supply infrastructure, road access, health facilities and primary schools. This has been facilitated through both infrastructure development and administration consolidation (with a 25% reduction in the number of villages).

The proportion of villages with key community infrastructure in the Project region was generally above the national average (refer to Table 6-28).

Table 6-28 Proportion of villages with key community infrastructure in the Project region

Region	No. of Villages	Percentage (%) of Villages						
		Electricity	Water Supply	Road Access	Market	Health Facility	Incomplete School	Primary School
National	8,507	75.30	14.70	80.50	6.80	16.40	17.70	75.50
Vientiane Province	434	98.60	20.30	97.20	10.10	15.20	20.30	76.70
Vientiane Capital	485	98.60	53.40	97.70	24.90	16.30	8.00	79.20
Xayabouly Province	432	87.70	18.50	98.10	11.10	22.00	4.60	85.90
Saysomboun Province	96	77.10	6.30	88.50	10.40	30.20	17.70	80.20

Source: NSC 2015

Table 6-29 Summary of local infrastructure of surveyed current Project villages

No.	District	Village	All Year Road Access	Grid Electricity	Village Health Centre	Village Medicine Box	Drug Store	Improved Water Source (drinking)	Village Market	Primary School	Secondary School	Irrigation
Vientiane Capital												
1	Sangthong	Kouay	✓	✓	✓	-	-	✓	-	✓	-	-
2		Taohai	✓	✓	-	✓	-	✓	-	✓	-	-
3		Xor	-	✓	✓	-	-	✓	✓	✓	✓	-
4	Xaythany	Hatkiang	✓	✓	✓	-	✓	✓	-	✓	-	-
5		Houana	-	✓	-	-	✓	✓	-	✓	✓	-
6		Nakhanthoung	✓	✓	-	✓	-	✓	-	✓	-	✓
7		Saen Udom	✓	✓	-	✓	-	✓	-	✓	-	-
Vientiane Capital												
8	Hin Heup	Borchan	✓	✓	-	-	-	✓	-	✓	-	-
9		Hinngon	✓	✓	-	✓	-	✓	-	✓	-	-
10		Khonekeo	✓	✓	-	✓	-	✓	-	✓	-	-
11		Na-An	-	✓	-	-	-	✓	-	✓	-	✓
12		Namthom	✓	✓	-	✓	-	✓	-	✓	-	✓
13		Naphong	-	✓	-	✓	-	✓	-	✓	-	✓
14		Phon Ngeun	-	✓	-	✓	-	✓	-	✓	-	-
15		Phonmouang	✓	✓	-	-	-	✓	-	✓	-	✓
16	Phonsavanh	✓	✓	-	-	-	✓	-	-	-	-	
17	Keo Oudom	Dansavanh	✓	✓	-	✓	-	✓	-	-	-	-
18	Phonehong	Houay Deua	✓	✓	-	✓	-	✓	-	✓	-	-
19		Nongkhone	-	✓	✓	-	-	✓	✓	✓	-	-
20		Phon Ngeun	✓	✓	-	✓	-	✓	✓	✓	-	-
21		Vangmon	✓	✓	-	✓	-	✓	-	✓	-	-
Xayabouly Province												
22	Paklai	Nakang	✓	✓	-	✓	-	✓	-	✓	✓	-

No.	District	Village	All Year Road Access	Grid Electricity	Village Health Centre	Village Medicine Box	Drug Store	Improved Water Source (drinking)	Village Market	Primary School	Secondary School	Irrigation
23		Nakhan	-	✓	-	✓	-	-	-	✓	-	✓
24		Meuang Pa	-	✓	✓	-	-	✓	✓	✓	✓	✓
25		Natoung	-	✓	✓	-	-	✓	-	✓	✓	✓
Saysomboun Province												
26	Anouvong	Mouangxoum	✓	✓	-	-	✓	✓	-	✓	-	-

Source: ES Village Survey (2016)

Current Lease Area

A summary of local infrastructure in current Project villages is presented in Table 6-29. Local infrastructure in surveyed villages is reflective of the regional trends. All 28 surveyed villages are connected to the grid, and most have a primary school and village medicine box. Very few villages have a secondary school, four villages have a health centre (souksala) and three villages have a market.

Further detail on local infrastructure and access to services at the regional and local level in the target Provinces is presented in Sections 6.12 (Health and Nutrition), 6.13 (Education), (Transport and Accessibility) and 6.14 (Electricity and Energy).

6.11 Transport and Accessibility

Project Region

Accessibility to District and Provincial capitals in the target Provinces is shown in Figure 6-15 and Figure 6-16.

The majority of villages in the Project region have year around access to road infrastructure. At the Provincial level this include approximately 89% of villages in Vientiane Province and 84% of villages in Xayabouly Province. However, a few areas have only seasonal road access, including parts of Pak Lai District, Xayabouly Province where current lease areas are located and Met and Kasi Districts in Vientiane Province or midland areas in Hin Heup District.

Most villages in Vientiane Capital, Vientiane Province and Xayabouly Province have easy (0 – 2 hours' travel time) to moderate (2 – 4 hours' travel time) accessibility to District centres, with some variation within the Provinces particularly in the north of Vientiane Province and the central areas of Xayabouly Province. Villages in Saysomboun Province experience more difficulty in accessing District centres, due to the terrain of the Province.

The Project region is serviced by National Road 13 (north from Vientiane Capital) and various Provincial and District roads, linking Project lease areas to the proposed Mill site in Hin Heup District (Vientiane Province). National and Provincial roads are sealed (i.e. concrete, asphalt or tarred), however many of the minor roads are gravelled or earthen.

Current Lease Areas

The majority of current Project villages are located more than 10 km from a main road leading to the District centre, with some villages located 10 – 30 km away and others between 30 – 60 km away (Table 6-30; Plate 6-16 to Plate 6-18). Average distance from the central road is 24 km. Most villages (69%) have year around road access, although five villages are difficult to access in the wet season, including Ban Houana in Xaythany District (Vientiane Capital), Ban Na-an, Ban Naphong and Ban Ngeun in Hin Heup District (Vientiane Province), and one of the villages in Pak Lai District (Xayabouly Province). Some of these villages are impacted by flooded streams and impassable road conditions during the wet season. Generally, these villages are also the ones located far from main roads.

Project associated road improvements and constructed bridges (where applicable) have provided improved access for some local villages near Project lease areas. This has facilitated improved accessibility within the village (e.g. to agricultural areas and forest resource collection areas) and to other villages and District centres.

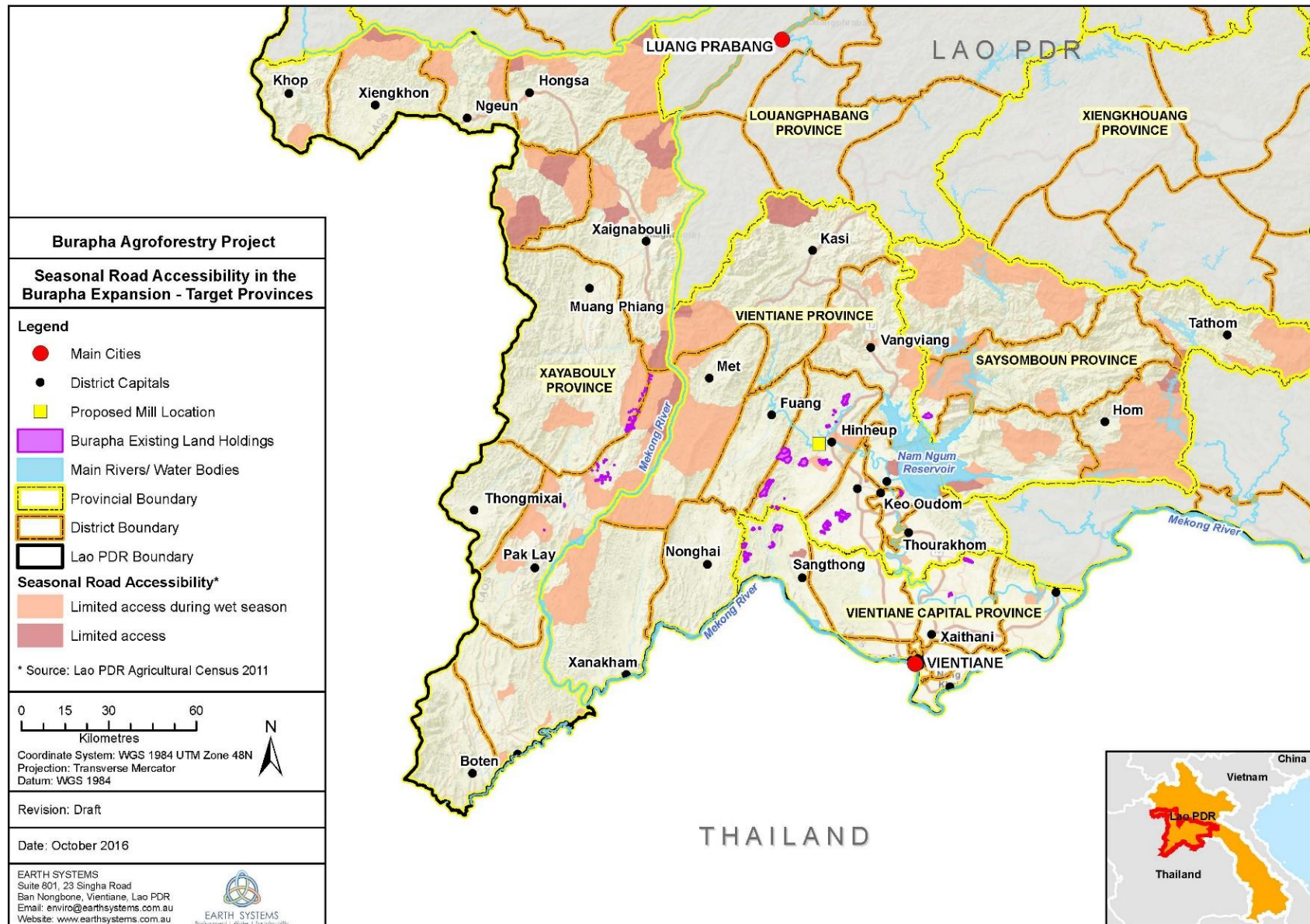


Figure 6-15 Road accessibility in target Provinces

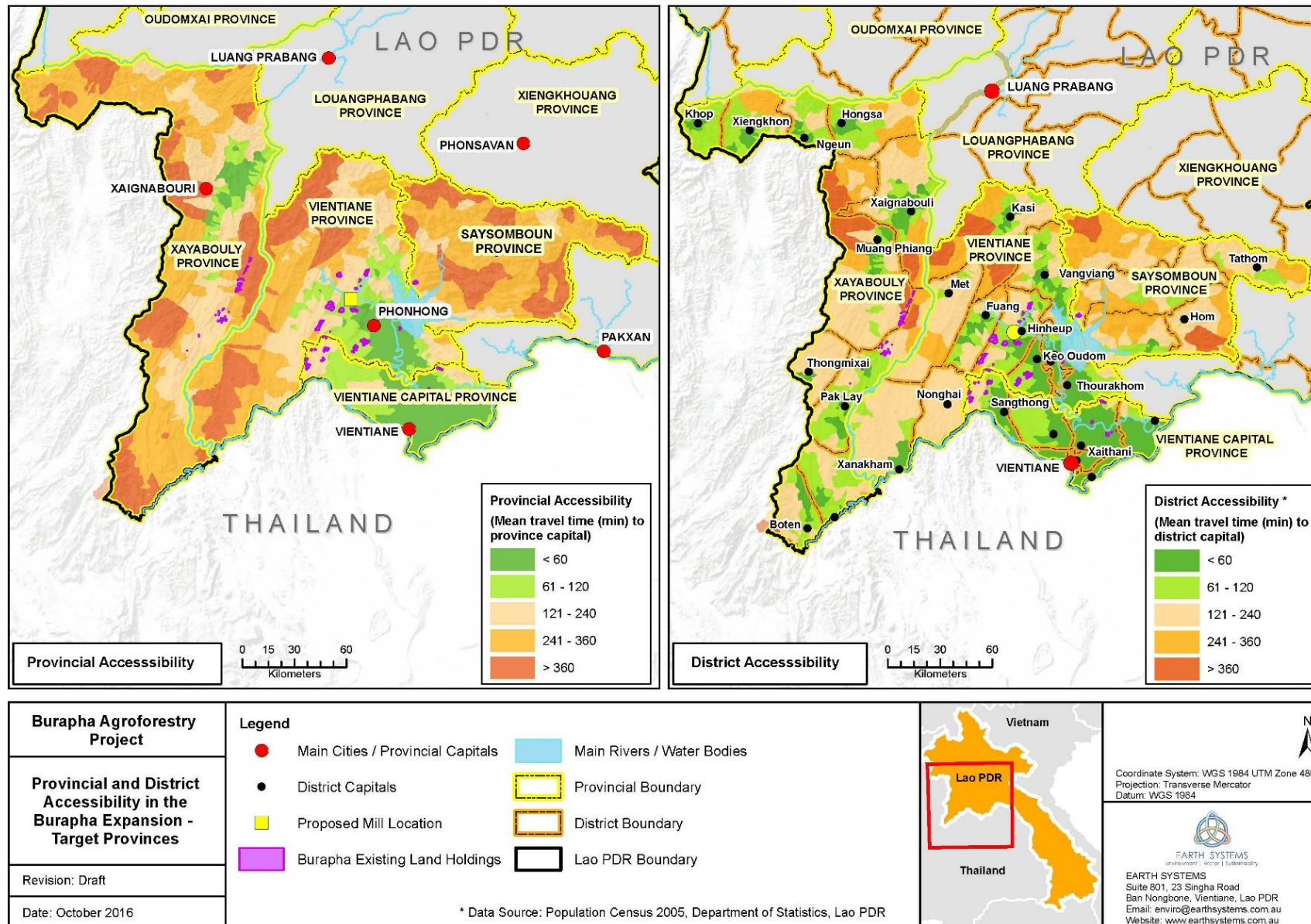


Figure 6-16 Access to provincial and District centres in the Project region

Table 6-30 Accessibility in surveyed villages

Province	No. of Surveyed Villages	Percentage (%) of Villages					Ave. Dist. to Main Rd to District Centre (km)
		All Year Road Access	Dirt / Gravel Road Only	Concrete, Asphalt or Brick Road	Both Road Types	>5 km from Main Rd to District Centre	
Vientiane Capital	7	71	29	14	57	86	22
Vientiane Province	14	79	43	21	36	71	13
Xayabouly Province	4	25	100	0	0	100	63
Saysomboun Province	1	100	0	0	100	100	45
Total / Mean	26	69	43	9	48	89	35.75

Source: ES Village Surveys (2016)



Plate 6-16 Road access to plots within Ban Nakhan, Pak Lai District



Plate 6-18 Road access in Ban Na-an, Hin Heup District



Plate 6-17 Road access to Ban Mouangsoum, Annouvong District

6.12 Health and Nutrition

6.12.1 Access to Health Services

Project Region

Accessibility to health facilities varies across the target Provinces is fairly good and at or above the national average. In Vientiane Capital, the significant majority of villages have good access to healthcare, with all villages being less than 10 km from a health centre and 94% having access to a District or provincial hospital within 30 km. Access to health care is more varied in the other target Provinces with approximately two thirds of the villages in Vientiane and Xayabouly Provinces, located less than 10 km from a health centre, and a slightly higher proportion (73% and 68% respectively) located approximately 30 km from a District or provincial hospital (LECS4; Table 6-31).

Current Lease Areas

Access to health care is also good in most surveyed Project villages. The primary source of medical treatment varied and was largely dependent on distance to health infrastructure. Villages close to District facilities tended to use the local hospital whilst villages situated far from hospitals and clinics (some villages in Vientiane Capital and Xayabouly Province), used village health centres and local health representatives. Most surveyed villages were within 10km of a health centre and 30 km of a hospital. A few villages however, are located further away from health facilities. This includes Ban Houaydeua, Phonehong District (Vientiane Province) which is located more than 18 km away from a health centre and 27 km from a hospital and Ban Nakang in Pak Lai District (Xayabouly Province) which reportedly has no access to health centres and is located between 60 – 70 km away from the Provincial hospital and 30 km from the District hospital (Table 6-32; Plate 6-19).

Table 6-31 Access to health facilities in the target Provinces

Province	Percentage of Villages (%)	
	<10 km of a Health Centre	<30 km from a Hospital
Vientiane Capital	100	94.1
Vientiane Province	67.5	73.2
Xayabouly Province	67.7	68.4
Saysomboun Province	-	-
<i>National</i>	66.6	57.6

Source: LECS4, 2008.

Table 6-32 Access to health services in surveyed current Project villages

Province	No. of Surveyed Villages	Percentage of Villages (%)		Ave. Distance from Village to Health Service (km)		
		Medicine Box	Health Centre	Health Centre	Clinic	Hospital
Vientiane Capital	7	86	43	2	32	29
Vientiane Province	14	64	0	7	19	18
Xayabouly Province	4	100	50	3	55	37
Saysomboun Province	1	0	0	2	16	25
Total / Mean	26	68	14	5	23	22

Source: ES Village Survey (2016)



Plate 6-19 Health Centre in Ban Nakhanthoung

6.12.2 Morbidity and Mortality

Project Region

Communicable disease is a leading cause of mortality in Lao PDR. Tuberculosis, dengue fever and malaria are common. Incidence of many preventable diseases can be quite high rural areas. Non-communicable diseases and injuries are increasingly problematic, including issues associated with tobacco and drug use and traffic related issues.

Current Lease Areas

Common illnesses reported in surveyed current Project villages over the last 12 months include fever, sore throat and diarrhoea. Incidence of tropical disease (i.e. dengue and malaria) in surveyed villages was reportedly very low (Table 6-33). There were also a few recorded cases of HIV/AIDS. Specific causes of death could not be determined.

Table 6-33 Number of health cases reported in surveyed villages in the target Provinces

Province	Population	No. of Cases										
		Malaria	Dengue	Cholera	ARI	TB	HIV/AIDS	STDs	Fever	Diarrhea	Sore throat	Other
Vientiane Capital	7,786	2	3	1	26	4	1	0	3,903	203	1,947	40
Vientiane Province	13,902	41	69	21	122	23	2	25	6,063	172	4,422	193
Xayabouly Province	6,205	0	0	10	67	0	0	0	700	30	340	0
Saysomboun Province	1,061	0	0	0	0	0	0	0	0	5	10	265

Province	Population	No. of Cases										
		Malaria	Dengue	Cholera	ARI	TB	HIV/AIDS	STDs	Fever	Diarrhea	Sore throat	Other
All surveyed villages	28,954	43	72	32	215	27	3	25	10,666	410	6719	498

Source: ES Village Surveys

6.12.3 Food Security

Project Region

Recent surveying conducted by the World Food Program (WFP 2013) indicates that despite the country's steady economic growth, people in Lao PDR continue to suffer from high rates of malnutrition, and face three serious problems: wasting, stunting and micronutrient deficiencies. Malnutrition is a much more serious challenge than food security, as a growing proportion of the population now have acceptable food consumption levels.

Key food security and nutrition indicators in the Project region are presented Table 6-34 and Figure 6-17 to Figure 6-19. In the Northern Lowlands Agro-ecological Zone, where most current lease areas are located, food security is generally better than in the midlands and highlands.

Rates of acceptable food consumption are above the national average across the target Provinces. However, consistent with national trends, nutrition remains a critical issue with key indicators exceeding WHO thresholds. Critical to serious levels of stunting were observed in children under 5 years old in Vientiane and Xayabouly Provinces, and moderate levels of wasting were recorded in all Provinces, except Vientiane Province where the prevalence of wasting was below WHO thresholds (WFP, 2013).

Households with poor / borderline food consumption tend to cultivate less land and rely on cash crop production as a source of income. They also tend to engage in less vegetable garden cultivation and household diets generally had a greater proportion of rice, with less animal protein. Non-Lao-Tai ethnic groups are generally more food insecure than Lao-Tai groups (WFP, 2007). High vulnerability to food insecurity tends to be associated with remote areas that have low access to basic infrastructure, low engagement in fishing and hunting and areas and dependence on upland farming in small plots in fragile areas (WFP, 2013).

Table 6-34 Key indicators of food and nutrition security

Indicator	Percentage (%) of Households					
	Vientiane Plains AEZ*	Northern Lowlands AEZ	Vientiane Capital	Vientiane Province	Xayabouly Province	Saysomboun Province#
Food Consumption						
Acceptable	97.7	84.3	96.6	95.3	90.3	-
Borderline	2.3	12	3.4	3.5	6.4	-
Poor	0	3.7	0	2.2	3.3	-
Inadequate Dietary Diversity						
Under 5 years old (U5)	3.8	15	3.7	5.4	11.7	-
Nutrition Indicators						
U5 Stunting	27	50	-	42.6	39	-
U5 Under-weight	4.4	4.9	-	18.9	23.2	-

Indicator	Percentage (%) of Households					
	Vientiane Plains AEZ*	Northern Lowlands AEZ	Vientiane Capital	Vientiane Province	Xayabouly Province	Saysomboun Province#
U5 Wasting	20.7	23	-	4.6	5.5	-
Infant Mortality Rate	-	-	-	31	59	-

Source: WFP, 2013; *Agri-ecological zone; # Data unavailable

Current Lease Areas

Village level surveying indicates that nutrition and food security is generally good in villages participating in the Agroforestry Project. Rice sufficiency is high; most households are engaged in a mixture of subsistence agriculture, natural resource collection and cash generating activities (i.e. trading, skilled and salaried work). Approximately 66% of households are reportedly rice sufficient year-round and a further 10% have rice for at least 9 months (Table 6-35). The remaining 9% of households experience rice security issues. Those that experience rice shortages typically purchase additional supplies or offer labour in exchange for rice.

The intercropping scheme has had a positive effect on agricultural development in participating villages which has resulted in improved food security for participating households. For example, villages such as Ban Phonmouang, Ban Khonekeo, Ban Phon Ngeun, Ban Naphong, Ban Namthom have been actively involved in the intercropping scheme. The Company supports local farmers to undertake agricultural (food production) activities in the plantation areas. In the initial stages of the plantation cycle agriculture development includes cropping (i.e. rice, corn, cassava and in the later stages of the plantation cycle this includes pasture and grazing.

Table 6-35 Rice sufficiency of surveyed current Project villages

Province	No. of Villages Surveyed	Percentage (%) Households with Rice			
		12 Months	9-11 Months	6-8 Months	≤ 5 Months
Vientiane Capital	7	82	13	3	2
Vientiane Province	14	67	12	10	11
Xayabouly Province	4	79.0	17.5	1	2.5
Saysomboun Province	1	100	0	0	0
Total	26	82	11	3	4

Source: ES Village Surveys (2016)

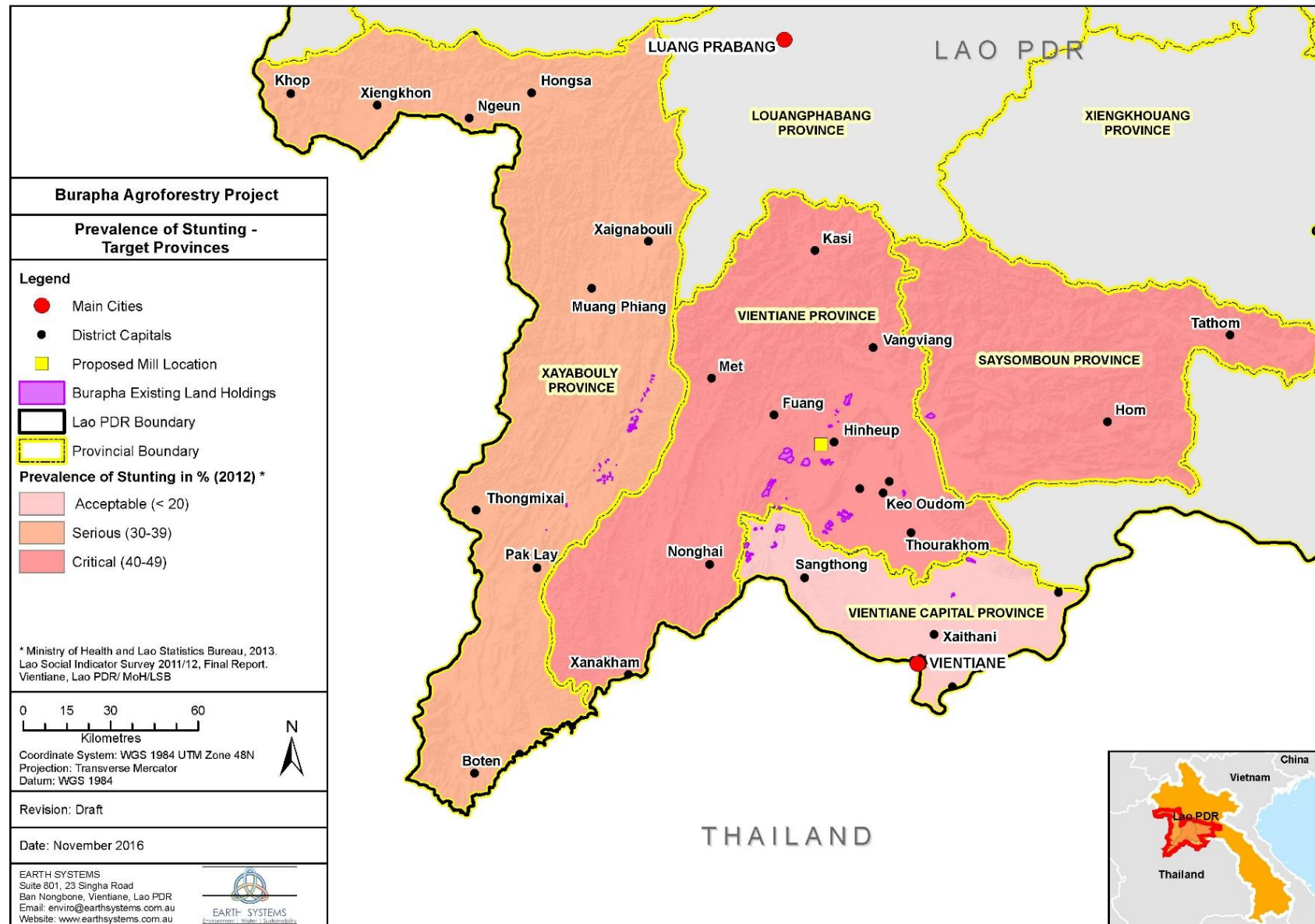


Figure 6-17 Prevalence of stunting in children under 5 years of age across the Project Region

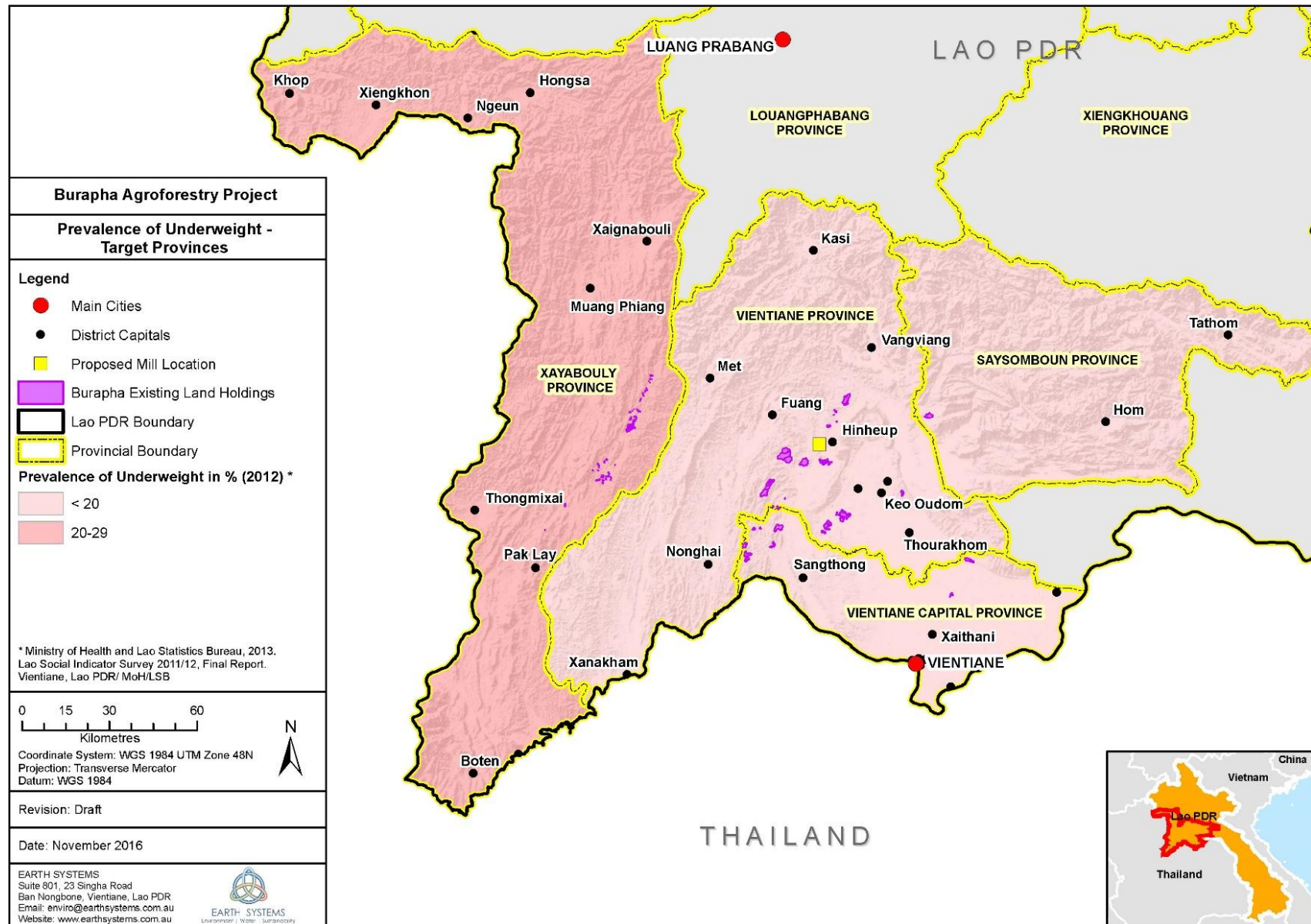


Figure 6-18 Proportion of underweight children under 5 years of age across the four target Provinces

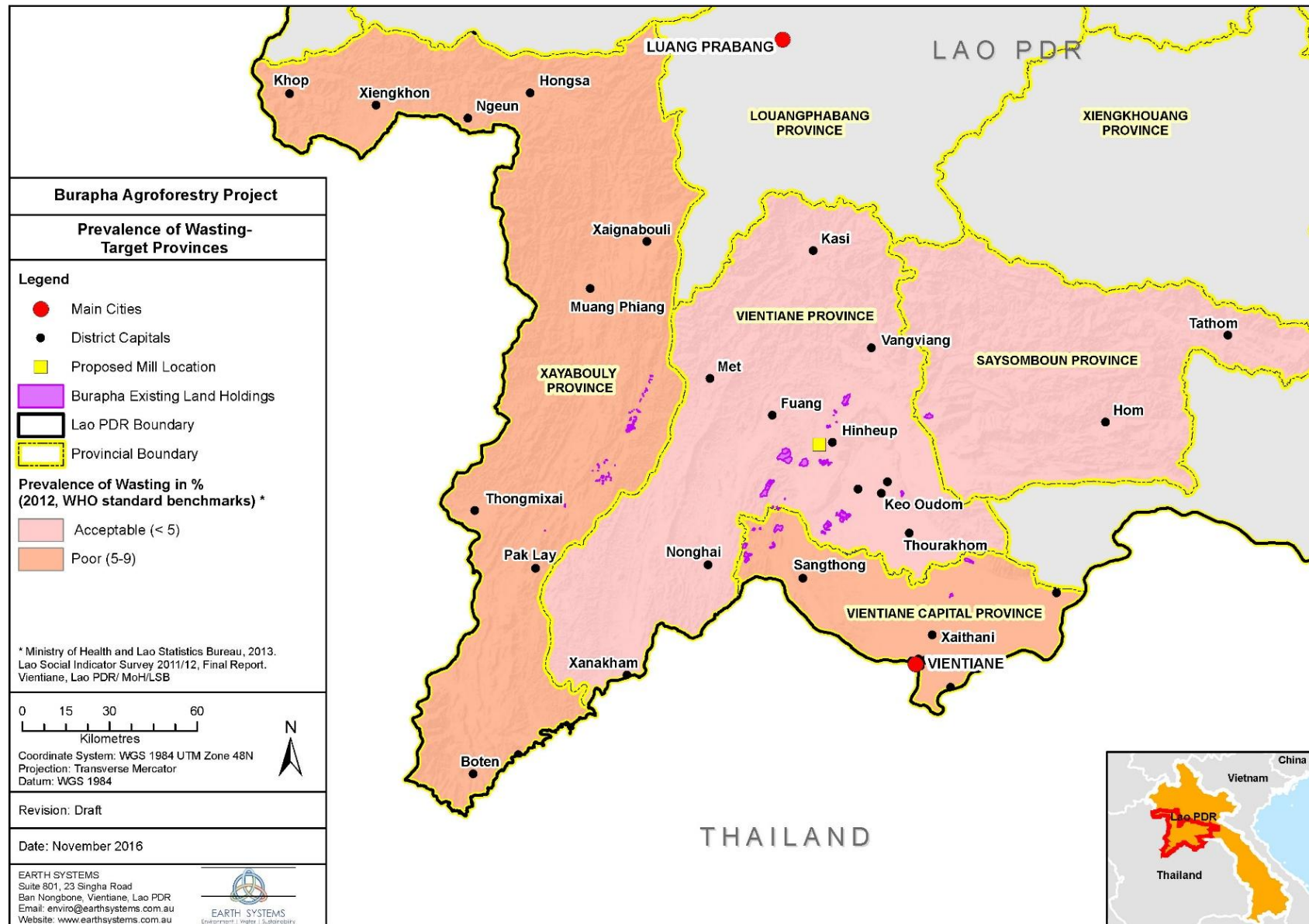


Figure 6-19 Prevalence of wasting in children under 5 years of age across the Project Region

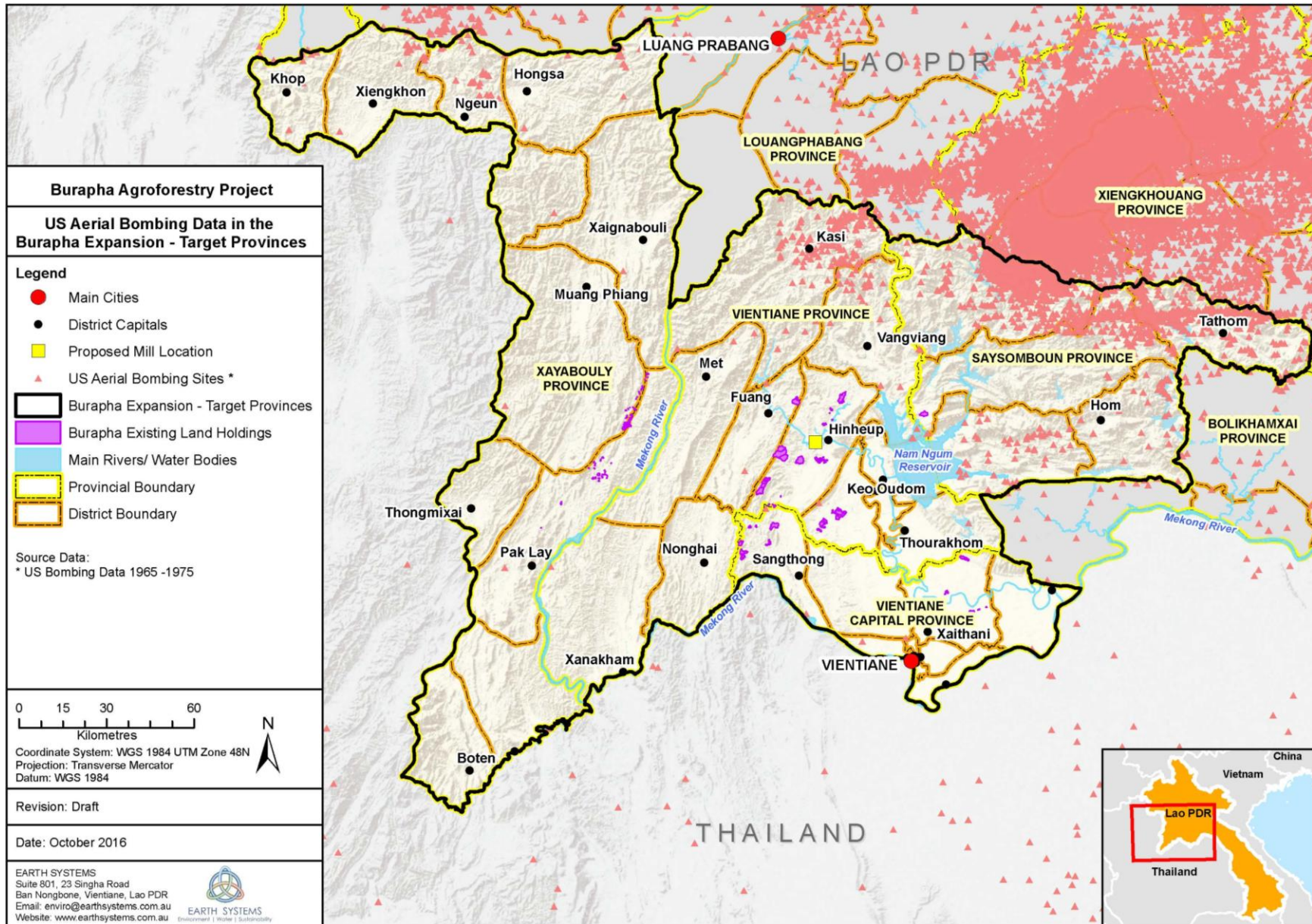


Figure 6-20 UXO incidence across the four target Provinces

6.12.4 Unexploded Ordnance

Unexploded ordnance (UXO) refers to explosive devices that have failed to detonate. Lao PDR is, per capita, the most heavily bombed country in the world. Throughout the Second Indochina War (1964-1973) over two million tons of ordnance were dropped on the country. More than 270 million cluster munitions were used, of which an estimated 80 million malfunctioned and remained live and buried in the Lao landscape after the war's end. UXO is still present in large parts of the country - approximately 25% of Laos' 10,000 plus villages are UXO contaminated (NRA, 2016). The Government of Lao has identified UXO contamination as an ongoing barrier to economic development and improved rural livelihoods (UXO Lao, 2016). Much of the data on UXO in Lao PDR relates to US bombing campaigns. However, these data are not comprehensive and bombing undertaken by the Thai and Lao governments has not been fully documented or mapped.

Project Region

There are very few known US aerial bombing sites or UXO within proximity of Burapha planted areas or land holdings. Most such bombing sites that have been recorded are located to the east and north-east of the land holdings (refer to Figure 6-20). In Vientiane Province, the majority of US aerial bombing sites are located in Kasi and Vangvieng Districts in the north of the Province and north of Burapha's landholdings. In Xayabouly Province there are no recorded UXO sites near Burapha's landholdings. In Saysomboun Province, there are three known US aerial bombing sites to the south of Burapha's landholding at Maung Xoum (next to the Nam Ngum Reservoir) but a far higher concentration of UXO to the north of this landholding, in Longchaeng District.

Current Lease Areas

None of the Project villages reported land affected by UXO or UXO related incidents (deaths or injuries) in the last five years. However, there is still a low to moderate potential for UXO to present a risk during ploughing or burning associated with the Project. UXOs are considered a moderate risk during future Project expansion, particularly to the north of existing landholdings.

6.13 Education

6.13.1 Access to Education Services

Project Region

As outlined in Section 6.10, access to education facilities is relatively good in the Project Region, with the proportion of villages having primary schools within the village being above the national average (75%), ranging from 76% in Vientiane Capital to 85% in Xayabouly Province.

Current Lease Areas

Education facilities in surveyed villages are relatively good. All surveyed villages had a primary school located in the village – apart from Ban Phonsavan in Hin Heup District (Vientiane Province), which was located 1 km from a primary school (Table 6-36). Whilst only 23% of villages had a lower secondary school in the village, most villages were within 10 km of a secondary school, except for Ban Houaydeua and Ban Borchan in Hin Heup District which were located between 10- 20 km away.

Table 6-36 Access to education services in surveyed villages

Province	No. of Surveyed Villages	Percentage of Villages (%)			Ave. Distance from Village to Education Service (km)			
		Primary School	All Year Primary School	Secondary School	Primary	Lower Secondary / Upper Secondary	Tertiary	Vocational
Vientiane Capital	7	100	43	29	0	1/3	59	51
Vientiane Province	14	93	0	0	0	6/8	87	65
Xayabouly Province	4	100	75	25	0	2/12	218	193
Saysomboun Province	1	100	0	0	0	2/2	160	100
Total	26	96	23	12	0	4/7	102	82

Source: ES Village Survey (2016)

6.13.2 Literacy and Education Status

Project Region

At the Provincial level, general education indicators in the Project region are fairly good. Adult literacy rates, including female literacy are generally above the national average, except for literacy rates in Saysomboun Province (Table 6-37). Literacy rates tend to be lower in rural areas, with a wider gap between male and female literacy compared to urban areas. The gender literacy gap was the smallest in Vientiane Capital. Primary and secondary school enrolment rates in the target Provinces are also above the national average.

Table 6-37 General education indicators in the target Provinces

Indicator	Vientiane Capital			Vientiane Province			Xayabouly Province			Saysomboun Province		
	Total %	F%	M%	Total %	F%	M%	Total %	F%	M%	Total %	F%	M%
Literacy												
Adult literacy	97.2	96.1	98.4	90.5	86.3	94.7	92.5	89.7	95.1	80.9	70.4	89.9
Enrolment												
Primary enrolment	109.5	107	111.2	107.1	106.4	107.7	111.9	110.4	113.5	112.9	109.9	115.7
Lower secondary enrolment	93.3	90.5	96.1	92.4	89.5	95.1	85.8	84	87.6	101.1	98.4	103.6
Upper secondary enrolment	70.2	70.8	69.5	57.4	52.6	62	51.8	49.7	53.9	57.3	50.2	63.7

F – Female; M – Male. Source: Annual School Census 2014-15, NSC, 2015; WFP, 2013 *2013 data. The gross enrolment ratio can be greater than 100% because of grade repetition and entry at ages younger or older than the typical age at that grade level.

Current Lease Areas

Levels of formal educational achievement among adults in the surveyed villages are fairly good, with primary school completion rates amongst adults at (94%), including for females (81%). The percentage of adults who have also completed lower secondary school is reportedly lower.

Lao is the most commonly spoken language in the surveyed. Other languages spoken include Khmu and Hmong. Male and female literacy rates are very high (>94%). Levels of comprehension of language spoken by outsiders were also high - indicating functional illiteracy.

6.14 Electricity and Energy

Project Region

As outlined in Section 6.10, grid electricity connection rates for villages in the target Provinces is above the national average (75.3%), and ranges from 77% in Saysomboun Province to 98% in both Vientiane Province and Vientiane Capital.

Data from the 2015 Census indicates that wood is the most common source of fuel used for cooking in the Project region in all Provinces except Vientiane Capital (Figure 6-21). Charcoal is also used throughout the Project region, though is more common in Vientiane Capital (45% of households). Use of charcoal is also more common in urban areas compared to rural areas. Other forms of energy such as electricity, sawdust and gas are only used by a small minority of households in the Project region, although electricity and gas is used by a higher proportion of households in Vientiane Capital (NSC, 2015).

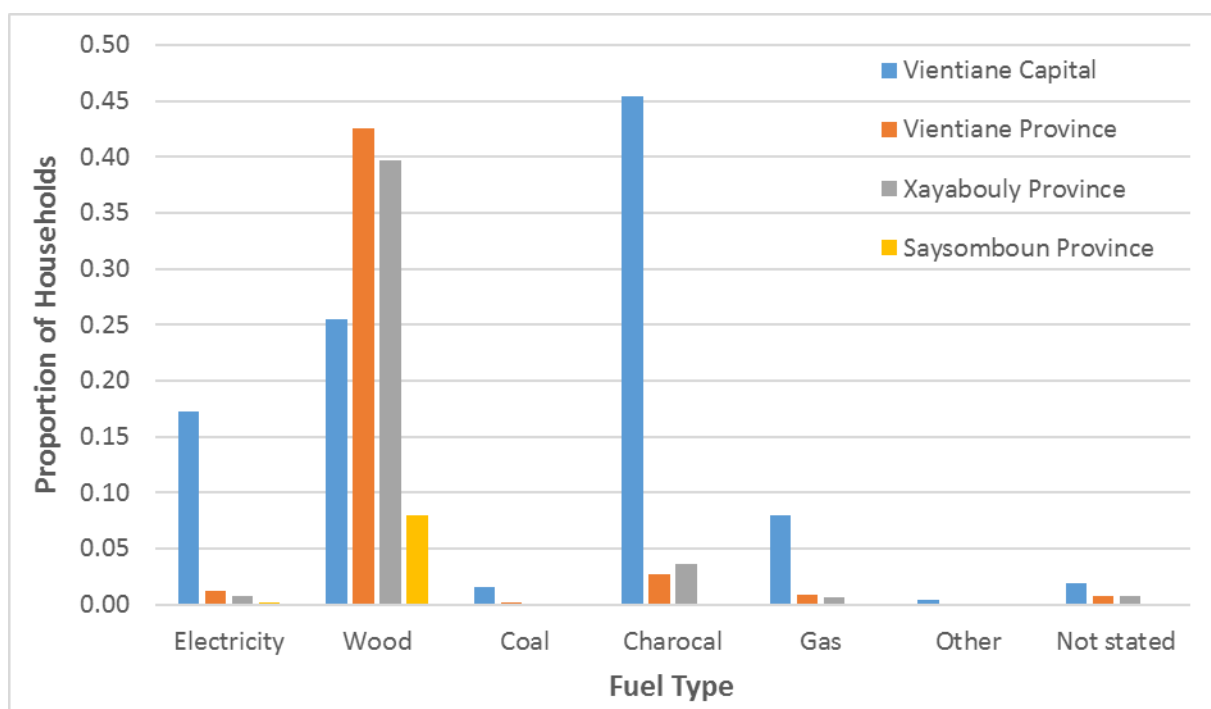


Figure 6-21 Sources of fuel used for cooking across the four targeted Provinces

Source: NSC, 2015

Current Lease Areas

All surveyed villages are connected to the electricity grid and 87% of households utilise electricity from the grid for lighting, refrigeration and communication needs. In Vientiane Province, there are two villages – Ban Na-an and Ban Vangmon, where some households use other forms of energy instead of grid electricity. In Ban Na-an, 2% of households only use oil lamps for lighting and in Ban Vangmon, 1.3% of households only use solar lighting. Both villages are planted villages.

For cooking, most households in the surveyed villages reportedly use wood (80%) and charcoal cooktop stoves (27%) as their primary means of cooking. Charcoal use is also sourced in nearby village lands. Some households also used gas and electricity for cooking, mainly in Vientiane Capital (Figure 6-22).

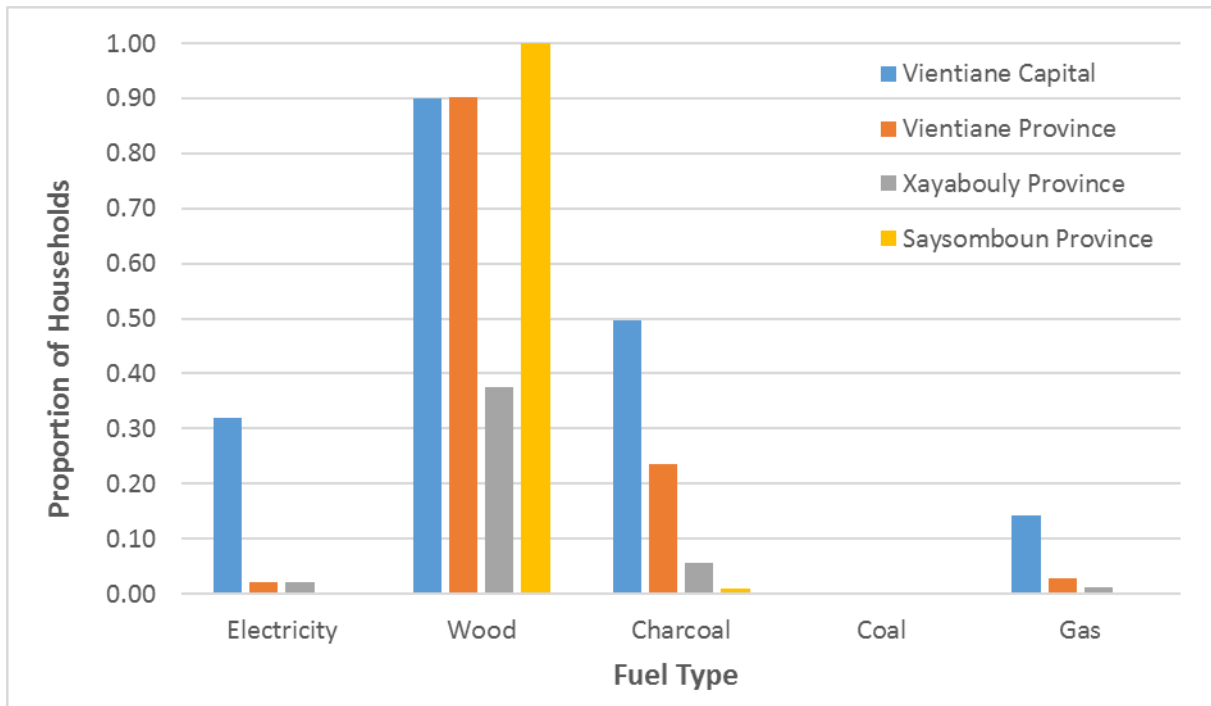


Figure 6-22 Sources of fuel used for cooking in surveyed villages (by Province)

Source: Earth Systems Village Survey (2016)

6.15 Gender

Livelihoods and Employment

Similar to the rest of Lao PDR, rural economies in the Project region have a gendered division of labour and a gendered division of the income and benefits of labour. Some roles are traditionally undertaken by men (e.g. hunting and fishing) and some roles are traditionally undertaken by women (e.g. collections of non-timber forest products - NTFPs, cooking and cleaning). Women undertake most household duties (i.e. cooking and cleaning), including the collection of water for household consumption or usage, and the collection of firewood or fuel and taking care of small livestock.

In the Project region, the share of women in wage employment in the non-agricultural sector is moderately high (30 – 40% at the District level), apart from the northern areas of Vientiane Province, where this share is slightly lower (20-30%).

In the surveyed villages, both men and women play a role in agriculture which is the primary source of income for many of the surveyed villages. Women also undertake the marketing and sale their agriculture products, which contribute to household income in combination with handicrafts, undertaking petty trade, and wage labour.

Women in the surveyed villages have benefited from Project employment and higher than minimum wages for casual labour. Village consultation has indicated that men and women from each participating family are given an opportunity to work on a rotational basis and that livelihoods / income generation has improved. Project related labour activities that women participate in include land preparation before cultivating, sowing agricultural crops, weeding and harvesting.

Education

The education gap between men and women in the Project region is generally lesser than other parts of Lao PDR. At the primary school level, the girl to boy ratio is relatively high (0.9 – 1) for most Districts in the Project region, with the gap widening at the lower secondary and upper secondary levels. At the upper secondary levels, the gender enrolment gap ranges between 0.5 – 0.9, with a few Districts in Xayabouly Province and Vientiane Capital having a relatively high proportion of females attending secondary school (ratio of 0.9 – 1). On average, women attend school for a shorter period than men – particularly in rural areas and among ethnic minorities.

Adult female literacy rates at the District level is also relatively high in the Project region, compared to other areas in Lao PDR, with Xayabouly Province and Vientiane Capital having similar male and female literacy rates (>90%). Female literacy rates are slightly lower in Vientiane Province (80-90%) and much lower in Saysomboun Province (60 – 70%).

Reflective of regional trends, primary school completion rates for females was relatively high (84%), as are female literacy rates (refer to Section 6.13).

Decision Making

Women's general role in decision-making is mainly related to managing household and/or family issues. As women also play a role in raising the livestock, they have the right to decide whether to sell the animals or their products or whether to buy more food supply for them. Also, as the household care taker and main money saver, women play a role in deciding to purchase more capital assets (e.g. land, house), productive assets (e.g. agri-inputs, small animals), and purchase of consumable products (e.g. clothes, food, medicines). To ensure proper care of the family, women can also decide in borrowing money from other households in the village. Besides having the right in decision-making at household level, at village level, women also play a governance role by being members of the village women's union and committee and participating in important village meetings.

6.16 Cultural and Historical Setting

Information on the cultural heritage setting of the Project is based on available literature as well as information collected as part of field surveys for the ESIA. Information on ethnicity and religion is provided in Section 6.3.

Regional Level

One of the most important areas of 'living' cultural heritage at the District and Provincial level, is the Pha Bong area, which includes large mountains of limestone cliffs on the western side of Meuang Hin Heup District. The area has numerous caves and vertical limestone spires, located approximately 800 m from Ban Phabong village. The Pha Bong Tourism Management and Development Plan emphasises the importance of promoting yet protecting cultural heritage in the Hin Heup District of Vientiane Province. This includes tourism awareness seminars conducted in the villages and village-based regulations for visitors to Pha Bong.

Current Lease Area

A subsample of 10 villages participating in the agroforestry Project were surveyed by a Lao Cultural and Archaeological specialist to identify culturally significant sites, archaeological sites, and artefacts that are representative of current lease areas. In addition, communities were asked about culturally significant sites, their locations, and their importance / meaning during the surveys conducted in June 2016. These surveys identified 6 cemeteries, 8 territorial spirit sites, 8 religious sites, and 15 natural/cultural sites (Table 6-38; Plate 6-20 to Plate 6-25). Further details are presented in the section below.

Table 6-38 Cultural heritage sites in selected surveyed villages

Surveyed Village / District	Cultural Heritage Sites			
	Cemeteries	Territorial Spirit Sites	Religion Sites	Natural Sites
Nongkhone (Phonehong District)	1	1	1	1
Houaydeua (Phonehong District)	2	1	3	1
Phone Mouang (Hin Heup District)		1		
Phonesoung (Hin Heup District)		2	1	
Borchan (Hin Heup District)	1	1		2
Taohai (Sangthong District)			2	1
Ban Sor (Sangthong District)		1		1
Ban Nakhon (Pak Lai District)	1	1		2
Ban Natoung (Pak Lai District)	1		1	7
Total	6	8	8	15

Natural / Cultural Sites

Fifteen natural/cultural sites identified in the subsample of surveyed villages including caves, waterfalls, and natural ponds. Specific examples are discussed briefly below:

- Tham Tha Heua located in Phou Phanang NBCA near Ban Taohai, Sangthong District – The exact location of this is unknown. It was last discovered approximately 15 years ago.
- Ho Phi Muang (Ban Sor, Sangthong District) - This site is in the south of the village near the river and bridge on a hilly area covered by old fallow forest with an area of approx. 1 ha. A ritual ceremony is organised at this site twice a year in June and December (Lao PDR's Lunar Calendar). The same offerings are provided each time - one pig, 12 chickens, one jar of alcohol, one box of sticky rice.
- Tham Phak Nao (Phak Nao Cave), Ban Natoung, Pak Lai District
- Tham Phi Kong Koi (Phi Kong Koi Cave, Ban Natoung, Pak Lai District – this cave is located near Nong Xieng lake.
- Nong Xieng Lake, Ban Natoung, Pak Lai District – the lake is approximately 2 ha in size. The village conserves this lake and organize village fishing day once a year;
- Waterfall, Houaydeua (Phonehong District) - Houay Nam Cheang is a small waterfall, 20 m wide and 50 m high. It is within a nationally protected forest and is therefore managed by the Government.

Territorial Spirit Sites

All the ethnic groups in surveyed villages believe in spirits that control various aspects of the cosmos and explain causality, including accidents, sicknesses, death and incomprehensible phenomena. Each spirit is associated with a certain location and power.

The most important powers in the spirit world are the Territorial Spirits (Phi Ban) that govern large areas and are important considerations when relocating villages. Territorial and mountain spirits receive offerings that belong to the particular situation of the village (e.g. pigs or chickens, along with alcohol and other items prior to the commencement of the marriage, making a new house). The origin of these spirits is often a legendary person/founder of the village. Mediums and politically powerful people have correspondingly powerful spirits and become associated with territory and people residing in that territory. A relationship develops between the living and the spirit consisting of offerings and respect for the spirit in exchange for protection and intervention in times of need or disaster. The ritual offerings consist of animal sacrifice, alcohol and various decorations. The date for the ceremony is agreed upon by the ritual specialists and approved by village authorities.

A total of 8 spirit sites were identified in the 10 surveyed villages. Specific examples include:

- Village spirit forest (Pa Sop Xong) in Ban Phonesoung, Hin Heup District - the site is approximately 2ha, located opposite to the village temple on the left bank of Nam Lik River at Nam Xong estuary. Villagers respect this forest as it is deemed sacred after two incidents happened there.
- Village spirit site, Ban Borchan, Hin Heup District - The elders of the village decided to have a small spirit house, known as Hor Phee. built in 1987. The concrete shrine statue is believed to house a spirit soul.
- Village spirit forest (Ho Pi Ban), Ban Sor, Sangthong District - There is large *Azelia xylocarpa* species (~80 cm in diameter) remaining in this spirit forest. Villagers also make offerings at certain times of the year.

Cemeteries

Six cemeteries were identified in the surveyed villages. Some cemeteries are close to the main settlement area and some are further away. In most cases, residents require permission from village authorities to hunt animals or cut down timber in these areas.

Religious Sites

Religious sites in the surveyed villages included current temples, old temple sites and local churches.

Archaeological Finds

Archaeological finds identified in the surveyed villages are presented in Table 6-39 below. These include artefacts such as statues, pots, stone tools and sandstones.

Table 6-39 Examples of archaeological findings recorded in selected surveyed villages

Item	Location	Comments
Ancient Buddha statue	Nongkhone (Phonehong District)	The statue is housed in the temple. Unidentified creation date but has long been in this location. Estimated to be 300 years old. Made of sandstone. ~3 m height, 2 m width. Has been damaged but repaired and painted in 1968. It is said to be significant in its representation of the Phra Hin and their architecture in the Lao Lanxang period.
Crafted ancient sandstones		The stones were found in a pit in the temple. Some stones were put around the temple shrine and some remain underground. Average sizes: 30 cm width, 50 cm height. Unknown year built / crafted.
Ancient pot	Houaydeua (Phonehong District)	A very old copper and steel pot. It was long ago used for cooling the alcohol refinery pot by pouring water in it.
Stone tool		Two items look like an ancient tool (flexcut) made from stone but the larger one produces a metallic sound when knocked. These two items were found in a stream ~10 km northeast from the village; they were collected by the village chief.
Pair of cymbals	Phone Ngeun (Hin Heup District)	This artefact belongs to Mr. Bounleud and was inherited from ancestors. Unknown age.
Copper / steel pot		The copper pot belongs to the village chief (Mrs. Phouvanh). More information can be obtained from Mr. Sisomphone.
Village temple and crafted ancient sandstones	Taohai (Sangthong District)	Approx. 10 old sand stones were discovered around the temple a long time ago. Age unknown but likely to be more than 300 years since they were worked. Could have been symbolic or boundary stones. The temple shrine was built on the old temple foundation. Only Taohai villagers use the temple.

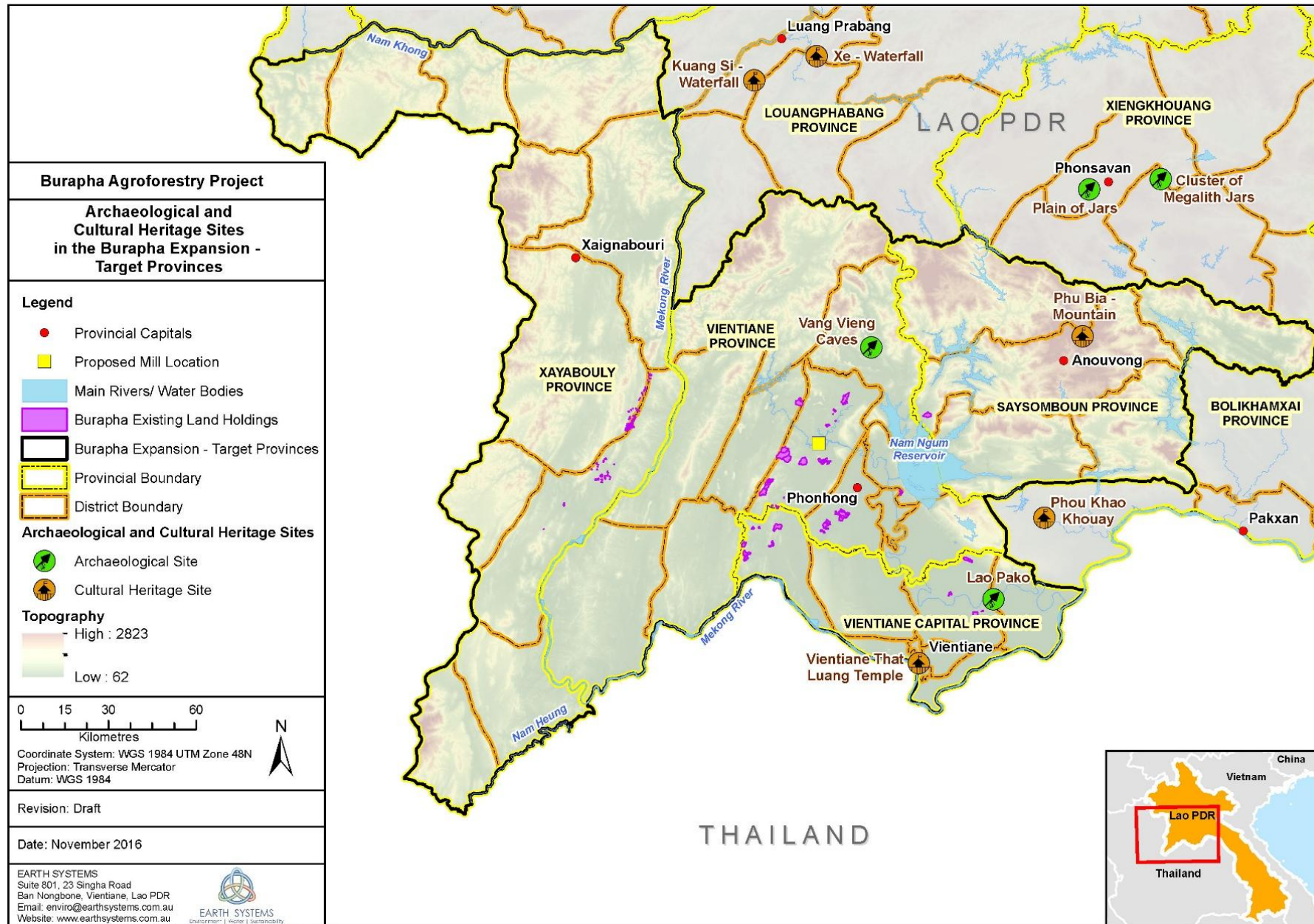


Figure 6-23 Known cultural heritage sites in the Project region



Plate 6-20 One of four standing crafted ancient sandstones at Ban Nong Khone



Plate 6-21 Ancient sandstone Buddha statue at Ban Nong Khone



Plate 6-22 Spirit House of Village (*Ho Phi Ban*), Ban Borchan, Hin Heup District



Plate 6-23 Cymbals, or 'saeng' of approximately 150 years old, Phon Ngen, Hin Heup District

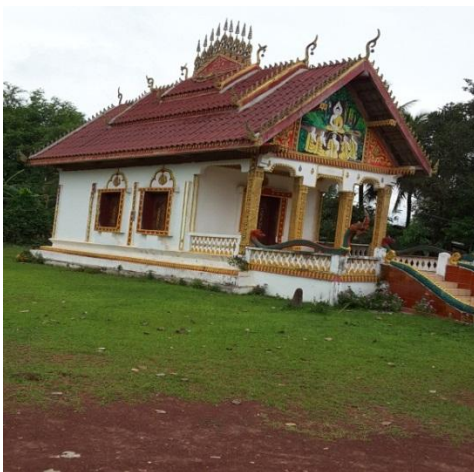


Plate 6-24 Wat at Taohai



Plate 6-25 *Pa Sop Xong* Spirit Forest, Ban Phon Sou

A photograph of a forest with a blue overlay containing text. The forest is composed of tall, thin trees with green foliage. The ground is covered in brown leaves and some small green plants. The blue overlay is a semi-transparent horizontal band across the middle of the image.

Chapter 7 | Physical Impacts and Mitigation Measures

Chapter 7 | Physical Impacts and Mitigation Measures

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7 PHYSICAL IMPACTS AND MITIGATION MEASURES

The following sections provide an assessment of the potential physical impacts / risks of the Project. Potential issues and findings associated with each physical aspect are discussed and appropriate management and mitigation measures outlined. The anticipated residual impacts are identified and the potential significance discussed for each aspect.

7.1 Physical Landscape and Soils

7.1.1 Issues and Findings

Landforms

The risk of significant impacts to landforms / geomorphology (and corresponding changes to surface flow / hydrology) is generally considered low for Project expansion. Existing Burapha operations have not required significant earthworks during plantation establishment.

The construction of access roads requires some impact on landform morphology with corresponding changes to surface water flow and some associated erosion and sedimentation of watercourses (refer to Section 7-4). Burapha has utilised existing access tracks to the extent practicable for current operations, with some access road extension and road widening / maintenance conducted where necessary. The Company will continue to utilise existing access roads where available as the Project Area expands.

The construction or upgrade of access roads will alter the physical landscape in the following respects:

- Previously arable soils will be compacted, rendering them unfit for flora / terrestrial habitat; and
- Access roads may alter surface water flow direction and velocity and provide substrate for erosion, topsoil losses via sediment transport, and subsequent impacts to aquatic habitat.

Soil Fertility

The Eucalyptus stock that Burapha plants are fast growing clones with high nutritional requirements. A proportion of nutrients are lost from the site when logs are exported, particularly when the trees are debarked at a mill. Additional nutrients are lost during site preparation when slash / vegetation is burned to prepare for planting (as well as potential soil carbon which may enhance soil structure). Lao PDR soils that have been subjected to swidden agriculture are typically nutrient poor, with low pH, and often growth limiting Al^{3+} and $H + Al$ concentrations as a result of the acidity.

Modification in soil fertility and other edaphic characteristics resulting from short-rotation Eucalyptus plantations has increasingly been the subject of scientific assessment in recent years. The findings vary considerably according to local soil character / fertility and the land use prior to plantation establishment. Some common trends (Hernandez *et al.*, 2009; Leite *et al.*, 2010; Rhoades and Binkley, 1996; Pereira *et al.*, 1996 and Herbert, 1996) are similar to that expected from swidden agriculture (refer to Table 7-1), including:

- Decreased exchangeable macro and micronutrients;
- Increased exchangeable Al^{3+} and $H + Al$ content;
- Decreased pH.

Table 7-1 Estimated increased catchment runoff from plantation area

Vegetation	Macronutrients (kg/ha harvested)		
	N	P	K
Natural Forest	16	2.5*	
Short rotation plantation	300	15	141
Cereal crop	750	225	450

*PK combined

Source: White (1987)

Leite *et al.* (2009) found increases in soil organic matter content after several plantation rotations when compared to neighbouring pasture land, though not to the level of neighbouring native forests.

Burapha's soil enhancement program has maintained soil fertility / character to promote rapid growth of plantation trees and agricultural productivity for its current operations. As the Project expands into new areas, the program will have to be similarly robust to maintain fertility for agroforestry operations. The Company will also have to extend its soil management program following the final harvest / at decommissioning to ensure the soils are not depleted prior to hand-over for village use, where agricultural activities or forest regeneration will depend on soil fertility.

7.1.2 Management and Mitigation Measures

Avoidance, mitigation and management measures will be aimed towards selecting appropriate locations for agroforestry operations, sustaining the chemical and physical properties of soils through a soil enhancement program, and implementing controls / measures to minimise soil losses to erosion and sediment transport.

Land Identification and Land Acquisition

Burapha implements the measures identified in its *Land Acquisition Manual* to minimise potential impacts to geomorphology and soil quality, including:

- Land with at least 80% of the area having slopes of less than 35° and vegetation growth that indicates favourable soil character for tree / agricultural productivity;
- Land with established road access or with very little road construction required;
- Characterising soil physical properties and fertility to identify soil profile limitations to cropping and fertiliser input requirements.

Site Preparation

During site preparation, Burapha will need to implement the following measures to minimise impacts to the physical landscape and soil quality by:

- Analysing soils (laboratory) to inform the need for and application rate of:
 - » Dolomite to raise pH and provided Calcium / Magnesium;
 - » Rock Phosphate for Phosphorous deficiency or AL toxicity; and
 - » General nutrients (NPK and micronutrients).
- Ploughing crops / vegetative matter into soil substrate in preparation for intercropping to improve soil structure; provide organic matter with nutrient quality, water holding capacity, and cation exchange capacity;
- Implementing stormwater, erosion, and sediment control measures provided in Section 7.4.2 to minimise soil losses through erosion of cleared areas and access roads.

Operations

After the vegetation clearance activities of site preparation, the rapid establishment of vegetation by crop planting will minimise soil losses from plantation areas to an acceptable level. Diligent application of erosion and sediment control for the road networks according to the management / mitigation measures listed in Section 7.4 will be required throughout operations to minimise soil losses and downstream impacts.

Burapha fertilises during year two of plantation operations to improve soil properties according to soil nutrient deficiencies identified through observation of growth rates and other tree reactions.

Decommissioning

Works conducted at decommissioning of individual lease areas will depend on the outcome of consultation with the GOL and affected villages. Management units will either be rehabilitated to prevent coppice sprouting of Eucalyptus and ongoing domination of the upper canopy or plantations will be handed over to the GOL or village for continued operations. Access roads will similarly require rehabilitation or will be handed over for continued use. Plantation decommissioning is addressed in Chapter 3 (Project Description).

If the area will not be utilised for ongoing plantation operations, it is anticipated that Burapha will rehabilitate plantation areas as follows:

- An herbicide (e.g. Garlon) will be painted on cut stumps to prevent coppice sprouting; and
- Soil pH and fertility will be characterised, and fertiliser applied to promote agricultural productivity or forest regeneration.

If access roads constructed by Burapha are not required for ongoing use by the village (or others), unsealed roads will need to be decommissioned as follows:

- Culverts will be removed and fill material excavated to pre-construction channel depths to avoid scour and sedimentation of watercourses;
- Road surfaces will be ripped to reduce compaction;
- Surfaces will be reshaped for hydrologic compatibility with the surrounding landscape; and
- Assess the post cropping land and soil quality by testing soil physical properties and fertility if natural the regrowth revegetation has been designated as future planned use.

7.1.3 Impact Assessment

Landforms are not expected to be significantly altered through plantation establishment. The ongoing existence of unsealed access roads will contribute to soil losses throughout operations, with erosion and sedimentation from the road network likely contributing to a **Moderate** impact to water quality. Losses to surface soils in plantation plots will be minimised through stormwater, erosion, and sediment control, with **Low** impacts anticipated for receiving waters (refer to Section 7.4 for erosion and sedimentation).

Burapha's soil enhancement program has satisfactorily replenished nutrients to promote plantation tree growth and successful intercropping. It is anticipated that this trend will continue as the operation expands to new areas and for successive plantation rotations. A final soil analysis at decommissioning, and soil condition to alleviate nutrient deficiencies / acid soils will likely provide more fertile soils conditions than that found at the initiation of project activity – given the likelihood of ongoing conversion of fallow forest from swidden agriculture. Impacts to soil fertility are expected to be **Negligible**.

Landforms and Soil Fertility Impact Assessment

Project expansion is expected to have a **Low** impact on surface morphology. Earthworks in plantation areas and use of unsealed roads will provide substrate for soil losses through erosion, with **Moderate** impacts anticipated.

Burapha's soil conditioning program is expected to enhance soil fertility throughout operations and into decommissioning. Impacts to soil character from Project expansion are expected to be **Negligible**.

7.2 Hydrology

7.2.1 Issues and Findings

The potential impacts of industrial Eucalyptus plantations on surface and groundwater hydrology will vary according to the phase of operations, as follows:

1. Surface water runoff and groundwater storage is expected to increase for the first 0 – 1 years following vegetation clearance; and
2. Surface flow and groundwater storage may decrease from years 4 – 7 of the plantation rotation.

The spatial distribution of current plantations across numerous stream catchments and the relatively small size of individual plantations relative to catchment area is likely to have mitigated potential impacts. Due to their respective distances from sensitive receptors, it is considered unlikely that current plantation operations have impacted water availability for beneficial uses (e.g. domestic water use and hydropower) or aquatic habitat, nor increased downstream flooding. With Project expansion, there is risk that operations may impact surface and / or groundwater hydrology if plantations are concentrated within discrete catchments.

The results of extensive research on forest hydrology dynamics identify that surface water runoff and groundwater recharge are highly effected by forest cover (Figure 7-1). In summary, vegetation clearance decreases evapotranspiration and surface water runoff / groundwater recharge increase. Establishment of fast growing trees increases evapotranspiration and surface water runoff / groundwater recharge may decrease relative to fallow forests or agricultural lands.

However, the rate of change is highly variable and potential impacts cannot be accurately quantified given the information available for the region and species. The following section provides a qualitative assessment and a quantitative assessment that is considered indicative only.

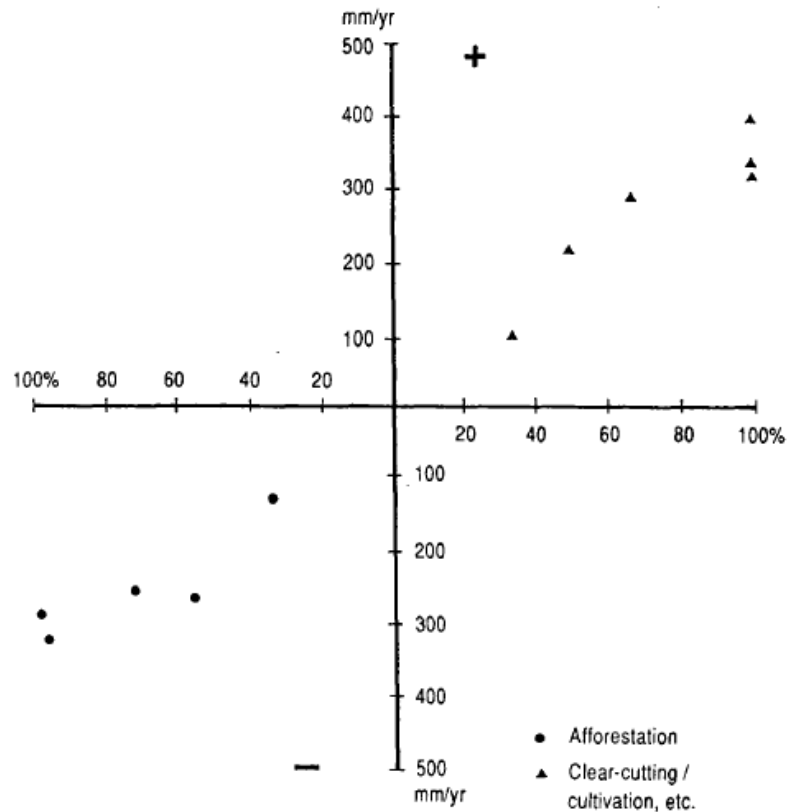


Figure 7-1 Mean annual absolute streamflow change (mm yr⁻¹) with absolute change in vegetation cover (%) showing increases in water yield (+) following clear-cutting and cultivation and decreases (-) with afforestation (source: Anderson and Spencer (1991) - modified from Oyebande (1998))

Plantation Years 0 – 1 Summary Results

Preliminary modelling indicates that clearance of fallow forest is expected to increase annual runoff and peak flow runoff from the plantations by approximately 35% and 33%, respectively (which is consistent much of the literature assessed). Given the relatively small size of plantation units (e.g. 50 – 200 ha) relative to perennial stream catchment area, changes to the hydrograph are expected to be localised in nature, and are not likely to contribute to significant regional flooding.

Table 7-2 provides estimates of increased annual streamflow for hypothetical catchments and the Nam Ngum 1 and Nam Ngum 2 hydropower projects catchments. Assumptions include 35% increase in stream flow during years 0-1 of plantation establishment; 33 and 50 percent of the 60,000 ha Burapha landholdings occur in the NN2 and NN1 HPP catchment areas, respectively; and that 100% of lease areas are cleared of vegetation.

Table 7-2 Estimated increased catchment runoff from plantation area (plantation age 0-1)

Catchment	Catchment Area (ha)	Plantation (ha)	Catchment % occupied by plantation	Percent annual increase in streamflow
Hypothetical small catchment	1,000	200	20.0%	7.00%
Hypothetical small catchment	5,000	200	4.0%	1.40%
Hypothetical medium catchment	10,000	200	2.0%	0.70%
Hypothetical medium catchment	15,000	200	1.3%	0.45%
Hypothetical medium catchment	50,000	200	0.4%	0.14%
Hypothetical large catchment	100,000	200	0.2%	0.07%

Catchment	Catchment Area (ha)	Plantation (ha)	Catchment % occupied by plantation	Percent annual increase in streamflow
Hypothetical large catchment	200,000	200	0.1%	0.035%
Nam Ngum 2 HPP	564,000	5,714*	1.5%	0.53%
Nam Ngum 1 HPP	846,000	8,571**	1.0%	0.35%

*Assumes 33% of 60,000 ha Burapha landholdings in the Nam Ngum 2 HPP catchment (28.57% age 0-1)

**Assumes 50% of 60,000 ha Burapha landholdings in the Nam Ngum 1 HPP catchment (28.57% age 0-1)

Hydropower

Hydropower projects are expected to receive nominal excess input from increased runoff, which will be offset by increased evapotranspiration of established plantations (refer to below).

Preliminary modelling indicates that surface flow increase may be in the order of 0.53% and 0.35% for the Nam Ngum 2 HPP and Nam Ngum 1 HPP, respectively, assuming 33% and 50% of future Burapha landholdings (60,000 ha) are established within their catchments (i.e. 20% of plantations would be 0 – 1 years old).

Plantation Years (4 – 7 yr. old) Summary Results

Plantations have very similar rates of biomass accumulation to pioneer species that revegetate disturbed areas (Lim 1985), thus evapotranspiration rates may be similar in four to seven-year-old plantations to fallow forests of the same age. At the catchment scale, reductions in maximum water yield, were found to be comparable for pine afforestation in southern Africa to first-year increases in runoff following forest clearance (Anderson and Spencer 1991). However, a number of paired catchment experiments have indicated that water use in Eucalyptus plantations exceeds that for Pine plantations. For example, Scott and Lesch (1997) indicated that afforestation with *Eucalyptus grandis* reduced streamflow by 90 – 100% compared to 40-60% in *Pinus patula* for a study conducted in South Africa.

Much of the research on hydrology in Eucalyptus plantation forestry indicates that evapotranspiration is likely to increase relative to the fallow forest the plantations replace, with a corresponding reduction in streamflow / groundwater recharge. Bosch and Hewlett (1982) summarized the results of 94 paired catchment studies and found that Eucalyptus forest types cause an average of 40mm change in water yield per 10% change in cover, with deciduous hardwood and scrub vegetation 25mm and 10mm, respectively (compared to cleared areas and agricultural plots). Other studies have measured decreases in stream flow ranging from 8% to 100% (Scott et al. 2000; Scott and Lesch 1997; Dye and Versfeld 2007; Bosch and Hewlett 1982; Zhang et al 1999).

Evapotranspiration is complex and the number of factors potentially influencing hydrology from change in land use requires broad estimation, with results considered indicative only. The average decrease in surface water flow in literature reviewed for this ESIA indicates was found to be 8 – 24%. As these numbers are indicative of flow from plantation area only that occupy far less than total catchment area (for a perennial stream for example), the actual changes in hydrology will be far less. Table 7-3 summarises the associated potential changes in surface water hydrology on a catchment basis.

Table 7-3 Estimated minimum and maximum decrease in surface water flow (four to seven-year-old plantations)

Catchment	Catchment Area (ha)	Plantation (ha)	Catchment % occupied by plantation	Annual decrease in streamflow	
				Approximate Minimum (%)	Approximated Maximum (%)
Small catchment	1,000	200	20.0%	1.600	4.80
Small catchment	5,000	200	4.0%	0.320	0.96
Medium catchment	10,000	200	2.0%	0.160	0.480

Catchment	Catchment Area (ha)	Plantation (ha)	Catchment % occupied by plantation	Annual decrease in streamflow	
				Approximate Minimum (%)	Approximated Maximum (%)
Medium catchment	15,000	200	1.3%	0.104	0.312
Medium catchment	50,000	200	0.4%	0.032	0.096
Large catchment	100,000	200	0.2%	0.016	0.048
Large catchment	200,000	200	0.1%	0.008	0.024
Nam Ngum 2 HPP	564,000	11,428*	2.0%	0.160	0.480
Nam Ngum 1 HPP	846,000	17,142**	1.9%	0.152	0.456

*Assumes 33% of 60,000 ha Burapha landholdings in the Nam Ngum 2 HPP catchment (57.14% age 4-7)

**Assumes 50% of 60,000 ha Burapha landholdings in the Nam Ngum 1 HPP catchment (57.14% age 4-7)

Hydropower

Using the assumption that surface flow from plantations will decrease by 8 – 24%, impacts to hydropower projects will be nominal. The results indicate that losses from evapotranspiration will be similar water volumes to gains from forest clearance. For example, annual losses in the Nam Ngum are estimated at 0.16 – 0.48% and annual gain is estimated at 0.53%.

Forest Clearance

Stormwater runoff increases following the removal of forests. In extreme storm events and following removal of a significant proportion of vegetation within a given catchment, increased runoff may enhance flood events (potentially impacting community safety and assets in / near watercourses). Forest canopies intercept rainfall which is readily evaporated in tropical climates. Groundwater is more effectively recharged beneath the canopy as a consequence of soil surface protection and high macroporosity and more groundwater is transpired and subsequently does not contribute to surface flow.

Extensive research has documented the changes to the hydrograph following vegetation clearance. Hewlett and Helvey (1970) found increases in surface water flow ranging from 11-22% in a paired catchment study. Mumeka (2009) found peak flows increased by as much as 100% and the time to peak flooding decreased following conversion of forest to agricultural land in Zambia. Ruang-panit (1985) found average surface runoff increased from 2.5 m³/ha to 4.7 m³/ha from forests with canopies with 80-90% crown cover and 20-30% crown cover, respectively in a tropical rainforest. Hewlett and Hibbert (1961) found modal and maximum yield increases of 2.5 and 4.5 mm yr⁻¹ respectively for each percentage fall in forest cover.

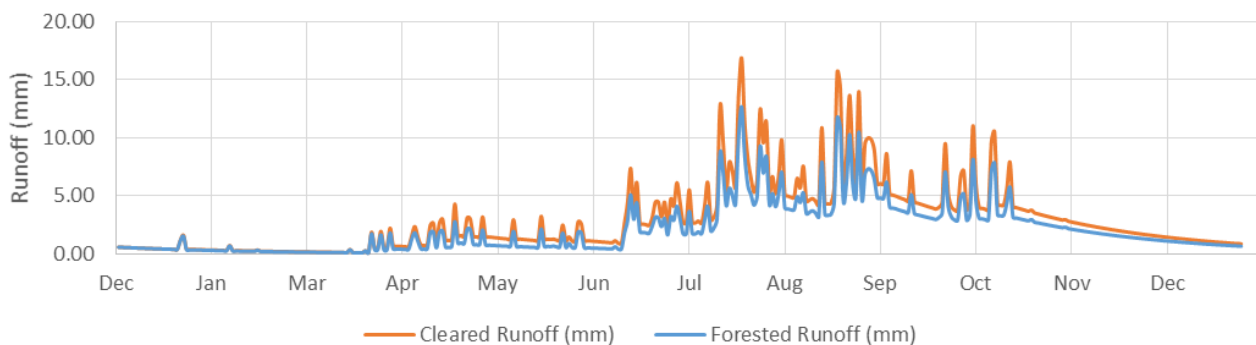


Figure 7-2 Modelled runoff in forested versus cleared catchments, central Lao PDR

Preliminary modelling for this ESIA supports these findings. The SIMHYD¹ hydrologic canopy interception model was setup to simulate median rainy season precipitation. The optimised model was then run with climate data representative of the Project Area catchments for the median year 1997 and canopy interception models for closed canopy forested areas and cleared areas. The model accounted for *Eucalyptus* and intercropping growth (which moderates the runoff values), and assumed forested canopy cover of 95%.

The results from preliminary modelling are provided in Table 7-4.

Table 7-4 Modelled surface water runoff in forested and cleared areas in central Lao PDR

Runoff Percentile	Forested Runoff	Cleared Runoff	Percentage Flow Increase
10%	0.3	0.3	11%
25%	0.5	0.8	51%
50%	1.5	1.8	26%
75%	3.2	4.2	33%
90%	4.9	6.6	33%
Max	12.6	16.8	33%
Annual Runoff	790.9	1070.2	35%

Established Plantations

Studies have conclusively determined that forested areas yield less surface water flow than unvegetated area, grasslands, and agricultural areas (Anderson and Spencer 1991; Sargent 1998; Scott and Lesch 1996). A number of studies have indicated that plantations established in former forests, grasslands, or shrubland areas consume more water than the baseline vegetation they have replaced, reducing streamflow as a result (Albaugh et al. 2013). The reduction in surface flow reflects the fast growth of plantation trees and the associated rate / volume of water lost via transpiration as well as increased evaporation from rain interception.

Eucalyptus species are known for their fast growth rates and corresponding capacity to use available water rapidly. Research indicates that water use in *Eucalyptus* plantations will exceed that of the young or old fallow forests they replace (Scott et al. 2008, Dye and Versfeld, 2007, Albaugh et al. 2013) and are likely to exceed that of natural forests in Lao PDR – though this cannot be substantiated conclusively without a detailed study of evapotranspiration in applicable pristine or regenerating forests.

Lima and O’Loughlin (1985) found that effects on soil moisture reserves in *Eucalyptus* plantations start to appear at the stand age of approximately 4-6 years

Catchment Water Balance

A basic water balance provides a framework for assessing the hydrological behaviour of a catchment and can be used to identify changes in water balance components. A simplified water balance for a catchment can be expressed as:

$$\text{Precipitation} = \text{Evapotranspiration} + \text{Surface Runoff} + \text{Groundwater Recharge} + \text{Change in Soil Water Storage}$$

Evapotranspiration and streamflow account for the greater majority of the water balance. Therefore, it is expected that a change in annual surface runoff associated with land use changes including vegetation clearance and plantation establishment should be reflected in annual evapotranspiration (Zhang et al. 1999), as follows:

- For most hydrological applications, the orographic effect of vegetation on precipitation can be ignored and it is appropriate to assume the precipitation is independent of vegetation type (Zhang et al, 1999);

¹ Simplified hydrological model

- Recharge (the amount of infiltrated water that reaches a groundwater system when too much water is available for vegetation or storage in the rooting zone) is generally the smallest component of the water balance (e.g. less than 5%); and
- The change in soil water storage is often only 5 to 10% of the annual water balance, and is generally assumed to be 0 over a longer period of time (e.g. 5-10 years).

Evapotranspiration

The rate of evapotranspiration from a vegetated catchment is fairly complex, with key processes that control it including rainfall interception, net radiation, advection, turbulent transport, leaf area, and plant available water. The relative importance of these factors depends on climate, soil, and vegetation conditions. Zhang et al (1999) compiled the results of more than 250 applicable studies conducted worldwide and found strong relationships for rainfall distribution and corresponding evapotranspiration, which differ considerably for forested areas versus grassland / agricultural plots (Figure 7-3).

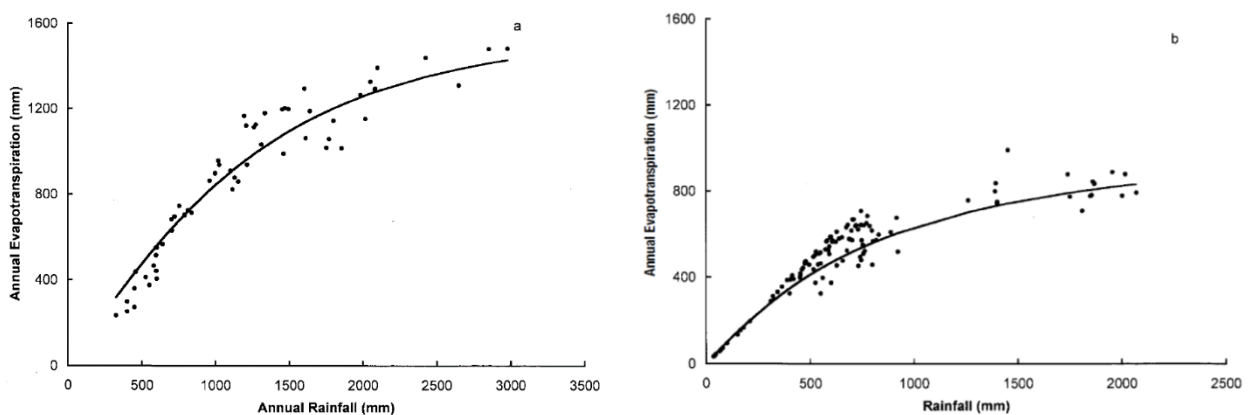


Figure 7-3 Scatter plots of the least-squares fit for (a) forested catchments and (b) grassland catchments.

Transpiration rates in *Eucalyptus* trees are comparably higher than many tree species. There is a strong relationship between tree water use rates and growth rates. According to experiments undertaken at the Forest Research Laboratory, Kanpur (India), *Eucalyptus* were more efficient in water use in comparison to native trees studied. *Eucalyptus* consumed 0.48 litres of water to produce a gram of wood, compared to 0.55, 0.77, 0.50 and 0.88 litre per gram for four native species, respectively (Prabhakar, 1998). However, mean annual growth of *Eucalyptus* per hectare was approximately 16 times greater. Enhanced productivity therefore significantly increased overall water demand. Similarly, Chaturvedi et al., (1988) found that of ten species tested for water consumption, *Eucalyptus tereticornis* was the most efficient in biomass production per litre of water consumed, but also consumed the most water overall, given its high productivity.

The volume of annual transpiration also varies with rooting depth as soil moisture is depleted. The deeper root systems of trees may enable them to access groundwater (Knight 1999). In this manner, plantation trees may reduce streamflow and groundwater reserves as water uptake / transpiration may continue for a considerably longer period of time as the tree delays dormancy and annual transpiration rates may exceed annual rainfall. Calder et al. (1997) found that root growth under *Eucalyptus camaldulensis* plantations in Karnataka, India averaged extension rates of 2.5 m per year, approximately double the rate of teak (*Tectona grandis*). The *Eucalyptus* roots extended to more than 7.4 m depth (maximum depth assessed for the study). The implications for groundwater recharge and surface water flow may be significant. *Eucalyptus* plantation water used approximated 3,400mm over a three-year period, exceeded the rainfall of 2,100 mm over the same period.

Groundwater Recharge and Baseflow

Forests may reduce dry-season flows as much as or more than they reduce annual water yields. Research indicates that baseflow (i.e. dry season flow) has likely increased with conversion of native forests to agricultural land, livestock grazing area, and young fallow forest (Anderson and Spencer 1991; Bruijnzeel, 1990).

Smethhurst et al. (2015) catchment hydrology for seven years, spanning two harvest events of *Eucalyptus grandis* hybrid plantations. Groundwater levels increased by 7.9 – 11.3 m in the months following two clearfelling harvests (seven years apart), with the water table rising 3.5 m beneath a thinned stand (second harvest). Water tables dropped at rates from 0 - 3.5 m per year, which varied according to precipitation.

In recent decades, the Lao people may have become accustomed to increased baseflow associated with vegetation clearance and hydropower projects have benefitted from increased surface water availability. Conversion of fallow to plantations may reverse the trend, with associated perceptions of impacts.

7.2.2 Management and Mitigation Measures

The key management considerations to avoid or minimise the localised impacts on downstream surface waters / downgradient groundwater will occur during land identification / acquisition. Burapha will:

- Avoid clearing a significant proportion of perennial stream catchments (e.g. > 30%) upstream of settlements / assets to avoid impacts associated with increased flooding;
- Avoiding the implementation of plantations immediately upslope of settlement areas to avoid any potential impacts to groundwater resources and water table levels from increased evapotranspiration; and
- Retain native vegetation on at least 10% of management units (no vegetation clearance), including steep slopes near sensitive areas or social receptors and riparian vegetation.

7.2.3 Impact Assessment

Though difficult to quantify volumes, research indicates that *Eucalyptus* plantation establishment on a relatively large scale (relative to catchment area) will increase surface water runoff and groundwater levels following vegetation clearance for approximately one to two years. Due to the likely spatial distribution of plantations across numerous catchments, impacts are expected to be **Low to Moderate** and localised in nature. However, should multiple plantations be established in the same catchment or a large unit comprise a significant proportion of the catchment, floodwaters may impact downstream villages / assets. Burapha will have to assess the location of settlements and assets where large plantations (vegetation clearance) relative to catchment area are planned.

As plantations establish, fast growing *Eucalyptus* plantations will increase evapotranspiration and reduce surface water flow relative to fallow forests that likely comprise the majority of catchments the Company will operate in. **Low to Moderate** level impacts will likely be localised in nature. Groundwater availability for village bores / wells and important surface water resources may be impacted if plantations are established immediately upstream of villages or if a significant proportion of catchments are converted to plantation. If plantation establishment upstream / upgradient of sensitive area is limited in extent (e.g. to 30%) impacts will likely be **Low**.

Hydrology Impact Assessment

Vegetation clearance for planation establishment will increase surface water flow and groundwater recharge until crops have established significant groundcover and tree growth / canopies allow for interception / evaporation and increased transpiration. Impacts are expected to be **Moderate** but will likely be localised in nature. As the Project area expands, Burapha will have to minimise the percentage of catchment area cleared where communities and assets may be impacted by enhanced flooding.

The increase in runoff will have a nominal net benefit for downstream hydropower projects.

As plantations establish, increased evapotranspiration will decrease surface water flow in streams and potentially groundwater availability. **Moderate** level impacts are similarly expected to be localised in nature. As the Project expands, Burapha will need to consider the location of community bores / wells and important aquatic habitat, and should consider limiting the percent of a given perennial stream catchment that will be converted to plantations.

Any decrease in runoff is not expected to significantly impact downstream hydropower operations.

7.3 Water Quality

7.3.1 Issues and Findings

Given the typical distance from industrial activity and population centres, water quality associated with currently plantation areas is generally good. Community beneficial uses are drinking and washing water, livestock drinking water, irrigation water, while good surface water quality supports a host of aquatic species that provide an important source of animal protein for communities in the region.

In the absence of suitable management and mitigation, surface and groundwater quality downstream / down-gradient of plantations, the tree nursery, and the Burapha sawmill may be impacted by the discharge of pesticides, hydrocarbons, fertilisers, additional hazardous / non-hazardous materials and suspended sediment if discharged to receiving waters. These potential contaminants provide risk for beneficial uses of water as well as for aquatic and terrestrial biodiversity.

Investigations of current operations for this ESIA indicate that soil erosion and sediment loading in receiving waters is a key issue, particularly where plantation access roads cross watercourses. Burapha's management of pesticides and other potentially hazardous materials and waste is robust, with well documented management plans. It is anticipated that with continued application of management and mitigation measures, impacts to watercourses from hazardous / non-hazardous waste during Project expansion are unlikely. The potential for erosion and sedimentation will require more robust management during Project expansion to protect aquatic habitat from potential impacts.

Potential impacts to water quality and management strategies are addressed in Sections 7.4, 7.5, and 7.6, for erosion and sedimentation, pesticides and fertilisers, and general waste, respectively.

7.3.2 Management and Mitigation Measures

Management and mitigation measures to protect downstream receiving waters during Project expansion are provided in Section 7.4 – 7.6.

7.3.3 Impact Assessment

Potential impacts to surface and groundwater from erosion and sediment transport, hazardous materials, and hazardous waste are assessed in Section 7.4.3, 7.5.3, and 7.6.3.

In summary, Burapha has a robust management strategy for handling, application, and storage pesticides, fertilisers, and hydrocarbons as well as disposal of associated wastes. Assessment of current operations indicated that the Company enforces these management and mitigation measures, with no impacts identified and the likelihood of historic impacts considered low. Given the diligent application of these management measures across additional plantation areas and at Work Camps, the likelihood of impacts during Project expansion are expected to be **Low**.

Vegetation clearance for plantation establishment every seven years and the ongoing existence of unsealed plantation access roads will promote erosion of soil surfaces and subsequent sediment loading in receiving

waters (refer to Section 7.2.2). Management measures (including riparian vegetation retention, planting trees to contours, and erosion and sediment controls on road surfaces) will minimise sediment inputs to the extent practicable, with **Moderate** impacts anticipated during the first rainy season following site preparation and **Low** impacts during subsequent years from the road network (refer to Section 7.4).

Water Quality Impact Assessment

The management of hazardous materials in current Work Camps and the tree nursery and mitigation requirements during application in current plantations has significantly minimised the associated risks for water quality. With diligent application of Company management and mitigation strategies, oversight of tree nursery contractors, and implementation of an effective water quality monitoring regime, impacts to water quality from hazardous materials are expected to be **Low**.

7.4 Erosion and Sedimentation

7.4.1 Issues and Findings

Plantations

Assessment of Burapha's current operations indicates that erosion of soil surfaces and sediment transport from cleared plantation areas has been relatively minor, with silvicultural methods and intercropping minimising impacts. Burapha plants plantations with tree rows along contours which increases infiltration of water into the substrate and reduces surface flow velocity. Retention of natural vegetation in riparian corridors has minimised streambank erosion and filtered sheet flow runoff, removing some of the sediment from suspension before it reaches the stream.

However, erosion and sedimentation of receiving waters from cleared plantation areas will remain a key issue for management of Project expansion. Potential impacts from erosion and sediment transport include topsoil loss and associated impacts to soil fertility and structure, suspended sediment impacting the quality of aquatic habitat, turbidity impacting visual amenity, and in extreme cases – impacts to beneficial uses of water for downstream villages.

Many of the soils that dominate the Project expansion area (often Acrisols and Cambisols) are fairly dispersive. Given the precipitation regime in central Lao PDR, with moderately high volumes of rainfall throughout the rainy season and often intensive rains from July – September, soils are prone to erosion following vegetation clearance. Plantation area will be particularly susceptible to erosion during the first rainy season following vegetation clearance, after which cover provided by plantation trees and agricultural crops are expected to stabilise soil substrate. Vegetation clearing promotes rain erosion, whereby the impact of raindrops dislodges particles. Roots also anchor soil on sloped land. Robust management will be required to protect soil quality and receiving waters throughout Project expansion areas.

Plantation Access Roads

Assessment of current Burapha operations for this ESIA identified a number of areas where access roads are eroding (particularly near stream crossings), contributing sediment to watercourses and impacting the quality of receiving waters. Unsealed access roads erode and significantly contribute to erosion of neighbouring landforms. Roads intercept, concentrate, and direct water from potentially large catchments on compacted surfaces to receiving waters. With increased water volumes and water velocity, the erosive capacity of waters discharging from roads may be significant. Research had identified that unsealed roads contribute significantly more sediment to receiving waters on a per unit area bases than cleared or uncleared forest area (Motha et al. 2003) particularly at stream-crossings (Wang et al. 2013). Wang et al. (2013) found significant impacts for the first seven months following construction of an access road and stream crossing in a forested area, with a sharp

reduction in sedimentation following vegetation establishment, but impacts still occurring (i.e. turbidity and TSS higher than pre-construction) at the conclusion of the study six years later.

Many unsealed roads in rural Lao PDR lack suitable stormwater management and erosion and sediment control measures are commonly not applied. As Burapha will favour the use of existing roads for Project expansion, roadworks is required to effectively manage stormwater to minimise erosion. Erosion and sediment control measures near stream crossings will be required to minimise impacts and annual road maintenance will be required to mitigate ongoing impacts.

Plantation Management

The operation of agroforestry plots has resulted in the following soil beneficial and negative erosional impacts associated with intercropping, weeding and livestock activities.

- The rice intercropping has shown to provide a good cover of exposed soil in-between Eucalypt stands during the first year of operations. This practice has mitigated long-term soil losses.
- The planting of cassava instead of rice has exposed soils over successive wet seasons, increasing the risk of inter-rill erosion and soil loss before an adequate canopy cover is achieved.
- Similar to site preparation, the operation of machinery has resulted in soil compaction and may provide preferential drainage pathways and subsequent erosion through track rutting, bunding etc.

7.4.2 Management and Mitigation Measures

Stormwater management on unsealed access roads and erosion / sediment control (ESC) in plantation areas and access roads is required to minimise impacts to receiving waters. The management regime requires planning, implementation, and maintenance. Measures are required during land identification / acquisition, plantation and road establishment, throughout operations, and upon decommissioning.

The following sections identify current Burapha measures and additional measures that will be implemented during Project expansion and throughout operations to minimise impacts.

Land Identification and Acquisition

A key component of Burapha's Land Acquisition Manual is its Land Selection Criteria, which includes the following criteria associated with protection of watercourses from erosion and sedimentation;

- At least 80% of the potential Forest Management Unit will have slopes < 35°;
- Soils will be capable of promoting rapid vegetation establishment; and
- Access will be considered to minimise road construction requirements.

Site Preparation and Establishment

Management during site preparation and road construction / upgrade are the most important components of the ESC management program. Burapha will need to apply the following to manage and mitigate potential erosion and sediment transport during site establishment:

Design and Planning

- Mapping existing topographic features and location of all surface waters to identify the most appropriate access road construction layout (minimises stream crossings) and inform stormwater and ESC requirements (refer to below).

Scheduling and Phasing

- Scheduling construction of roads, associated stormwater channels, and installation of ESC facilities for early in the dry season for completion in advance of the rainy season;

- Phasing soil disturbing activities such that critical areas (highly erodible soils, areas adjacent receiving waters, steep slopes, etc.) are not disturbed during the rainy season to the extent practicable. Priority will need to be given to stabilising / planting steepest slopes / areas near watercourses to limit the time of soil exposure;
- Implement forestry best practices for vegetation clearance during the rainy season (e.g. hand clearing, windrows, vehicle exclusion zones, etc.);
- Stripping and stockpiling topsoil early in the dry season to allow for implementation of ESC facilities in cleared areas and for soil stockpiles; and
- Planning grading activities to minimise the length of time between initial soil exposure and final grading.

Plantation Establishment

- Planting tree rows to contour and ripping soil along the contour line to promote water infiltration on machinable land;
- Clearing of vegetation by hand to the extent practicable to minimise compaction;
- Prohibiting machine clearing for slopes >15°, hand clearing vegetation on slopes from 15-25°, requiring a permit from Company CEO to clear sloped ranging from 25-35°;
- Prohibiting vegetation clearance on slopes steeper than 35°;
- Refining the Burapha riparian vegetation retention policy to be more robust. It is recommended that natural vegetation be retained in riparian corridors, as follows;
 - » **Seasonal Streams** – protected by a buffer zone of 5 m on each side of the stream bank, with all natural vegetation retained. Seasonal streams have a stream bed and bank, with water flowing at least intermittently during the rainy season, but less than 365 days / year;
 - » **Perennial Stream** - protected by a buffer zone of 10 m on each side of the stream bank, with all natural vegetation retained. Perennial streams flow for 365 days in an average precipitation year.
 - » **Perennial Rivers** - protected by a buffer zone of 25 m on each side of the stream bank, with all natural vegetation retained. These can be defined by name (i.e. “Nam” = River) or stream width (reaches 10 m width in the Project Area).
- Clearly delineating and marking edge of clearance / vegetation retention areas and training staff to ensure avoidance of vegetation in riparian areas;
- Where rice is not planted, planting Vetiver grass in-between select tree rows across steep plots to divert or break slope lengths/water and improve soil infiltration. Vetiver grass may also be used to stabilise road margins to help break flow velocity.

Road Construction / Upgrade

Burapha will need to employ the following on newly constructed roads and during upgrade of existing roads to the extent practicable:

- Constructing / upgrading roads during the dry season to the extent possible and completion of ESC facilities for unsealed roads before the onset of the wet season;
- Designing roads to include a drainage system that channels water from road surfaces to outlets with ESC facilities, including rip-rap at inlets and outlets of culverts and channels and sediment control basins constructed for larger catchment areas;
- Construction roads with cross-fall slopes (maximum 3%) to promote rapid drainage from unsealed road surfaces to avoid scouring.

- Constructing waterbars (as per below) where cross-fall is insufficient, to direct water to road discharge channels;
- Constructing conveyance channels for the uphill side of road networks to move stormwater from inslope to discharge on vegetated areas greater than 100m from watercourses, to the extent practicable;
- Installing culverts at drainage crossings, perpendicular to the road alignment and implemented with appropriate slopes to facilitate water and sediment movement;
- Minimise batter slope angles to the extent feasible;
- Transporting excess soil to temporary stockpiles, with stockpile locations identified prior to the onset of construction;
- Leaving vegetation intact on road verges and roadside batters to the extent practicable to reduce surface flow velocity and erosive potential;
- Constructing waterbars prior to the onset of the rainy season on road surfaces within 250 m of watercourse crossings, according to spacing in Table 7-5;
- Planting Vetiver grass (Truong *et al.*, 2008) or other native grasses for erosion control on roadside batter slopes (i.e. 3:1 or greater) in the absence of rice.

Table 7-5 Waterbar spacing on roads within 250 m of watercourse crossing

Percent Slope	Spacing (m)
<5	75
5 – 15	45
15 – 30	30
>30	15

Operations

The following management / mitigation will need to be employed during plantation maintenance / harvest phases:

- Maintaining ESC facilities annually and prior to the onset of annual rains, throughout operational areas with the intent of completion by March of each year;
- Scheduling harvest and haulage of Eucalypts for the dry season; and
- Prohibiting work off of road surfaces / sealed surfaces during heavy rains to minimise soil compact and erosion.

Decommissioning

Burapha will need to consult with the GOL and village authorities for end-land uses following the completion of the lease. Burapha (in consultation with the GOL / village) will either (a) sign a new lease to extend the time period for operations; (b) hand the facilities over to the GOL or village for continued *Eucalyptus* plantation operations; or (c) decommission the area for reestablishment of native vegetation. Decommissioning of plantations is discussed in the *ESMMP* (Volume D, Chapter 5).

Roads will be similarly addressed near the end of the concession / lease period. Burapha will consult with the GOL / village to identify whether the road will be handed over to the State / village or will be decommissioned. Burapha will employ the following for roads that will be decommissioning (if applicable), where the end land use is identified as natural vegetation, in-part to avoid ongoing erosion and sediment transport:

- Ripping road surfaces to reduce compaction;
- Reshaping contours for hydrologic compatibility with the surrounding landscape;

- Revegetation with native plant species of local provenance; and
- Re-directing drainage as necessary to minimise erosion until vegetation is established.

7.4.3 Impact Assessment

The Burapha Agroforestry Project will manage stormwater and apply erosion and sediment control measures that effectively minimise erosion and sediment transport. As the Project expands into new areas, more robust measures for minimising erosion of roads near watercourse crossings and enhanced requirements for vegetation retention in riparian corridors will improve outcomes. While some erosion and sedimentation is unavoidable, given the seasonal rains and vegetation clearance requirements for plantation forestry, impacts to water quality are expected to be Moderate, with no significant impacts to beneficial uses of water and aquatic habitat.

Erosion and Sedimentation Impact Assessment

Impacts to water quality from erosion and sedimentation have been most pronounced where access roads cross watercourses. With the implementation of stormwater, erosion, and sediment control facilities on access roads and retention of larger riparian buffers during Project expansion, impacts from erosion and sedimentation on water quality are expected to be **Moderate**, but localised in nature.

Impacts to beneficial uses of water and aquatic habitat are expected to be **Low** on a regional basis and potentially more significant for localised areas.

7.5 Fertilisers, Pesticides, & Other Chemicals

7.5.1 Issues and Findings

Burapha operations (nursery and plantations) require the use of a number of hazardous materials, including pesticides / herbicides, hydrocarbons, and fertilisers; some of which generate waste (collectively referred to as hazardous materials). If improperly managed, these materials may pose a threat to community and occupational health and safety; water and soil quality; and biodiversity. To-date, management measures have been suitably robust at Work Camps, the tree nursery, and in plantations, with no historic impacts substantiated for this ESIA.

Due to the increased volumes of these materials required for the Project expansion, diligent application of management and mitigation measures will be required to avoid potential impacts.

Burapha has *Standard Operating Procedures* and *Work Instructions* for chemical / fertiliser storage and handling and have refined their ***Emergency Preparedness and Response Plan*** to incorporate international best practices for transport, storage, handling / application of hazardous materials and appropriate disposal of hazardous waste as well as protocols for responding to an accidental discharge. Burapha staff will routinely monitor storage and handling of these materials to ensure that Company procedures are effectively implemented.

It is anticipated that Burapha will review and periodically change the specific pesticides / herbicides and fertilisers utilised for plantations / nursery applications. The following section evaluates materials currently used for Company operations.

Plantations

Burapha currently utilises the following hazardous materials for plantation establishment and operations:

- Herbicides, including Glyphosate and Metsulfuron.

- Soil conditioners and fertilisers such as Dolomite, Rock Phosphate, Boron and general fertiliser (NPK 15-15-15); and
- Hydrocarbons for vehicles and equipment.

Herbicides

Burapha uses Glyphosate and Metsulfuron for broad scale weed control. Both are broad spectrum herbicides that are generally used as foliar applicants. Over-application, poorly time application (i.e. with rain forecasted), or inadvertent application on non-target plants may impact vegetation planned for retention, excess material may discharge to receiving waters, and spilled material may impact soil quality.

Glyphosate

Glyphosate is a non-selective herbicide that prevents the plants from making certain proteins required for plant growth. The following is summarised from Cornell (1994). The herbicide binds tightly to soil particles and will persist until broken down by microbial degradation and is therefore not likely to pollute groundwater. Because Glyphosate is tightly bound to the soil, little is transferred by rain. One study found that less than two percent of the applied chemical is lost to runoff in the event of rain following application. The herbicide can move when attached to soil particles in erosion / sediment transport. In water, the herbicide is strongly adsorbed to suspended organic and mineral material and is broken down by microorganisms. Its half-life in water ranges from 12 days to 10 weeks.

Glyphosate is virtually non-toxic for fish, non-toxic for mammals, and slightly toxic for birds. There is very low potential for the compound to build up in the tissues of aquatic invertebrates, other aquatic organisms, as well as terrestrial species.

The herbicide has low toxicity for humans. Accidental ingestion of glyphosate formulations is generally associated with only mild, transient, gastrointestinal features. Dermal exposure to ready-to-use glyphosate formulations can cause irritation and photo-contact dermatitis has been reported occasionally. Inhalation is a minor route of exposure but spray mist may cause oral or nasal discomfort, an unpleasant taste in the mouth, tingling and throat irritation. Eye exposure may lead to mild conjunctivitis, and superficial corneal injury is possible if irrigation is delayed or inadequate.

Metsulfuron

Metsulfuron is used as a selective pre and post-emergence herbicide for broadleaf weeds and some annual grasses. It is a systemic compound with foliar and soils activity and it works rapidly after plant uptake. The herbicide inhibits cell division in the shoots and roots of the plant. Because it has residual activity in the soils, it is necessary to allow ample time for the chemical to break down before planting certain crops.

Residual Metsulfuron has a very low toxicity for mammals, birds, fish and insects (refer to MSDS for detailed toxicology) and does not bioaccumulate. The chemical is fairly mobile as its residues will predominate in the water phase over sediment, and the herbicide or its metabolites may persist in groundwater / surface water over time. The principal risk is the foliar uptake (spray drift) by non-target vegetation.

The environmental fate is largely dependent on soil temperature, moisture content, and Ph. The chemical will degrade faster under acidic conditions, in soils with high moisture content, and high temperature (broadly consistent with Lao PDR). Half-life estimates for Metsulfuron range from 14-180 days, with an overall average of reported values of 30 days (Cornell, 1993). The residue is moderately persistent in water, with a half-life for dissipation of > 84 days when high concentrations are applied, and ~20 days at concentrations applied for typical forestry uses (Thompson et al. 1992).

Chronic and acute toxicity assessments have found no observable effects and very low toxicity, respectively for terrestrial and aquatic biodiversity.

Fertilisers

Fertilisers may impact water quality through the leaching of nutrients due to over-application, inappropriate application timing, inappropriate storage, or unsecure disposal. Excess nutrient leaching is unlikely to result in high impacts to sensitive receptors as the toxicity is low and is readily mineralised by natural environmental metabolic process. Over-fertilisation may lead to the eutrophication of waterbodies, which may decrease dissolved oxygen level, potentially impacting aquatic biodiversity.

Hydrocarbons

Diesel fuel or other hydrocarbons will be utilised for vehicles / equipment and potentially for power generation. The accidental release of hydrocarbons may impact receiving waters (surface and groundwater) and soil quality. Hydrocarbons are also a fire hazard, which threatens occupational health and safety as well as air quality.

Tree Nursery

Several hazardous materials are utilised at the nursery. Residences are nearby, with households having wells / bores in proximity to the nursery (i.e. ~200 m). Groundwater is used for gardens / domestic water (not drinking water), surface waters drain to an important fishery, and livestock / biodiversity utilise receiving waters. The following materials and their associated waste products provide risk that will need to be managed to avoid impacts:

- *IBA* (active ingredient 3-Indolebutyric Acid) - used to stimulate root generation in cuttings for clonal production;
- *Benlate (benomyl)*– a fungicide that is selectively toxic to micro-invertebrates and invertebrates;
- *Funguran* (copper hydroxide) – a broad scale fungicide;
- *Termicide* – a pesticide to control termite attack;
- *Glyphosate* – for weed control;
- *Metsulfuron*- for weed control;
- *Hydrocarbons* – for power generation; and
- *Fertilisers* – to promote tree growth.

IBA

IBA (3-Indolebutyric Acid) is a synthetic auxin used by Burapha to initiate root formation in clonal Eucalyptus cuttings. The odourless powder has significant acute and chronic toxicity for humans and other mammals if ingested at high doses, and causes skin irritation, eye irritation, and respiratory tract irritation with exposure at lower doses. Information on ecotoxicity was not available.

Benlate

Burapha dips clonal plantation stock in Benlate to minimise that chance for transfer of various pathogens from the nursery to plantations. The fungicide has no acute toxicity for mammals, but may cause skin irritation, moderate eye irritation. The chemical has reportedly caused headaches, diarrhoea and sexual dysfunction for unprotected agricultural workers.

The primary concern with Benlate involves potential chronic effects. In 1993, a possible link was identified between exposure of pregnant mothers to benomyl and their children being born without eyes (anophthalmia) or with related syndromes including reduced eyes and blindness due to severe damage of the optic stem. Studies have since demonstrated that eye defects can occur at relatively high doses (pan-UK, 1997).

Benlate binds strongly to soil and does not dissolve in water to any great extent. When applied to grasses, it has a half-life of three to six months, and when applied to bare soil the half-life is six to 12 months (pan-UK, 1997).

Funguran

Funguran (copper hydroxide) is a fungicide that Burapha employs as a preventative measure to combat the potential spread of blights, rust, etc.

Copper hydroxide is hazardous in the case of ingestion (potentially fatal), potentially damaging to eyes, and slightly hazardous in the case of skin contact or inhalation (irritant). The pesticide is very toxic for aquatic life and may have long lasting implications if discharged to receiving waters.

Termicide

Termicide is used for termite control at the nursery. There are several termiticides marketed – each having slightly different toxicity levels for humans and terrestrial / aquatic biodiversity. The majority are highly toxic if consumed and a mild irritant from skin contact.

Termicide is toxic to certain aquatic species and for bees. It is extremely important that surface and groundwaters are not contaminated. The substance shows a medium adsorption to soil and is classified as immobile – not likely to leach to groundwater.

Most termiticides emit highly toxic fumes in the event of burning (hydrogen chloride, hydrogen cyanide, carbon monoxide). Respiratory protection is required for use of the substance and firefighting.

Glyphosate, Metsulfuron, and Hydrocarbons

As above.

7.5.2 Management and Mitigation Measures

Burapha will develop or refine, implement, communicate, adhere to and maintain relevant and current planning documents / databases, including the following:

- **Waste Management Plan** – The Plan will need to define all on-site and off-site strategies, operational controls and management practices relating to hazardous and non-hazardous waste management. Hazardous materials and potential waste streams and their sources will need to be identified, classified and managed;
- **Hazardous Materials Register** – The Register will need to specify: the name and description of materials; classification (code, class, or division) of Hazmat; quantity stored / used per month; maximum intended inventories and safe upper / lower parameters; characteristic that makes it Hazmat (flammability, toxicity, etc.); and chemical incompatibilities (e.g. a matrix).
- **Emergency Preparedness and Response Plan** – Burapha will need to refine the current Plan to identify all communication protocols for emergencies, with appropriate phone numbers posted in the plan and storage areas; internal and external (community) notification procedures and contact details; specific responsibilities for individuals and groups; decision processes for assessing severity of the release and determining appropriate actions; and facilities evacuation route(s) and staging areas.

Burapha will update their current *Standard Operating Procedures* and *Work Instructions* for Hazardous Materials, to incorporate management measures outlined below and in the Project **ESMMP** (Volume D) to ensure the safe transport, storage, handling and appropriate disposal of hazardous materials located at work camps, the tree nursery, and plantation areas and protection of occupational and community health and safety and ecological values.

Training

Employees and relevant contractors will need to be trained to manage hazardous materials, meet compliance with regulatory requirements, apply proper use of PPE, and understand emergency response and preparedness planning. Training programs will need to include:

- List of employees to be trained;

- Specific training objectives;
- Mechanisms to achieve objects (e.g. hands-on workshops, videos, etc.);
- The means to determine whether the training program is effective;
- Training procedures for new hires and refresher courses for existing employees; and
- Inspection and maintenance procedures.

Personal Protective Equipment

Burapha supplies PPE for all chemical handling. The Company will need to review MSDS and product labels and:

- Ensure PPE utilised offers adequate protection for materials stored and handled on-site;
- Identify PPE that is commensurate with risks / toxicity;
- Supply appropriate PPE and require its use at all times; and
- Routinely monitor staff to ensure PPE are utilised at all times.

Herbicide Application

Burapha manages herbicide applications accordingly:

- The use of nationally and internationally banned chemical pesticides or herbicides, as well as World Health Organization Type 1A and 1B and chlorinated hydrocarbon pesticides is prohibited;
- Herbicides is mixed and applied according to MSDS and label instructions;
- Herbicides is mixed at least 50 m from watercourses; and
- Herbicides is not applied if rain is forecasted or likely for the day.

In addition, the Company should consider:

- Mixing herbicide tanks with an inert dye prior to application to ensure that only target species are sprayed, and over-application is avoided;
- Posting MSDS and label instructions in work camps and at the nursery in Lao and English languages;
- Ensuring the full contents of containers are be used and rinsing / disposal in accordance with MSDS / label; and
- Ensuring suitable clean up material are on-hand for all applications.

Fertilisers

- Burapha uses quality certified sources of fertilizers; and
- Where applicable, soils are tested for nutrient status / pH prior to fertilisation to ensure that areas are not over-fertilised.

Storage

- All hazardous materials storage installations are well-ventilated areas that are protected from rain. Facilities (including temporary), will need to be designed and constructed for secondary containment which have the capacity to hold a minimum of 110 percent of the volume of the largest tank in the containment area.
- Secondary containment for bulk storage tanks will need to have a typical water permeability equivalent to untreated concrete;
- Where applicable, storage facilities will need to include suitable fencing, signage, roofing, and lighting;

- Incompatible materials will need to be segregated / stored in separate facilities - corrosive, oxidizing, and reactive chemicals need to be separate from flammable materials and from other chemicals of incompatible class (e.g. acids and bases, oxidizers vs. reducers, etc.);
- Watertight receptacles need to be provided for waste oil, oily rags, spent oil filters, solvents and oily containers;
- Suitable clean-up materials (e.g. Sorbex) need to be stored in appropriate locations for quick response by trained personnel;
- Herbicides, pesticides, fertilisers, fuel etc. will need to be labelled with appropriate signage that indicates the level and type of risk. Original containers should be utilised.

Transport

- Burapha staff transporting hazardous materials to site need to be trained in handling, emergency communication, and clean-up procedures; and
- Hazardous materials transporters need to have readily available emergency response plans and clean-up materials.

Disposal

Hazardous materials disposal methods will be described in the *Waste Management Plan*, including the following:

- Hazardous waste disposal strategies, including the use of licensed off-site facilities unless otherwise described in MSDS and product labels;
- If suitable off-site disposal facilities for hazardous wastes are not available or are not adequate in protecting human health and the environment, on-site disposal options will be considered where legally authorised; and
- On-site disposal facilities need to be supported by scientifically defensible studies that demonstrate compliance with relevant laws and permits and will avoid potential impacts on human health and the receiving environment.

Vehicle Maintenance

- Vehicle maintenance bays, equipment laydown areas and re-fuelling stations need to be constructed on impervious surfaces (equalling concrete) and any potentially oily runoff from these areas needs to be contained by perimeter bunding or interception drains; and
- Maintenance and refuelling areas are sited more than 100m from the surface waters.

Occupational Health and Safety

Burapha requires strict adherence to *Chemical Handling SOPs* and *Work Instructions*, specifying personal protective equipment (PPE) requirements for all personnel applying herbicides, fungicide, termicide, IBA, etc. However, documentation and training will need to be refined for specific roles at the Company, to ensure personnel are aware of risks, and are provided suitable protection.

The Company will need to review and potentially update their OHS policies for the nursery and Work Camps to ensure:

- That PPE requirements are suitable for the hazardous materials utilised, as per MSDS and product labels (e.g. respirators, lab coat, safety glasses, boots, gloves, self-contained breathing apparatus for IBA); that PPE are readily available, and utilised appropriately;
- Up-to-date and relevant information from Materials Safety Data Sheets is incorporated into training;

- Appropriate signage (Lao and English languages), colour coding, etc. clearly identifies hazardous materials;
- At risk people are not exposed to hazardous materials (e.g. Benlate may cause birth defects – pregnant women need to be aware); and
- That training and hazardous materials storage, handling, and disposal procedures are suitably robust to protect staff.

Reporting

- Communication protocols and contact numbers are identified in Burapha's **Emergency Preparedness and Response Plan (EPRP)**. The **EPRP** will need to be refined as the Project expands to include additional contact details, and precise protocols for responding to emergencies in site-specific locales;
- Spills or releases of hazardous materials will need to be reported to regulatory authorities; and
- Communication lines will need to be established with local emergency service groups. Information related to hazardous materials will be reported to local emergency services in the event of a spill.

Monitoring

- Hazardous materials storage areas and distribution, transport, and handling procedures will need to be routinely monitored (refer to **ESMMP**, Volume D) to verify that management and disposal conforms to applicable standards; and
- The results of audits will need to be recorded and included in monthly and annual reports.

7.5.3 Impact Assessment

Adherence to management and mitigation measures listed above for transport, storage, handling, containment, and disposal of pesticides / other hazardous materials and waste products are expected to minimise the likelihood and severity of impacts.

Herbicides used in plantations have relatively low persistence, low toxicity, and are biodegraded by microbes rapidly. With the diligent application of management measures identified above, risks are minimal and impacts are expected to be **Low**.

Herbicides, Fertilisers, & Other Chemicals Impact Assessment – Plantations

With the application of management measures currently required for Company operations, and incorporation of measures identified above and detailed in the ESMMP, the risks associated with storage and application of herbicides, fertilisers, and other chemicals and disposal of waste products are expected to be suitably mitigated, and it is anticipated that impacts will be **Low**.

The pesticides and rooting hormones utilised at the nursery range from non-toxic to toxic for humans and biodiversity, and present a risk for occupational and community health and safety and biodiversity in downstream receiving waters. Robust management for occupational and community health and safety are required to minimise risks and avoid impacts. With continued adherence to Company policies and routine monitoring of storage, application, PPE utilisation, etc. impacts are similarly expected to be **Low**.

Pesticides, Fertilisers, & Other Chemicals Impact Assessment – Nursery

With a review of MSDS / product labels, and monitoring to ensure staff use appropriate PPE during chemical handling, it is anticipated that risks to occupational health and safety will be minimised and impacts avoided. Company strategies for transport, storage, handling, and disposal of hazardous materials and fertilisers is considered suitably robust to minimise the likelihood and severity of impacts to receiving waters, soil,

biodiversity, livestock, etc. Burapha will need to ensure that the contracted labour at the tree nursery adhere to similarly robust management measures.

With the diligent application of management measures identified above and detailed in the ESMMP, impacts are expected to be **Low**.

7.6 General Waste

7.6.1 Issues and Findings

General waste such as plastic, paper, metals, wood and food scrap wastes will be generated at work camps and the nursery. As wastes break down, leachate (potentially including heavy metals and persistent organic particles (PoP) / compounds) may discharge and accumulate. Improper storage and disposal contaminate receiving surface water; increase in populations of scavenging wildlife due to food wastes, including rats, birds and monkeys and other potential vectors for disease; and impact visual amenity.

Sewage from camps will provide a potential source of nutrients and pathogens that may be released into receiving waters via greywater or septic systems. Contaminated surface run-off from solid waste storage areas may convey additional sources of pathogens and nutrient loads to local surface and groundwater if not properly managed.

7.6.2 Avoidance, Mitigation and Management Measures

General waste will be appropriately stored and managed to avoid potential impacts. Waste management may require the construction of specifically designed facilities at work camps (i.e. storage and separation area for recyclables; residue waste landfill for non-recyclables and non-hazardous materials; sewage and grey water treatment plants) whereas the nursery will likely require only small refinement of storage / handling (e.g. greater separation of waste and assessment of recycling opportunities).

Waste management should be based on the following hierarchy (in decreasing order of preference):

1. Minimise the production of waste.
2. Maximise waste recycling and reuse.
3. Treatment of waste.
4. Safe waste disposal.

The first priority for the management of wastes should be to reduce the volume of generated, which may be achieved by:

- Procuring supplies that produce less waste by virtue of the way they are produced, packaged or consumed;
- Procuring supplies that have been produced from recycled materials, if possible; and
- Maximising the efficiency of all on site production processes.

Burapha will need to develop, implement, communicate, adhere to and maintain a relevant and current *Waste Management Plan* which defines all on-site and off-site strategies, operational controls and management practices relating to hazardous and non-hazardous waste management. The Plan should be periodically reviewed or updated whenever relevant changes are made to site operating practices. Potential waste streams and their sources need to be identified, classified and managed during operations and incorporated into the *Waste Management Plan* and the design of on-site facilities.

Burapha will need to develop and implement a process for segregation of non-hazardous and hazardous wastes that is appropriate to their disposal methods. To maximise recycling and reuse, non-hazardous waste should be segregated into three categories as follows:

- Biodegradable materials – vegetation and food scraps;
- Recyclable materials – processed timber; hard plastic; glass; metal; paper and cardboard; and tyres (waste will be further segregated within this category.); and
- Non-hazardous residue waste.

Additional measures will include:

Temporary Waste Containment

- Provide a sufficient number of waste containers and locate them strategically at Work Camps / operational areas to ease disposal;
- Secure lids to bins that store food waste to prevent scavenging; and
- Provide rain protection for all temporary waste facilities.

Recycling

Burapha will need to investigate recycling facilities located in proximity to the tree nursery and work camps, and will transfer recyclable waste (batteries, tyres, glass, paper, scrap metal, aluminium cans), if available.

Waste Collection and Off-Site Disposal

- Burapha will need engage a suitably licensed waste collection and disposal contractor for the nursery and work camps (if applicable);
- Waste will need to be disposed of at sites approved by local authorities. Non-hazardous waste may be disposed of at landfill sites. The landfill sites must be more than 50 m from a watercourse and be covered by soils on a weekly basis (when in use) to avoid scavenging by pests and dispersion of the rubbish;
- Off-site landfill facilities should be approved by local authorities;
- Waste will be collected regularly and further sorted where required.

Burning

Burapha may need to acquire permits from relevant GOL authorities to burn waste. Waste burning at work camps and plantation areas will need to require adherence to management measures for wildfire (refer to Section 7.7);

- Plastics and other substances that may generate toxic fumes will not be burned;
- Site personnel will need to be present, with suitable equipment for firefighting available; and
- Burning will not be conducted on dry, windy days.

Landfills

- Landfills will need to be designed, constructed and operated to ensure geotechnical stability, prevention of adverse impacts to wildlife, and surface and groundwater quality;
- The potential for leachate generation and the estimated leachate impact from landfills should be evaluated and managed. Discharges from landfills will meet applicable standards;
- Waste disposed of in landfills should be routinely covered to prevent wind-blown dispersion of litter and odours and to limit access for native fauna / pest species;

- Landfill sites will need to have a fence or berm erected around their perimeter. Signage at the entrance will include appropriate contact information, accepted wastes for disposal, and banned wastes from disposal;
- Off-site treatment and / or disposal facilities should be inspected prior to their selection and use to verify that they are engineered and operated in a manner that protects human health and environmental receptors. Periodic follow-up inspections of these facilities are likely required; and
- Non-hazardous waste storage and disposal facilities will need to be periodically audited to ensure the efficacy of environmental management measures.

Sewage

Appropriately sited and sized septic systems and greywater treatment facilities will need to be employed at work camps. Routine monitoring will ensure:

- That treatment facilities are appropriate to prohibit discharge of nutrients and pathogens; and
- Housekeeping is sufficient to avoid potential health impacts.

7.6.3 Impact Assessment

The successful implementation of the prescribed solid waste management principles and management measures is expected to reduce the risk of significant impact from general waste management to **Very Low**. Uncertainty regarding waste management during Project expansion (e.g. location of work camps, potential landfill, refuse disposal methods, etc.) will need to be detailed in Burapha's Waste Management Plan to ensure general waste management measures meet expectations of stakeholders and are adequate to protect physical, biological, and social receptors from potential impacts.

General Waste Impact Assessment

With Project expansion, greater volumes of general waste will be generated and the spatial distribution of waste management facilities is unknown. With development of a detailed *Waste Management Plan*, incorporation of measures listed above and in the *ESMMP*, and application of waste management strategies and mitigation measures, impacts are expected to be **Very Low**.

7.7 Wildfire

7.7.1 Issues and Findings

Given the propensity of Eucalyptus stands to burn, there is significant risk for wildfires in plantations, potentially threatening community and occupational health and safety, community assets, terrestrial / aquatic ecology, and Company assets in the event that fires spread beyond plantations.

Eucalyptus forests are prone to intense wildfire when ignited. Most *Eucalyptus* species have evolved to depend on fire for reproduction and competitive advantage. The leaves produce a highly combustible oil; leaf litter and bark often decays very slowly due to concentrations of phenolics providing additional highly combustible material; and crowns are not dense – allowing sub-canopy plant establishment (additional fuel loading). The fire regime is very different from the vegetative communities of Lao PDR and very different to what Lao people are likely accustomed to.

The use of fire for agricultural site preparation is widespread, providing a potential ignition source that may accidentally spread to plantations and rapidly become wildfire. It is estimated that 90% of fires in Lao PDR are caused by the practise of slash and burn agricultural methods (Evans, 1992). Uncontrolled fires (wildfire) are generally associated with high temperatures, high winds, and low precipitation.

Burapha currently employs broadcast burning to reduce slash during site preparation. As Burapha's plantations expand, suitable preparation and prevention protocols are required to minimise the chance for the spread of fire beyond the plantation areas into neighbouring forested areas.

Plantations and adjacent forested areas, communities, etc. shall and must be diligently protected. Burapha will employ a number of management measures to minimise the risk of ignition of plantation trees; minimise the risk for the spread of wildfire if ignited; ensure capable and trained personnel have the means to fight fires; and ensure communication protocols are suitable.

7.7.2 Management and Mitigation Measures

Land Identification and Acquisition

Burapha implements the following management measures during land identification and acquisition to minimise fire risk:

- Natural vegetation retention areas are identified (e.g. riparian buffers and ridgetops) and incorporated into plantation design;
- Topography is considered for prospective new access roads to incorporate roads into the fire management regime by providing firebreaks in key locations; and
- Location of villages and community assets is considered during land acquisition. Areas immediately adjacent settlements or downslope of settlements are avoided.

Planning

- Relevant waterbodies should be mapped for sourcing water to extinguish fires throughout operational areas;
- Evacuation and staging areas will need to be pre-determined for each plantation, for inclusion in the ***EPRP***;
- A UXO risk assessment will need to be conducted. Controlled burns should not be conducted prior to UXO clearance in areas where risk of UXO explosion is identified (e.g. in northern regions of Project Provinces); and
- Burapha will need to implement the ***EPRP***, contacting relevant agencies, communities, staff training, preparation of firefighting materials and equipment, etc. (refer to below).

Workforce Training

All Burapha staff (full time and part time) have induction and periodic refresher trainings. Training will need to include:

- Emergency preparedness and response methods;
- Individual responsibilities;
- Firefighting equipment / techniques;
- Fire prevention measures (as below);
- Communication protocols to react to fires;
- Proper PPE; and
- Emergency escape pathways and staging areas.

Equipment

- Burapha will maintain firefighting spray units at regional offices, which will be brought to site for broadcast burning;
- All Company vehicles will be equipped with a functioning dry-type fire extinguisher;
- Each semi-permanent or permanent staff camp will have a functioning dry-type fire extinguisher, knapsack, rubber headed beating stick, and rake-hoe; and
- Where available, tractors and bulldozers are on-hand during controlled burns to aid in fire suppression.

Site Preparation (Controlled Burns)

Burapha incorporates the following into site preparation activities to mitigate the potential for wildfire:

- Firebreaks are incorporated into site preparation activities. Slash will need to be pulled back a minimum of three (3) metres from vegetation retention areas prior to broadcast burning activities;
- A firebreak surrounds the plantation area to minimise the chance for spread of fire beyond the plantation area during broadcast burning events;
- Native vegetative surrounding plantation boundaries and along riparian corridors is retained to act as a natural fire retardant (i.e. vegetation less prone to burning);
- Cleared brush / slash is left to dry for 4-6 weeks prior to burning;
- Firefighting equipment is on-site during broadcast burning activities; and
- Trained personnel inspect the site to ensure the fires has been completely extinguished following controlled burns.

Burning should only be conducted under a strict set of circumstances:

- A person trained in fire protection and broadcast burning techniques should be present to coordinate burning activities;
- Burning should be prohibited when wind conditions (or forecasted wind) is excessive (e.g. exceeds 40 km / hr);
- Burapha contacts local communities in advance of broadcast burning; and
- Controlled burns within 1,000 m of settlements require written authorisation from the village authority.

Prevention

- Burapha conducts annual inspections of plantation areas to record fuel loads, fuel types, etc. to prescribe fuel load reduction as needed, potentially including:
 - » Maintenance on firebreaks surrounding plantations; and
 - » Thinning and / or herbicide application to reduce shrubs beneath the canopy.

Detection

- Burapha plans to increase the number of plantation guards and Khum officers for large plantations to aid in fire detection and response.

Communications

- Regional fire departments and local communities will need to be contacted prior to controlled burns;
- Emergency contact numbers will need to be posted in work camps and in company vehicles, with contact information for local fire brigades, hospitals and ambulances, and communities in proximity to plantation;

- In the event of wildfire detection, staff follow the communication protocol provided in the **EPRP**.

Fire Response

A detailed fire response protocol has been developed for Burapha’s **EPRP**, with training requirements, communication protocols; equipment needs, and chain-of-command. Burapha will need to review the **EPRP** annually to refine it (add contact details as the Project expands, implement new procedures where required, etc.).

7.7.3 Impact Assessment

Given the widespread use of burning for agricultural site preparation, broadcast burning for plantation preparation, and the volatility of *Eucalyptus* trees, the risk for wildfire cannot be entirely mitigated. Burapha will need to ensure that training, communication protocols, fuel reduction management, and firefighting equipment and additional management measures identified above, in the **ESMMP**, and in Burapha’s **EPRP** are implemented. The **EPRP** must be updated to account for communication requirements throughout the expanding plantation footprint.

The risks associated with wildfire will remain high, but sound application of management measures are expected to protect community and occupational health and safety and ecological values, with potential for impacts considered **Moderate**.

Wildfire Impact Assessment

With Project expansion, additional areas with established *Eucalyptus* stands will be at risk for wildfire. The associated risks to community and occupational health and safety, community and Company assets, and ecological values in surrounding forests requires robust management.

Strict adherence to the Burapha **EPRP** (incorporating management measures provided above and in the **ESMMP**), a commitment to updating the plan with up-to-date contact details for the expanding Project area, routine monitoring and implementation of preventative measures, and annual training in individual’s respective obligations, is expected to mitigate the high risks, with potential for impacts considered **Moderate**.

7.8 Noise

7.8.1 Issues and Findings

Agroforestry

During site preparation and plantation management, noise emissions are generated during road construction / upgrade, tractor operation for site preparation, chainsaws for harvest, etc. As current plantations are not in close proximity to settlement areas (e.g. 5–15 km), noise from these activities has not impacted residents to date. Vehicle movements through villages may generate nuisance level noise emissions. However, Burapha operates during the day only and requires adherence to speed limits through villages. During the conduct of Local Knowledge Surveys in each of the villages currently participating in agroforestry operations, noise was not identified as an issue. As the Project expands to new areas, noise emissions will have to be considered to prevent disturbing sensitive receptors.

In the absence of hearing protection, noise emissions associated with the preparation and harvest of plantation areas are an Occupational Health and Safety (OHS) risk (refer to Table 7-6).

Table 7-6 Source noise levels of agroforestry site equipment (adapted from Malherbe 2005, Holland 1981)

Construction & Closure Equipment	Maximum noise levels at source dB(A)
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Haul truck	121.0
Dump truck	119.0
Hydraulic Excavator	124.8
Dozer	115.5
Grader	113.7
Wheeled Loader	116.4
Operations Equipment	Maximum noise levels at source dB(A)
Chainsaws	115.0
Haul Truck	121.0
Wheeled Loader	116.4

The factors that will affect noise emissions from road traffic will include the volume of traffic, the speed of traffic and the composition of traffic (number of heavy vehicles versus light vehicles). Impacts will reflect the magnitude of the change in the existing noise regime and the sensitivity of the receptors. Given that noise from road traffic in remote village areas is currently low, and negligible at night, increased traffic levels (and associated noise levels) are likely to result in infrequent and short duration nuisance noise impacts. Noise impacts from vehicle traffic tend to be most significant within 10 m of the road, reducing to almost negligible at 50 m from the road (*US Department of Transportation, Federal Highway Administration, 2011*).

Burapha Sawmill

Significant noise is generated at the Burapha sawmill in Nabong. Wood splitters, saws, etc. generate sound levels that exceed safe operating levels in the absence of proper hearing protection. The Burapha *OHS Policy and Principles Manual* clearly articulates Company commitments to providing appropriate PPE.

It was noted during the conduct of a due diligence assessment for Burapha that the Company was providing hearing protection. However, several staff were not wearing them in noisy areas. A corrective action report was generated, and it understood that monitoring for PPE use and training identifies the *requirement* to wear hearing protection and additional PPE is now conducted.

7.8.2 Avoidance, Mitigation and Management Measures

Plantations

Burapha will need to implement the following measures to minimise impacts from noise emissions:

- A ***Grievance Mechanism*** (refer to ***ESMMP*** for framework) to record and respond to community or staff complaints; and
- Provision of hearing protection for staff and require its use during noisy activities (i.e. monitor for adherence to hearing protection use during chainsaw use, tractor use, etc.).

Specific mitigation and management measures to minimise noise emissions along Plantation Access Roads will need to include:

- Scheduling haul truck times for daylight hours;
- Maintaining road surface to reduce rumble;
- Avoiding village centres with access roads to the extent practicable; and
- Setting a speed limit through villages to reduce noise emissions.

Burapha Sawmill

Burapha supplies hearing protection to staff at the sawmill. In addition, the Company will:

- Inform staff of the potential damage to hearing from noise emissions at the mill (during induction and annual training);
- Require that hearing protection is used at all locations inside the sawmill; and
- Monitor staff for use of PPE and record non-compliance to inform the need for corrective action (i.e. warnings).

7.8.3 Impact Assessment

As the majority of noise generated at plantations will be far from villages, risk for impacts to community receptors from plantation activities is considered negligible. Vehicle transport through villages may generate infrequent and short duration nuisance level impacts during the day. The implementation of management measures listed in the *ESMMP* (Volume D) and above is expected to minimise impacts to a level that is acceptable for stakeholders. The Grievance Mechanism will allow Burapha to respond to community complaints, and adaptively manage (e.g. further enforcement or reduction of speed limits, communications with villages regarding timing of transit, etc.). Impacts to communities are expected to be **Low**.

Noise Impact Assessment - Plantations

Noise generated in plantation areas is expected to be far enough from settlement areas to mitigate potential impacts. As the Project expands into as yet unidentified areas, Burapha will have to evaluate potential for impacts, and respond to grievances. Vehicle transit on unsealed roads may generate infrequent and short duration nuisance level noise impacts for communities. By restricting hauling to daylight hours and enforcing a speed limit through villages, impacts are expected to be **Low**.

Occupational health and safety risk associated with chainsaws and other noise sources at plantations will be mitigated through provision of PPE, requirement for its use, and monitoring to ensure it is used appropriately. Impacts are expected to be **Low**.

Provision of PPE and requiring its use at the sawmill and during noisy activities in plantations will effectively mitigate the occupational health and safety risk, and impacts are also expected to be **Low**.

Noise Impact Assessment - Sawmill

Noise generated at the sawmill presents an occupational health and safety risk that will continue to be mitigated through provision of PPE. Burapha will need to diligently require its use and monitoring to ensure it is used appropriately. Impacts are expected to be **Low**.

7.9 Air Quality

7.9.1 Issues and Findings

Plantations

Vegetation clearance and burning, vehicle movements on unsealed roads, and additional operational activities will generate air emissions that may be present nuisance level impacts. During the assessment of current operations, the following emissions were identified:

- Vehicle transit on unsealed roads generating dust; and
- Broadcast burning of slash and other agricultural wastes (SO₂, NO_x, CO and VOCs).

As plantation operations expand to new areas, additional villages will be exposed to dust as access roads tend to pass through village centres. The dispersal and concentration of dust emissions to areas surrounding plantation sites and road networks is complex, however mainly dependent on factors such as the distance of receptors from the site and prevailing wind conditions. Wind-borne road TSP dust typically impacts within 200 m of the road (Watson, 2000).

Burning of slash during site preparation will also provide an infrequent (i.e. every seven years) and moderately short duration impact, which may impact communities and poses a slight occupational health and safety risk. The inhalable fine particles PM_{2.5} are usually dispersed further than larger particulates which may have implications for forestry workers who are directly exposed to emissions or to a lesser degree, vulnerable community members located near operations.

Sawmill

The manufacture of wood products results in the generation of fine airborne wood particles and dust at the Burapha sawmill. Typical activities that produce dust include machining operations (e.g. sawing, routing, turning) and hand or machine sanding. Other sources of breathable wood dust may occur when bagging the dust from local exhaust ventilation systems, using compressed air to blow dust off articles and sweeping of sawmill floors.

Reported health effects associated with exposure to dust from wood products include:

- Skin disorders such as allergic dermatitis – certain timbers are known to produce adverse health effects and sensitisation;
- Asthma and impaired lung function;
- Nose irritation;
- Throat irritation, and
- Sore and watering eyes.

A rare type of nasal cancer has also been reported in people who have worked with hard woods in very dusty wood-working environments with little or no dust control.

Nursery

As discussed above in Section 7.5, several hazardous materials are utilised at the nursery, some of which provide a significant health and safety risk if inhaled. Materials Safety Data Sheets for each of the products require the use of either dust masks or respirators.

Burapha will have to ensure that the provision of PPE is commensurate with risks from exposure.

7.9.2 Management and Mitigation

Plantations

Management measures to minimise impacts to communities in located in proximity to plantation areas and access roads will need to include:

- Limiting earthworks near villages during very dry, windy conditions (i.e. road construction / maintenance);
- Informing villages prior to broadcast burning, and obtaining written permission from villages within 1,000 m of plantation areas;
- Imposing a speed limit on roads through villages on unsealed roads (e.g. 20 km/hr through communities); and

- Consulting with communities regarding the need to apply water to roads during heavy use in the dry season.

Burapha will implement a **Grievance Mechanism** (refer to **ESMMP**) and will adapt management according to complaints received. For example, dust generation on roads may require watering the surfaces during heavy use in the dry season.

Burapha staff will need to be protected from air quality impacts, accordingly:

- Dust masks will be provided for staff clearing vegetation;
- The Company will need to evaluate PPE requirements for herbicide application, and provide the level of protection commensurate with risks; and
- The Company will need to enforce requirements for PPE use and monitor to ensure its application.

Sawmill

The sawmill is outfitted with appropriate exhaust ventilation to minimise potential impacts. In addition, the following will need to be implemented:

- **PPE** – Dust masks are required for all staff exposed to particulates. Burapha will need to informally monitor daily (e.g. supervisor checks) and formally monitor monthly for PPE use;
- **Preventative maintenance** – Burapha should check for damage to ducting and dust collectors; replace or empty waste collection bags, inspect ductwork and fans for dust build-up; conduct an annual overhaul of the exhaust systems; and record records of inspections, repair and maintenance;
- **Housekeeping** – Burapha should implement a ‘clean as you go’ policy, ensuring clean-up is a part of daily work activity; will consider methods for improved cleaning such as damping surfaces before sweeping or using an industrial vacuum clear fitted with a HEPA filter; and
- **Training and Informing** – Burapha will need to inform workers of the hazards and risks associated with exposure to wood dust, will train workers on the correct use of control measures, and supervise staff to ensure that adapted control measures are used correctly.

Nursery

Burapha manages hazardous materials at the nursery to avoid impacts to occupational health and safety. The Company need to review its practices and products and ensure management includes the following:

- **Training and Informing** – Burapha will need to inform workers of the hazards and risks associated with exposure to chemicals used in the nursery and supervise staff to ensure that adapted control measures are used correctly;
- **Assessment of Alternatives** – Where applicable, the Company should investigate less toxic alternatives;
- **PPE** – Burapha will need to investigate the appropriate PPE that is commensurate with risk for each product, and will supply and require the use of PPE that should be used; and
- **Monitoring** - Burapha will need to informally monitor daily (e.g. supervisor checks) and formally monitor monthly PPE use and the efficacy of design controls.

7.9.3 Impact Assessment

Plantations and Access Roads

Some air quality impacts from dust generation and slash burning are unavoidable. With implementation of the management measures listed above and in the **ESMMP**, impacts are expected to be **Low**, with occasional short-term **Moderate** nuisance level impacts. Adherence to very low speed limits is expected to minimise impacts

to level that is acceptable for communities. However, adaptive management following community or workforce complaints may be required, including road watering during the dry season.

The health and safety of Burapha staff will be protected with the provision of suitable PPE, and requirement for its use. Occupational health and safety impacts at plantation is expected to be **Negligible**.

Air Quality Impact Assessment – Plantations

Dust and exhaust emissions generated in plantation areas are expected to be far enough from settlement areas to mitigate potential impacts. As the Project expands into as yet unidentified areas, Burapha will need to evaluate potential for impacts, and respond to grievances appropriately. With ongoing communications with communities, impacts from plantation areas are expected to be **Low**.

Vehicle transit on unsealed roads will generate nuisance level dust impacts for communities in the absence of management. By restricting hauling to daylight hours and enforcing a speed limit through villages, impacts are expected to be **Moderate**, but infrequent and short-duration events.

Sawmill

With design controls already implemented, and routine maintenance for equipment and dust extraction systems, the health and safety of the workforce is expected to be suitably protected given provision of appropriate PPE. With strict adherence to management measures and monitoring to ensure implementation of Company obligations, impacts are expected to be **Negligible**.

Air Quality Impact Assessment – Mill

The sawmill is equipped with suitable controls to minimise dust emission. Burapha supplies dust masks at the mill. Routine informal and formal monitoring will be required to ensure people are using PPE appropriately. Impacts are expected to be **Negligible**.

Nursery

Chemicals used in the facility will have to be appropriately stored and handled to protect the health and safety of the workforce. Burapha will review MSDS and product labels to ensure that PPE is commensurate with risks. Personnel need to be informed of risks to ensure that management measures are adhered to. With provision of protective equipment and routine informal and formal monitoring, impacts to health and safety from inhalation of chemicals is expected to be **Negligible**.

Air Quality Impact Assessment – Tree Nursery

Fumes from chemical applications at the tree nursery present significant occupational health and safety risks that will be mitigated through provision of suitable PPE that is commensurate with risks involved, requirement for its use, and monitoring to ensure it is used appropriately. Impacts are expected to be **Negligible**.

7.10 Climate and Greenhouse Gases

7.10.1 Issues and Findings

Climate change has arisen as a major global issue caused largely by our unsustainable use of resources. An estimated 30% of reported increases in global greenhouse gas emissions have come from deforestation activities and the degradation of pristine forested land (Mackey, 2014). In Lao PDR, climate change is recognised as a severe threat to the country's ecosystems, communities and water resources (UNDP, 2010). For South East

Asia, rainfall is expected to increase by about 7% by the end of the 21st century and the frequency of extreme temperature and precipitation events is set to increase. The extreme weather changes may impact agroforestry operations by increasing the risk of fire, water stress or flooding and landslides. Large scale land use changes such as forestry schemes can significantly contribute to a positive and negative climatic feedback process. Burapha's current operations are likely to contribute to both the positive and negative feedback scenarios described below. As plantation operations expand, these positive and negative feedback effects will be enhanced, i.e. potentially greater negative effects and greater positive effects.

Clearance of Vegetation

The clearance of vegetation, and especially of primary forest habitats, can contribute significant increases in global carbon dioxide emissions. When deforestation occurs, this carbon is released back into the atmosphere as the biomass is broken down by respiratory organisms or burnt as a method of waste disposal. The Project has potential to contribute to increases in global CO₂ emissions in this way.

Based on published data, it is estimated that fallow forest has approximately 70 t/ha of above ground biomass and at 50% carbon content (standard for forests, Ribeiro et al., 2015) this equals 35 tonnes of carbon per hectare (C t/ha). It is also estimated that there is 23.1 t/ha of biomass below ground, equalling 11.5 C t/ha (Snowdon et al., 2000).

Removal and land clearing of fallow forest with 35 C t/ha is estimated to result in 64 tCO₂e emissions. Non-CO₂ gases assumed to be emitted by removal of fallow forest include CH₄, N₂O, CO and NO_x.

In contrast to the CO₂ emissions associated with vegetation clearance, Burapha's focus on degraded forest land and plantation planting should offset initial contributions during site establishment activities.

Carbon Sequestration Potential

The proposed agroforestry plantation plans will ultimately create a carbon sink - utilising atmospheric CO₂ for biomass production through the process of photosynthesis. The carbon sink potential of the plantations will depend on the end use of the products made from the wood pulp, as well as the effects that plantation development will have on soil carbon storage. The soil is a major store of carbon in terrestrial ecosystems. Soil carbon can be lost as CO₂ by employing conventional tillage agriculture techniques, increasing the breakdown of soil organic matter by soil microbial activity.

It has been estimated that *Eucalyptus* stands over five developmental stages (1, 2, 3, 4-5 and 6-8 years old) have total C pools of 113, 173, 204, 161 and 163 C t/ha, respectively (Du et al., 2015). Estimates are based on both above and below ground biomass, as well as mineral soil C, with most of the C sequestered below ground.

Energy Use

Throughout the development of the project, electricity will be needed at a number of project locations and in the surrounding villages. In such rural areas, electricity will likely be provided by generators running on fossil fuels, and producing greenhouse gas emissions.

Machinery use during the land clearance, operations and decommissioning stages will have a number of climate related impacts. Most of the machinery used (e.g. tractors, chainsaws, transportation equipment) will rely on fossil fuels (e.g. petrol / diesel) to run. The burning of these fuels will release carbon dioxide and smaller amounts of other greenhouse gases into the atmosphere. Trucks can consume 0.5 kg/km of diesel and at 2.7 kg of CO₂ emissions per litre can equal 1.6 kg per 1 km (Table 7-7).

There is also a risk that the use of the machinery may enhance other climate related impacts such as the loss of soil carbon due to tillage practices or the excessive removal of habitat, above and beyond what is needed for plantation development.

Table 7-7 Emission factors for different fuel types and uses (Berg and Karjalainen 2003)

Fuel Type	Emission Factors g/kg Fuel		
	CO ₂	CO	NO _x
Diesel	3,188	26.6	38.4
Diesel forest machines	3,126	19.2	64.7
Petrol equipment and vehicles	2,450	340	22.8
Diesel road vehicles	2,838	12.8	37.5
Railway diesel	2,826	10.4	39.3

7.10.2 Mitigation and Management Measures

Land Identification and Acquisition

When identifying and acquiring land for plantation development a number of factors should be taken into account in order to avoid, manage and mitigate potential climate and greenhouse gas related impacts:

- Plantation development will only be carried out on degraded land. This is in accordance with FSC criteria and Burapha's environmental policy. Primary forest habitat will in no circumstances be converted into agroforestry plantations.

Site Preparation

- At least 10% of Forest Management Units will have vegetation retained. Buffer zones will be maintained around water courses (See Section 7.4 for specification)
- Vegetation removal should be minimised wherever possible in order to avoid unnecessary degradation of buffer zones or surrounding forest land.
- During vegetation clearance and ground preparation, machinery use should also be minimised wherever possible to reduce unnecessary greenhouse gas emissions from the burning of fossil fuels.
- During site preparation, the disturbance of soil (e.g. tilling and compaction) will also be minimised to help prevent the degradation of soil and loss of its carbon storing potential.
- Wide spacing between Eucalyptus trees will be implemented. This will help reduce the impact storm damage could have on the plantation's productivity and increase the resilience of the ecosystem.

Operations

- Train staff in energy saving activities to reduce the project's total GHG footprint such as switching off engines when not in use, efficient use of materials, route planning, and energy efficient equipment will be used on Plantation sites and surrounding villages wherever possible (e.g. energy efficient lightbulbs).
- Burapha will engage in research and development activities into energy efficient technologies that could be utilised on the Plantation sites (e.g. solar power, wind power) to provide electricity supplies.
- Agricultural residues will be incorporated into the soil wherever possible to help maintain the loss of soil carbon.

7.10.3 Impact Assessment

Providing the management and mitigation measures relating to greenhouse gases are implemented, the expansion of Burapha's operations are thought to present a **Minor** risk to the environment., with the potential for an overall positive impact. However, due to the large number of variables and greenhouse gas emission and sequestration scenarios, there is a high level of uncertainty associated with this conclusion.



Chapter 8 | Potential Biological Impacts and Mitigation Measures



Chapter 8 | Potential Biological Impacts and Mitigation Measures

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8 POTENTIAL BIOLOGICAL IMPACTS AND MITIGATION MEASURES

Burapha has developed and implemented silvicultural manuals, policy documents and standard operating procedures that specify Company management strategies for avoiding or minimising impacts to biological receptors during plantation establishment and management, with Special Management Areas (SMA) established for key locations that require avoidance or more robust management. Current policies (where applicable) and further measures identified in this chapter will carry forward as the Project expands into new regions.

The Company has also recently developed a **High Conservation Value Assessment and Management Plan** (ES, 2016) that will be finalised prior to expanding FSC certification. The assessment identifies primary threats to High Conservation Values (HCVs) within the Burapha Project area of influence and articulates measures to avoid impacts to key biological receptors (in addition to social components) and provides measures to enhance areas of High Conservation Value. Where appropriate, these management strategies are summarised in this Chapter, and incorporated into the Project **ESMMP** (Volume D).

This chapter and the **ESMMP** builds upon management plans for current plantations, providing additional measures for incorporation into Company practices and associated documentation to ensure compliance with national requirements and fulfillment of Company commitments to applicable international standards.

8.1 Terrestrial Flora and Habitat

8.1.1 Issues and Findings

Current Operations

As per Burapha's **Land Acquisition Manual**, the Company has cleared degraded habitat to establish their current plantations. These areas had previously been subjected to timber harvest by outside entities and periodic vegetation clearing and burning for swidden agriculture. Vegetative communities converted to plantations have met the Lao PDR definition of either barren land, unstocked forest, or degraded forest; generally having been comprised of young or old Fallow Forest. Fallow Forest is generally dominated by native species, with a dense shrub layer and sometimes scattered remnant trees of low resource value, with invasive shrubs typically well-established. Floral species diversity is considerably lesser in Fallow Forest than native forests in the region (with similarly lower fauna diversity inhabiting them). During the conduct of Local Knowledge Surveys and Biodiversity Focus Group Discussions, villagers indicated that the plantations provide poor habitat value, particularly where weeding is implemented to the extent intended for Company operations. Vegetation surveys for this ESIA and review of secondary information identified similar results, with plantations offering little habitat value and significantly less species diversity than the Fallow Forest they have replaced.

- The primary impact of plantation implementation was found to be the conversion of low to moderate value habitat to even aged stands, with very little herbaceous or shrub layer vegetation in the understory, and thus poor habitat value.

Additional impacts identified include:

- Participating villages clearing several areas that were intended for riparian buffers to provide for additional land for agricultural planting; and
- Unidentified outside parties using access roads to harvest trees in surrounding forested areas.

Project Expansion

As the Project expands into new locations, vegetation clearance will result in the direct temporary long-term loss of degraded habitat and associated flora. This impact is mitigated by the relatively small size of individual plantation units, the fact that the Fallow Forest that will be cleared for future plantations would otherwise likely be subjected to periodic clearance for agriculture, the moderately low habitat value of the disturbed forest that will be converted, and Burapha requirements for retaining native vegetation on at least 10% of plantation units as Special Management Areas (refer to Section 8.1.2).

The loss of flora species is an inevitable component of site preparation for plantation development. The majority of the species that dominate Fallow Forest are native pioneer shrubs, trees, and bamboo species that are found throughout the Project Provinces, given the widespread application of swidden agriculture. Threatened flora were not identified during surveys but have the potential to occur based on habitat characteristics and range / distribution identified in database searches (e.g. IUCN, 2016). However, it is considered unlikely that significant populations of nationally or globally threatened flora still grow within the frequently disturbed fallow habitat. Threatened species are unlikely to grow in the habitat due to their high resource value, and have thus been opportunistically harvested from swidden plots and accessible surrounding forests.

The severity of habitat loss for terrestrial fauna and native flora during Project expansion will depend on:

- Habitat type and quality – The use of young fallow will have a low impact on habitat value, while removal of >5 years-old fallow forest may have a moderate level impact on habitat value for several disturbance tolerant species (refer to below);
- Access – indirect impacts (forest clearance) outside of plantation boundaries will likely increase significantly if new roads are constructed or current roads are extended to access plantation areas;
- Regional (biogeographic) context – The number, size, and clustering of Burapha plantations in close proximity to each other (e.g. within the same sub-catchment); and
- The area of native vegetation retained and allowed to regenerate to native forest communities within plantation boundaries (i.e. retention of migration corridors).

Access and Resource Use

The development of access roads for plantations would likely promote increased resource extraction and potentially significant degradation of terrestrial ecology, if previously inaccessible areas are utilised for Burapha plantations. The risk for impacts is considered very high, as non-timber forest product (NTFP) and timber forest product (TFP) harvest have been found to increase significantly as access is provided. The use of existing access roads to establish new plantations would avoid such impacts. This issue is addressed below for surrounding habitat.

Expansion of Swidden Agriculture

The conversion of historic swidden agricultural land to plantations may lead to indirect impacts outside of plantation boundaries, as farmers may clear forest / vegetated areas to compensate for that lost for plantation implementation. This issue is addressed below for surrounding habitat. However, the provision of agricultural land and employment opportunities may instead preclude the need for expansion of swidden land.

Threatened Habitat and Flora

Unique and/or threatened ecosystems are not likely to be found within the degraded habitat used for Project expansion. However, remnant patches of natural forests may occur (e.g. patches of Mixed Deciduous Forest, Dry Dipterocarp Forest, etc.) as well as seasonal wetlands in the area of influence (i.e. within or downstream of plantations). Burapha is committed to protecting and enhancing Special Management Areas (SMAs) and High Conservation Value Forests (HCVFs) throughout plantation

establishment and management (refer to management, below). Impacts to threatened habitat are not anticipated.

Threatened flora are not likely to grow naturally in the degraded habitat in the region as they are typically high value timber and NTFPs that are found in less accessible and less disturbed forest communities. Some threatened plants are cultivated throughout the region, but these agricultural commodities or trees will likely be located on village agricultural land or plantations, thus will be avoided.

The range of several species of conservation significance overlaps the potential Project expansion area that may require avoidance and protection, include:

- *Azelia xylocarpa* (EN, nationally VU);
- *Anisoptera costata* (EN);
- *Aquilaria crassna* (CR, EN);
- *Dalbergia bariensis* (EN);
- *Dalbergia cochinchinensis* (VU);
- *Dipterocarpus alatus* (EN, VU);
- *Dipterocarpus retusus* (VU, DD);
- *Diospyros mun* (CR, DD);
- *Hopea chinensis* (CR, VU);
- *Hopea odorata* (VU, Lower Risk / Conservation Dependent / Near Threatened (LR/CD/NT));
- *Hydnocarpus annamensis* (VU);
- *Melientha suavis* (N/A, VU);
- *Pometia pinnata* (N/A, VU);
- *Pterocarpus macrocarpus* (N/A, VU);
- *Shorea henryana* (EN, VU);
- *Shorea roxburghii* (EN, LR/CD/NT);
- *Shorea thorelii* (CR, VU); and
- *Sindora siamensis* (LR/LC, VU).

Wildfire

Given the propensity of *Eucalyptus* forests to burn, there is significant risk that fires ignited near or within plantations will become wildfires. Wildfires have the potential to threaten adjacent terrestrial ecology (in addition to community and occupational health and safety, community and Company assets).

Eucalyptus forests are prone to intense wildfire when ignited. Most *Eucalyptus* species have evolved to depend on fire for reproduction and competitive advantage. The fire regime is very different from that of native vegetative communities of Lao PDR and very different to what Lao people are likely accustomed to. The use of fire for agricultural site preparation and hunting is widespread, providing a potential ignition source that may spread to plantations (along with natural or other anthropogenic ignition sources). In the absence of suitable management, there is also a risk that controlled burns for Burapha plantation site preparation may threaten neighbouring terrestrial (and aquatic) ecology.

The potential impacts of wildfire are addressed in the Physical Impacts chapter (Chapter 7), with management and mitigation measures provided to minimise the chance of wildfire and respond appropriately.

Herbicides

The risks, potential impacts, and management measures associated with herbicide use during plantation establishment or management are provided in Chapter 7. Non-target plants and trees may be impacted by the use inappropriate herbicides, inappropriate timing of application (wind and rain), over-application, or accidental application to non-target species.

Burapha utilises Glyphosate and Metsulfuron, both of which are highly immobile, generally non-toxic for fauna, and present a low risk for impact if properly applied and managed.

Surrounding Habitat

Where Burapha plantations abut higher value habitat, the plantation area of influence may expand beyond operational boundaries, with potential impacts including:

- Development of swidden / upland agricultural plots outside of plantation boundaries to replace land converted from swidden agriculture to industrial plantations;
- Increased access and resource extraction;
- Indirect habitat and flora degradation from edge effects;
- Invasive plants spreading from disturbed sites to less impacted areas (refer to Section 8.3); and
- Increased intensity of wildfire in eucalypt plantations, potentially spreading to adjacent forested stands (refer to Chapter 7).

Forest Conversion for Swidden Agriculture

In replacing historic swidden agricultural area with industrial tree plantations, the potential for 'leakage' is considerable. 'Leakage' has been described by the International Panel on Climate Change (IPCC) as the indirect impact of protecting *carbon storage in a certain place at a certain time on carbon storage at another place or time*" (IPCC, 2000) In the context of plantation forestry, 'leakage' is commonly used to describe enhanced resource extraction or forest conversion for agriculture and associated degradation of forests outside of plantation boundaries indirectly resulting from conversion of land use for plantation establishment.

The potential for forest conversion to upland agricultural plots in surrounding forests may be exacerbated by population growth. Vientiane Capital, Vientiane Province, Saysomboun Province, and Xayabouly Province have a total population (2015) of 1,778,574, with 22%, 67%, 65% and 60% respectively, classified as rural inhabitants and annual population growth rates of 1.6%, 1.5%, 2.8%, and -1.2%, respectively. Though urbanisation is increasing rapidly in Lao PDR, formally rural areas are now classified as urban due to infrastructure development. Therefore, a proportion of people identified as urban dwellers are still cultivating land for subsistence or small scale industrial agriculture (e.g. in Ban Hin Heup).

The potential for 'leakage' will be mitigated through provision of land for agriculture within plantations.

Access and Resource Use

Access to resources that may be exploited is a significant issue in the region. The remaining forests that are pristine or relatively undisturbed exist either because they are inaccessible or are in the interior of conservation areas. If Project-related road creation into previously inaccessible areas is necessary, this would likely lead to the degradation of natural habitats surrounding plantation sites. Significant impacts could occur through increased exploitation of timber and NTFPs, clearance for agriculture, creation of non-Project tracks and controlled burning for agriculture, hunting and grazing.

To the extent practicable, Burapha has utilised previously existing access roads to establish plantations, with road building only required to extend road branches from the main access roads to key locations. As current plantations have been implemented on swidden agricultural areas (with corresponding access to the plot), the Company has not likely opened new areas that would be exploited for resources. However,

the conversion of foot trails or motorbike access trails to roads accessible for trucks would likely provide for more intensive resource harvest by outside entities, which is a key threat to habitat and flora throughout the potential Project expansion area.

Pre-existing access to the site is one of the key determinants of Burapha's *Land Selection Criteria*, therefore the risk of opening-up previously inaccessible areas for exploitation of resources is unlikely as the Project expands. The continued use of degraded land will likely preclude significant road building for future plantation establishment.

Fragmentation and Edge Effects

Vegetation clearance for the Project may result in localised and regional habitat fragmentation. Residual fragments or adjacent forested areas may be vulnerable to degradation caused by edge effects (e.g. altered environmental conditions). Edge effects are created by the remaining fragments having a larger/longer edge than contiguous forest (Laurance et al., 2009). The microclimate (solar radiation, soil and air temperatures, soil moisture conditions, wind regime) is different from that of interior conditions, with the distance of edge effects into forested areas differing according to the parameter of interest (e.g. changes in solar radiation will extend less distance into the forest than wind). The potential impacts of edge effects also depend on aspect of the remnant forest (e.g. south facing may be most pronounced for solar radiation and temperature). Edge effects may influence floral species composition bordering cleared areas, with pioneer plants favouring increased exposure to sunlight. Trees within the edge effects area are also more prone to windfall.

Wildfire

As is detailed in Chapter 7 and discussed above, *Eucalyptus* stands can burn at extremely high temperatures. The magnitude of impacts from wildfire on surrounding ecology will depend on the ecological value of neighbouring vegetation and Burapha management strategies to prevent wildfire (e.g. firebreaks) and respond appropriately. If the Project acquires land near Protection Areas or other high value ecology, the risk for impacts may be significant.

8.1.2 Avoidance, Mitigation and Management Measures

Avoidance, mitigation and management measures are divided into Project phases (where applicable), including land identification and acquisition, plantation establishment, plantation management (or operations), and decommissioning.

Land Identification and Acquisition

Burapha has developed and recently refined its ***Land Acquisition Manual*** that has detailed ***Land Selection Criteria*** that are requirements for land that would be leased for plantation establishment. Criteria applicable to avoidance and minimisation of impacts to terrestrial habitat and flora include:

- The Company will clear only degraded forest or Fallow Forest for plantations, with pockets of forest within a plantation boundary retained for regeneration as SMAs (refer to below). The Forest Law (2007) defines each as follows:
 - » *Degraded Forestland are the forestland areas where forests have been heavily and continually damaged and degraded causing the loss of balance in organic matter, which may not be able to regenerate naturally or become a rich forest again.*
 - » Fallow forest are the forest areas where deforestation for cultivation has been practiced or areas which have gone under various forms of encroachment for many years. These areas have a possibility of becoming rich natural forests in the future again.
- Burapha does not acquire land within International, National, Provincial, District or Village Conservation Areas and applicable buffer areas;

- At least 80% of potential lease / concession areas will have slopes of less than 35°; and
- Areas of High Conservation Value (HCV) as defined by the HCVRN and FSC are avoided to the extent practicable. If HCV is found to occur within the prospective plantation boundary, the Company delineates it for vegetation retention (refer to below), HCV management (per the Company *HCV Assessment and Management Plan*), and monitoring.

The following measures will need to be incorporated into the land acquisition process, for implementation during the reconnaissance surveys and detailed land survey:

- Participatory Land Use Mapping will need to be conducted with villages to identify land use categories established according to the GOL Land and Forest Allocation program and the Participatory Land Use Program (PLUP) to ensure that Conservation and Protection Areas / Forests are avoided;
- A manual of threatened and endemic vegetation that may occur throughout the Project Provinces will need to be developed, with a photograph of the entire tree / plant and close-up photographs of leaves and reproductive bodies (e.g. fruit, cones, etc.). The manual would be disseminated to appropriate personnel and used as follows:
 - » Surveyors would familiarise themselves with species of concern prior to reconnaissance surveys / detailed land surveys and carry the manual into the field to identify threatened species; and
 - » Detailed land surveys should include line transect studies to identify, flag, and mark (GPS coordinates) threatened species / sensitive ecosystems for retention.

Community Engagement

Burapha staff have identified that timber harvest by outside entities may be the greatest threat to natural habitat / forested areas within and adjacent plantation boundaries. During site surveys, tractors and trucks passed through plantations regularly – potentially for the collection of TFP. Burapha will need to consult with villagers collaborating in the agroforestry operations to communicate the benefits of SMA and HCVF retention and enhancement to provide for NTFP resources, protect water quality / aquatic habitat, and provide habitat connectivity for important fauna species.

The obligation to avoid clearing of riparian buffers will need to be clearly communicated. Burapha will need to communicate (verbally and in contracts) that villagers will not be allowed to conduct agricultural activities in areas that were intended for riparian SMA (i.e. vegetation clearance in riparian buffers will essentially be unpaid labour that cannot be profited from in any way). Burapha will need to consult with Village authorities to ensure land allocation for family farming in plantations reflects vegetation retention areas (i.e. the size of plots designated for families should reflect plantable area, not total area which may be dissected by a stream).

Staffing

Burapha has employed Khum officers to oversee plantations during periods of time when no operational activities are being conducted. These employees are residents of villages participating in the agroforestry operations. Burapha may need to hire Khum officers for each plantation (potentially more than one) and empower them to enforce prohibition of harvesting trees in SMA, using fire for hunting in proximity to plantations, etc.

During community consultation, communities should be made aware of Khum officer' responsibilities. Villagers in participating communities may be less likely to circumvent restrictions enforced by a local community member than that from non-resident Burapha employees.

Burapha will need to provide Khum officers with a protocol for reporting illegal logging in a manner that does not compromise the safety or social standing of that individual.

Plantation Establishment

Burapha will need to protect SMA, HCVF / HCV through adherence to the Project **ESMMP**, Burapha policies for avoiding sensitive areas (riparian vegetation, steep slopes, etc.), and that identified in their **HCV Assessment and Management Plan**. SMA and HCVF / HCV management is provided in the Vegetation Retention Section (below).

Vegetation Retention

Burapha has committed to retaining at least 10% of the naturally occurring vegetation in each individual plantation unit. Vegetation retention areas include any SMA and HCVF / HCV (Plate 8-1, Plate 8-2). Vegetation retained will be actively avoided, monitored, and allowed to regenerate into forested environments. Retention areas will serve to maintain and enhance native forest, provide migratory pathways for terrestrial and aquatic fauna, provide for erosion and sediment control, and retain high value (e.g. threatened) species and ecosystems.

Areas at boundaries of plantation units that are high value habitat / forested areas will be returned to the GOL / village, with replacement area sought that meets Company criteria for vegetation clearance. Forested areas / high value habitat surrounded by plantation will be retained as SMA or HCVF for protection and enhancement.

Trees, shrubs, and herbaceous plants in SMA or HCVF will not be harvested or damaged in any way. However, NTFP collection will not be prohibited, provided collection does not involve removal of trees or shrubs (i.e. fruit collection, mushroom collection, insect harvesting, and additional non-invasive NTFP gathering by villagers will be allowed). Enhancement will generally be comprised of protecting areas from harvest (by the Company and outsiders to the extent practicable) to allow for natural regeneration / successional processes to provide for multi-layered / structured vegetative communities and higher value habitat.

Chemical application is prohibited in SMA and HCVF.

Special Management Areas

Vegetation retention in SMA will include:

- Riparian corridors, comprised of:
 - » Five (5) metre buffers on each side of stream bank edge for seasonal streams;
 - » 10 metre buffers on each side of stream bank for perennial streams;
 - » 25 metre buffers on each side of perennial rivers (often indicated by name – “Nam”);
 - » 50 metre buffers from perennial and seasonal wetlands; and
- Land with slopes > 35°;
- Natural forest communities within plantation boundaries as defined by the MAF / GOL (> 20% canopy cover from trees taller than 5 m with diameter at breast height (dbh) > 10 cm), including:
 - » Mixed Deciduous Forest;
 - » Coniferous Forest;
 - » Dry Dipterocarp Forest;
 - » Evergreen Forest; and
 - » Gallery Forest;
- Five (5) trees with contiguous canopy with dbh greater than 10 cm each (and all vegetation underneath);

- Single trees with diameter (dbh) greater than 40 cm;
- Standing dead trees (snags) unless deemed unsafe for agricultural activities; and
- Seasonal wetlands.



Plate 8-1 SMA avoidance in Borchan plantation **Plate 8-2 Riparian retention area (SMA) in Phonngeun plantation**

High Conservation Value Forest and High Conservation Values

High Conservation Values (as defined by the HCVRN and FSC) that will need to be avoided during land acquisition or protected during plantation establishment are provided as follows:

- *HCV1: Species Diversity* - Concentrations of biological diversity including endemic species, and rare, threatened or endangered species (RTE), that are significant at global, regional, or national levels, with regional criteria applied as follows:
 - » Known presence of populations of multiple endemic or RTE species;
 - » Important populations or an abundance of individual endemic or RTE species, representing a substantial proportion of the regional, national, or global population, which require the land seasonally or year-round;
 - » Small populations of individual endemic or RTE species, where the survival of such species is dependent on the area in question;
 - » High overall species richness, diversity, or uniqueness within the defined area when compared to other sites within the same biogeographic area.
- *HCV2: Landscape-level ecosystems and mosaics* - Large landscape level ecosystems and ecosystem mosaics that are significant at global, regional, or national levels and that contain viable populations of the great majority of the naturally occurring species in natural patterns of distribution and abundance, with regional criteria as follows:
 - » Large areas relatively far from human settlement, roads, or other access;
 - » Smaller areas that provide key landscape function such as connectivity and buffering, if they have a role in maintaining larger areas in the wider landscape; or

- » Large areas that are relatively more natural and intact than others in the region and provide habitat for species with large land range requirements.
- *HCV3: Ecosystems and habitats* - Rare threatened, or endangered ecosystems, habitats or refugia, with regional criteria as follows:
 - » Rare ecosystems and ecosystems that are threatened by human actions, including Dry Dipterocarp Forest, Evergreen Forest; Coniferous Forest, and seasonal wetlands.
- *HCV4: Ecosystem services* - Basic ecosystem services in critical situations, including protection of water catchments and control of erosion of vulnerable soils and slopes. In the context of the Project expansion area examples include vegetation or land critical for protection of:
 - » Surface or groundwater flow required by downstream receptors, including industrial activities, settlements, aquatic biodiversity, etc.;
 - » Water quality;
 - » Structures or high value areas from wildfire; and
 - » Soil character.

SMA and HCVF retention

HCVF and individual HCV trees / species and all SMA within plantation concession / lease are boundaries need to be adequately delineated and marked to ensure Company retention policies as adhered to. The following steps will need to be implemented to avoid encroachment:

- Tree flagging with a colour designated for delineating boundaries will be utilised to mark SMA / HCVF boundaries and individual plants / trees for retention. Staff across regional areas will need to be informed about flagging procedures and no plantation areas will be cleared without approval by management;
- Survey / measure SMA and HCVF boundaries (and additional vegetation retention areas) and flag boundary every 10 – 20), with marked trees and everything to the stream side / forested side of marked trees left 100% intact (riparian buffer, natural forest, fire protection area, steep slopes, etc.);
- Individual HCV trees should be marked with flagging and GPS during surveys:
 - » Trees / plants that are deemed small enough should be evaluated (individuals) for transplant;
 - » All trees with a diameter > 40cm and clusters of five trees or more with diameter > 10cm and contiguous canopy should be left uncut;
 - » HCV trees (including snags, threatened / endemic trees) should have all vegetation below the canopy retained.
- If a cluster of threatened flora species is identified, the entire area should be flagged off, with GPS waypoints recorded for retention of the entire area, including a 20m buffer from the outer edges of the retention area; and
- Contractors and casual employees will need to be informed of requirements for strict adherence for protection of delineated vegetation retention areas, SMA, HCVF, and individual HCV (e.g. threatened species);

Chemical Application

Management for chemical application is described in Chapter 7, Physical Impacts. In summary, the following measures will protect vegetation intended for retention as well as aquatic habitat / biodiversity:

- Burapha will not apply chemicals that are banned for use in Lao PDR or by the FSC;

- Herbicide application will be prohibited during windy conditions and with rain forecasted for within two days of application;
- Herbicides will not be applied within 10 m of any watercourses and within SMA or HCVF; and
- Dye will be applied to the herbicide mix to minimise over-application and ensure only target species are sprayed.

Controlled Burns

Management measures for controlled burns is provided in Chapter 7. Implementation of the measures will be important to minimise the chance of wildfire damaging plantations, adjacent stands, community and Company assets, etc.

Monitoring

Vegetation Clearance

Burapha foresters and regional managers will need to monitor vegetation clearance to ensure that only that intended for plantation establishment is cleared. This will be accomplished by adhering to the Burapha Silviculture SOP and the **ESMMP**. In summary, monitoring prior to vegetation clearance will include:

- Surveying the prospective plantation area for SMA and HCVF, including all native forest communities, comprised of > 20% canopy cover by native trees of at least 5 m in height and 10 cm diameter (dbh);
- Ensuring areas required for native vegetation retention are clearly demarcated and flagged in advance of vegetation clearance for plantation establishment (i.e. SMA and HCVF as above); and
- Ensuring all delineated clearance areas are comprised of only Fallow Forest or Degraded / Unstocked Forest for plantations; and
- Periodic site checks during clearance operations to ensure SMA and HCVF are not encroached upon by the seasonal workforce.

Plantation Management

The majority of management and mitigation measures for habitat preservation required during land acquisition and plantation establishment phases will also be required during plantation management. During plantation management, Burapha will need to:

- Conduct periodic village consultations to reinforce Company policy regarding native vegetation retention in SMA / HCVF;
- Ensure chemical applications are conducted according to measures identified in the **ESMMP**;
- Conduct routine monitoring identified in the **ESMMP** to ensure habitat protection measures are effective;
- Ensure the Khum officer routinely checks habitat retention areas, potentially responding to the sound of chainsaws in plantation areas (e.g. communicating illegal logging activities to appropriate GOL authorities); and
- Maintaining fire breaks and additional fire management measures provided in Chapter 7 and the ESMMP.

Decommissioning

Burapha will need to consult with the appropriate GOL and Village authorities regarding post-plantation land use for plantation areas. In the absence of robust management, *Eucalyptus* will coppice sprout following final harvest and likely dominate the overstory of the regenerating forest. Refer to Section

8.3.2 for management measures to provide for re-establishment of native forests or agricultural land following the end of Burapha operations in each management unit.

8.1.3 Impact Assessment

Plantation establishment will require conversion of disturbed or Fallow Forest to *Eucalyptus* or *Acacia* plantations. These unavoidable impacts will remove low to moderate value habitat for common flora and fauna in the region, and replace them with very low quality habitat largely devoid of native species, pending the level of weeding in the understory.

Strict adherence to *Burapha Land Selection Criteria* in their *Land Acquisition Manual* will minimise impacts, which are expected to be localised in nature, given the partitioning of plantation units across broad areas currently utilised for swidden agriculture.

On a landscape level, impacts will be more pronounced, as 60,000 ha of plantation concessions will alter the regional composition of native vegetative communities. Retention of natural vegetation in riparian corridors and in remnant patches of native forest will minimise fragmentation and provide connectivity between native vegetative communities.

Measures identified to avoid or minimise wildfire (Chapter 7), utilisation of only existing access roads to the extent practicable, and minimising illegal harvest / removal of SMA and HCVF through empowering Khum operators and through extensive village consultation will be key factors in reducing the overall regional impacts of vegetation conversion to **Low – Moderate** on a regional scale.

Terrestrial Habitat and Flora Impact Assessment

As the Project expands into new areas, vegetation clearance for individual plantations is expected to have a **Low** and localised impact on common habitat and widely distributed flora species. On a landscape level, impacts will be **Low – Moderate** given the conversion of as much as 60,000 ha of fallow / degraded forest to very low value habitat. This will be mitigated by habitat connectivity provided by retention of native vegetation in Special Management Areas (at least 6,000 ha).

8.2 Protection Areas

8.2.1 Issues and Findings

Current Landholdings

Burapha avoids International, National, Provincial, and District Conservation Areas and Protection Forests per their *Land Acquisition Manual*. However, the 'bottom-up' approach to land acquisition has led to encroachment into a National Protection Area (previously referred to as National Biodiversity Conservation Area or NBCA) and Provincial Protection Area, due to unclear boundaries and land-use designation and approvals granted to the Company that had not followed the legislated process for conversion of Protection Forest land for industrial uses. Burapha is working with applicable land managers to clarify the most appropriate resolution.

Phu Phanang National Protection Area

The Burapha Houaydeua plantation encroaches upon the eastern boundary of the Phu Phanang NPA. There is some dispute regarding the boundary location between the NPA land managers (Lao National Army) and the managers of the land immediately to the east (local police force, Plate 8-3, Plate 8-4). In addition, the residents of Ban Houaydeua have customary user rights to the area and have been practising swidden agriculture near their settlement prior to and following the establishment of the NPA. Twenty-two (22) ha of Burapha *Eucalyptus* plantation area has been established within the boundary of the NPA, as

defined by the NPA land managers, with additional Burapha concession / lease area planted within the NPA buffer of 500m.



Plate 8-3 Vegetation at Phu Phanang NPA boundary

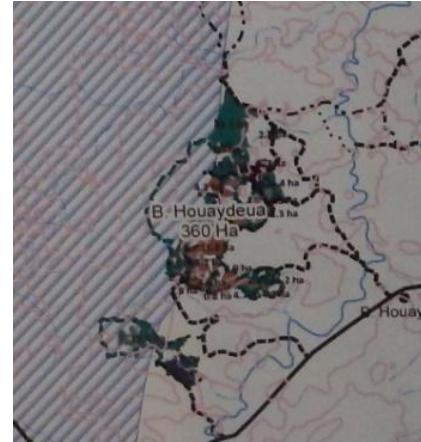


Plate 8-4 NPA and plantation map

All of the concession and lease area (the Company has two separate agreements) were cleared of native vegetation prior to 1993, with swidden agriculture practiced throughout the area (verified with 1992 Landsat 5 TM satellite imagery and 1997 GOL FIPD Land Use data). The area met Company *Land Selection Criteria* regarding the degraded nature of the vegetation. However, the lease agreements with Ban Houaydeua and concession agreement with Hin Heup District were signed according to a boundary definition for the NPA that is now under investigation. Burapha consultation with the NPA land managers and MAF are ongoing, and the Company is seeking resolution with applicable stakeholders.

Phu Khao Khoay National Protection Area

The majority of Burapha's 208 ha Houana plantation unit (adjacent Ban Nakhanthoung) is within the Phu Khao Khoay NPA buffer area, which extends 500 m from its boundary. However, the land transitions from degraded forest and Burapha plantation in the buffer areas to rock outcrop for some distance within the NPA, before habitat that is being protected occurs some 500 m up the slope. The rock outcrop provides a natural buffer for the NPA habitat (refer to Plate 8-5 and Plate 8-6). Burapha's utilisation of this land, which was previously cleared by an individual landowner, has not been disputed by GOL authorities due to the biophysical barrier between the plantation and the NPA vegetated area.



Plate 8-5 Phu Khao Khoay southern border adjacent the Burapha plantation



Plate 8-6 Phu Khao Khoay boundary with marker north of Burapha plantation

Phu Inthin Provincial Protection Forest

Burapha has been provided concessions to six (6) distinct plantation units that fall within the boundaries of the Phu Inthin PPA, including the following plantation units: Ban Borchan, Ban Phonngeun, Ban Phonmouang B, Ban Naphong A, Ban Naphong B, and Ban Namthom. Each of these units were acquired via community leases with the associated villages. Village representatives believed they had land tenure right to lands within the PPA, and had cleared the areas for swidden agriculture. The Company was granted permission to establish plantations, without formal conversion of the areas from Protection Area status. Plantations have been established in the Ban Borchan, Ban Phonngeun, Ban Phonmouang B units, while the remainder have not been cleared for plantation implementation.

In a letter to the Governor of Vientiane Province (12 February 2015), the Head of Division of Natural Resources and Environment, PONRE for Vientiane Province recommended conversion of the 1453.54 ha of PPA land that was provided to Burapha in lease agreements with Ban Phonmouang, Ban Borchan, and Ban Phonngeun for industrial tree plantation operations, citing that the area is comprised of young bamboo forest. The letter recommends that the relevant District authorities should withdraw / cancel land documents and lease agreements for Ban Naphong and Ban Namthom units.

Plantation Expansion

Burapha is committed to avoiding International, National, Provincial, District and Village Protection and Conservation Areas. The greatest risk for encroachment on Conservation and Protection areas is at the village level.

Villages and District authorities have been found to irregularly impose restrictions on harvest and conversion of these areas to agricultural lands and in some cases plantation forests. In many villages across the Project Provinces, Village Conservation / Protection Areas are now fallow, having been incorporated into the swidden agriculture rotation.

The results of the Land and Forest Allocation Program and the Participatory Land Use Planning process are irregularly followed by villages and often not enforced by District or Provincial Authorities (Thongphanh, 2004; Thongphanh et al, 2010) possibly due to a lack of adequate resources.

8.2.2 Avoidance, Mitigation and Management Measures

Current Landholdings

Phu Phanang NPA

Burapha has halted plantation expansion into the remainder of the concession until the status of the land is officially clarified.

The Company is currently working with the Phu Phanang NPCA (NPA) land managers (national army) to clarify the extent of plantation overlap with the NPA and obligations of the Company going forward for this land. In addition, it is understood that MAF has been directed by the Prime Minister to rezone Protection, Conservation, and Production Area boundaries due to the inclusion of degraded forests within protection area boundaries. Management strategies will depend on the outcome of applicable GOL evaluation and designation of Burapha obligations, which may include:

- Decommissioning the site;
- Allowing the Company to continue operations in currently planted areas with no further expansion within the NPA or buffer;
- Rezoning of degraded areas on the eastern portion of the NPA to outside future NPA boundaries, allowing the Company to proceed with establishment within the remainder of the concession and lease areas.

Phu Inthin Provincial Protection Forest

Burapha is consulting with applicable GOL authorities to reach a resolution acceptable to stakeholders. Given the degraded nature of the majority of the PPA, the area may be rezoned for village use, including lease for industrial tree plantation. Burapha may also pursue conversion of the lease areas from Protection Forest to village utilisation forest via consultation with the National Assembly (refer to below).

Project Expansion

Burapha has committed to avoiding establishment in Conservation and Protection Forests, which is stipulated in their recently strengthened *Burapha Land Acquisition Manual*. Land acquisition will need to adhere to the following for Protection Forests and Conservation Areas.

Conservation and Protection Areas

Burapha will not acquire concessions or leases for plantations in International, National, Provincial, District, or Village Conservation and Protection Areas, regardless of overlapping village land tenure and associated customary user rights.

Project expansion will include avoidance of Conservation / Protection Areas, by prohibiting acquisition of land / plantation establishment in:

- NPA and 500 m buffer areas;
- Internationally recognised protection areas;
- Provincial, District, and Village Conservation and Protection Areas.

Protection Forest

Burapha will need to avoid establishing plantations in Protection Forests, unless applicable GOL and Ministry of Agriculture and Forestry (MAF) authorities agree that it is in the best interest of the Country. Given the degraded nature of the vegetation in many of these areas, the MAF and / or applicable GOL authorities may approve implementation of plantations in protection areas (with specific approvals required).

The GOL may consider implementation of industrial tree plantations in Protection Forests, provided their status is officially changed. Use of National, Provincial, District, or Village Protection Forest for plantation establishment would need to adhere to the *Lao Law on Forestry* (2007) and the *Decree on Protection Forest PM/333* (2010). Protection Forests are divided into 'Absolutely Prohibited Zone' and 'Utilisation Zone'. Conversion would need to be sought for land with degraded vegetation in the Utilisation Zone.

Article 19 of the *Decree on Protection Forest PM/333* (2010) describes conversion of Protection Forest for other uses as follows:

In the case that it is necessary to change the protection forests and the protection forestry lands to other purpose for the ultimate benefit to the country, the following principles must be taken:

1. *The change of the protection forests at the national and provincial levels must be approved by the Standing Committee of the National Assembly upon the request by the Government;*
2. *The change of the protection forests at district, municipality levels must be approved by the Government upon the request by the National Land Administration in agreement with the Ministry of Agriculture and Forestry;*
3. *The change in the protection forests at the village level must be approved by the Provincial or City Administrations upon the request by the Provincial or City Land Administrations in agreement with the Provincial or City Departments of the Agriculture and Forestry.*

Burapha will need to meet the following criteria if Protection Forest land is converted for industrial tree plantation establishment:

- The 'Absolutely Prohibited Zone' cannot be utilised for plantation establishment. This zone is described in Article 7 of the Decree on the Protection Forest PM/333 (2010) as: *forests and landscapes with slopes over 35 degrees, the areas of stream origin, the forest along river banks or road sides and other areas with high risks to affect the environment.*

Village Protection and Conservation Area

Avoidance of village level protection and conservation area will require robust due diligence by Burapha. Burapha will need to conduct the following to avoid these areas:

- Consultation with District and / or Provincial authorities to identify the results of Land and Forest Allocation (LFA) Programs and Participatory Land Use Planning (PLUP) conducted for prospective collaborating villages;
- Consultation with villages, including a participatory mapping exercise that identifies the boundaries of conservation and protection areas;
- Review of LFA and / or PLUP documents that are generally held by village authorities;
- Strict adherence to Company policy to avoid conservation and protection areas.

8.2.3 Impact Assessment

The Company has strengthened its *Land Acquisition Manual* to clearly demonstrate that it will not acquire land for plantation establishment in protection and conservation areas. It is anticipated that International, National, Provincial, District, and Village level protection and conservation areas will not be impacted during Project expansion.

Avoidance of these areas may require robust consultation activities with GOL authorities and due diligence during consultation with villages and District Authorities. With diligent application of avoidance measures, impacts are not anticipated.

Protection Area Impact Assessment

Burapha will need to conduct comprehensive due diligence assessment on prospective plantation areas to ensure they do not encroach upon protection and conservation areas or their buffers (particularly at the village level). With strict adherence to Company policy regarding land acquisition and diligent consultation activities, impacts to protection and conservation areas during Project expansion are expected to be **Nil**.

8.3 Invasive Plants

The implementation of *Eucalyptus* and / or *Acacia* plantations provides some risk for establishment and spread of non-native invasive plants, namely: (i) the potential for the spread of the *Eucalyptus* / *Acacia* beyond plantation boundaries; (ii) domination of plantation trees following the end of the concession period; and (iii) introduction or spread of invasive weed species.

8.3.1 Issues and Findings

Current Operations

Encroachment of Eucalyptus into Neighbouring Forest

Burapha plantation trees have been found to produce viable seed during the seven-year plantation rotation. If unmanaged, *Eucalyptus* may spread beyond plantation areas and change the species assemblage of neighbouring stands. However, *Eucalyptus* advancement beyond plantation boundaries will

be slow and easily managed. Botanical surveys conducted for this ESIA found no evidence of natural regeneration of plantation trees within or outside plantation boundaries.

Periodic surveys will be required to ensure plantation trees do not successfully establish outside of Burapha concession areas.

Eucalyptus Post-Decommissioning

As the Burapha *Eucalyptus* plantation trees rapidly coppice sprout following harvest, there is significant risk that the stands will dominate the canopy in perpetuity following the end of the concession agreement in the absence of suitable management. Such dominance of the upper canopy would significantly alter the species assemblage of regenerating forests following the final harvest and handover of the lease / concession area. The rapid nature of coppice sprouting would likely allow the exotic trees to outcompete regenerating natural species, and the composition of the shrub and herbaceous layers underneath may be affected by the lack of light penetrating an even-aged and uniform canopy; soil conditions from *Eucalyptus* leaf litter may unfavourably alter soil conditions for plant establishment; and the potential preclusion of native trees from establishment may decrease seed dispersion from native trees.

Removal of eucalypt stumps or prevention of coppice sprouting will need to be a key management measure for decommissioning plantation units.

Invasive Plants

Current Burapha operations are unlikely to have contributed to the spread of invasive plants in their current operations. Invasive weeds are prolific in degraded / fallow forests throughout the region. Burapha's site preparation and weeding activities has reduced the cover of these plants within plantation boundaries, with a net reduction when compared to neighbouring vegetation. Invasive weeds have established in road margins and other cleared areas not utilised for plantation trees or intercropping, where weeding has not been intensive and the lack of canopy provides the light requirements for pioneer invasive plants.

The two most widespread species in and surrounding plantations, *Chromolaena odorata* and *Imperata cylindrica* are highly invasive plants that have established and in some areas dominated lands disturbed by forest harvesting and agricultural site preparation throughout the Project Provinces. Given the distribution of these species throughout the region, their introduction clearly predates Burapha activities.

Plantation Expansion

As the Project expands into new areas, the risk for the introduction and / or spread of invasive plants may be more significant than that found in current operational areas, while risks associated with unintended spread of eucalypts and post-decommissioning dominance will be similar to that identified for current operations.

Encroachment of Eucalyptus into Neighbouring Forest

As above, Burapha plantation trees have been found to produce viable seed within the seven-year plantation rotation. The level of risk and significance of potential impacts of plantation trees encroaching upon neighbouring vegetation will reflect the land use of neighbouring areas and the species composition in these areas. If Burapha establishes plantations adjacent to natural forests, protection areas, or other high value habitat; the implications of eucalypt encroachment are greater.

As Burapha acquires accessible land that has been subjected to logging and swidden agriculture, it is anticipated that neighbouring sites will be similarly degraded and subjected to periodic vegetation clearance for swidden agriculture.

Where Burapha implements plantations adjacent less degraded forest, protection areas, etc. surveys in adjacent areas will be required to ensure these trees are removed.

Eucalyptus Post-Decommissioning

The risks for post-commissioning dominance and potential impacts on species composition and habitat value following the cessation of concession / lease periods remains the same for future plantations as that indicated above.

Other Invasive Plants

The risks associated with invasive plants may be more significant during Project expansion. Burapha vehicles, workers' boots, and other machinery may be vectors for invasive plant seed that could be moved from a highly-impacted area to an area less impacted by invasive plants, or a particular species may be introduced to an area.

Though *Imperata cylindrica*, *Chromolaena odorata*, and *Mimosa pudica* are common throughout the region, it is possible that one or more of the species (or other applicable weeds) have not yet established in future plantation areas. The ability of these species to establish, spread, and dominate landscapes is well documented.

Although native to Asia, the grass *I. cylindrica* has spread far beyond its original range and can rapidly dominate an area where it has been introduced (GISD, 2016b). Its invasiveness and invasive potential are due to its extensive rhizome (root) system, tolerance of a wide range of soils, drought tolerance, genetic plasticity and fire adaptation. The extensive rhizome system encompasses at least 60% of the total biomass. One hectare of the grass can produce 4.5 million shoots, 10 metric tons of leaf material and more than 6 metric tons of rhizomes (ISSG, 2016). The rhizome system is relatively well-protected underground and can easily regenerate from any human-related or natural disturbance. The grass can reproduce asexually from rhizomes or through prolific seed production. *Imperata cylindrica* out-competes native species by its dominance of above and below ground biomass and can deprive competitors of nitrogen. The extensive rhizome systems allow rapid regeneration after fire and appears to favour frequent intense fires.

Chromolaena odorata (Siam weed) is native to South and Central America, but has spread far beyond its natural range into Asia, Australasia and Africa. The weed is an herbaceous perennial that forms dense shrubs, preventing the growth of other species (GISD, 2016a). *Chromolaena odorata* out-competes other species by forming these dense stands and by allelopathic effects (i.e. chemical inhibition). In sub-tropical and tropical areas, the weed *C. odorata* grows in a wide range of habitats and soils. The weed can sprout from roots or reproduce from seed, with a large volume of seed. Seeds can remain dormant and viable for up to 5 years, while plants can germinate and produce seeds within 12 months.

Mimosa pudica prefers open and disturbed areas, being intolerant of shade and dense forest canopies. The weed can seed all year round, producing over 650 seeds per plant per year. Seeds have bristles on their outer-casing that cling to clothing or to the fur of mammals. Repeated burning and fires can encourage the spread of the species.

Surrounding Areas

The risks associated for surrounding areas are similar to that described for plantation establishment. However, the risks may be more significant but also less likely, as follows:

- Surrounding habitat may be higher value native forest, thus the encroachment of invasive plants would more significantly impact the quality of the habitat for flora and fauna;
- Invasive plants are generally pioneer species, requiring light (i.e. no overstory) to establish and dominate an area. The light regime in well-established forest understories does not favour establishment of weed species. Encroachment would likely be confined to road margins or open patches that have been subjected to disturbance.

8.3.2 Avoidance, Mitigation and Management Measures

Land Identification and Acquisition

Burapha will need to identify weed species during reconnaissance surveys and detailed site surveys. If areas have not been subjected to establishment of key weed species, more robust management strategies will be required before and during ground disturbing activity to prevent introduction.

Plantation Establishment and Management

Burapha actively manages weed establishment and spread of invasive shrubs during site preparation, when the likelihood of establishment is greatest (i.e. vegetation removal and soil disturbance). Established agroforestry plots are dominated by plantation trees and rice within months of establishment. The management regime is robust, currently including:

- Glyphosate and / or Metsulfuron application to the cleared area prior to tree planting and agricultural / intercropping implementation;
- Intensive manual weeding (slashing) or mechanical weeding (tractor) between rows to prepare for grass planting / livestock grazing.

Burapha is trialling the use of veviter grass (*Chrysopogon zizanioides*) for planting and establishment on road margins, where invasive plants tend to be most prolific as plantation develop due to the light penetration from the road clearing. Veviter is a perennial bunchgrass of the Poaceae family, native to India. Veviter that does not produce seed can be obtained, thus the plant will not become an invasive weed. The primary purpose will be erosion control, but this plant will cover area otherwise likely to host invasive plants.

Prior to any ground disturbing activities in new plantation areas, Burapha will need to:

- Wash vehicles, equipment, and boots prior to relocation from other operational areas or stockyards; and
- Confine vehicle movements to designated pathways.

Decommissioning

Burapha will need to consult with the appropriate GOL and Village authorities regarding post-plantation land use for plantation areas. In the absence of robust management, Eucalyptus will coppice sprout following final harvest and likely dominate the overstory of the regenerating forest.

Provided the GOL / applicable village authorities want the end land use to be something other than ongoing *Eucalyptus* plantation, a decommissioning methodology will need to be developed in consultation with stakeholders. Decommissioning methods may include:

- Painting the stumps with an appropriate herbicide following final harvest to prevent coppice sprouting (e.g. Garlon) and at least one follow-up application of Glyphosate after one growing season to kill any coppice sprouts;
- Stump removal and a follow up monitoring to ensure no seedlings, sprouts from missed stumps, etc. establish; or
- Pocketing, which comprises drilling to apply the herbicide beneath the bark, allowing the phloem to transport the herbicide throughout the rooting system.

8.3.3 Impact Assessment

The implementation of *Eucalyptus* and / or *Acacia* plantations provides some risk for establishment and spread of non-native invasive plants, namely: (i) the potential for the spread of the *Eucalyptus* / *Acacia*

beyond plantation boundaries; (ii) domination of plantation trees following the end of the concession period; and (iii) introduction or spread of invasive weed species.

Eucalyptus / *Acacia* advancement beyond plantation boundaries during the concession / lease period will be slow and easily managed, with routine monitoring expected to identify and eliminate naturally regenerated plantation trees.

As the Burapha *Eucalyptus* plantation trees rapidly coppice sprout following harvest, there is significant risk that the stands will dominate the canopy following the end of the concession / lease agreement. The Company will need to consult with the GOL and / or collaborating villages regarding post plantation land use for these areas. Unless those with land use rights intend to continue *Eucalyptus* tree plantations, a strategy for eliminating the species will need to be agreed upon. There are a number of effective strategies from preventing reestablishment of the plantation trees. Provided agreement is reached for an appropriate strategy, impacts are not anticipated.

Highly invasive shrubs species occur throughout the Project Provinces in areas that have been subjected to disturbance, often quickly dominating cleared areas due to their ability to rapidly colonise a wide variety of soil types and disperse high volumes of seed. There is also risk that invasive plants will be introduced to currently unaffected areas during Project expansion. Seed is easily move from one region to another via relocated mechanised equipment and boots. Given Company weed management strategies, operations are not expected to increase the population of existing weed species. Application of management measures identified above and in the **ESMMP** are expected to reduce the risk of introducing invasive plants to unaffected areas.

Invasive Species Impact Assessment

By monitoring buffers for the spread of *Eucalyptus* / *Acacia* beyond plantation boundaries and removing seedlings, it is anticipated the Burapha can effectively prevent plantation species establishing outside of plantation boundaries, with impact expected to be **Low**.

Burapha will need to consult with the GOL / villages to identify proposed end land uses for plantation areas upon decommissioning, and determine the most effective measure for ensuring the species do not re-establish and dominate the canopy. *Eucalyptus* can be prevented from regenerating with appropriate management. Provided a suitable method is agreeable for stakeholders, and diligent application of the selected methods, impacts are expected to be **Low**.

Burapha employs weed management strategies that minimise the spread of invasive plants. The Company will need to ensure that seed from plants are not transferred to areas that currently unaffected. With application of prescribed management measures in the **ESMMP**, it is anticipated that Burapha activities will not contribute to the spread of invasive plants, and Project-related impacts are expected to be **Low**.

8.4 Terrestrial Fauna

8.4.1 Issues and Findings

Current Plantations

Primary impacts to terrestrial fauna are similar to that described in Section 8.1 for habitat. The conversion of degraded or fallow forest to monoculture plantations has reduced the quality of the habitat for terrestrial fauna. The establishment of shrub and herbaceous vegetation in between tree rows is controlled through weeding activities to promote better outcomes for intercropping and reduce competition for nutrients and water with plantation trees. Therefore, habitat value within plantations is not favourable for most native fauna. During the conduct of village Local Knowledge Surveys and Biodiversity Focus Group Discussions,

it was identified that very few terrestrial species are observed within plantations, with the exception of occasional rodent sightings. Villagers indicated that they do not hunt in plantations due to the absence of target species.

Project-related impacts have been found to be largely indirect, with impacts related to:

- Direct habitat loss, including habitat for breeding, feeding and movement;
- Displacement from habitat and creation of barriers (e.g. open clearings); and
- Outside entities utilising access roads to hunt.

Burapha has retained native vegetation along perennial watercourses, providing a migratory pathway between more suitable habitat.

Direct impacts may have included:

- *Mortality during controlled burns* - less mobile fauna and / or small species capable of hiding in slash may have been killed during controlled burns for site preparation. The method of preparation for burning (i.e. vegetation slashing in advance of burns) likely caused more mobile fauna to leave the site, and conducting burns that advance from one side to the other allows another opportunity for mobile fauna to escape.

Plantation Expansion

Project related impacts to fauna during Project expansion are expected to be similar to that identified for current operations (habitat loss, barrier to movement, access to hunting areas, controlled burns).

Habitat Loss

The impact on fauna during Project expansion is expected to be similar to that identified for current operations, with indirect impacts related to the conversion of low to moderate value habitat to the very low quality habitat.

Fallow forest provides habitat for a range of species from different taxa and potentially a few conservation important / priority species (refer to Chapter 6 Biological Settings). Fallow forest provides cover, food and nesting sites / materials – as is evident by the continued hunting activities conducted in such habitat throughout the region. Vegetation clearance will impact species that use or are resident of these habitats. Occasional visitors will be impacted by the loss of foraging and / or breeding habitat. Due to the degraded nature of the habitat prior to clearance, it is more likely that resident species are generalist and / or disturbance-tolerant species. These species will likely adapt to the loss of habitat and move elsewhere. Removal of breeding habitat may be significant because breeding site construction is energetically costly and species can be very selective in their choice of nesting sites (Virani *et al.*, 2010).

Sites close to protected areas, high-quality natural habitat, wildlife corridors and habitat continuity may have a higher level of impact due to the possibility of greater species diversity (refer to Surrounding Forests, below).

Loss of habitat will result in displacement of fauna, which will move into surrounding areas for food and other resources. Displacement may increase competition for resources in surrounding habitat (e.g. nest sites).

In summary, the impact significance of the loss of habitat for fauna will depend on:

- *Habitat quality* – use of degraded or fallow forest will minimise the severity of impact from habitat loss for fauna;
- *Extent of land clearance* – individual plantation areas will be constrained in size, which will minimise impacts;

- *Regional (biogeographic) context* – the number, area and clustering of other plantation sites in the region could increase the significance of the loss of one site's habitat;
- *Connectivity with refuge habitat* – displaced fauna that can find similar or better habitat nearby will be impacted less by the loss of habitat, than fauna who reside in remnant patches distant from refuge habitat;
- *Fauna species biology* – as highly disturbance-tolerant species are more likely to adapt to the changed conditions, the impact significance will be species / taxa-specific, e.g. whether they are resident or migratory / temporary users of the habitat.

Barriers to Movement

Existing disturbance in the region has already reduced the capacity of the potential plantation sites to provide migration routes for many fauna species. The creation of newly cleared areas will create barriers to some animal movements. Barriers to home-range use and movement can alter communication, sociality and reproduction (Taylor and Goldingay, 2010). Some species exhibit strong avoidance of cleared areas and will avoid even narrow (<30 m wide) clearings (Laurance et al., 2009). Many species that avoid cleared areas will align their territories along or abutting clearings and therefore clearings become significant barriers to movement (Laurance et al., 2009). It is likely that some species present in fallow and degraded forest are accustomed to crossing open clearings. For smaller ranging resident species (e.g. reptiles, frogs), the clearings will represent a significant barrier to movement.

Impacts to migration pathways will be mitigated by the provision of SMA (refer to below).

Access to Hunting

If road construction or road extension is required for Project expansion, areas that may have been inaccessible or less accessible to hunting will likely be utilised for fauna harvest. This will be particularly true where plantations are established near high value habitat. Many studies have identified that enabling / easy access for humans provides the greatest risk for exploitation of resources, including fauna species that are hunted for food, sale, and medicinal purposes in the area (refer to Surrounding Habitat).

Controlled Burns

Controlled burns for site preparation will likely lead to the direct mortality of less mobile fauna and smaller animals capable of hiding in slash. Noisy activities and removal of habitat in advance of controlled burns will likely flush more mobile fauna from the site. Smaller and / or less mobile species are likely to hide in slash and may be killed during burning operations.

The Company plans to start trialling the clearing of vegetation in strips surrounding the plantation area and adjacent riparian buffers to provide firebreaks that protect the riparian area and neighbouring forests / vegetation during the larger controlled burn for the remainder of the area. If the trials are successful they will be adopted as a standard management practice. This initial disturbance will likely flush fauna from the region.

Surrounding Habitat

Indirect impacts to terrestrial fauna in surrounding habitat may include barriers to movement, competition for habitat, and access to hunting (as above). Direct impacts are not anticipated, with the potential exception of controlled burns escaping the Project area, and wildfire extending into neighbouring vegetation.

Barriers to Movement

Anticipated impacts are similar to that discussed above for plantation expansion. The plantations will provide barriers to movement for some species, with migration between fragmented habitat affecting species according to their tolerance to disturbance.

The impact will be highly depended on land selection for plantation establishment. Where plantations are surrounded by fallow forest / degraded habitat, impacts are expected to be minimal. Establishment of larger plantations that dissect forested areas would fragment otherwise high value habitat.

Competition and Displacement

Loss of habitat will result in displacement and movement of individuals into surrounding areas searching for food and other resources. Displacement may increase competition for resources in surrounding habitat (e.g. nest sites). Where resources are already limited, competition will be high and impacts to population numbers may occur. Should plantation development create small, isolated and fragmented habitat, these patches are unlikely to be able to sustain adequate fauna biodiversity in the long-term. Displacement is also likely to increase exposure to introduced species, predation and interaction with humans or anthropogenic disturbance.

Access and Resource Extraction

Hunters will use access roads to harvest fauna for consumption or sale. Where Burapha is required to construct or extend access roads to implement plantations, fauna populations and potentially species diversity will be impacted. This will be particularly significant for areas adjacent higher value habitat, where villagers have identified several threatened species known to occur in adjacent habitat and IUCN (2016) has identified a number of species whose range may extend throughout certain portions of the Project Provinces (refer to Table 8-1). Refer to Chapter 5 (Biological Setting) for regionally important fauna that may inhabit the region.

Table 8-1 Globally threatened fauna that have the potential to inhabit surrounding habitat

Taxa / Significance	Species and Threatened Status
Globally Threatened Mammals	Sunda pangolin <i>Manis javanica</i> EN ARL / C
	Chinese pangolin <i>Manis pentadactyla</i> EN ARL
	Northern pig-tailed macaque <i>Macaca leonina</i> VU PARL / C
	Lar gibbon <i>Hylobates lar</i> EN ARL / R
	Dhole <i>Cuon alpinus</i> EN ARL
	Fishing cat <i>Prionailurus viverrinus</i> EN LKL
	Asiatic black bear <i>Ursus thibetanus</i> VU ARL / R
	Bint urong <i>Arctictis binturong</i> VU ARL
	Large-spotted civet <i>Viverra megaspila</i> VU PARL
	Sambar deer <i>Rusa unicolor</i> VU PARL / C
Northern white-cheeked gibbon <i>Nomascus leucogenys</i> CR PARL / R	
Globally Threatened Birds	Yellow-breasted bunting <i>Emberiza aureola</i> EN
Globally Threatened Reptiles and Amphibians	Black and white spitting cobra <i>Naja siamensis</i> VU PARL
	King cobra <i>Ophiophagus hannah</i> VU PARL / R

KEY: CR – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; DD – Data Deficient; LR – Lower Risk; LC – Least Concern; N/A – Not Assessed; Duckworth et al. 1999 national threatened status: ARL – At Risk in Lao; CARL – Conditionally At Risk in Lao; LKL – Little Known in Lao; PARL – Potentially At Risk in Lao; MAF 360 / 2003 Regulation: R – Restricted; C – Controlled

8.4.2 Avoidance, Management and Mitigation Measures

Land Identification and Identification

Burapha will need to consider the quality of adjacent land during initial surveys for plantation areas. Potential plantation areas adjacent protection / conservation areas or high value forested communities will increase the likelihood of indirect impacts to fauna and direct impacts from utilisation of access roads for hunting.

Plantation Establishment and Management

Burapha will implement the following to avoid or minimise potential impacts to terrestrial fauna throughout plantation operations:

- Burapha staff are prohibited from hunting in Project areas (prohibition cannot apply to seasonal workforce comprised of villagers whose land the plantation is implemented on);
- Controlled burns will need to have firebreaks to protect riparian buffers, additional SMA, and adjacent habitat. Activity associated with vegetation removal from firebreaks, and ignition of firebreaks prior to burning the remainder of the plantation area will likely scare more mobile species from the area. Controlled burns for the remainder of the area should be done in progressive sections, moving from one side to the other, to allow for animal escape to the extent practicable.

Management for fauna will largely comprise habitat retention and management to allow for specific areas to regenerate to forested communities, with management summarised from the **ESMMP** as follows:

- Retaining native vegetation in riparian corridors (SMA) and allowing this vegetation to advance into multi-layered / structured forest for migratory pathways;
- Retaining patches of natural forest (i.e. > 20% canopy cover of trees greater than 10cm in diameter (dbh); areas that have five trees of greater than 10 cm dbh with contiguous canopy, and all vegetation underneath; single trees with diameters of at least 40 cm (dbh); and dead snags (unless deemed unsafe for intercropping activities); and
- Retaining natural vegetation on slopes exceeding 35°.

Burapha will need to periodically consult with affected villagers and conduct induction trainings for full-time and seasonal staff that will include:

- Training of staff and contractors regarding the prohibitions and penalties for illegal hunting and wildlife trading;
- Educating villagers of the existence of threatened fauna potentially inhabiting the Project area of influence and the consequences of hunting these species; and
- Training and empowering Khum officers to report illegal hunting activities in a confidential manner.

8.4.3 Impact Assessment

Project-related direct impacts to terrestrial fauna are not anticipated for the majority of operational activities, as driving on access roads is conducted at slow speeds given road conditions; equipment / operational noise will move fauna from tree felling / slash removal activities; and hunting will be prohibited. Some fauna may be directly impacted by controlled burns for site preparation.

The remaining and potentially more significant impacts will be indirect, with an inevitable reduction in habitat for terrestrial fauna through conversion of fallow habitat to plantations. This will be mitigated by retention of at least 10% of natural vegetation in plantation areas, including wildlife corridors along streams and other Special Management Areas.

It is anticipated that people will utilise access tracks to reach hunting grounds. As Burapha favours the use of existing roads for plantation establishment / operations, plantation establishment may not influence current fauna harvest volumes. The construction of new access roads, extension of existing roads into relatively inaccessible areas, or creation of roads where only foot / motorbike trails existed may significantly impact terrestrial species populations and diversity. However, given the use of only fallow forests / degraded areas, previous access to the areas is considered likely.

Terrestrial Fauna Impact Assessment

Primary impacts to terrestrial habitat will be indirect, with conversion of low to moderate value fallow habitat to low quality habitat provided by plantations. Direct impacts may include some mortality for less mobile fauna unable to escape the fire during controlled burns.

As the Project expands, the Company will need to avoid constructing or extending access roads to areas that were previously inaccessible for vehicles. The risk for this impact is low, as one of the primary criteria for Burapha in acquiring land is accessibility.

With implementation of prescribed management measures, impacts to terrestrial fauna are expected to be **Low** given the retention of Special Management Areas in plantation units.

8.5 Aquatic Habitat and Biodiversity

8.5.1 Issues and Findings

Current Operations

Plantations and Access Roads

Burapha implements a number of management / mitigation measures to protect water quality and aquatic biodiversity (refer to Chapter 7). During assessment of operations for the *BAFCO Environmental and Social Due Diligence Report* (ES, 2015) and for this ESIA, the risk for impacts to aquatic habitat and aquatic biodiversity was found to be minimal. Plantation operations provide some risk for aquatic habitat and biodiversity, with potential impacts including:

- Increased sediment input into receiving water impacting the quality of aquatic habitat during the rainy season;
- Accidental spillage or improper application of herbicides potentially impacting water quality and biodiversity; and
- Improper application of fertilisers potentially leading to eutrophication and / or decreased dissolved oxygen concentrations.

Perennial (and potentially seasonal) streams running through or downslope of current plantation areas are inhabited by a number of aquatic species, many of which are important sources of protein for rural communities (refer to Chapter 5). These streams flow to rivers and potentially wetlands that are inhabited by a wider range of fish, crab, shrimp, aquatic reptiles, amphibians, aquatic invertebrates, etc. including species that are identified as globally threatened by IUCN. Given the number of new species / endemic species identified during the conduct of recent intensive fish studies (e.g. refer to Kottelat studies) it is likely that considerably greater species diversity, endemism, and perhaps threatened species occur throughout the region. Continued application of robust management / mitigation measures to protect water quality (as per Section 7) will be required to avoid impacts to aquatic biodiversity in plantations.

Access

As for terrestrial flora and fauna, increased access may lead to increased fishing pressure in streams near plantation units / access roads. During the conduct of Local Knowledge Surveys, it was identified that the small seasonal and perennial streams near plantations are often not favoured fishing areas. The operation has not provided additional access to the larger perennial streams and rivers that are commonly harvested of fish and other aquatic organisms.

Erosion and Sedimentation

Some erosion and sediment transport to receiving waters has occurred as a result of Project implementation (refer to Chapter 7 for a comprehensive assessment and identification of management). Vegetation clearance, ploughing for intercropping and unsealed roads provide sediment for transport during the rainy season months. Burapha prescribes a number of measures that reduce erosion and sediment loading of streams. However, sediment invariably reaches streams, with coarser grained material settling out in slower reaches and finer grained material transported to larger streams and rivers. Erosion of road surfaces is likely the greatest contributor of sediment to receiving waters for Burapha operation.

Herbicides

As is detailed in Chapter 7 of this ESIA, Burapha utilised Glyphosate and Metsulfuron for weed control. Both are highly immobile and have low toxicity. If properly applied, these herbicides will not reach watercourses or groundwater, as each binds tightly to soils. The results of consultations indicate that aquatic habitat and biodiversity has not been impacted during current operations.

Fertilisers

Burapha applies a general fertiliser (NPK), and often rock phosphate, boron, and dolomite to improve soil conditions for tree growth. Overapplication or improperly timed application could lead to discharge into receiving waters. There is little concern regarding acute or chronic toxicity, however excessive nutrients may lead to eutrophication and / or decreased dissolved oxygen concentrations which directly affects the health and vitality of aquatic biodiversity. Burapha incorporates slow release fertilisers into the soil and does not fertilise during the rainy season. The risk for associated impacts in current operations were found to be low.

Tree Nursery

The risk for impacts to aquatic biodiversity at the Nabong Farm tree nursery are more significant given the chemical application regime. The following materials and their associated waste products provide risk that will need to be managed to avoid impacts:

- *IBA* (active ingredient 3-Indolebutyric Acid) - used to stimulate root generation in cuttings for clonal production;
- *Benlate (benomyl)* – a fungicide that is selectively toxic to micro-invertebrates and invertebrates;
- *Funguran* (copper hydroxide) – a broad scale fungicide;
- *Termicide* – a pesticide to control termite attack;
- *Glyphosate* – for weed control;
- *Metsulfuron* - for weed control; and
- *Fertilisers* – to promote tree growth.

Funguran and Termicide are highly toxic for aquatic life and may have long lasting implications if discharged to receiving waters. The remainder of these chemicals have low toxicity and bind tightly to soil, with very little risk of discharge to surface waters.

The tree nursery drains to the Houay Som (a small seasonal stream) and a perennial wetland system to the north of the site. The wetland system discharges to the Houay Chiem (a seasonal stream), which then discharges to the Nam Ngum River, approximately 2 km north of the nursery. The wetland is an important fishery for villagers of Ban San Oudom (stocked) and a wide variety of aquatic species inhabit the Nam Ngum River. The diligent application of measures identified in the Burapha *Chemical Management SOP*, Sections 7.5.2 and 8.5.2, and the Project **ESMMP** will be required to avoid impacts to aquatic habitat and biodiversity.

Plantation Expansion and Area of Influence

Plantations

The risks for impacts during Project expansion are like that identified for current operations, with the area of influence extending well beyond plantation boundaries (i.e. receiving waters flow to high value aquatic habitat). Risk for potential impacts are as follows:

- *Sedimentation* - The likelihood for erosion and sedimentation associated with vegetation clearance and access road use is high, but impacts are not expected to be significant. Burapha management for erosion in sedimentation is more robust than that observed in typical swidden agricultural plots in the region. Cumulatively, erosion and sedimentation is impacting aquatic habitat and potentially aquatic species (refer to Chapter 11);
- *Herbicides* - The risk for impacts from herbicide application (Glyphosate and Metsulfuron) are considered low given that these pesticides bind tightly to soil particles, have low acute and chronic toxicity for aquatic biodiversity, and are applied during the dry season;
- *Fertilisers* - The risk for impacts from fertiliser application is considered low, given the method and timing of application, extremely high concentrations required to be considered toxic, and Company policies for storage and handling;
- *Access* - The risk for impacts associated with improved access to fishing grounds is considered low, given the likely areas for plantation expansion. Plantation areas will likely be near small seasonal or perennial streams distant from favoured fishing grounds; and
- *Leaf litter* - Surface run-off through *Eucalyptus* litter may change nutrient availability in downstream watercourses. Population numbers and species diversity of aquatic invertebrates and fungi have been found to be lower in streams in *Eucalyptus* plantations than in deciduous and mixed forests (Abelho and Graça, 1996; Pozo et al. 1998; Bärlocher and Graça, 2002; Ferreira et al., 2006). *Eucalyptus* leaf litter may provide lower food quality for detritivores since leaves have oil glands, thick cuticle and outer wax coating. The thick cuticles may delay colonisation and decomposition by aquatic flora and fauna (Abelho and Graça, 1996). Several studies have demonstrated that the effect of *Eucalyptus* plant litter may be attenuated by maintaining riparian corridors of the original vegetation (e.g. Ormerod et al., 1993; Abelho and Graça, 1996).

Given the potential wide spatial distribution of plantations across the four Project Provinces, there is likely greater species diversity in potential receiving waters. More than 481 fish species have been identified in Lao PDR, as well as 37 species of amphibian, seven (7) crab species, and 10 shrimp species. Given the uneven distribution of thorough taxonomic study throughout the country, this likely accounts for a fraction of the aquatic species diversity. The Nam Ngum – Nam Lik River Basins are home to more than 125 fish species, as well as populations of amphibians, aquatic reptiles, and aquatic invertebrates. Very little robust taxonomic study of aquatic species beyond fish has been conducted in the Project Area.

At least 14 globally threatened fish are known to inhabit Project Area rivers. The majority of these fish species are considered more likely to be found within the Nam Lik, Nam Ngum and Nam Song rivers, with some venturing into their tributaries (IUCN, 2016) and seasonally flooded areas for spawning.

Though risks for significant impacts to aquatic habitat and biodiversity are considered low, management and mitigation measures are required to protect these resources.

Tree Nursery

With the current capacity to provide up to three million clonal seedlings per annum and room for expansion to the east of the site, it is anticipated that the current nursery will be utilised to provide stock for expansion. The risks for impacts are considered the same as for current operations, with management measures required to avoid discharge of Funguran and Termicide (and any other chemicals that may be used in the future) and minimise the likelihood of impacts.

8.5.2 Avoidance, Management and Mitigation Measures

Management and mitigation measures for aquatic habitat and aquatic biodiversity are provided in the Chapter 7 (Physical Impacts and Mitigation Measures), specifically in Section 7.4.2 for erosion and sedimentation and Section 7.5.2 for fertilisers, pesticides, and other chemicals. The comprehensive list of management and mitigation measure requirements to avoid impacts provided in these sections are summarised as follows:

- *Riparian vegetation retention* – natural vegetation along surface waters will not be cleared, with buffer areas of 5 m, 10 m, and 25 m on each side of seasonal streams, perennial streams, and rivers respectively and 25 m buffers from seasonal or perennial wetlands. This will protect the quality of habitat (shading), filter-out some of the sediment transported in surface waters; and decrease leaf litter / bark input from eucalypt trees;
- *Erosion and sedimentation* – measures described in Chapter 7 to minimise sediment inputs into receiving waters include implementing better stormwater management on access road surfaces, implementing additional erosion and sediment control measures on road surfaces such as waterbars and discharge outlets near stream crossings; planting tree rows to contour; conducting major ground disturbing activities during the dry season; clearing vegetation only on slopes less than 35° and hand clearing on slopes ranging from 15 – 35°; and planting veviter grass in key areas prone to erosion;
- *Fertilisers, pesticides, and other chemicals* – Accidental discharge of these materials will need to be avoided by ensuring designated controls are in place during transport, storage, application, and disposal. Fertilisers and herbicides will not be applied during the rainy season, and riparian buffers will be avoided.

The use of nationally and internationally banned chemicals pesticides or herbicides as well as World Health Organisation Type 1A and 1B pesticides is prohibited; herbicides will need to be mixed and applied per MSDS and label instructions; and herbicides will not be applied if rain is forecasted for the day.

Employees and relevant contractors will be trained to manage potentially hazardous materials and will need to be informed of the potential for impacts to aquatic biodiversity. Contracted employees at the tree nursery will need adhere to Burapha policies for potentially hazardous materials and general waste.

Burapha will need to continuously update its *Emergency Preparedness and Response Plan* to ensure that all communication protocols and relevant contact details are readily available to all staff to respond to a major spill event.

- *Access* – Burapha will need to adhere to its *Land Identification and Acquisition Manual* to minimise the need for road construction or extension to reach plantation areas. The Company should avoid providing access to areas that were previously inaccessible by car or truck.

8.5.3 Impact Assessment

Impacts to water quality from erosion and sedimentation have been most pronounced where access roads cross watercourses. With the implementation of stormwater, erosion, and sediment control facilities on access roads and retention of larger riparian buffers during Project expansion, impacts from erosion and sedimentation on water quality are expected to be Moderate, but localised in nature. Impacts to aquatic habitat are expected to be Low on a regional basis and potentially more significant for localised areas.

With the application of management measures currently required for Company operations, and incorporation of measures identified in Chapter 7 and detailed in the *ESMMP*, the risks associated with storage and application of herbicides, fertilisers, and other chemicals and disposal of waste products are expected to be suitably mitigated, and significant impacts are not anticipated.

As tree nursery employees are Contractors (i.e. not directly managed by Burapha), the Company will need to ensure that chemical management at the Nabong Farm is as robust as that required for Burapha, particularly given the toxicity for aquatic biodiversity associated with two chemicals currently utilised at the site. If transport, storage, handling, and disposal methods align with Burapha policies and obligations, significant impacts are not anticipated.

Aquatic Habitat and Aquatic Biodiversity Impact Assessment

With the application of prescribed management and mitigation measures, Project related impacts to aquatic habitat are expected to be **Low** and limited to rainy season increase in suspended sediment concentrations. Strict adherence to riparian vegetation retention will promote the ongoing existence of favourable aquatic habitat, with respect to water temperatures, shading, aquatic vegetation, etc.

With diligent application of management measures to protect water quality (i.e. potentially hazardous materials transport, storage, handling, and disposal), impacts to aquatic biodiversity are expected to be **Low**.



Chapter 9 | Potential Social Impacts and Mitigation Measures



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9 POTENTIAL SOCIAL IMPACTS AND MITIGATION MEASURES

9.1 Economic Development

9.1.1 Issues and Findings

National and Regional

At the national and regional level the Project will support the Government's socio-economic development goal of continued strong and inclusive growth in association with human resource development, social development, and effective protection and sustainable use of natural resources (8th NSEDP 2016).

The Project will bring significant foreign capital into Lao PDR. Burapha has invested approximately 26 million USD for the Project to-date and the proposed expansion will require an additional investment of approximately 120 million (135 million USD including mill operations). Project expansion will also make a significant contribution to GOL tax revenues. Land rent is estimated at USD 600,000 per annum. Other Government revenue is expected to include Company profit tax, employee income tax, value added tax and fees associated with transport, processing, and export of finished products.

The Project supports the Government's objectives of developing strong agriculture and forestry sectors (8th NSEDP 2016). In addition to commercial wood production, the implementation of Burapha's agroforestry model will result in the development of agricultural plots for cash crops and local food production and the provision of job opportunities for local communities.

The Project is also critical to Burapha's plans to establish a plywood mill and then a large biorefinery in Hin Heup District, Vientiane Province. These facilities will help to develop the country's value adding capabilities and create a market for wood from the Project and potentially other plantation forestry projects in Lao PDR, including farmer wood plantations. They will also result in additional foreign investment, employment and spin-off business opportunities.

Local Economy

The Project is seeking to maximise economic development opportunities for the local communities including agriculture development, local employment, community development, and smallholder plantation development through an outgrower scheme.

Agriculture development (Refer Section 9.4)

The Project's intercropping model will provide communities with access to land for agricultural between the rows of commercial trees, allowing for intercropping during the first year and grazing during the remaining years of the tree production rotation. This is expected to support the current transition of local economies from subsistence to cash-based economies and contribute to increased household income.

Local Employment (Refer Section 9.2)

Burapha places an emphasis on providing employment opportunities for communities that participate in the Agroforestry Project. An estimated 4400 full time positions will be required to implement the expanded Project including 2400 skilled and 2000 unskilled positions. An estimated 3.7 million man-days of casual labour will be required during the plantation establishment phase and 4.4 million man-days during plantation management phase. This will result in the payment of an estimated \$50 million USD per annum (at today's rates) to local communities over the 7-year rotation.

Community / Village Development Funds

The Project will provide community development funds for participating communities as per the current model (for lease and cooperation agreements with villages) which includes contributions to Village Development Funds (LAK 1 – 3 million / USD 120-350 per ha) and reportedly Khum Development Funds (LAK 40,000 / USD 5 per ha) and District Development Funds (LAK 80,000 / USD 10 per ha) over the 30 to 50-year lease periods. Khum and District funds are intended to be used for developing the office and administration sectors. VDFs will be used by villages for food security, income generation activities, education, and health, water and sanitation infrastructure or other priority areas that have been defined that contribute to village development. If effectively managed, the Project has the potential of contributing between LAK 50 billion / USD 6 million and LAK 150 billion / USD 17.5 million for VDFs and a further LAK 6 billion / USD 750,000 during the life of the Project.

Spin-off Business Opportunities

Project investments in local employment and community development funding will stimulate the local economy by providing spin-off opportunities for suppliers and businesses (i.e. local shops and suppliers).

Outgrower Scheme (Refer Section 9.4)

Burapha has a policy to promote local farmers to participate in a Project out grower's scheme with the purpose of building up long-term assets for farmers and extending the Company's raw material base. The outgrower scheme is expected to generate additional income for participants.

Consultations with villages currently participating in the agroforestry scheme have indicated that the scale of benefits derived from Project implementation vary for communities / individuals for a variety of factors, including the size of the plantation area (which has direct implications on the number and duration of employment opportunities, the number of households that chose to participate in the intercropping, and the relative success and sustainability of the community development interventions.

While economic and agricultural development will have obvious benefits, there is some potential for impacts that will need to be carefully managed, including:

- Local price increases – Increased consumption and disposable income of some households may drive up the costs of local goods and services, particularly in areas with large Project land areas / large numbers of participating Project villages. This may have disproportionate impacts on low income and other vulnerable households;
- A hands-off approach (by the Company) to decision making regarding provision of employment and spending of community development funds has led to some perceived or actual problems for some of currently participating villages. There is considerable risk that employment and development funding will not be equitably distributed if left to khum managers / village authorities;
- Intergenerational changes over the 30 to 50-year lease period and the potential for conflicts due to perceptions in best use for village land.

New employment opportunities are expected to increase average income in Project villages, and potentially profoundly benefit rural communities with fewer outside employment opportunities. A collaborative approach to management of job, intercropping land, and VDF funding will facilitate equitable benefits for all members of participating communities.

9.1.2 Avoidance, Mitigation and Management Measures

Burapha will implement the following management and mitigation measures to minimise impacts to, and promote development of, economic development during the development and management of the Project:

- Update Burapha's human resource policies to reflect a commitment to local employment, training and skills development and ensure equal opportunity and employment practices for all people in the Project Area (refer to Section 9.2);

- Establish and implement Project Village, Khum and District Development Funds in coordination with affected village, Khum and District authorities, and consult with communities regarding expenditure of development funds;
- Align the VDF to the Government's socio-economic development and poverty reduction plans and initiatives and ensure that the VDF targets vulnerable groups and promotes equitable development;
- Promote use of VDF funds for the development of food security, income generation, financial management, education, health and other priority areas (particularly groups identified as most impacted by the Project);
- When applicable, develop and implement a procurement and supply policy, which favours local products and services;
- Further develop and implement the Project's out-growers scheme which supports the development of small-holder hardwood plantations on privately held land;
- Regularly consult with local communities and ensure appropriate management of grievances through the implementation of an international standard grievance mechanism; and
- Regularly monitor employment statistics and socio-economic conditions in participating villages to ensure effectiveness of employment management measures.

9.1.3 Impact Assessment

The Project expansion is expected to generate direct and indirect economic benefits for the Lao PDR economy, regional economies, and for communities and individuals. At the national and regional levels Project expansion 68,750 ha will require significant foreign investment that will be injected into the economy, land rents, as well as other tax revenue (i.e. company profit, employee income, VAT etc.).

At the local level, the Project will improve local economies through agricultural development, full time and casual employment, spin-off business, community development and smallholder plantation forestry development. If managed effectively, these activities will contribute positively incomes and economic development in numerous rural communities across the four Project Provinces.

With diligent consultation and engagement with Project communities and local governments; targeted measures to promote equity; and regular social monitoring to ensure measures are sufficient, economic benefits of the model are expected to be significant.

Economic Development Impact Assessment

The Project is expected to generate significant economic benefit for local, regional and national economies through an estimated 120-135 million USD in foreign investment; 600,000 USD in annual land rent revenues to regional governments; significant revenue in annual employment; as well as agricultural development, community development, spin-off business and small holder plantation development.

The Project is expected to have a **Moderate / High** benefit on economic development in the Project region with successful implementation of measures to promote equitable distribution of Project benefits across and within Project villages / Districts, with a focus on disadvantaged and vulnerable groups.

9.2 Employment

9.2.1 Issues and Findings

Employment Opportunities

The Project expansion will provide employment opportunities in Project villages and across the Project Region. This will include provision of full-time and casual / seasonal Company employment and contracted labour.

Direct Employment - Casual Labouring

Project employment for collaborating villages includes work on brush clearing; thinning, fertilizing; plantation maintenance; and (potentially) harvesting of trees for processing and sale. The work is seasonal, with job requirements and the number of days offered highly dependent on the stage of the plantation cycle. The Company pays for casual labour via one of two primary methods: (i) a daily rate of 50,000 kip (as of 2017); or (ii) per unit achieved (e.g. area planted, weeded, fertilised, etc.). Of the two payment methods for casual labour, employees reportedly earn more working per unit than for the daily wage, with each exceeding Lao minimum wage requirements. Payment per unit area completed is also proving to be more effective for the Company as it decreases risks and tends to increase efficiency.

Plantation establishment is typically conducted during the wet season, though site preparation is initiated in advance of the rains. Approximately 74 man-days per ha are required to prepare for and plant the trees. Approximately 4,440,000 man-days will be required for the full 68,750 ha (55,000 ha of plantation) equating to approximately LAK 222 billion (USD 27.75 million) in wages for casual employees.

Plantation management is typically conducted in the dry season and includes 12 man-days for weeding over the 7-year cycle and approximately 88 man-days per ha during harvesting, with additional work provided for thinning, fertilising, singling, etc. Approximately 6,000,000 man-days will be required for the full 68,750 ha, equating to LAK 300 billion (USD 37.5 million) each 7-year cycle.

Direct Employment - Full time positions

The Project also requires a workforce of full time technical staff, support staff and managers to oversee the establishment and implementation of the Project. The current operation employs 120 full-time staff, including 45 full-time sawmill employees. These staff are located in Burapha's head office (Vientiane Capital), regional offices and in selected Project villages. An estimated 4400 full-time positions will be required to implement the expanded Project at full capacity.

Indirect Employment

Indirect employment opportunities are also available through contractors and other service providers (such as plantation area preparation, road construction and maintenance tree harvest, and transport, etc.).

Potential Employment Issues

While Project employment is expected to be an important income generation activity for people in Project villages and across the Region, there are several issues which require consideration to ensure stakeholders' expectations are met.

Casual and Seasonal Nature of Employment Opportunities

Most casual employment opportunities are linked to the seasonal and cyclical nature of plantation management. This is expected to suit many rural households in the Project region whose livelihoods are still predominately agriculturally based and the supplementary income will likely be well received. For these households, the timing of work opportunities in relation to their primary agricultural livelihood activities (i.e. rice planting) requires careful consideration to barriers conflict with activities that are critical for food security. This issue is expected to be amplified in villages / regions where there are large areas of plantations and limited workforce.

Cyclical Nature of Employment Opportunities

Project employment opportunities at the local level will also be intermittent - linked to the plantation forestry cycle. This presents challenges for the Project which requires a reliable workforce and for communities who seek more stable and reliable income sources. Burapha's agroforestry model aims to address this through a rotational planting approach which involves the incremental establishment of plantations of multiple ages within a given village boundary and in turn provide a more on-going stream of labour opportunities. This approach is proving challenging to implement in the early stages of the Project, however is expected to

become more wide-spread as the Project plantations expand, the success of initial plantations is observed by participating villagers, and the Company can access more land

Uptake of Project employment opportunities

The uptake of Project employment opportunities in villages will depend on the other available employment opportunities as well as effective engagement with villages regarding Project employment opportunities. Currently, the number of households employed during plantation establishment and management varies widely across participating villages (refer to Chapter 6).

In villages where there are ample other employment opportunities or where residents prefer to use available labour on their own agricultural plots, the demand for Project employment may be lower. For villages with high demand for Project employment, real or perceived barriers (such as low awareness of employment opportunities, distance of plantations from settlements and lack of transportation, inability to divert labour for plantation work, and ineffective recruitment processes) will need to be addressed. This will require careful management during Project expansion to ensure that Project employment benefits are maximised.

Labour shortage and Outside Workforce

Current Project plantation areas are generally small (i.e. average 104 ha per village) and labour requirements can be met in the village or from the surrounding area. In some Project villages (i.e. Ban Nakhanthoung, Ban Borchan, Ban Nakhan (Paklai District)), outside labour has been used where local labour could not be sourced at key times. In these cases, aligning Project employment to the agricultural cycle, will maximise the chance that local residents are able to benefit from the Projects.

Project expansion may result in labour shortages in some areas across the region – i.e. where there is a high ratio of plantation area to available workforce. The presence of an outside workforce has the potential to create social conflict and presents risks to community health and safety (refer to Section 9.7).

Inequitable Employment

There is potential for conflict to arise because of perceived or actual inequalities in the share of employment opportunities between groups such as poor vs non-poor households; ethnic groups (i.e. Mon-Khmer and Lao Tai); males and females; and recent migrants versus long-term residents. This could also occur if recruitment processes are not actively managed and some households are favoured by decision makers for Project employment.

A key issue for the Project will be ensuring that poor and disadvantaged households are provided the opportunity to benefit from employment opportunities. These groups may experience more barriers to gaining employment (i.e. inability to engage in employment recruitment processes, limited or no labour, etc.). Currently, the level of engagement with vulnerable groups during Project recruitment varies across surveyed villages. Actively targeted recruitment processes and measures to reduce potential barriers sometimes experienced by vulnerable groups will assist in ensuring equitable employment opportunities.

Workforce Protection

Workforce protection is a key aspect of the Project. Risks posed to workers across Lao PDR include discrimination (i.e. gender or ethnicity), forced labour, child labour and occupational health and safety. Burapha supports the UN's Universal Declaration of Human Rights and the Core Conventions of the International Labour Organization (ILO). Burapha's *Code of Conduct* strictly prohibits child or forced labour. The Company has a policy with a minimum age requirement, and stipulations for workers between 14 – 17 years of age (including weekly hour restriction and prohibition from hazardous work).

Occupational health and safety risks are inherent in plantation operations. Burapha has outlined its exiting OH&S policies in the *BAFCO OHS Policy and Principles Manual* (refer to Section 9.8) and provisions for OHS are provided in the ESMMP.

Social Change

The presence of the Project and associated employment opportunities have the potential to impact the social dynamics of Project villages (refer Section 9.1). Potential employment related social change issues include inequitable employment / household income changes, inflation of basic goods and services, transfer of local authority and intergeneration changes over the life of the Project.

9.2.2 Avoidance, Mitigation and Management Measures

The following management and mitigation measures will need to be implemented to minimise employment related impacts during Project establishment and management:

- Develop and implement a clear communication policy regarding employment to address community and local government expectations. Ensure this policy and Project employment opportunities are clearly communicated to all potentially interested members of the participating community through early engagement activities prior to plantation establishment;
- Align the timing of Project casual employment opportunities with local agricultural schedules to the extent practicable;
- Communicate, promote and where possible implement a rotational employment approach to maximise employment opportunities across the plantation cycle;
- Develop a preferential employment policy that prioritises the employment of Project village residents and people from vulnerable groups. Take a proactive role in the allocation of jobs to ensure that the process is fair and equitable. Ensure that Project village residents do not wish to have employment with the Project before outsourcing to contractors;
- Further articulate and implement Burapha's Dignity and Respect Policy to ensure equal opportunity employment and wages for all ages, sexes and ethnic groups;
- Develop and implement a human resource training program and ensure the continuous training and development of local employees;
- Extend the company's Code of Conduct (including labour standards) to Burapha's contractors and suppliers through contractual obligations and conduct sufficient due diligence to ensure conformance;
- Continue to prohibit the use of child or trafficked labour and monitor / enforce this policy;
- Implement measures outlined in Section 9.6 to mitigate occupational health and safety risks and ensure appropriate working conditions for local communities;
- Through the community development funds, ensure that non-employee residents in local communities derive economic benefit from the Project;
- Regularly consult with local communities and ensure appropriate management of grievances through the implementation of an international standard grievance mechanism
- Regularly monitor employment statistics (i.e. employment register) in local villages to ensure effectiveness of employment management measures.

9.2.3 Impact Assessment

Employment opportunities are likely to be one of the most significant economic benefits to local communities from the Project. The Project is expected to create approximately 4400 full time positions and over 8 million man-hours of casual labour opportunities valued at 32 billion LAK / 4.4 million USD; as well as additional indirect employment with Project contractors over the life of the Project.

Implementation of the above management and mitigation measures will ensure that employment opportunities are prioritised for local communities and distributed equitably across these communities. This is

expected to maximise the ability of households from all groups, to take up employment opportunities and benefit from associated incomes.

Management and mitigation measures will require consideration of specific socio-economic circumstances in each Project village and will require regular monitoring to ensure these measures remain relevant and effective.

Employment Impact Assessment

Project employment and income generation is expected to provide **Moderate to High** benefits on economic development, creating approximately 4400 full time positions and over 8 million man-hours of casual labour opportunities valued at 32 billion Lao Kip/ 4.4 million USD; as well as additional indirect employment with Project contractors over the life of the Project.

The benefits of Project employment will be maximised through prioritising local employment; working to align employment opportunities with local agricultural cycles, and ensuring that employment opportunities are equitably distributed within Project communities

9.3 Land Acquisition and Land Use

9.3.1 Issues and Findings

The Project does not involve any involuntary displacement or resettlement and seeks to minimise adverse social and economic impacts from land acquisition through implementation of the Company's Land Acquisition Process and intercropping model.

Land Acquisition

Burapha seeks to acquire land for the Project through the negotiation of land lease agreements, including leasing concessions on State land or leasing communally or individually held land in local villages. Lease periods range from 30 – 50 years (refer to Chapter 3).

The Project depends on access to degraded forest lands for the establishment of plantations. Much of the land across the Project region has been allocated to villages through Village Land and Forest Management Agreements (VLFMAs) or is under the customary tenure of local communities. Some of these areas have been formally allocated through land use certificates (or similar instruments) to individual households though most remain community land.

Burapha recognises the rights and interests of local communities as the traditional managers of their lands and engages with the government and directly with villages regarding the land-lease. The Company follows carefully established criteria as outlined in their Operations Manual for Land Acquisition. The principles of FPIC (Free, Prior and Informed Consent) are a core element of the Company's land acquisition process.

Burapha provides the following financial compensation for all land acquired for the Project:

- State land rent (~ USD 10 per ha per year¹) to District / Provincial government over the life of the lease; and
- Community land rent in the form of VDF contribution (between LAK 1 – 3 million / USD 120 – 350 per ha²) over the life of the agreement (refer Section 9.1); or
- Compensation for individually held land (negotiated on a case by case basis).

Key risks associated with the Project's land acquisition process are outlined below.

¹ Adjusted for inflation

² Adjusted for inflation

Inadequacy of the Land Acquisition Consultation Process

A key risk for the Project is the perceived or actual inadequacy of land identification and acquisition consultation process amongst all or part of the target community – for example it has been reported by some participating villages that decision making is undertaken mainly by the village chief or a Company hired Khum Manager, sometimes without the engagement of the rest of the village. To address this risk, Burapha will need to take a proactive role in engaging participating communities early in the process of land acquisition to negotiate potential leases from villages / individuals as well as allocation of work. The Company is committed to achieving Free Prior and Informed Consent in-part, through its Good Faith Negotiation Policy (GFN) This approach has been strengthened recently to ensure better on-ground implementation and participation from women and other vulnerable groups.

Land ownership / tenure disputes

There is the potential for land ownership / tenure disputes to arise from delineation of plantations in areas under conflicting ownership status (i.e. between individual villages or with government / private leases). Burapha Land Selection Criteria requires that this land be identified and avoided. A potential issue associated with Burapha's bottom-up approach to land acquisition has been its inconsistent engagement with relevant GOL stakeholders. Issues include an emphasis on District level government engagement; a reliance on District government reporting processes for engagement and approval at higher levels of government; and inconsistencies in District government engagement during land acquisition activities and approvals processes.

Inadequacy / inequity of land compensation

There is potential for perceived or actual inadequacy or inequity in land compensation arrangements including the implementation of Village Development Funds and intercropping agreements. Of key concern is the potential disproportionate impact land acquisition may have on certain groups of people who are more dependent on communal land and associated resources (i.e. poor and vulnerable households) and the lack of targeting of village development activities funded through the VDF. As the Project expands a more active management of the VDF process is recommended to ensure they are effectively implemented in villages and the potential to use it for livelihood restoration is maximised.

Changed Community Perceptions over the Lease Period

There is the potential for changed perceptions over 30 – 50-year lease period, particularly as socio-economic conditions in these villages change (i.e. population increases, land availability becomes scarce). Younger generations may become unsatisfied with agreements / leases as competition for land intensifies and other potentially more lucrative uses of the land are identified.

Land Use

The Project will acquire fallow / degraded land suitable for plantation establishment. Land may also be acquired for plantation access roads where required.

According to Government land use data (FIDP 2010), there is approximately 29,912 ha of land classified as fallow forest (young and old) or slash and burn land across the Project region (refer Chapter 5). To date, Burapha has acquired land use rights to approximately 8,000 ha (gross Project land) and has planted approximately 3,000 ha across approximately 23 villages in six Districts within the four target Provinces. The Company is seeking a total of 68,750 ha for the Project, 55,000 of which will be plantations.

The current uses of degraded forest land vary across the Project region and are dependent on land tenure arrangements. Most land is classified as 'community land' within villages and is generally used for swidden agriculture, cattle grazing, forest resource collection and may have been allocated for planned agricultural expansion. The Company will not acquire land currently used for permanent agriculture.

Potential livelihood impacts associated with agriculture and forest use are discussed in Sections 9-4 and Section 9-5 respectively. Potential issues concerning land conversion are discussed below.

Offsetting Impacts on Swidden Land and Grazing Lands

The Project will offset loss of swidden agricultural and grazing land through the development of agricultural plots between plantation rows and the development of intercropping agreements with villages. Under the Project's intercropping model space will be provided between rows to allow for intercropping or cattle grazing. This spacing can be reduced where necessary. If the area is unsuitable for agriculture crops, spacing may be reduced to three (3) meters

This approach has been effectively implemented in ~90% of the current Project villages. The development of agricultural plots will be dependent on the suitability of this approach in each individual area. Some of the current Project villages have chosen not to participate in the intercropping model due to a range of factors (i.e. land is too far away from the village settlement; land is considered not suitable for agriculture, villagers have access to jobs that preclude the time expenditure, etc.).

Land Availability

Based on current operations, Project plantation areas in local villages range from 31 ha in Ban Nathom, Hin Heup District (Vientiane Province) to 480 ha in Ban Natoung, Pak Lai District (Xayabouly Province). Lease areas generally account for between 1 -14% of villages, with an average of 10%. However, lease areas in two villages, Ban Khonekeo, Hin Heup District and Ban Phonngeun, Phonehong District account for nearly 60% of village land area, mainly due to the very small village size (672 ha and 427 ha respectively). The amount of swidden / degraded forest land ranges in surveyed villages from 0-3,423 ha per village, with an average of 743 ha. To maximise the benefits of the Project's intercropping model, Burapha is seeking enough land to allow for division of the area into several plots and staged development / multiple rotations (refer Section 9.4).

At present, 13 of the 23 participating villages have plantations of multiple ages within their boundaries. There are several challenges which need to be overcome to facilitate the broader implementation of the rotation approach. These include pressures on the Company to achieve annual plantation targets; initial community reservations regarding the potential benefits of the Project and the success of the intercropping model (i.e. need to prove it can work before they can acquire more land); competition for land and associated concerns of leaving land secured under lease undeveloped for a number of years; community expectations to realise the benefits associated with plantation development (i.e. VDF payments, employment etc.). These challenges are expected to be addressed in part as the Project expands and the success of the model is demonstrated.

In addition, the fact that plantation land will not be burned during preparation for second rotation stands (and onward), less nutrient availability may decrease rice yield and rapid coppice sprouting of eucalypts may shade intercropping areas more rapidly. These issues will need to be evaluated to overcome potential challenges.

As the Project expands, land use impacts may be amplified if large percentages of a village, village cluster's or a District's available degraded land or total land area is converted. In this instance, the ability of traditional land uses to provide resources critical for local livelihoods will be reduced and the importance of the intercropping model to compensate for this will increase.

9.3.2 Avoidance, Mitigation and Management Measures

Burapha will implement the following management and mitigation measures to minimise land acquisition and land use impacts during the development and management of the Project:

- Continue to implement the Project's land acquisition process including consultation and approval from Government at required stages and free, prior and informed consent consultation process with villages;
- Apply Burapha's Land Selection Criteria to ensure that Project development is in balance with the total land within the village and sufficient for applying the rotational intercropping Model;
- Avoid acquisition of land where there are indications of border conflicts with bordering villages should not be acquired;

- Provide fair and adequate compensation for Project land through VDF's and Village Land Use Agreements, with an emphasis on the most affected households (including vulnerable groups);
- Review land lease fees on an ongoing basis to account for changing socio-economic conditions over the 30 – 50 period of the lease;
- Establish and implement Project Grievance Redress Mechanism at the village and District levels including the establishment, training and resourcing of village grievance redress committees; and
- Regularly consult and engage communities regarding Project land use and Village Land Use Agreements over the life of the Project.

9.3.3 Impact Assessment

The Project does not involve any involuntary displacement or resettlement. Potential adverse social and economic impacts and issues associated with land acquisition process including inadequate consultation, land ownership / tenure disputes and inadequate / inequitable land compensation will be managed through effective implementation of the Project's Land Acquisition Process including FPIC approach and land selection criteria.

The implementation of the Project will result in the conversion of up to 55,000 ha of degraded forest land across the Project region. Impacts on current swidden land uses within degraded forest landscapes are expected to be offset by the provision of agricultural area within plantations.

Impacts on land availability within villages and in the Project Region and changing community perceptions will be minimised through effective consultation and engagement with Project villages over the life of the Project.

Land Acquisition

Project expansion is expected to result in **Low - Moderate** impact on community land availability and associated livelihoods. The Project does not involve any involuntary displacement or resettlement. Potential adverse social and economic impacts from land acquisition and conversion will be minimised through effective implementation of the Project's Land Acquisition Process and intercropping model as well as ongoing consultation with Project communities.

9.4 Agriculture

9.4.1 Issues and Findings

The conversion of degraded forest land may impact land currently used by households for swidden agriculture and livestock grazing (i.e. prevention of access during initial years of the plantation cycle).

While data on swidden agriculture is unclear because much of this activity is not recorded, government data suggests that between 85-95 % of households across the Project region are involved in this activity to some extent. Village consultation for this study indicated much lower utilisation of this practice though results were variable across Project villages depending on their location, relative poverty / wealth, ethnicity and traditional farming practices. Village surveying also indicated that several current Project villages have significantly reduced swidden agricultural practiced and switched to lowland or permanent cultivation.

Government data on animal husbandry across the Project region indicate that over 33% of households hold cattle and 15% buffalo. Regional statistics are generally reflected in current Project villages. Cattle graze on grasslands and in swidden / degraded forest lands.

Agricultural Development

Agricultural development within the Project plantation areas is an integral part of the Project's Agroforestry model and is intended to mitigate the loss of these swidden agriculture lands and enhance food security and livelihoods. Burapha is currently implementing the intercropping model in at least 20 of the current Project villages and intends to expand this where feasible throughout the Project region.

Key elements include the provision of agricultural plots between plantation rows (refer Section 9.3), the development of village intercropping agreements; support for the development of agricultural crops and pasture; and support for livestock (i.e. cattle) development.

Village Intercropping Agreements

Burapha develops intercropping agreements between the Company and each Project village. These agreements provide the community with land use rights for agriculture plots in the Project areas. In principal, land is to be used by the farmers from the village that the land belongs to. The village authority or Company hired Khum Manager is responsible for dividing and allocating this land to individual families.

While this process provides an important legally binding agreement between Company and village there is potential for real or perceived inequity in the provision of individual plot allocations, particularly if some households are favoured over others or if some groups are not specifically engaged. The hand's off approach to agricultural plot allocation reduces the Company's ability to ensure that benefits are equitably distributed. This is particularly important for poor or disadvantaged households who may lack alternative livelihood options and the ability / resources to benefit from other project benefits (i.e. lack of labour to benefit from employment opportunities). As the Project expands, a lack of formal arrangements for plot allocation may affect the distribution of Project benefits and result in inequitable opportunities in some villages.

Intercropping - Cropping, Pasture and Livestock Development

The Project supports local farmers to undertake agricultural (food production) activities in agriculture plots between plantation rows. This includes cropping in years 1 and potentially year two (if requested by farmer) of the plantation cycle and pasture / grazing in years 3-7 (refer Chapter 3). The Company support includes field trials in combination with extension of regional experience from R&D on upland agriculture. Farmers participating in the scheme for the first time are provided with seeds for edible crops. Additional support may also be provided through the VDF. The company does not provide support for cash-crops or agricultural inputs (i.e. fertiliser).

The initial cropping stages of the model are well established and there is general satisfaction with the results, although the number of households participating in intercropping varies for villages currently participating (refer to Chapter 6). Key benefits include increased crop production, food security and labour savings for participating families and the transfer of improved farming systems in other agricultural areas in the village (i.e. other permanent agriculture plots). Other potential benefits include improved roads leading to enhanced availability of agricultural inputs, improved access to market and access to previously inaccessible land.

Some villages choose not to conduct intercropping due to already having sufficient agricultural land.

In years three to seven of the plantation cycle, tree shading prohibits intercropping though provides potential for livestock grazing activities. There is currently varied success with respect to livestock grazing in Burapha plantations (refer to Chapter 6). Real or perceived issues affecting grazing in plantation areas include the distance of plantations from settlement areas preventing access for livestock and suitability of fodder. Other potential barriers include low ownership of livestock in some villages and lack of direct support for livestock related initiatives (e.g. health, management etc.) or the purchase of livestock. Experience from other project in Lao PDR have proven that grazing is feasible. Burapha is currently conducting its own R&D and trials to develop the most successful approaches.

Potential impacts and challenges associated with the further development of the intercropping scheme include:

- Variable socio-economic and physical conditions – The Project region is large and socio-economic and physical conditions vary from village to village. These aspects need to be understood through the land acquisition consultation process (including FPIC consultation, socio-economic surveying, environmental surveying) and considered during the implementation of the model.
- Confidence in the intercropping model – While confidence in the model is growing, the reluctance of some villagers to take up the scheme due to their risk-averse nature threatens the Project's ability to mitigate potential livelihood impacts.
- Multiple rotations – Existing challenges regarding the development of multiple intercropping rotations within village project areas is limiting the model's potential for providing more regular / consistent crop and grazing activities.
- Allocation of plots and employment opportunities – as the Project expands, formal arrangements or an active involvement in plot allocation and local recruitment is recommended to ensure Project benefits are equally distributed.
- Clear communication processes with villages – whilst most villages are aware of Project related opportunities, consultation for this study indicated that information regarding employment and intercropping opportunities should be better communicated.
- Soil fertility – cycles for soil remediation will be altered with burning conducted only for site preparation for the first plantation cycle. Nutrient replenishment from burning will not occur for second, third rotations, etc. potentially requiring soil remediation as the Project progresses;
- Employment – coppice sprouting of eucalypts will reduce the need for planting (and associated employment) during subsequent rotations (following the first). This is expected to be managed somewhat as trees will be replaced as clones improve through R&D activity.
- Livestock Development – Households who currently manage livestock and rely on degraded forest areas for grazing are expected to benefit most from the provision of pasture / grazing lands. Other households, not currently engaged – typically poorer households may face barriers of entry including available labour, cost of purchasing animals and experience in managing herds. There is potential for the Project's VDF to support livestock development to benefit disadvantaged household.

9.4.2 Avoidance, Mitigation and Management Measures

Burapha will implement the following management and mitigation measures to minimise impacts to agriculture and promote the development of new agricultural opportunities during the development and management of the Project:

- Continue to promote the development of the Project's intercropping model through effective engagement with Project villages and the development of tailored solutions for specific circumstances where required. Ensure processes are in place for early and regular communication and engagement with villages regarding the Project opportunities
- Develop and manage Project lands in accordance with Burapha's intercropping model to maximise agricultural land to ensure food security;
- Take a more active role in the allocation of individual plots through the village intercropping agreement process to ensure that the process is fair and equitable and households most affected by the loss of swidden and grazing lands and associated livelihoods are prioritised;
- Through the VDF, develop and implement initiatives to further improve agricultural livelihoods including supporting agricultural development in plantation areas across the 7-year plantation cycle;
- Impacts to soil fertility versus swidden agricultural cycles will need to be assessed and strategies developed to minimise soil disturbance and promote ongoing soil restoration; and
- Regularly monitor the effectiveness of agricultural development activities.

9.4.3 Impact Assessment

The conversion of degraded forest land may utilise land currently used by households for swidden agriculture and livestock grazing. The successful implementation of the Project's intercropping model is expected to mitigate potential losses of agricultural land and lead to net benefits for the livelihoods of those dependent on communal land in Project villages through the provision of agricultural plots within plantations.

Key factors for success of the model likely include:

- Interest and confidence in the intercropping model;
- Provision of adequate areas of agricultural land per interested family within plantations;
- Implementation of multiple plantation units within a village (i.e. of varying age) to provide for more continuous cropping and livestock grazing activities;
- Development of fair and equitable village intercropping agreements which target directly affected households; and
- Appropriate support for the development of food crops and pasture and development of livestock holdings either directly or through the VDF.

Agriculture

With the effective implementation of the intercropping model, the Project is expected to result in **Moderate** benefits for agricultural based livelihoods in Project villages. Success of intercropping is expected to vary across villages due to the range of socio-economic conditions present in the Project Provinces, requiring effective consultation and engagement with individual communities and tailored solutions to best suit specific circumstances.

9.5 Forest Resource Use and Ecosystem Services

The potential impacts of the Project on terrestrial biodiversity and High Conservation Values are discussed in Chapter 8 – *Biological Impacts*. This section provides a summary of the Project impacts on forest resource use and other ecosystem services.

9.5.1 Issues and Findings

Forests (both modified / disturbed and more natural habitats) provide important economic, ecological, social and cultural functions for communities across the Project Region. Forests form a crucial economic base for rural communities, providing a variety of Timber Forest Products (TFPs) and Non-Timber Forest Products (NTFPs). NTFPs are important supplementary subsistence for household consumption and medicine while TFPs provide material for construction and energy. Their trade can also provide a valuable source of cash income, which is used to buy rice in times of rice deficits (de Beer and McDermott 1989).

In current Project villages, 95% of households reportedly collect NTFPs and 86% collect TFPs. Common NTFPs collected include materials such as bamboo and rattan for handicrafts and other uses. Edible resources such as bamboo shoots, and forest vegetables (e.g. mushrooms) and forest fruits are also collected. These products are sourced from all types of village landscapes including upland agriculture fields, degraded forests, production forests, and conservation forests.

Ecological functions of forests across the Project region include carbon storage, nutrient cycling, water and air purification, and wildlife habitat. Important functions for local communities include flood protection, protection of water quality and habitat for wildlife.

Forest also provide social and cultural benefits. Fallow forests are an important part of traditional farming (i.e. swidden agriculture) and livelihood practices (i.e. TFP and NTFP gathering). Many villages have designated

small conservation forests as 'spirit forests' or cemeteries and these form an important spiritual / religious function.

Direct Impacts on Forest Resources

Conversion of Forest Lands and Loss of Forest Resources

Burapha has established plantations on approximately 3,000 ha to date. Project Expansion has the potential to directly impact ~55,000 ha of degraded forest and associated forest resources across the Project region. Impacts of vegetation clearance on ecology is covered in more detail in Chapter 8 – Biological Impacts.

Burapha's Land Selection Criteria requires that land acquired for the Project meet the government's definition of 'degraded land' and land allowed for forest production – i.e. – "where forests have been heavily and continually damaged and degraded causing the loss of balance in organic matter, which may not be able to regenerate naturally or become a rich forest again" (Forestry Law 2009). This is equivalent to *Modified Habitat* as per IFC PS 6. This practice was confirmed during Earth Systems site visits in 2015 and 2016, where vegetation adjacent to each plantation visited was highly degraded, in the early stages of regeneration, with pioneer invasive species often dominant or pervasive.

As outlined in Section 9.3, degraded forest lands are important sources of non-timber and timber forest products in the Project Region. The extent of impact on local food security and livelihoods is likely to vary between different villages and between individual households within villages depending on a range of factors including geographic preferences for collection of NTFPs, the availability of access to other high quality forest areas as sources of NTFPs and the overall dependence of the village or household on NTFPs as a source of food and / or cash income. If implemented effectively, the agroforestry model may provide a net benefit as a transition to a more cash based economy would alleviate the need for intensive forest resources extraction.

Rehabilitation and Protection of Forests

The Company is committed to the protection and natural regeneration of remnant forest (Special Management Areas) within their plantation boundaries. The average area within plantation lease areas that is not cleared has averaged approximately 20% of the land area thus far. Active protection of watercourse buffer areas / higher value forest will allow for natural rehabilitation of forest resources if managed effectively.

Indirect Impacts on Forest Resources

Impact on Remaining Forest Resources

There is potential for indirect impacts on remaining forest areas because of increased usage pressures as degraded forest areas are replaced with plantations. Ultimately, in the short term, this may reduce the capacity of adjacent forests to provide NTFPs and TFPs for village populations. In the long term the pressure is likely to be reduced as dependence on NTFPs as a food source is reduced due to increased rice production from intercropping and increased cash incomes from employment.

Improved road access through Project road construction and upgrades may facilitate better access to additional forest resource collection areas, with some potential for less sustainable NTFP / TFP harvesting.

9.5.2 Avoidance, Mitigation and Management Measures

Burapha will implement the following management and mitigation measures to minimise impacts on forests resources and forest resource use during the development and management of the Project:

- Implement the Company's Land Selection Criteria targeting degraded land and avoiding the establishment of plantations in natural forests.
- Implement the measures outlined in Chapter 8 – Biological Impacts in accordance with Burapha's Land Acquisition Operating Manual (OM) to minimise potential impacts on flora and vegetation during land identification, acquisition and site preparation.

- Protect remnant forest within plantation areas (i.e. HCV forests and riparian buffers or minimum of 10% of area) and establish / implement clear management and use requirements for these areas with Project villages;
- Support the improved management of remaining village forests by supporting villages and District governments through community development initiatives, to strengthen natural resource management and the Participatory Land Use Planning Process;
- Provide guards at Work Camps that may intervene if outsiders use plantation roads to access NTFP, TFP, hunting areas;
- Prohibit Burapha employees and contractors from collecting NTFP / TFP from surrounding forests, except for residents who have historically utilised the area for resource extraction; and
- Monitor the potential Project impacts of the loss of forests and natural resource based livelihoods with a focus on poor and vulnerable households.

9.5.3 Impact Assessment

Conversion of degraded forest land for the Project will result in a reduction of areas within the village available for hunting and collection of NTFPs and TFPs. Loss of forest resources will be partially offset by the protection of riparian forest areas and other Special Management Areas within the plantations. Successful implementation and adoption of the intercropping model, project employment, and development initiatives, with a focus on poor and vulnerable groups are expected to mitigate impacts to forest resource based livelihoods.

Regular social monitoring will be used to determine the effectiveness of mitigation and management measures, particularly for poor and vulnerable groups. Where necessary, measures will require adjustment.

Forest Resource Use Impact Assessment

The Project will result in **Low to Moderate** impacts on forest resource based livelihoods as a result of direct loss of degraded forest resources and indirect impact on remaining forest resources. Forest resource based livelihood impacts are expected to be mitigated by the development of alternative livelihood opportunities through Project employment and agricultural development activities.

9.6 Food Security

9.6.1 Issues and Findings

Food insecurity and malnutrition are still major issues for many rural households in the Project region. In rural areas children are twice as likely to be malnourished and micronutrient deficiencies can also be a serious problem (WFP, 2013). In current Project villages, 4% of household's experience rice insufficiency (and only have enough rice for less than 5 months of the year). The high percentage of households in current Project villages reportedly collecting NTFPs (95%), many of them edible, highlights the dietary importance of forest resources in these communities.

Food Security and Nutrition Implications of Conversion of Degraded / Fallow Forests

As discussed in Section 9.5, degraded forests targeted by the Project typically support swidden agriculture and natural resource based livelihoods in rural villages across the Project region. Conversion of these areas has the potential to impact food security and nutrition of people within these villages, particularly the poor and vulnerable, though households participating in the scheme will have rice crops every seven years. It also has the potential to increase pressure on remaining forests, exacerbating the trend towards shorter rotational cycles and reducing agriculture and forest resource productivity – with potentially adverse impacts on future food security. These pressures may be exacerbated as village populations and household numbers increase

over the Project's lease period. There is some debate as to whether pressure on remaining forest will increase or decrease, as the Project provision of land for agriculture may reduce the need to establish further agricultural plots and reverse the trend of shorter fallow periods with swidden agriculture. This will invariably depend on the level of participation across village demographics.

The Project is seeking to address these potential impacts through its focus on food production. The intercropping model has the potential to improve food and nutritional security through the provision of agriculture plots and support for participating farmers for food production (i.e. crops and livestock). Increased household income could also contribute to improvements in household nutrition through increasing the ability of households to purchase (and consume) a greater variety of food from local markets.

Positive impacts on food security and health are likely to be most pronounced for households with direct employment with the Project and those participating in intercropping. Other households may experience indirect benefits (i.e. better local medical services; increased indirect incomes facilitating better access). There is potential for poor and disadvantaged households to experience disproportionate food security and nutritional impacts due to the loss of livelihoods associated with converted degraded / swidden lands and barriers to their ability to benefit from positive impacts such as employment and intercropping. Provided poor / disadvantaged households are key beneficiaries of the model, they also may benefit the most.

It will be important to closely monitor changes in food availability and nutrition at the household level (especially with vulnerable groups) to ensure that the intercropping model and other measures are effective.

9.6.2 Avoidance, Mitigation and Management Measures

Burapha will need to implement the following management and mitigation measures to address food security and nutrition related impacts during Project establishment and management:

- Include food security and nutrition awareness in the Project's Community Health and Safety Program (refer Section 9.7); and implement this program in Project villages;
- Ensure the effective implementation of the Project's intercropping model (refer Section 9.4) with an emphasis on stable and increased food production and nutritional variety;
- Identify poor and disadvantaged households who may be disproportionately impacted by land conversion activities and implement targeted measures to ensure food / nutritional security for these households both in the short and long-term; and
- Regularly monitor changes in food availability and nutrition at the household level (especially with vulnerable groups) to ensure that Project mitigation measures are effective.

9.6.3 Impact Assessment

The Project's intercropping model is critical in ensuring that potential food security and nutrition impacts associated with degraded / swidden land conversion are addressed. Successful implementation of this model coupled with increased incomes from job provision are expected to result in improved food security and nutrition in Project villages across the Project region.

The identification of poor and disadvantaged households who may be disproportionately impacted by the Project and the development of targeted measures will be important to ensure food / nutrition security for these households in the short and long-term.

Monitoring of household food security and nutritional diversity will be important over the life of the Project, to assess effectiveness of management and mitigation measures and adapt if required.

Food Security

The Project is expected to result in **Moderate** benefits for food security in Project villages with the successful implementation of the Project's agroforestry model.

The success of intercropping and employment on food security is expected to vary across villages due to the range of socio-economic conditions across central Lao PDR, requiring effective consultation and engagement with individual communities and tailored solutions to best suit specific circumstances

9.7 Community Health and Safety

9.7.1 Issues and Findings

Project expansion has the potential to contribute to improved access health services for people in Project villages. However, Project implementation provides some risks for community health and safety that will require diligent management.

Access to Improved Health Services

Project expansion has the potential to contribute to improved access to health services and facilities through the allocation of VDF funds to develop community health facilities; road upgrades and maintenance, and increased household incomes allowing for household members to access better medical treatment (i.e. travel to better facilities) and pay for treatment.

Traffic and transport safety

Ambient traffic conditions on village roads across the Project region are typically very light. The presence of large trucks on these roads presents a risk to community safety from vehicle collisions. Village road usage is expected to be infrequent, and mainly during vegetation clearance, plantation establishment and in the harvesting period every seven years. However, the potential for impacts on road infrastructure and community safety during these periods is high and requires careful management. Degradation of these roads during these periods may increase safety risks further.

Wildfire

Potential impacts of wildfire are covered *Chapter 7 – Physical Impacts*. Given the propensity of Eucalyptus stands to burn, there is significant risk for wildfires in plantations, potentially threatening community safety. Burapha will employ a number of management measures to minimise the risk of ignition of plantation trees; minimise the risk for the spread of wildfire if ignited; ensure capable and trained personnel have the means to fight fires; and ensure communication protocols are suitable, especially when informing about the risks of burning in or adjacent to plantations.

Workforce and Communicable Disease

The majority of the Project workforce is expected to be employed within and around Project villages. A small workforce consisting of people employed from across Lao PDR and internationally will oversee plantation establishment and management. Contractors (i.e. clearing, harvesting, and chipping contractors) will also be required. This presents potential impacts including social disruption and the spread of communicable disease.

Public Access to Site and On-site Physical Hazards

Most the Project plantation areas will be shared spaces that are used by local communities for intercropping purposes. This presents several community safety risks, especially during key times in the plantation cycle (i.e. establishment, thinning and harvesting). Hazards include the presence of heavy machinery, transport (refer above).

UXO

There is a low to moderate potential for UXOs to present a risk during ploughing or burning associated with the Project. Whilst, there are very few known US aerial bombing sites in proximity to Burapha planted areas or land holdings, UXOs are considered a moderate risk during future Project expansion, particularly to the north of existing landholdings.

9.7.2 Avoidance, Mitigation and Management Measures

Burapha will need to implement the following management and mitigation measures to address community health and safety related impacts during Project establishment and management:

- Develop and implement a Community Health and Safety Program;
- Encourage the use of the VDF for improvements in health care facilities and services in Project villages and the wider area including support for programs to prevent communicable diseases
- Conduct community health and safety risk assessment for each Project village and tailor mitigation measures to adequately address key risks identified;
- Implement measures identified in the Project's traffic and transport management plan (refer Burapha Mill Project ESSMP) to eliminate / mitigate community safety risks of Project transportation
- Implement measures identified in Chapter 7 to reduce the risk and potential impacts of wildfire;
- Include community health and safety aspects in employee induction programs and ensure all employees and contractors adhere to the Company's Code of Conduct
- Develop and implement a clear procedure regarding public access to Project areas during high risk periods (i.e. harvesting);
- Implement Burapha's UXO assessment and management procedures; and
- Regularly monitor community health and safety issues through ongoing community consultation and the implementation of the Project's grievance redress mechanism.

9.7.3 Impact Assessment

The Project is expected to contribute to improvements in community health and safety across the Project region including increased food security and nutrition of local communities and improved access to health infrastructure and services.

Community health and safety risks relating to Project transport, wildfire, flooding, outside workforce and UXO will remain high however potential impacts will be mitigated through effective implementation of measures outlined above and in Chapter 7 and the Company's Emergency Preparedness and Response Plan.

Community health and safety risks will vary in villages across the Project region and at different times during the plantation cycle. Burapha will address this through the conduct of community health and safety risk assessments in each Project village and regular monitoring of community health and safety issues through community consultation and the grievance redress mechanism.

Community Health and Safety Impact Assessment

The Project is expected to result in **Moderate** benefits to community health and safety through improved access to health infrastructure and services.

The Project is expected to present some community health and safety hazards associated with transport, wildfire, public access to site, and UXO. Though community health and safety risk cannot be entirely avoided, effective implementation of mitigation and management measures is expected to reduce the likelihood and consequence of impacts to **Low**.

9.8 Occupational Health and Safety

9.8.1 Issues and Findings

Burapha has committed to best practice occupational health and safety (OH&S) through its OH&S Policy and *OH&S Principles Manual*. The manual provides targets, specifies integrating OH&S into daily activities through

proactive and preventative measures and documents requirements to actively renew health and safety programs through continuous improvement and monitoring.

Physical hazards

Work on plantation areas present several physical hazards associated with timber felling, harvesting and log loading, transportation and unloading, etc. Equipment that could pose an occupational hazard at plantation sites include tractors and field equipment such as chainsaws. Exposure to physical hazards varies depending on the type of work and the equipment used.

During plantation establishment, OH&S risks may arise from UXO clearance work, and the use of heavy equipment and mobile machinery during vegetation clearing and site maintenance. During operations, activities such as timber harvesting and log extraction presents OH&S risks through hazards related to falling objects or trees, roll-over of mobile plant, chainsaw recoil and working too close to other operators. OH&S risks associated with other activities such as loading, transporting and unloading logs include risk of falling logs, rollover of log truck.

Plantation work also presents a risk of exposure to noise (e.g. from mobile machinery) which has the potential to be harmful to hearing. Noise reduction measures and protective equipment will reduce the potential impact of high noise levels on plantation workers.

Chemical Exposure

Chemical hazards represent potential for illness or injury due to single acute exposure or chronic repetitive exposure to toxic substances. For the workforce in plantation areas, sources of chemical hazards include pesticides / herbicides and fertilisers as well as exhaust gases, fuels and oils for portable machines such as chainsaws and other machines.

Burapha uses broad spectrum herbicides such as Glyphosate and Metsulfuron and soil conditioners and fertilisers such as Dolomite, Rock Phosphate, Boron and general fertiliser (NPK 15-15-15). Whilst potential health impacts of exposure vary, these are generally considered to have low toxicity for humans. Products used in the tree nursery range from non-toxic – toxic for human and include IBA (3-Indolebutyric, Acid Benlate (Benomyl), Funguran, and Termicide which are respectively used to initiate root formation in clonal Eucalyptus cuttings, control fungus, rust, termites, and weeds. Further details are presented in Chapter 7.

Symptoms of exposure to exhaust emissions from mobile machinery vary and can include irritation of the upper respiratory tract and eyes, as well as skin problems. Fuels are also a fire hazard, and require careful storage and handling.

Air Quality

Burning of slash during site preparation will provide an infrequent and moderately short duration impact, which may pose some OHS risk. The inhalable fine particles PM_{2.5} are usually dispersed further than larger particulates which may have implications for the workforce working directly on the plantations.

Working Environment

Workers in the plantation areas will be exposed to working conditions common to rural outdoor environments including exposure to heat, inclement weather conditions and potential hazards from biological agents (e.g. reptile and insect bites, infection and disease transmission). Other hazards include stress, work related fatigue and dehydration which could increase the risk of injury.

Camps may be remote from health facilities. Therefore, staff must be trained to prevent injury to the extent possible, and respond to medical emergencies in a timely manner. Furthermore, Work Camp staff may also be first responders to emergencies such as wildfire, chemical spill, etc. necessitating robust emergency preparedness and response planning to ensure occupational and community safety.

9.8.2 Avoidance, Mitigation and Management Measures

Burapha will need to implement the following management and mitigation measures to minimise OHS risks during the development and management of the Project:

- Implement the company's OH&S manual, and emergency and response procedures;
- Develop and implement a comprehensive OH&S training program and operator certification program for specific tasks and duties to ensure awareness and competence of all personnel on site;
- Consult with, and where appropriate support the development of local health facilities which may be required by the Project;
- Ensure that qualified first-aid can be provided at all times through the provision and maintenance of first aid equipment / infrastructure and trained staff; and
- Regularly monitor and report OH&S incidents and the effective implementation of OH&S mitigation measures, and develop / implement corrective actions where required.

9.8.3 Residual Impact Assessment

OH&S risks associated with work on plantations cannot be entirely avoided however through diligent implementation of the above management and mitigation measures the likelihood and consequence of OH&S impacts will be Low. As most the workforce will be sourced from local villages, safety related training will be of particular importance.

Regular monitoring and reporting of OH&S incidents and the development of effective corrective actions is necessary to ensure measures remain relevant and applicable to plantation establishment and management as the Project expands.

Occupational Health and Safety Impact Assessment

Though OH&S risk cannot be entirely avoided, implementation of robust training that considers the hazards inherent in various jobs; strict implementation of OH&S management measures; and monitoring to ensure staff are adhering to Company policies is expected to reduce the likelihood and consequence of impacts **Low to Moderate**

9.9 Water Resource Use

9.9.1 Issues and Findings

Rural communities across the Project region are typically reliant on natural water resources for drinking, cooking, bathing, irrigation, stock watering, etc. Households access water directly from streams / rivers, groundwater wells, *Nam Lin* (gravity fed water piped from local streams). Increasing, households in rural areas are utilising bottled water for drinking, as pathogen levels in natural sources are often quite high.

Local waterways are also important sources of fish and other aquatic resources.

Ground Water Availability

The establishment of eucalyptus plantations may increase evapotranspiration relative to fallow forest potentially reducing surface water flow and groundwater availability, though assessment for this study (refer to Chapter 7) indicates a low probability for perceivable impacts. If realised, water availability for village bores / wells could be affected, particularly if plantations occupy a significant proportion of water resource catchments. These potential impacts may be mitigated by limiting the extent of plantation development in the village water supply catchments, and providing alternate sources of water in the unlikely event of significant impacts to water availability.

Surface Water Quality

Development of the Project's plantation areas, associated infrastructure and roads, and ongoing operations has the potential to adversely affect downstream surface water quality. Water quality impacts will likely include increased suspended solids from erosion of disturbed soils (though this may not differ from current agricultural practices) and from erosion of unsealed roads. If unmanaged, chemicals used in plantation and nursery management or drainage from facilities used to store fuel and park vehicles may impact receiving waters and beneficial uses.

Degradation of surface water quality could compromise the ongoing beneficial uses of downstream surface water and the quality of habitat for aquatic fauna, thereby impacting the availability of these resources. Excessive sedimentation may affect the amenity of watercourses, impacting recreation, tourism, etc.

Investment in Community Water Resources

Participating villages may benefit from investments made using the Village Development Fund for the installation of bores and gravity-fed systems. Further, there is potential for community development initiatives implemented by the Project to target programs promoting village hygiene.

9.9.2 Avoidance, Mitigation and Management Measures

Burapha will need to implement the following management and mitigation measures to minimise water resource related impacts during the development and management of the Project:

- Implement erosion and sediment control measures outlined in Section 7.4 to minimise downstream impacts from plantations, supporting infrastructure and roads;
- Implement measures outlined in Section 7.5 to mitigate potential impacts of the use of fertiliser, pesticide and other chemicals on local water resources;
- Implement measures outlined in Section 7.6 to mitigate potential impacts of general waste on local water resources;
- Monitor potential impacts on local water resources through consultation with Project communities, implementation of the Project's Grievance Redress Mechanism and water quality monitoring where necessary; and
- Provide alternative sources of domestic water in those villages where monitoring suggests that the amenity of existing sources is impacted by Project development.

9.9.3 Impact Assessment

As outlined in Section 7.4 impacts on hydrology are not anticipated and impacts on water quality are expected to be limited to sedimentation and will be localised in nature. Associated impacts on water resource use will be dependent on the proximity of plantations, key water resources and settlements.

Impacts on water resource quality will be mitigated through the implementation of measures identified in Chapter 7 relating to riparian vegetation retention, erosion and sediment controls, management of hazardous materials and general waste management.

Regular consultation with Project villages and effectively implementation of the Project's grievance mechanism will be required to monitor any community concerns regarding key water resources.

Water Resource Use Impact Assessment

Impacts on the availability and quality of water resources are expected to be **Nil** and localised in nature if applicable. Impacts on the quality of water resources are only anticipated if plantations are developed immediately upstream of key water abstraction areas. Management and mitigation for water quality are expected to minimise impacts to a level acceptable to stakeholders.

9.10 Fishing and Aquatic Resources Use

9.10.1 Issues and Findings

Impact on Aquatic Resource Based Livelihoods

The potential impact on aquatic resource based livelihoods will be dependent on the efficacy of water quality management measures employed by Burapha (refer to Chapter 7 and above).

In the absence of suitable design controls and diligent application of management / mitigation measures, plantation establishment and nursery practices may impact habitat quality from sediment loading, and in an extreme event, directly impact aquatic fauna populations from chemical exposure

As is detailed in Chapter 7, aquatic faunae are not expected to be significantly impacted by Project expansion, and aquatic resource use should not be affected provided management controls are effectively implemented.

9.10.2 Avoidance, Mitigation and Management Measures

Burapha will need to implement the following management and mitigation measures to minimise impacts on fishing and aquatic resources during the development and management of the Project:

- implement the measures outlined in Section 7.2 (Water Quality), Section 7.4 (Erosion and Sedimentation), and Section 8.4 (Aquatic Biodiversity) to protect surface water quality and aquatic resources;
- Implement design controls and management / mitigation measures specified in Section 7.3 (Hazardous and Non-Hazardous Waste) to protect aquatic resources used by local communities. This includes implementation of the **Waste Management Plan** and **Emergency Preparedness and Response Plan**.
- Monitor potential impacts on fisheries through community consultation and the Project Grievance Redress Mechanism.

9.10.3 Impact Assessment

With the implementation of management measures to identify in Chapter 7, impacts on fishing and aquatic resource use are expected to be **Low**.

Fishing and Aquatic Resource Use Impact Assessment

With effective implementation of management and mitigation measures for aquatic habitat, aquatic biodiversity, and water quality, the potential for impacts on aquatic resource availability is expected to be **Low**.

9.11 Archaeology and Cultural Heritage

9.11.1 Issues and Findings

There are few known sites of national / regional archaeological and cultural significance across the Project region however information on potential sites and the presence of others is generally limited. There are numerous sites of local importance in villages including temples, spirit forests and other natural features such as caves, rocky outcrops, grasslands, or water sources, which through the course of generations have become part of the cultural landscape for the local villages.

In the absence of effective management and mitigation measures the following impacts could occur as the result of plantation establishment:

- Physical disturbance or damage to sites;
- Disruption of access to sites;
- Changes to the setting of sites; and
- Discovery and removal of items by staff and contractors.

These impacts could potentially lead to the following outcomes;

- Loss of cultural or scientific information;
- Damage to national or local identity;
- Negative sentiment towards and opposition to the Project; and
- Loss of potential future tourism benefits.

Avoidance of Significant Sites

The Project is not expected to result in direct impacts on sites of international, national or regional archaeological or cultural heritage significance. Land acquisition for plantation development is guided the *Burapha Land Acquisition Manual* which includes carefully established criteria to ensure that areas of cultural heritage significance are avoided during the land acquisition process. During the early stages of land identification, consultation is also conducted with the relevant National, Provincial and District authorities ensure that whether any sites of cultural significance or are not likely to be within, or in proximity to, the expected boundaries of the proposed land area to be acquired.

At the village level, land acquisition and plantation establishment is not expected to directly impact areas of local cultural heritage significance. During initial village consultation, areas of cultural importance are mapped to ensure these areas are excluded from potential plantation areas. At the land survey stage, representatives from potentially affected villages participate in reconnaissance surveys and detailed land surveys to ensure that cultural heritage and / or sites of cultural significance are not impacted before, during or after Project implementation.

Chance Finds

There is a high likelihood that Project activities (i.e. land clearance and preparation) may unearth items of historical importance. There is also the potential, although less likely, that archaeological sites of significance are discovered – some of which may be known by villages but not officially recorded.

Burapha has developed a Chance Find Procedure that specifies handling of historical / cultural sites or items upon discovery.

9.11.2 Avoidance, Mitigation and Management Measures

Burapha will need to implement the following management and mitigation measures to avoid impacting sites or artefacts of cultural significance during the development and management of the Project:

During the land identification and acquisition phase includes:

- Continue to avoid plantation establishment on cultural heritage sites through effective identification of sites during the land identification process and the FPIC process;
- Work with District and Provincial Departments for Tourism and Cultural Heritage to ensure that plantation establishment is not undertaken in areas that are important for generating current or future tourism (e.g. biodiversity and scenic beauty).

During plantation establishment and management:

- Train staff in the Chance Find Procedure and require strict adherence to its provisions (i.e. halt work until village and GOL authorities have inspected the site and cleared it for operations);
- Protect archaeological and cultural heritage sites through creation of buffer zones (as per Burapha Silviculture Operations Manual);
- Prohibit contract workforce from accessing culturally significant sites;
- Ensure that access routes to culturally significant sites are maintained for people that actively use them. Paths, roads, and other access routes identified by local people should be preserved. If necessary, site access will only be restricted by the Project after consultation and agreement with the affected communities is reached;
- Include cultural heritage training in employee / contractor inductions including protection of significant sites (including tourist sites) and culturally appropriate conduct in villages;
- Ensure communication, information dissemination and community development is conducted in culturally appropriate and sensitive ways and supports cultural values in affected villages;
- Sites of local cultural heritage near affected villages should be inspected regularly to confirm no inadvertent or unreported damage has occurred and to identify any risk of Project impacts.

9.11.3 Impact Assessment

The Project is not expected to impact any archaeological, cultural (and natural) sites of international, national, regional or local significance.

Effective implementation of Burapha's Land Acquisition Process including engagement with relevant authorities and participatory mapping of important sites; and the company's Land Selection Criteria which prohibits establishment of plantations on or near these sites, will mitigate the potential for direct impacts.

The effective implementation of Burapha's Chance Find Procedures will ensure the preservation of sites or items that are yet to be discovered.

Cultural Heritage Impact Assessment

With adherence to measures identified in Burapha's *Land Acquisition Manual* and implementation of a Chance Find Procedure, the Project is not expected to pose a risk for archaeological and cultural heritage sites / artefacts of significance. The potential for impacts is considered **Negligible to Low**.

9.12 Gender, Vulnerable Groups and Ethnic Minorities

9.12.1 Issues and Findings

Plantation development projects may result in disproportionate impacts on vulnerable groups including women, vulnerable households and ethnic minorities as these groups tend to use communal lands that may be converted to plantations (i.e. are often not land holders). If vulnerable groups are not specifically given the

opportunity for inclusion in intercropping and employment opportunities, the benefits derived from Project implementation will not overcome communal land lost to plantation establishment.

Key issues and findings are presented below.

Gender

Project expansion is likely to have a differential impact on men and women. Key issues and benefits include:

- *Employment and Income Generation* – village consultation has generally indicated that men and women from each participating family are given an opportunity to work on a rotational basis and that livelihoods / income generation has improved. The development and implementation of Burapha's labour policies, promoting equal opportunity and anti-discrimination will be important in continuing to ensure that women also have access to these opportunities. Agricultural development through Project expansion could assist in facilitating increased access to markets which could benefit women through the sale of local produce, NTFPs and handicrafts.
- *Labour* - women traditionally do a large majority of farm work (such as planting, weeding, and harvesting) in addition to their off-farm and domestic chores such as firewood collection, meal preparation and childcare. Whilst women would likely to benefit from labour opportunities provided by the Project, their workload may prohibit inclusion.
- *Loss of forest resources* - loss of access to forest resources and associated household income has particular implications for women as they are the ones mainly responsible for the collection and sale of NTFPs. Women may also have additional labour burdens if they must walk further away or spend more time looking for NTFPs.
- *Consultation and Decision Making* - Men typically dominate community decision making. Women are typically under-represented within community leadership and their attendance and active participation at community meetings is often low. In some cases, some villagers (often women) can be left out of the negotiation process for land lease fees / taxes paid to villages for lease areas. Burapha will need to further develop and implement a public consultation and dissemination plan that will ensure more active participation in consultations between the Company and affected communities.
- *Anti-social behaviour* – Increased cash income and food shortages may lead to anti-social behaviour such as gambling and drug abuse, which can then lead to crime and domestic violence. This behaviour, when it occurs, tends to disproportionately affect women, as women are most often the targets of crime and domestic violence.

Vulnerable Households

Current Project villages showed low levels of vulnerability during village consultation. The most common group were single female headed households, although there were a small proportion of landless households and households living under the poverty line.

Other households requiring specific consideration include households most dependent on forest resources and / or swidden agriculture, households with little permanent agricultural land and households with limited or no labour including the elderly / infirmed and some young couples.

Project land acquisition could affect poor households disproportionately as they are often most dependent on NTFPs and typically rely on upland fields to produce their staple food. The poor are also often the most risk averse and reluctant to take on new agricultural techniques (e.g. intercropping) as they have less resources to fall back on in case of failure. Though employment with Burapha will mitigate this impact for some, surveys (ES, 2016) indicate that not all poor / disadvantaged households are employed by the Project, and many don't have the resources (people) available for intercropping.

The elderly, infirm and disabled are particularly vulnerable to changes in socio-economic conditions and livelihood activities such as those associated with reduced forest productivity or reduced productivity of agricultural resources and they often have reduced capability to forge a new lifestyle and accept changes to routines.

A key issue for the Project will be ensuring that poor and disadvantaged households and other vulnerable groups can benefit from employment opportunities. These groups may also experience more barriers to gaining employment than other households such as limited or no additional people available to work and no means for transport to plantations. Currently, the level of engagement with vulnerable groups during Project recruitment varies across villages. Whilst some villages did report that vulnerable households were selected for employment, clear processes for doing so were not always in place.

If unmanaged, Project benefits during expansion could go to more affluent households and could exacerbate existing levels of inequality in the target region. Effective recruitment processes, specifically targeting vulnerable groups and measures to reduce potential barriers experienced by vulnerable groups will assist in ensuring equitable employment opportunities.

With proactive management measures, such as targeted employment / training and community development, the Project has the potential to have a significant and positive impact on the livelihoods of vulnerable households.

Ethnic Minorities

Whilst the Lao-Tai dominate most of the target region in terms of population numbers, there is still a relatively large proportion of ethnic minorities residing in the target Provinces, particularly the Khmu ethnic group. Several participating villages have both Lao and Khmu populations. There is also a small Hmong population across the target region, though this group are more predominate in Vientiane and Saysomboun Provinces. Potential issues could arise if ethnic groups within villages or neighbouring villages perceive that the Project is favouring one group over another.

9.12.2 Avoidance, Mitigation and Management Measures

Burapha will need to implement the following management and mitigation measures to minimise impacts on women, vulnerable groups and ethnic minorities during the development and management of the Project:

- Ensure consultation specifically targets vulnerable groups to ensure that they have an opportunity to express concerns and provide input into the compensation / community development process;
- Implement preferential employment and training policy for people from vulnerable groups and implement measures to reduce potential barriers to employment such as provision of transport to plantation areas;
- Ensure that those people that use the land that will be converted to plantation are given the first opportunity to participate in intercropping and casual labour opportunities;
- Cooperate with the Lao Women's Union at the District and Provincial level to ensure adequate women representation on the Project's VDF committees;
- Encourage allocation of a portion of the VDFs for vulnerable groups (portion to be determined at the village level); and
- Ensure that specific indicators are created to monitor Project impacts (positive and negative) on vulnerable groups.

9.12.3 Impact Assessment

As the Project expands, ensuring Project benefits are equally accessible to women, ethnic minorities and vulnerable households in participating villages will minimise the potential for disproportionate impacts on these groups, and if implemented effectively, will provide a net benefit.

With the implementation of management and mitigation measures identified above including community engagement and grievance resolution; equal opportunity and targeted employment policies; targeted community development interventions; and regular social monitoring, potential residual impacts on these groups are expected to be low.

Gender, Vulnerable Groups and Ethnic Minorities Impact Assessment

The Project is expected to have **Low** impact on women, vulnerable groups and ethnic minorities with the effective implementation of FPIC consultation during land acquisition, equal opportunity employment policies; and targeted livelihood interventions through the intercropping model and village development fund initiatives.

Regular monitoring through community consultations and biennial socio-economic surveying will assist the Company in understanding the impacts (positive and negative) of the Project and the effectiveness of management and mitigation measures.



Chapter 10 | Risk Assessment



Chapter 10 | Risk Assessment

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10 RISK ASSESSMENT

10.1 ESIA Risk Assessment Methodology

10.1.1 Methodology and Approach

The natural environment will generally be altered by the construction and operation of any development project, which will result in some environmental and social impacts. This ESIA has considered risks and opportunities that may arise from the development of the Project, while the risk assessment has analysed potential (adverse) risks associated with expansion of the Burapha Agroforestry Project. The methodology for this risk assessment is based upon ISO 31000 Risk management – Principles and Guidelines, 2009 and ISO 31010 Risk Management – Risk Assessment Techniques, 2009.

The risk assessment has been conducted prior to consideration of management and mitigation to identify the most significant potential risks. These risks are assigned rankings in order of magnitude / probability, in the absence of mitigation. Once initial risks have been assessed and ranked, proposed controls are identified to avoid or reduce the anticipated impacts. Control measures focus on either reducing the likelihood of occurrence or on decreasing the magnitude of the consequence to reduce the residual risk ranking to acceptable levels. The expected residual risks are generally lower than the initial risk ranking by one or two orders of magnitude.

Risks associated with the Project have been categorised into the following phases:

- Plantation Establishment;
- Plantation Management; and
- Decommissioning.

In addition, risks have been classified by thematic areas (i.e. physical, biological and social). Project phases account for current operations and expansion of land area. The risk assessment focuses on the potential impacts of the Project and does not assess alternatives that are no longer being considered.

10.1.2 Risk Assessment Criteria

The criteria matrix used for the assessment are provided in Table 10-1 below. These are based on standard ISO 31000 risk criteria (2009), and have been adapted for the Project.

Likelihood

As per ISO 31000, Likelihood is defined as ‘the chance of occurrence’. In risk management terminology, the word ‘likelihood’ is used to refer to the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically (such as a probability or a frequency over a given time period). Further definition of Likelihood rankings is provided in Table 10-1 and Table 10-2.

Consequence

As per ISO 31000, Consequence is defined as ‘the outcome of an event affecting objectives’. As outlined in the ISO standards: an event can lead to a range of consequences; consequence can be certain or uncertain and can have positive or negative effects on objectives; consequences can be expressed qualitatively or quantitatively; and the initial consequences can escalate through knock-on effects (refer to Table 10-3).

Table 10-1 Risk assessment criteria matrix with Likelihood and Consequence rankings

Likelihood		Consequence				
		1	2	3	4	5
Level		Slight	Low	Medium	High	Extreme
5	Almost	Medium	High	High	Very High	Very High
4	Likely	Medium	Medium	High	High	Very High
3	Possible	Low	Medium	Medium	High	High
2	Unlikely	Low	Low	Medium	Medium	High
1	Rare	Low	Low	Low	Medium	High

Table 10-2 Summarised descriptions of Likelihood rankings

Likelihood		Summary
1	Rare	Very unlikely in the current or in a changing environment. Conceivable but highly improbable. The aspect / event may occur in very exceptional circumstances.
2	Unlikely	Less likely to happen in the current or a changing environment. The impact could occur at some time. The aspect / event has happened elsewhere under slightly similar circumstances.
3	Possible	It could happen in the current or a changing environment. The aspect / event has occurred before here or in similar circumstances elsewhere.
4	Likely	It probably will happen in the current or in a changing environment. The aspect / event is expected to occur. The aspect / event occurs in most circumstances.
5	Almost Certain	Frequent occurrence in current or in a changing environment. The aspect / event has occurred. The aspect / event occurs in almost all circumstances.

The descriptions of each of the numerical consequence rankings used are described in their respective environmental and social and contexts in Table 10-3.

Table 10-3 Consequence description

Consequence		Environmental	Social
1	Slight	Slight / temporary impact on environment. Corrected < 1 day. Any spill contained within primary containment.	Slight impact on community well-being. Written / verbal complaint from community. Immediately rectifiable.
2	Low	Minor non-compliance resolved within one week. Low impacts on biophysical environment. Easily compensated loss of some non-endangered flora / fauna.	Low but ongoing impact on community health / well-being. Takes some time to resolve.
3	Medium	Non-compliance(s). Requires < 2 weeks' remediation. Impacts on biophysical environment, managed locally. Loss (> 1 hectare or non-threatened fauna) of flora / fauna. Any spill < 500 litres contained within area already impacted by Project. Quickly contained & corrected hazardous spills or emission on or off site.	Impacts that go beyond the local concerns but are recovered quickly and without significant lasting reputational or relationship impacts.
4	High	Significant non-compliance. (Against local or recognised international standards.) High local impacts on biophysical environment. Loss of endangered / highly regarded flora / fauna. Significant spillage outside containment but on-site. Non- acutely hazardous spill or emissions off site.	National and international concerns. Sustained NGO / stakeholder activism resulting in reputational damage. Difficult to resolve quickly.

Consequence		Environmental	Social
5	Extreme	Severe impacts on biophysical environment. Very difficult to resolve and remediate. Significant loss of endangered / highly regarded flora / fauna. Acutely hazardous spill or equivalent emission on or off site.	Complete breakdown of relationship with key stakeholders. Sustained negative media coverage on a national international level. Cessation or severe restriction of operations. Public outrage.

10.1.3 Risk Assessment Process

The methodology used for each step in the risk assessment process for the ESIA is outlined below. Figure 10-1 shows how the risk assessment process fits within the overall Risk Management Process.

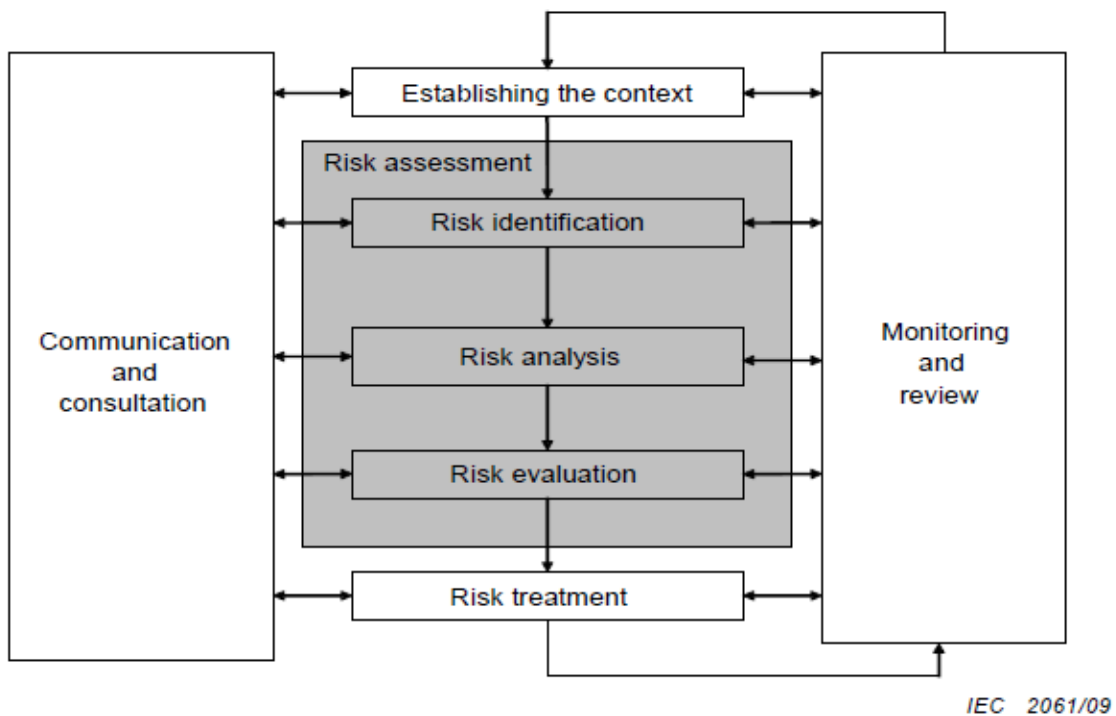


Figure 10-1 Risk Assessment Process (shaded) within the overall Risk Management Framework (ISO 31010)

Establishing the Context

ISO 31000

“Before starting the design and implementation of the framework for managing risk, it is important to evaluate and understand both the external and internal context of the organization, since these can significantly influence the design of the framework.”

Within the context of ISO 31000, a comprehensive review of internal and external factors was undertaken for this risk assessment. This included internal factors that were under the control of Burapha (e.g. OHS) and external factors that are beyond Burapha’s control to manage (e.g. natural disasters). The analysis of risk included collecting information from:

- Field and site visits;
- Consultations with relevant stakeholders (refer Chapter 12);
- Available Project information, including:
 - » Existing Burapha policies, plans and procedures;
 - » Specialist environmental and social technical studies (refer ESIA Volume C); and
 - » Compiling additional baseline information relevant to the Project area (refer Chapters 4-6).

Communication and Consultation

ISO 31010

“Communication and consultation with external and internal stakeholders should take place during all stages of the risk management process.

Therefore, plans for communication and consultation should be developed at an early stage. These should address issues relating to the risk itself, its causes, its consequences (if known), and the measures being taken to treat it. Effective external and internal communication and consultation should take place to ensure that those accountable for implementing the risk management process and stakeholders understand the basis on which decisions are made, and the reasons why particular actions are required.”

Stakeholder engagement and consultation were key during the ESIA process, especially for the risk assessment. Stakeholder engagement and consultation included discussions with:

- Villages potentially affected by the Project (e.g. through formal village consultations, refer Chapter 12);
- Burapha;
- GOL authorities (Central, Provincial and District); and
- Local NGOs.

These stakeholders and consultations are described in Chapter 12.

Risk Identification

ISO 31010

“The purpose of risk identification is to identify what might happen or what situations might exist that might affect the achievement of the objectives of the system or organization. Once a risk is identified, the organization should identify any existing controls such as design features, people, processes and systems.

The risk identification process includes identifying the causes and source of the risk (hazard in the context of physical harm), events, situations or circumstances which could have a material impact upon objectives and the nature of that impact”

The risk identification process involved the generation of a comprehensive list of potentially significant environmental and social risks based on events that might create, enhance, prevent, degrade, accelerate or delay the achievement of Project objectives. For the current risk assessment, this process included:

- A review of risks previously identified in:
 - » Consultations with relevant stakeholders;
 - » Burapha environmental and social databases and relevant documentation;
 - » Specialist environmental and social technical studies (refer to ESIA Volume C).

- Benchmarking against international standards; and
- Development of a Project Risk Register.

Risk Analysis

ISO 31010

“Risk analysis consists of determining the consequences and their probabilities for identified risk events, taking into account the presence (or not) and the effectiveness of any existing controls. The consequences and their probabilities are then combined to determine a level of risk.

Risk analysis involves consideration of the causes and sources of risk, their consequences and the probability that those consequences can occur. Factors that affect consequences and probability should be identified. An event can have multiple consequences and can affect multiple objectives.”

The risk analysis has followed ISO standards for anticipating the consequence of risks (as per Table 10-3) in order of magnitude. Some environmental risks are more objectively assessed than social risks (e.g. oil spills). For example, causes and sources of risk were assessed (e.g. hydrocarbon leak) and the magnitude of the consequence (e.g. 50 L spill). Likelihood is considered independently of consequence. Likelihood was assessed as the probability of those consequences occurring. Likelihood and consequence classification of risk required a thorough understanding of:

- Project environmental and social baseline;
- Presence/absence of existing controls;
- Predictions based upon common risks experienced by other similar projects; and
- Potential impacts of agroforestry implementation, as well as the likely effectiveness of mitigation measures.

This process was used to inform risk evaluation and guide the treatment of risks.

Risk Evaluation

ISO 31010

“Risk evaluation involves comparing estimated levels of risk with risk criteria defined when the context was established, in order to determine the significance of the level and type of risk.

Risk evaluation uses the understanding of risk obtained during risk analysis to make decisions about future actions. Ethical, legal, financial and other considerations, including perceptions of risk, are also inputs to the decision.”

Based on the results of previous steps, risks were evaluated by allocating a ‘Level of Likelihood’ and ‘Level of Consequence’ to each of the risks. The evaluation of Likelihood and Consequence were based on criteria outlined in Table 10-2 and Table 10-3 respectively. Risk exposure is then calculated based on the formula below, to identify the level of risk exposure as either Low, Medium, High or Very High, as per Table 10-1.

Risk Exposure = Level of Likelihood x Level of Consequence

Treatment

ISO13010

“Having completed a risk assessment, risk treatment involves selecting and agreeing to one or more relevant options for changing the probability of occurrence, the effect of risks, or both, and implementing these options.

This is followed by a cyclical process of reassessing the new level of risk, with a view to determining its tolerability against the criteria previously set, in order to decide whether further treatment is required.”

For this part of the risk assessment process, additional controls have been identified for the mitigation and/or reduction of risk, after careful evaluation of anticipated Project risks from a ‘business as usual’ scenario. Upon implementation of these controls, the consequences and likelihood of the risk have been re-evaluated to assess the anticipated residual level of overall risk exposure.

Results

The findings of the environmental and social risk assessment for the Project are provided in Table 10-4. The implementation of the proposed management and mitigation measures is expected to reduce the anticipated residual level of overall risk exposure for most of the identified risks. No expected residual risks were identified as ‘Extreme’ or ‘High’ based on the criteria listed in Table 10-1. Table 10-4 summarises the ‘medium’ (moderate) residual risks that remain. If mitigation and monitoring measures are effectively implemented, all identified risks will be reduced to a residual risk of moderate or low.

Table 10-4 Environmental and Social Risk Assessment for the Burapha Agroforestry Project

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts	
							Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank		
Physical Risks and Proposed Management Measures															
Land conversion	Land conversion and landscape altered	✓	✓	✓	✓	Plantations requiring vegetation clearance	Terrestrial habitat and flora, ecosystem services, community	3	5	15	Select only non-arable, degraded, unstocked or fallow forest for plantation operations, and consult with DONRE and PONRE for permission prior to leasing land. Survey, delineate and demarcate clearance boundaries.	1	5	5	Loss of fallow, non-arable, unstocked and/or cleared land for Project
Erosion and Sediment Transport	Significant increases in total suspended solids in downstream watercourses		✓	✓	✓	Vegetation clearance, unsealed road network, annual site-preparation for intercropping, harvesting	Water quality, aquatic biodiversity, aquatic habitat	2	5	10	Retention of riparian buffers, suitable stormwater and erosion / sediment control measures for road networks, best practices for forest industry when clearing during the rainy season.	2	3	6	Minor increases in suspended solids downstream of Project
Soil Quality	Loss of topsoil due to erosion		✓	✓		Vegetation clearance and earthworks, road construction, lack of suitable stormwater, erosion and erosion control	Terrestrial biodiversity, ecosystem services, water quality	2	2	4	Implementation of stormwater, erosion, and sediment control measures	2	1	2	Minor losses of topsoil
	Degradation of soil fertility			✓	✓	Rapid nutrient uptake from plantations, agriculture, potential changes to pH of soil	Terrestrial biodiversity, ecosystem services, water quality	3	2	6	Fertiliser inputs, incorporating expended organic material of intercropping into soil	2	2	4	Enriched soil in areas, some minor changes in

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts
							Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank	
													soil composition	
Hydrology	Significant adverse impacts on hydrological conditions downstream	✓	✓		Changed hydrological regimes due to Project infrastructure and vegetation clearance potentially leading to landslides and flooding at village level	Environment, community	3	3	9	Limit size of plantation area cleared at one time to be within individual catchments to avoid cumulative effects; maintain and retain riparian buffers; minimise vegetation loss; conduct drainage monitoring and management; ensure minimum flows in the dry season are consistent with previous years	3	1	3	Localised minor or negligible changes in flow and hydrology
				✓	Loss of surface and groundwater flows from eucalypt growth and water requirements, rapid transpiration from fast growing plantation species	Surface / groundwater hydrology	3	2	6	Limit size of plantation area within individual water resource catchments for villages to avoid cumulative effects, retention of riparian buffers	2	1	2	
Water Quality	Significant adverse impacts on downstream water quality, breach of regulatory requirements	✓	✓		Discharge of contaminated water from the work camps (greywater and sewage)	Water quality, aquatic biodiversity, aquatic habitat, community, compliance	4	2	8	Appropriate waste water treatment system for sewage installed	2	1	2	Negligible to minor impacts from overflows or in the event of accidents

Risk / Aspect / Hazard		Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts
								Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank	
			✓	✓		Discharge of pesticides, hydrocarbons, fertilisers and additional hazardous and non-hazardous materials	Water quality, aquatic biodiversity, aquatic habitat, community, compliance	5	2	10	Proper transport, storage, handling, and disposal of hazardous materials; routine surveys of camp facilities; vehicle / equipment maintenance at least 100 metres from surface waters	4	1	4	Localised impacts on water quality in the event of accidents
Noise	Noise impacts on local communities		✓	✓		Chainsaws / heavy equipment during clearing and harvesting	Community satisfaction, compliance, terrestrial fauna	2	2	4	Require concentrated harvest / clearance activities during daylight hours, implement Grievance Mechanism	1	2	2	Minor nuisance residual impact on local communities, fauna likely to flee
Air Quality	Air quality impacts on local communities, Breach of air quality standards		✓			Air emissions generated from field preparation activities	Health and safety, community, compliance, terrestrial biodiversity	2	3	6	Ensure slash is adequately dry for rapid burn; minimise burn areas through effective fire control; implement Grievance Mechanism	1	3	3	Minor nuisance residual impact on local communities
			✓	✓		Dust generated travel on unsealed roads, vegetation clearance	Health and safety, community, compliance, terrestrial biodiversity	2	3	6	Employ dust minimisation measures such as road watering unsealed roads through villages, enforcement of speed limits, implement Grievance Mechanism	1	3	3	Minor nuisance residual impact on local communities

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts	
							Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank		
Hazardous and Non-Hazardous Materials	Contamination of soil, surface, and / or groundwater from labour camps		✓	✓		Improper waste facility or transport design, lack of education of project workforce, lack of monitoring and regulatory enforcement.	Water quality, soil quality, livestock, regulatory compliance	4	2	8	Education programs for workforce, adaptation and implementation of proper waste management registers and procedures, monitoring and enforcement.	3	1	3	Negligible to minor impacts from overflows or in the event of accidents
	A spill or accidental release of a hazardous substance leading to contamination of soil or water sources		✓	✓		Inadequate storage facilities, inadequate handling of hazardous materials, accident during transportation and inadequate training or education on hazardous materials management.	Safety, environment, community, reputation, compliance	5	2	10	Best Practice for transport, storage, handling and disposal of hazardous materials, maintaining an inventory of hazardous materials on site, provision of MSDS, Implementation of appropriate environmental emergency response procedures and adequate emergency response supplies, transportation safety measures, workforce training, routine monitoring.	4	1	4	Localised impacts on water quality in the event of accidents
Accidental Events and Natural Hazards	Wildfire, natural occurrence, increased frequency and intensity from eucalypt high oil content in leaves			✓		Escape from agricultural plot site preparation burning, lightning, arson. Inadequate fire management and breaks, lack of training or preparation from Emergency Response Plan	Terrestrial habitat, flora, fauna, environment, community	5	3	15	Implementation of appropriate fire breaks; ensure community satisfaction with operations: require sufficiently wide fire breaks; educate communities on volatility of eucalypt species, require riparian buffer retention	4	2	8	Risk of infrequent (well contained) fires remain

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts	
							Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank		
Natural disaster and / or associated discharge of contaminants		✓	✓	✓	Floods, landslides or earthquake, inadequate training or preparation in Emergency Response Plan	Community / occupational health and safety	5	2	10	Require plantation development away from steep slopes above communities, develop and implement environmental emergency response procedures, store hazardous materials according to Best Practices	4	2	4	Background likelihood remains, localised impacts on communities and water quality in the event of incidents	
Biological Risks and Proposed Management Measures															
Terrestrial Biodiversity	Loss and fragmentation of habitat suitable for native species		✓	✓	✓	Vegetation clearance for plantation establishment	Terrestrial habitat and flora, ecosystem services	4	5	20	Avoid and protect High Conservation Values (HCV). Select only non-arable, degraded, unstocked forest or fallow forest for plantation operations, survey, delineate and demarcate clearance boundaries where applicable.	2	5	10	Loss of fallow, non-arable, unstocked and/or cleared land for Project, including the loss of common native flora
	Loss and/or significant adverse impacts on flora communities/species of		✓	✓		Inadequate identification of HCV species / habitat. Lack of surveying for species of concern, improved access due to project road construction providing easier access	Biodiversity, compliance	4	3	12	Restrict activities to fallow / degraded forest areas. Avoid and protected HCV, including riparian buffers. Conduct pre-clearance surveys, mark and avoid vegetation for retention, adhere to FSC Principles and	2	2	4	Residual impacts unlikely as plantations will be established in degraded

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts
							Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank	
conservation significance					for logging, NTFP collection, etc.					Criteria and IFC Performance Standard 6 Guidelines				landscapes. Low probability of impact.
Loss and/or significant adverse impacts on fauna species and habitat of conservation significance		✓	✓		Loss and fragmentation of habitats, even-aged eucalypt plantations providing poor habitat for native species. increased pressure on wildlife due to improved access for hunting.	Biodiversity, compliance	4	3	12	Retain native vegetation in riparian zones to provide wildlife corridors for transit; Retain any HCV species / forest within FMUs	2	3	6	Not anticipated for HCV species / habitat
Increased vehicle collision of vertebrate fauna		✓	✓	✓	Increased road traffic, frequency and size of vehicle	Vertebrate fauna	3	1	3	Careful traffic planning, enforcement of speed limits, provision of traffic signs, regular vehicle maintenance, drivers operating within assigned skill level, driver education, incident reporting, move large road kill to the side of the road to prevent predator collisions	2	1	2	Minor probability that some fauna may be hit by Project-related traffic
Introduction or spread of invasive flora and fauna		✓	✓	✓	Introduction of species on equipment / vehicles relocated to site and surrounds	Terrestrial and aquatic biodiversity	2	5	10	Pre-treat vehicles / workers' boots before entering new worksite (wash-down facilities), implement eradication and monitoring programs, target key species (e.g. <i>Imperata cylindrica</i>)	2	2	4	Invasive species eradication will minimise residual impact, but

Risk / Aspect / Hazard		Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts
								Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank	
	Spread of eucalypt (or other non-native plantation species), dominance of species after lease concludes				✓	Coppice sprouting, seed spread	Terrestrial and aquatic biodiversity	4	3	12	Consult with the GOL / communities regarding post-lease land use expectations. Implement eradication programs, remove (stump removal or herbicide application) of plantation species at end of lease period, pending stakeholder consultation	3	1	3	100% eradication is difficult and improbable
	Adverse impacts on protected areas/watershed reserves	✓	✓	✓	✓	Inappropriate land acquisition	Environment, compliance, GOL dissatisfaction	4	3	12	Implement 'no-go' policy for conservation / protection forests. Develop and adhere to robust land acquisition policy that requires appropriate GOL approvals prior to leasing land for plantation.	2	1	2	Not anticipated
Aquatic Biodiversity	Turbidity and sediment impacts on aquatic biodiversity		✓	✓	✓	Erosion of unsealed roads, cleared areas and sediment transport / settling changing stream morphology	Aquatic habitat, aquatic biodiversity, ecosystem services, nutrition, Company reputation	2	4	8	Mark and avoid important riparian habitat for retention; implement stormwater; erosion and sediment control on roads near watercourse crossings; adhere to FSC Principles and Criteria and IFC Performance Standard 6 Guidelines; rehabilitate riparian habitat; minimise watercourse crossings.	2	3	6	Localised changes in turbidity, Low impacts on aquatic biodiversity

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts	
							Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank		
Loss of good quality habitat for connectivity of remnant populations	✓	✓	✓	✓	Lack of suitable riparian buffer altering habitat (shading, sediment) and migratory pathways for aquatic and terrestrial biodiversity	Aquatic habitat, aquatic biodiversity, ecosystem services, nutrition, Company reputation	3	3	9	Retain riparian vegetation as much as possible. Compensate participating communities if affected by decreased agricultural area as a result	1	2	2	Some fragmentation to remain, decreasing connectivity	
Loss and/or significant adverse impacts on aquatic biodiversity		✓	✓		Spills of hazardous materials, inappropriate herbicide application (timing / materials)	Aquatic habitat, aquatic biodiversity, ecosystem services, nutrition, Company reputation	5	3	15	Ensure dry conditions during and following herbicide application (check weather forecasts). Avoid applications during windy conditions. Store and handle herbicides according to label.	2	1	2	No impacts anticipated with diligent application of hazardous materials management.	
Social Risks and Proposed Management Measures															
General	Lack of understanding among local communities regarding potential impacts and benefits Agroforestry Project		✓	✓	✓	Lack of adequate consultation and coordination with local authorities and communities	Community unrest, project schedule, company reputation, compliance.	3	3	9	Implementation of a community engagement plan ensuring adequate consultation and coordination, participation of stakeholders at appropriate times (ongoing consultation)	1	2	2	Negligible to minor impact remains as there is still a risk that a minority of people will

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts	
							Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank		
Community dissatisfaction with grievance process		✓	✓	✓	Lack of adequate resourcing by Company; Time-lag between resolution and action.	Community unrest, reputation.	3	2	6	Development and implementation of a robust grievance mechanism in accordance to national and international standards	2	1	2	be dissatisfied	
Land Use (General)	Community dissatisfaction with community / private land loss, restricted land use / access, and livelihood impacts as a result of land acquisition and conversion		✓	✓		Land conversion resulting in loss of agriculture land (i.e. Swidden or Expansion) and natural resources (i.e. NTFPs and TFPs)	Community unrest; Livelihoods; Project schedule; Compliance	4	4	16	Implement a robust land acquisition policy that includes FPIC; Assess livelihood impacts and develop effective livelihood restoration measures (i.e. agroforestry)	3	2	6	Negligible to minor impact remains as there is still a risk that a minority of people will be dissatisfied
	Lease / taxation issues	✓	✓	✓	Land leases with villages / individuals often conflict with District / Provincial understanding of ownership	GOL Unrest; Community Unrest; Company Reputation	3	3	9	Implementation of a more robust land acquisition policy that includes communities and applicable Village, District, Provincial, and Central consultation and sign-off.	3	1	3		
	Land ownership / tenure disputes	✓	✓			Delineation of plantations conducted with village in areas under conflicting ownership status (i.e. btw villages or with government / private concessions)	GOL unrest, community unrest, company reputation	3	2	6	Implement a robust land acquisition policy. Consult with the GOL and community leaders to ensure land disputes are settled in advance of land acquisition	2	1	2	

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts	
							Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank		
Perceived inequitable or inadequate compensation for land use impacts	✓	✓			Individuals with limited proof of tenure / 'informal' village land tenure processes that do not align with government tenure processes.	GOL unrest, community unrest, company reputation	3	3	9	Honour customary land use rights. Implementation of a more robust land acquisition policy that includes communities and, applicable Village, District, Provincial, and / or Central consultation and sign-off	2	2	4		
	✓	✓	✓		Compensation for land loss not implemented in accordance with Lao national and international standards; inadequate consultation; ill-defined land ownership	Community unrest, schedule, reputation, compliance, disruption of social structures	4	2	8	Implementation of a more robust land acquisition (FPIC) and compensation and grievance process.	2	1	2		
	✓		✓	✓	Changed perceptions over 30 – 60-year lease period. Younger generations not satisfied with agreements / leases	Community unrest, schedule, reputation, compliance, disruption of social structures	3	2	6	Implementation of a community engagement plan ensuring adequate consultation and coordination, participation of stakeholders at appropriate times (ongoing consultation)	2	2	4		
Land Use (Agricultural)	Plantations in Village, District, Provincial, National, or	✓	✓	✓	✓	Inadequate consultation with GOL / international databases during land acquisition	Degradation of or limitations to regeneration of	4	2	8	Inclusion of DONRE, PONRE, MAF, Army in land acquisition framework.	4	1	4	Negligible to minor impact remains as

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts
							Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank	
International Protection Areas without proper consent.						natural forest communities							there is still a risk that a minority of people will be dissatisfied	
Loss of upland agricultural land		✓	✓		Land conversion resulting in loss of agriculture land used for swidden agriculture or planned for agricultural expansion	Livelihoods, community health (nutrition)	2	4	8	Stagger plantation establishment of multiple years to maximise benefits of agroforestry; Work with villages to create permanent agricultural land (cropping and grazing); Assess livelihood impacts and develop effective agroforestry practices targeted at households most impacted by loss of swidden land	1	2	2	Negligible to minor impact remains as there is still a risk that a minority of people will be dissatisfied
Forest Resource Use	Adverse impacts on community forest use due to forest conversion		✓		Loss of forest resources (i.e. TFP, NTFP, terrestrial habitat), ecosystem services due to swidden / degraded forest conversion	Ecosystem services; livelihoods; community health	4	4	16	Support GOL and communities to develop / implement Integrative NRM plans; protection / restoration of riparian / HCV areas; livelihood restoration	2	2	4	Negligible to minor impact remains as there is still a risk that a minority of people will be dissatisfied

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts
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	✓	✓	✓		Increased pressure on remaining forest resources	Ecosystem services; livelihoods; community health	3	3	9	Support GOL and communities to develop / implement Integrative NRM plans; maintain / restore high biodiversity value areas of the Project Area; staff prohibitions on collection of forest resources; education and awareness programs.	2	2	4	Negligible to minor impact remains as there is still a risk that a minority of people will be dissatisfied
Water use	Surface water quality impacts on community uses of water in streams (drinking, fisheries, domestic use); breach of regulatory requirements.	✓	✓	✓	Sedimentation of water downstream of plantations from vegetation clearance, earthworks, and unsealed road network	Aquatic habitat, aquatic biodiversity, community unrest, community livelihood, regulatory compliance	2	4	8	Implementation of stormwater, erosion and sediment control measures, monitoring and reporting adherence to discharge standards	2	2	4	Minor increases in suspended solids downstream of Project
		✓	✓	✓	Discharge of hazardous materials (pesticides, fertilisers, fuels) due to improper handling / storage	Aquatic habitat, biodiversity, livestock, community unrest, community health, regulatory compliance	5	3	15	Implementation of hazardous materials management controls; adherence to use and discharge standards; monitoring and reporting; consultation.	5	1	5	Localised residual impacts on water quality in the event of accidents

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts	
							Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank		
Ground water quality impacts on local community uses of groundwater (drinking, domestic use), breach of regulatory requirements.			✓		Contamination of groundwater due to improper handling/storage of hazardous materials	Community unrest, community health, regulatory compliance	3	3	9	Best Practice management of hazardous materials, including proper transport, storage, handling, and disposal of hazardous materials, Workforce training, Routine monitoring of storage and application.	3	2	6	No impacts anticipated with diligent application of hazardous materials management.	
Water availability impacts on community use of surface and ground water		✓	✓		Loss of surface and groundwater flows from eucalypt growth and water requirements, rapid transpiration from fast growing plantation species	Community unrest, community health,	3	2	6	Limit percentage of catchment utilised for plantations; monitoring and reporting; stakeholder consultation; grievance mechanism; Provide new wells if proven a consequence of plantation establishment.	3	1	3	Low residual impacts	
Economic Development and Employment	Failure to meet stakeholder expectations regarding employment opportunities		✓	✓	✓	Inadequate consultations with communities and / or inadequate / inequitable implementation of employment opportunities including number, rates etc....	Community unrest, livelihoods	4	4	16	Consult with community to ensure that they are well informed and have realistic expectations of employment opportunities; maximise employment opportunities	4	1	4	Minimal residual impacts

Risk / Aspect / Hazard		Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts
								Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank	
	Failure to meet stakeholder expectations regarding economic improvement		✓	✓		Inadequate consultations with communities or unsuccessful implementation leading to expectations for employment, community development (i.e. roads), agro-forestry and other development initiatives not being met	Community unrest, livelihoods	4	4	16	Consult with community to ensure that they are well informed of economic improvement / community development initiatives; successful planning and implementation of these initiatives	4	1	4	
Occupational Health and Safety	Child labour		✓	✓	✓	Employment opportunities lead to children engaging in labour activities	Breach of national and international law, health and safety	4	4	16	Awareness raising in communities. Implementation of robust labour policy and procedures. Prohibit children < 14 years of age from activities. Restrict activities of children >14 years of age. Support education services and adequate / culturally appropriate child care arrangements.	2	1	2	Minor risk that children will be involved in activities
	Serious injury during vegetation clearing, site maintenance		✓	✓	✓	Steep terrain, unsuitable use of heavy machinery, inadequate training, lack of PPE, unmaintained equipment	Injury or death	5	3	15	Operations / equipment training, equipment maintenance and upkeep, emergency response planning, provision of first aid equipment and training, provision of PPE and enforcement of use	4	2	8	Risk of infrequent significant injury remains, minor to negligible

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts	
							Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank		
Serious injury during harvesting activities			✓		Lack of training, Unsuitable staffing selection, Lack of PPE Unmaintained equipment.	Injury or death	5	3	15	Specific chainsaw training and utilisation of suitable personnel, emergency response planning, provision of first aid equipment and training, provision of PPE and enforcement of use	4	2	8	risk of mortality	
	Injury or death from UXO (plantation work and agroforestry)		✓	✓	✓	Lack of UXO clearance: Excavation / ploughing for roads / plantations,	Occupational / community health and safety, company reputation	5	2	10	UXO risk assessment and clearance as part of plantation establishment in moderate to high risk areas, conduct education and awareness programs	5	1	5	100% UXO eradication has proven difficult, therefore residual impact remains for accidents after areas cleared of UXOs
Community Health, Safety and Nutrition	Health and nutrition issues		✓	✓	✓	Project activities (i.e. conversion of swidden areas) lead to food insecurity	Community health and safety; company reputation	5	4	20	Employment opportunities; alternative livelihood activities through VDF	5	2	10	Low residual impacts
	Health and safety issues		✓	✓	✓	Project activities (i.e. transport, access to unsafe sites, workforce etc.) present increased hazards to local communities	Community health and safety; company reputation	5	4	20	Health and safety awareness; transport safety measures; workforce management measures	5	2	10	Low residual impacts

Risk / Aspect / Hazard		Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts
								Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank	
	Wildfire		✓	✓	✓	Escape from plantation or agricultural plot site preparation burning, lightning, arson	Injury or death; Livelihoods; Resources	5	3	15	Require sufficiently wide fire breaks, educate communities on volatility of eucalypt species, require riparian buffer retention	4	2	8	Risk of infrequent (well contained) fires remain
	Landslips and flooding		✓	✓		Significant land clearance of catchments; Plantations established on steep slopes near communities	Injury or death, community assets	5	1	5	Retention of riparian buffers; Restrict plantation establishment to slopes of less than 35%, and avoid slopes near communities	4	1	4	Background likelihood remains, localised impacts on communities and water quality in the event of incidents
Traffic / transport	Increased frequency of accidents along transportation routes	✓	✓	✓		Lack of safe driving training, speed limits in villages not set and/or enforced, negligible vehicle maintenance, poor road conditions, drug or alcohol intoxication, overloading vehicles	Community / occupational health and safety, compliance.	5	3	15	Careful traffic planning, enforcement of speed limits in villages, provision of traffic signs, regular vehicle maintenance, drivers operating within assigned skill level, driver education, incident reporting	4	1	4	Minor risk remains for traffic accidents
	Impact on land and water resources (associated livelihoods) from hydrocarbon spills		✓	✓		Unsafe transportation of hazardous materials, lack of traffic control measures, inadequate road safety controls	Community health and safety, community resources, terrestrial and	4	2	8	Driver safety training, enforcement of speed limits, emergency response procedures and response kits (spill kits)	3	1	3	Minor risk remains for traffic accidents

Risk / Aspect / Hazard	Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts	
							Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank		
along access roads						aquatic habitat and biodiversity, compliance									
Impact on community due to dust during dry season (from transportation), breach of regulatory requirements			✓	✓		Nuisance dust generated from road traffic, lack of dust control measures	Community health and safety, community satisfaction, compliance	2	4	8	Dust minimisation measures such as road watering and construction of sealed/gravel roads in key areas, careful planning of transport routes, enforcement of speed limits, ongoing monitoring, grievance mechanism	1	3	3	Minor nuisance residual impacts
Vulnerable Groups	Inequitable impact on vulnerable groups such as poor households, women and the elderly		✓	✓		Improper implementation of employment policies and compensation and livelihood restoration programs, social development programs	Community, disruption of traditional social structure	4	1	4	Consult with particular attention to vulnerable groups, implement Lao employment policies, target livelihood development programs to benefit vulnerable groups, implement Grievance Mechanism, conduct social monitoring	2	1	2	Negligible to minor impact remains as there is still a risk that a minority of people will be dissatisfied
	Ethnic conflict due to inequitable impact (real or perceived) on different ethnic groups		✓	✓		Inconsistent compensation or consultation between ethnic groups, improper implementation of employment policies.	Community unrest, disruption of traditional social structure	4	1	4	Consult with all ethnic groups with particular attention to minority groups, implement Lao employment policies, require equitable compensation, implement Grievance mechanism and conduct social monitoring	2	1	2	

Risk / Aspect / Hazard		Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts
								Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank	
Cultural Heritage	Community dissatisfaction due to adverse impacts upon sites of cultural heritage importance (i.e. cemeteries, spirit forests), breach of regulatory requirements.	✓	✓	✓		Land disturbance and inappropriate cultural heritage management, lack of implementation of chance find procedures, increased access to areas of cultural heritage significance, noise impacts	Cultural heritage, community unrest, regulatory and company compliance	4	1	4	Map and avoid areas of cultural significance during FPIC process for land acquisition; implement Chance Find Procedure, consultation, compensation and facilitation of appeasement ceremonies if agreed upon by community; require staff education and awareness programs; and implement Grievance Mechanism.	2	1	2	Cultural heritage and archaeology can remain hidden after avoidance/mitigation, Chance Find Procedure ensures minor to negligible residual impact on any remaining sites or artefacts, there is also still a risk that a minority of people will be dissatisfied
Archaeology	Disturbance of sites of archaeological importance	✓	✓	✓		Lack of understanding of archaeological values, inadequate Chance Find Procedure, inadequate archaeological assessment and management.	Regulatory non-compliance, community upheaval	4	1	4	Implement Chance Find Procedure, staff and contractor education and awareness programs	2	1	2	

Risk / Aspect / Hazard		Land Identification & Acquisition	Plantation Establishment	Plantation Management	Decommissioning	Likely Primary Causes	Potential Receptors / Impacts	Initial Risk			Project Design and Management Controls	Residual Risk			Residual impacts
								Consequence	Likelihood	Risk Ranking		Residual Consequence	Residual Likelihood	Residual Risk Rank	
Visual Amenity	Plantations perceived as impacting visual amenity in more sensitive areas (i.e. near protected forests etc.)		✓	✓		Large plantation stands established in close proximity to villages and or sensitive areas.	Community unrest	2	3	6	Implement integrative landscape / NRM management approaches and measures to protect / restore HCV forests	2	1	2	Potential residual impacts due to differing perceptions

10.2 Risk Management Summary

10.2.1 Summary of Key Risks Prior to Mitigation

The findings indicate that prior to mitigation, it is anticipated that out of the 59 potential risks identified for the Project, there would be three (3) Extreme, 13 High, 36 Moderate and seven (7) Low risks. The most significant potential risks prior to the implementation of additional management measures are outlined in Table 10-4.

The implementation of proposed management and mitigation measures is expected to reduce the anticipated residual level of overall risk exposure for most of the identified risks (refer to Table 10-4). No expected residual risks were identified as Extreme or High based on the criteria in Table 10-1 after the implementation of proposed controls. Table 10-5 summarises the Moderate residual risks that remain.

The three Extreme unmitigated risks include the significant loss of habitat / resources from conversion of fallow forest, increased food insecurity due to loss of upland agricultural land, and hazards to the community from Project activities (e.g. traffic / transport). Prior to mitigation, High risks include fire and community safety, perceived inequality, release of hazardous materials and impacts on ecosystem services (e.g. aquatic, terrestrial) and natural resources (e.g. water / forest resources). These risks are expected to be reduced significantly through the implementation of measures listed in the ESMMP (Volume D). It is anticipated that there will be no Extreme or High risks. Residual risks that may remain include 14 Moderate and 45 Low.

10.2.2 Approach to Risk Management in ESIA

Management and mitigation measures have been proposed for each key risk associated with the Project. These are summarised in Table 10-4 and are described in detail in the relevant sections in Chapters 7 - 9, as well as in the ESMMP. The risks will be managed and mitigated in accordance with the level of risk exposure and with due consideration of the nature and scale of the potential impacts.

10.2.3 Residual Risks

The implementation of proposed management and mitigation measures is expected to reduce the anticipated residual level of overall risk exposure for most of the identified risks (refer to Table 10-4). No expected residual risks were identified as Extreme or High based on the criteria listed in Table 10-1 after the implementation of proposed controls. Table 10-5 summarises the Moderate residual risks and potential impact that remain.

Table 10-5 Summary of Moderate risks after mitigation

Aspect	Likely Primary Cause	Expected Moderate Residual Impact (After Mitigation)
Land conversion and landscape altered	Plantations requiring vegetation clearance	Conversion of fallow, non-arable, unstocked areas to plantation
Significant increases in total suspended solids in downstream watercourses	Vegetation clearance, unsealed road network, annual site-preparation for intercropping, harvesting	Moderate seasonal increases in suspended solids in downstream receiving waters
Wildfire, increased frequency and intensity due to eucalypt volatility	Escape from agricultural plot site preparation burning, arson. Inadequate fire management and breaks, lack of training or preparation from Emergency Response Plan	Risk of wildfire remains. Capability to minimise spread.
Loss and fragmentation of habitat suitable for native species	Vegetation clearance for plantation establishment	Loss of fallow, non-arable, unstocked and/or cleared land for Project, including the loss of common native flora

Aspect	Likely Primary Cause	Expected Moderate Residual Impact (After Mitigation)
Loss and/or significant adverse impacts on fauna species and habitat of conservation significance	Loss and fragmentation of habitats, even-aged eucalypt plantations providing poor habitat for native species. Increased pressure on wildlife due to improved access for hunting.	Not anticipated for HCV species / habitat
Turbidity and sediment impacts on aquatic biodiversity	Erosion of unsealed roads, cleared areas and sediment transport / settling changing stream morphology	Localised changes in turbidity, Low impacts on aquatic biodiversity
Community dissatisfaction with community / private land loss, restricted land use / access, and livelihood impacts as a result of land acquisition and conversion	Land conversion resulting in loss of agriculture land and natural resources (i.e. NTFPs and TFPs)	Negligible to minor impact remains as there is still a risk that a minority of people will be dissatisfied
Ground water quality impacts on local community uses of groundwater (drinking, domestic use), breach of regulatory requirements.	Contamination of groundwater due to improper handling/storage of hazardous materials	No impacts anticipated with diligent application of hazardous materials management.
Serious injury during vegetation clearing, site maintenance	Steep terrain, unsuitable use of heavy machinery, inadequate training, lack of PPE, unmaintained equipment	Risk of infrequent significant injury remains, minimised likelihood and Company preparedness
Serious injury during harvesting activities	Lack of training, unsuitable staffing selection, lack of PPE, unmaintained equipment.	
Injury or death from UXO (plantation work and agroforestry)	Lack of UXO clearance: Excavation / ploughing for roads / plantations	100% UXO eradication has proven difficult, therefore residual impact remains for accidents after areas cleared of UXOs
Health and nutrition issues	Project activities (i.e. conversion of swidden areas) lead to food insecurity	Low residual impacts
Health and safety issues	Project activities (i.e. transport, access to unsafe sites, workforce etc.) present increased hazards to local communities	Low residual impacts
Wildfire	Escape from plantation or agricultural plot site preparation burning, lightning, arson	Risk of infrequent (well contained) fires remain

10.2.4 Risk Monitoring and Review

ISO 31010

'As part of the risk management process, risks and controls should be monitored and reviewed on a regular basis to verify that:

- *Assumptions about risks remain valid;*
- *Assumptions on which the risk assessment is based, including the external and internal*
- *Context, remain valid;*
- *Expected results are being achieved;*
- *Results of risk assessment are in line with actual experience;*

- *Risk assessment techniques are being properly applied; and*
- *Risk treatments are effective.*

Accountability for monitoring and performing reviews should be established.'

Periodic risk monitoring and review are critical to managing environmental and social risks effectively over the Project life, and feed into all steps in the risk management process (refer Figure 10-1).

Risk

As part of its corporate Environmental and Occupational Health & Safety System (EOHS), Burapha is committed to developing a risk management system for the Project consistent with ISO 31000 Risk Management — Principles and Guidelines (2009). This will need to include:

- Ensuring there is accountability, authority and appropriate competence for managing risk;
- Development of an organization-wide Risk Management Plan to ensure that the risk management policy is implemented and that risk management is embedded in all of the organization's practices and processes;
- Allocation of appropriate resources for risk management;
- Establishing appropriate internal and external communication and reporting mechanisms; and
- Monitoring and review of the risk management framework.

10.2.5 Risk Management Framework

Based on the ISO 31000 *Risk Management — Principles and Guidelines* (2009), key elements of the risk management framework are:

- Risk hierarchy;
- Risk governance and accountabilities; and
- Risk System.

To ensure that the risk management framework is effective and continues to support organisational performance, Burapha is committed to:

- Regularly assessing the quality of risk management processes to identify opportunities for improvement;
- Measuring risk management performance for the Project against indicators, which are periodically reviewed for appropriateness;
- Periodically measuring progress against, and deviation from, a Project-specific risk management plan;
- Periodically reviewing whether the risk management framework, policy and plan are still appropriate for the Project, given the organisations' external and internal context;
- Reporting on risk, progress with the risk management plan and how well the risk management policy is being followed; and
- Reviewing the effectiveness of the risk management framework.

Decisions relating to the improvement of the risk management framework, policy and plans need to be based on the results of monitoring and reviews. These decisions will aim to improve the organisation's management of risk and its risk management culture.

Burapha will need to periodically monitor and review the risk assessment conducted for the Project to:

- Ensure controls are effective and efficient in both design and operation;

- Obtain further information to improve risk assessment;
- Analyse and learn lessons from events (including near-misses), changes, trends, successes and failures;
- Detect changes in the external and internal context, including changes to risk criteria and the risk itself which can require revision of risk treatments and priorities; and
- Identify emerging risks.

Progress in implementing risk treatment measures and plans provides a performance measure. The results of the monitoring and review processes need to be incorporated into the overall performance management, measurement and external and internal reporting activities.

The results of monitoring and review need to be recorded and externally and internally reported as appropriate, and also be used as an input to the review of the risk management framework.

10.2.6 Risk Management Records

ISO 31010

'Risk management activities should be traceable. In the risk management process, records provide the foundation for improvement in methods and tools, as well as in the overall process.'

Recording risk information that is concise, accurate and timely enables reports to be generated that build corporate knowledge and contribute significantly to informed discussion on risk and uncertainty.

In accordance with ISO 31000 Risk management – Principles and Guidelines (2009), Burapha will need to ensure that “Systems are in place to ensure that sustainability related records are established and maintained, accurate, legible, identifiable, securely stored, and have established retention times based on legal requirements.”

All environmental and social risk assessments conducted and associated documentation need to be recorded and stored in the Community, Social & Environmental Compliance (CSER) Department environmental and community files. These records need to include:

- Internal risk assessments;
- External risk assessments;
- Department Risk and Opportunity Register;
- Relevant Company procedures, standards, policies and plans;
- Relevant international guidelines and standards;
- Audit results; and
- Incident reports.



Chapter 11 | Cumulative Impacts

Chapter 11 | Cumulative Impacts

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11 CUMULATIVE IMPACT ASSESSMENT

Cumulative impacts result when the impacts derived from a project are added to or interact with impacts associated with other projects or actions within a particular time and place. The combined, incremental effects of human actions may be compounded, leading to environmental and social impacts that exceed that associated with implementation of any individual project or action. Note that the assessment of cumulative impact aims to identify the significance of the Project's contribution to any potential cumulative impacts, and the need, if any, for additional management measures to avoid exacerbation of such impacts.

For this Project, cumulative impacts may also be considered in the context of expansion of the Burapha Agroforestry Project alone. If multiple plantations are sited within a given catchment or otherwise within close proximity to each other, impacts may be compounded (e.g. for hydrology, erosion and sedimentation, regional biodiversity, etc.), with cumulative impacts more significant than for that considered for an individual unit.

Existing and planned projects are discussed in Section 11.1 and their potential cumulative impacts in relation to the current Project are discussed in Section 11.1.

Summary Findings

Project expansion will likely contribute to cumulative benefits and impacts as follows:

- *Socio-economic development* – Project expansion will contribute to improved socio-economic developments at the local, regional, and national levels. It is anticipated that the Project's contribution will have a moderate beneficial impact relative to other large scale developments in the area;
- *Hydrology and hydropower* – vegetation removal across the area will contribute to greater discharge to surface waters, potentially increased water resources for hydropower generation, and potentially increased flooding. Burapha's contribution will be minor, given that plantations / crops will establish cleared areas rapidly;
- *Erosion and sediment transport* – the expansion will add to erosion and sedimentation in applicable catchments. This is a growing problem in Lao PDR as more areas are cleared. The additional input from the plantations will likely be minor, given the rapid establishment of vegetation within a year of planting;
- *Forest clearing* – With forest clearance for development projects / agriculture; terrestrial habitat and the availability of forest resources, including non-timber forest products and timber forest products are cumulatively impacted. Burapha's contribution will be relatively minor given the Company's use of only fallow / significantly degraded forests;
- *Air quality* – Controlled burns for agricultural site preparation and plantation establishment will contribute to air quality impacts from approximately January – March each year. Depending on access to land, the Company will clear up to an estimated 15,000 ha per year (at least 10% of vegetation uncleared in each unit), and its contribution will be moderate. However, burning will only be conducted for the first rotation. Impacts will therefore be short-term; and
- *Wildfire* – implementation of large Eucalyptus plantations or a number of small plantations in close proximity to each other may cumulatively enhance the likelihood of wildfire.

11.1 Existing and Potential Projects

This assessment considers moderately large to large developments that require vegetation clearing for implementation / operations.

Given the size of the region that the Project will expand into, there are a vast number of agricultural and / or industrial projects in the Project Expansion Area that may interact with the Burapha Project to provide some level of cumulative impact. Representative current and planned large scale projects that required or will require significant vegetation clearing for implementation are provided below.

11.1.1 Hydropower Projects

The GOL has to date signed MOUs or is undertaking research on more than 70 hydropower projects (HPP; Table 11-1; Figure 11-1). Of these, 24 are either operational or under construction (Ministry of Energy and Mines, 2014).

Table 11-1 Current and planned hydropower projects in the Burapha Agroforestry Project region

Project Name	Province	Installed Capacity (MW)	Progress	COD (Planned)
In Operation				
Nam Ngum 1	Vientiane Province.	155	Operational	1971
Nam Leuk	Vientiane Province	215	Operational	2000
Nam Mang 3	Vientiane Prefecture.	40	Operational	2004
Nam Lik 1-2	Vientiane Province	100	Operational	2010
Nam Ngum 2	Vientiane Province	615	Operational	2011
Nam Ngum 5	Luang Prabang Province	120	Operational	2012
Planned Projects				
Nam Lik 1	Vientiane Province	65	Pre-Const.	2017
Xayburi HPP	Xayabouly Province	1,260	Pre-Const.	2019
Pak Chom HPP	Vientiane and Xayabouly Provinces	1,872	Pre-Const.	TBD
Luang Prabang HPP	Luang Prabang Province	1,410	Feasibility	TBD
Pak Lay HPP	Xayabouly Province	1,320	Feasibility	TBD
Pak Beng HPP	Xayabouly Province	1,230	Feasibility	TBD
Nam Ngum 4	Xieng Khuang Province	220	Feasibility	TBD
Nam Ngum 3	Vientiane Province	460	Planning	2018
Nam Bak 2	Xayabouly Province	40	Feasibility	TBD
Nam Bak 1	Xayabouly Province	160	Feasibility	TBD
Sanakham HPP	Vientiane Prefecture	700	Feasibility	TBD

Potentially Applicable Large-Scale Projects

Nam Ngum Basin Hydropower Projects

- *The Nam Ngum 1 Hydropower Project* – The Nam Ngum 1 HPP impounds the Nam Ngum River, Vientiane Province, approximately 60km north of the Capital City. The reservoir surface area is approximately 370 km² and the catchment area approximately 8,460 km².
- *The Nam Ngum 2 Hydropower Project* – The Nam Ngum 2 HPP is located approximately 90 km north of Vientiane and approximately 35 km upstream of the Nam Ngum 1 HPP dam (just upstream of the reservoir). The Project captures water from a catchment area of 5,640km², and has a reservoir that covers approximately 100 km² at full supply level.
- At least four more Nam Ngum River hydropower projects are in various stages of planning or construction, each of which will have a reservoir / transmission lines (etc.) that require vegetation clearance.

- *Nam Bak 1 Hydropower Project* – the Nam Bak 1 HPP will be built on the Nam Bak River, one of the main tributaries of the Nam Ngum River, which discharges to the Nam Ngum approximately 1.5 km downstream of the Nam Ngum 2 dam.
- *Nam Leuk Hydropower Projects* - The Nam Leuk project area is within the Phou Khao Khouay National Biodiversity Conservation Area. The Nam Leuk project diverts water into the Nam Ngum reservoir via a 40 MW power station. The project is also associated with the Nam Song Diversion Area, which diverts the majority of the flow of the Nam Song River into the Nam Ngum reservoir, to increase generation at the existing Nam Ngum Power Station.

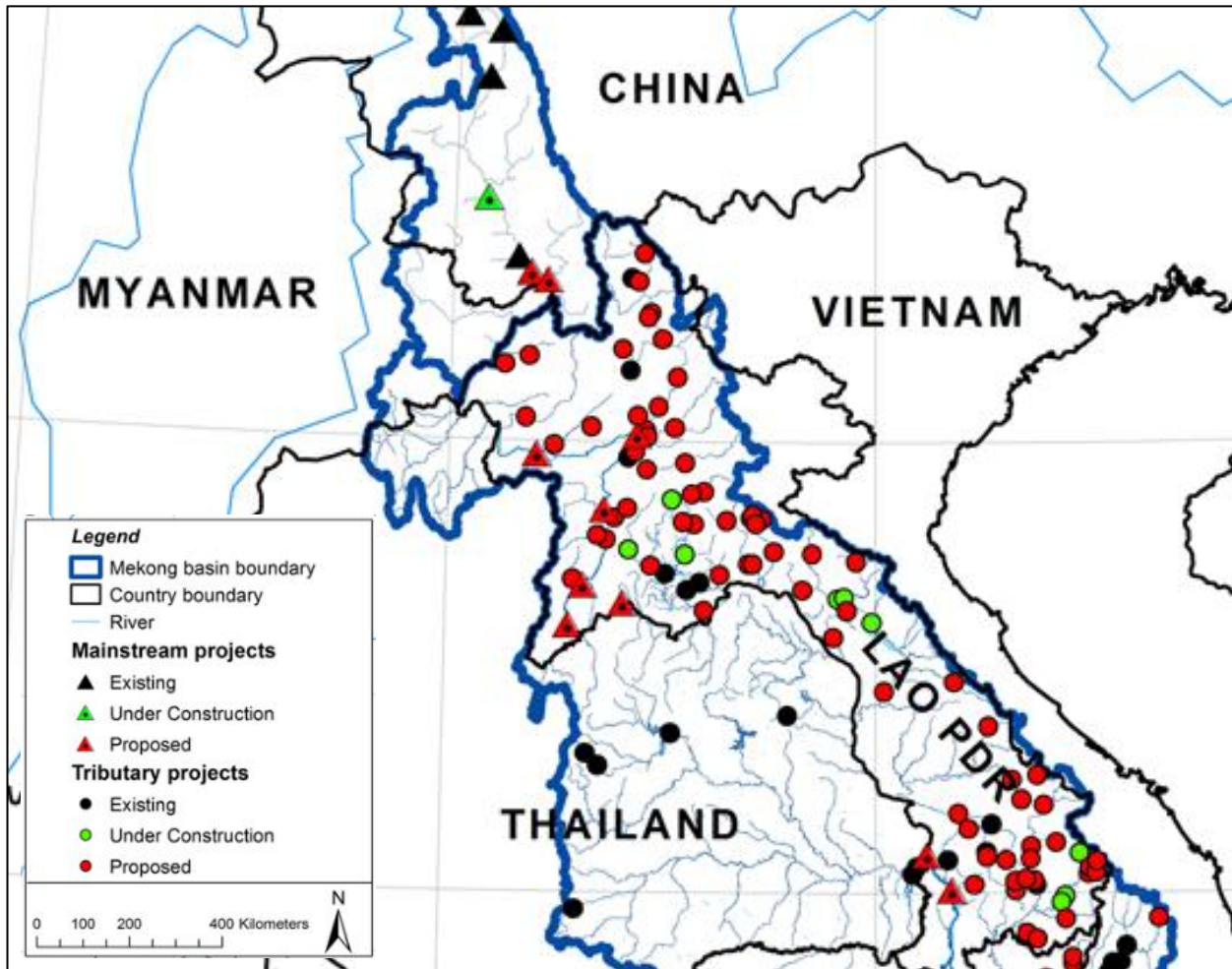
Nam Lik River Hydropower Projects

- *Nam Lik 1-2 Hydropower Project* – The Nam Lik 1-2 HPP is located on the Nam Lik River approximately 150km northwest of Vientiane in Feuang District, Vientiane Province. The reservoir covers approximately 24.4 km² at Full Supply Level.
- *Nam Lik 1 Hydropower Project* – The Nam Lik 1 HPP will be located 90 km north of Vientiane in Hin Heup District, Vientiane Province. The project will impound the Nam Lik River near Ban Hin Heup, with the reservoir covering approximately 11.5 km² at Full Supply Level.
- *Nam Mang 3 Hydropower Project* - The Nam Mang 3 HPP is 80km north-east of Vientiane, has a 10 km² reservoir at Full Supply Level.

Mekong River Hydropower Projects

A cascade of at least 11 hydropower projects are planned for implementation on the main stem of the Lower Mekong River, five of which are planned for Lao PDR.

- *Pak Beng Hydropower Project* – The Pak Beng HPP is the northernmost cascade on Lower Mekong River in Lao PDR. It will have a reservoir that covers 87 km².
- *Luang Prabang Hydropower Project* – The Luang Prabang HPP will be located north of Luang Prabang City 3km upstream of the confluence with the Nam Ou River. The Project will have a reservoir that covers 90 km² at Full Supply Level.
- *Xayaburi Hydroelectric Power Project* – The Xayaburi HPP will impound the Mekong River approximately 350 km upstream of Vientiane. The Project will harness water from a catchment area of approximately 272,000 km², with a reservoir covering approximately 49 km² at Full Supply Level.
- *Pak Lay Hydropower Project* – The Pak Lay HPP, located in Pay Lay District, will have a reservoir that covers approximately 108 km².
- *Sanakham Hydropower Project* – The Sanakham HPP will be located just upstream of the Lao – Thai border in Vientiane Prefecture. The project will have a maximum reservoir area of 81 km².



Source: Adapted from University of Canterbury, Data source – MRC Hydropower Database

Figure 11-1 Current and planned hydropower projects in the Mekong Basin, Lao PDR

11.1.2 Mining Projects

Table 11-2 provides the primary mining, quarry, and exploration projects in Vientiane Prefecture and Vientiane, Xayabouly and Saysomboun Provinces. Additional concessions are included in Figure 11-2.

Table 11-2 Major mining and quarrying operations in the Project Area

Mining Operation	Material	Province
Hongsas Power Plant and lignite/limestone mine	Lignite, Limestone	Xayabouly
Phu Kham Copper-Gold Operations	Copper, Gold	Vientiane
Ban Houayxai Gold-Silver Project	Gold, Silver	Vientiane
Phonsavan Project	Copper, Gold	Saysomboun
Vanmieng Metallurgical Coal Mine	Metallurgical Coal	Vientiane
Bavan Khi	Metallurgical Coal Mine	Vientiane
Sino Lao Thong Mang Pilot Project	Potash	Vientiane Prefecture
Lao Cement Ltd	Limestone, White Clay, Mudstone	Vientiane Prefecture
Veunkham Salt Production	Salt	Vientiane Prefecture

Mining Operation	Material	Province
Phialat Gold Panning	Gold	Vientiane Prefecture
Thong Mang Pilot Project	Coal	Vientiane Prefecture
Kasi Exploration Project	Zinc	Vientiane Prefecture

Potentially Applicable Projects

Vientiane Province

- *Phu Kham Copper-Gold Mine* - This open pit mine project is situated approximately 140 Km away from Vientiane City. The MEPA concession area covers 2,637 km², with a Project footprint of approximately 5 km².
- *Ban Houayxai, Gold and Silver Mine* - This gold and silver open pit mine project is situated 25 Km west of Phu Kham mine. The MEPA concession area covers 2,637 km², with a Project footprint of approximately 3 km².
- *Padaeng Zinc Mine / Kasi Exploration Project* - This project concession covers 800 km² in the Kasi District of Vientiane Province. The extent of the project footprint has not been identified for this assessment.
- *Lao Cement Ltd – Limestone, White Clay and Mudstone Reserves* - A cement plant successfully went into production in Vang Vieng and has been operational since 2002.
- *Veunkham Salt production, Xaythany district, Vientiane* - This is one of the biggest salt production sites in Lao PDR.

Vientiane Prefecture

- *Sino Lao – Thong Mang Pilot Project* - Potash mine, Xaythany district - The aerial extent of the project is expected to reach up to 41.25 Km². The project will extract products of potassium chloride and magnesium chloride for industrial use.
- *Phialat Gold Panning* - Sakai mining company has been working on this small alluvial gold deposit since 2005. The projected size of the Project footprint has not been identified for this assessment.

Xayabouly Province

- *Hongsa Limestone and Lignite mine* - An open cast lignite and limestone mine is situated adjacent to the 1,878 MW Power Plant. The projected size of the Project footprint has not been identified for this assessment.

Saysomboun Province

- *Phonsavan Copper-Gold Project*- The Project is located close to the town of Phonsavan in the east of Saysomboun Province, approximately 100 kilometres north of Phu Kham. The Project footprint is expected to encompass approximately 2 km².

11.1.3 Agriculture

The majority of current Burapha plantations and anticipated future lease areas are in the Northern Lowlands Agro-ecological zone of Central Lao PDR, where relatively good access, topography, and soil conditions favour intensive fixed plot agriculture / tree plantation operations, with considerable area also utilised for shifting upland cultivation. Table 11-3 provides land area per agricultural activity. As data recording and provision of information in Provincial Socio-Economic Development Plans is not uniform for the four Provinces, the table is not complete. Therefore, land use estimates are significantly understated, and a number of land uses known to occur in relative abundance are not included (e.g. agarwood and teak plantations).

Table 11-3 Indicative agricultural and plantation land area

Land Use	Province			
	Vientiane Pref.	Vientiane	Xayabouly	Saysomboun
Plantation				
Rubber	188,143	18,324	**	6,836
Eucalyptus	**	**	**	**
Teak	**	**	**	**
Mulberry	875	**	**	**
Noni	250	**	**	**
Fruit	4,478	**	**	**
Other ¹	**	6,676	**	**
Agarwood	**	**	**	**
Cassava	3,026	**	4,300	1,291
Total Plantation	196,772	25,000	4,300	8,127
Agriculture (non-rice)				
Total Land	109,844	90,768	265,104	138,340
Swidden Agriculture*	16,565	743,100	65,854	18,866
Rice				
Lowland rainfed paddy	55,530	52,376	31,118	10,367
Irrigated dry season paddy	17,166	9090	2,294	**
Upland rainfed paddy	**	5162	14,946	**
Total rice production area	72,707	66628	48,358	10367
Total Agricultural and Plantation Land	395,888	925,496	383,616	175,700

*Swidden Agriculture land area generated from GOL FIPD Land Use Data (2010)

**Not available

Tree plantation operations include Rubber, Teak, Eucalyptus, Agarwood, Mulberry, Noni, and various fruit orchards. Rice production (unirrigated / irrigated lowland and upland rice) covers the greatest land area for agricultural cropping. The land area devoted to fixed plot cash crop agriculture has been expanding, with crops such as maize, sugarcane, chilli, cucumber, cabbage and a host of other crops occupying significant land area.

Fixed-plot agriculture and plantations require clearance of native vegetation of similar topography / condition to that utilised for Eucalyptus operations. It is therefore anticipated that impacts from agriculture and agroforestry will be similar, each cumulatively contributing.

11.1.4 Transportation Infrastructure

Transportation infrastructure occupies a moderate land area across the four Project Provinces, and is advancing, with new major and minor road developments in planning or construction phase. One major development is underway and a feasibility study is being conducted for a second (refer to below). Additional roadworks is ongoing throughout the region, with road widening or construction of new roads requiring conversion of vegetated areas.

- *Kunming – Singapore rail link* - A section of the new regional railway development plan connecting China, Lao and Thailand called the 'Kunming – Singapore rail link' began construction in Lao PDR in December 2015. The construction of the line that connects Boten with Vientiane covers a distance of 427.2 Km.
- *The Vientiane – Hanoi Highway Project* which would involve the construction of a 760km highway, is currently in the feasibility study stage. The highway route is planned to start in Vientiane, pass through Pakxan in Lao's Bolikhamxai Province and subsequently through to Nghe An Province and Hanoi in Vietnam.

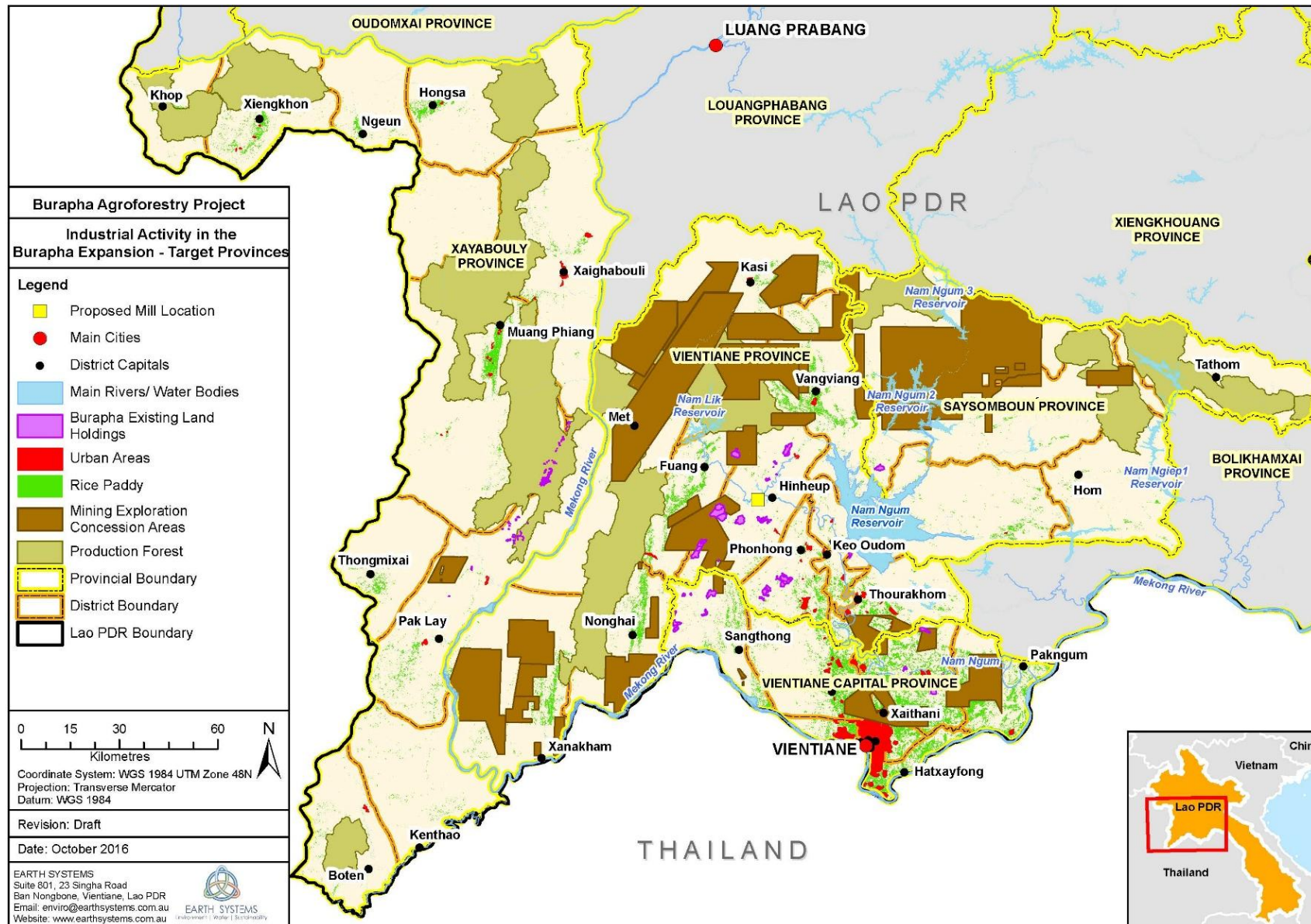


Figure 11-2 Current reservoirs, mining exploration permits, agriculture (non-comprehensive), and major road infrastructure in targeted expansion Provinces

11.2 Assessment of Cumulative Impacts

The Burapha Agroforestry Project, along with other current and planned development projects throughout Vientiane Prefecture, Vientiane Province, Xayabouly Province, and Saysomboun Province will cumulatively provide benefits and impacts.

This cumulative impact assessment considers the effects of multiple projects occurring within a region as well as multiple Burapha plantations implemented within the same catchment or otherwise in close proximity to each other.

11.2.1 Socio-Economic Development

Regional / Local Community Benefit

Industrial development has been fairly rapid in much of Vientiane Prefecture, Vientiane Province, Xayabouly Province, and Saysomboun Province relative to the majority of other Lao Provinces due to their proximity to the Capitol City and improving transportation infrastructure. Mean incomes are higher than the national average and incidence of poverty are lower than the national average, respectively. Capital and operating expenditure, employment opportunities, government fees, and flow-on effects of cash injection into the local economy provided by industrial activity in the Project Area will be bolstered by Burapha Agroforestry Project expansion.

Cumulative benefits to regional / local communities are expected to include:

- Additional employment opportunities;
- Increased competition for labour which may improve salaries;
- Injection of cash and transition to a cash based economy from employment, land lease fees, etc.;
- Skills training associated with various project needs; and
- Decreased reliance on subsistence agriculture.

Importantly, Burapha operations will be largely implemented in foothill regions, in higher elevations that preclude significant paddy rice production and in areas that are less accessible for industrial development where incidence of poverty is higher than Provincial averages. The Burapha Project is expected to elevate the incomes of some of those most in need.

National / Provincial Economy

Industrial development in the Project Provinces provide a range of direct and indirect benefits to Lao PDR. Direct cumulative benefits will include:

- Capital expenditure and operating costs – expenditure required to develop new projects / provide ongoing financing to existing projects and operational costs will likely result in flow-on effects to the national economy;
- Income and payroll tax and other government fees – taxes and other government fees will provide money to Provincial and national GOL, likely to have a flow-on benefit for infrastructure development;
- Indirect benefits – including flow-on benefits and external effects, such as local business development and increased consumption in local communities resulting from the injection of cash into the economy. These benefits will similarly generate tax fees.

Socio-Economic Development Cumulative Benefits

Increased development will generate significant direct and indirect economic benefits for the local, regional and national economy. Cumulative benefits are expected to be **High**. Burapha's contribution to socio-economic development is expected to be **Moderate**.

11.2.2 Forest Clearance

The availability of terrestrial habitat and forest resources (NTFP and TFP) is impacted by development projects that require (or have required) clearance of significant area of vegetation and conversion to something other than native habitat. Impacts range from temporary (e.g. for shifting cultivation) to permanent (i.e. for road development, hydropower). Burapha's relative contribution to this impact is considered low, given that vegetation conversion will not be permanent, and native habitat retention areas in each plantation will contribute to some area of habitat improvement, and migration corridors.

Hydropower reservoirs for nine (9) of the 12 projects discussed above have or will cover approximately 1,492 km², most of which was likely terrestrial habitat (while some is riverine). Additional habitat is removed for transmission lines, access roads, associated buildings, etc. Impacts to habitat are more difficult to assess for mining projects (as the extent is largely unknown for exploration sites). Vegetation removal / conversion for agriculture is widespread throughout the region and may be temporary and shifting.

Though plantation forests remain vegetated the majority of plantation landholding (e.g. rubber, eucalyptus) provide poor habitat value, even in comparison to the fallow forest / degraded habitat they replace largely due to even aged stands providing very little light for understory growth. Connectivity between higher value habitat may also be degraded as potential migration corridors are cleared for industrial projects.

Implementation of a number of Burapha plantations within the same catchment or otherwise in close proximity to each other may cumulatively effect regional biodiversity in the same manner. Conversion of a high proportion of vegetation in a region may significantly impact habitat availability and provide barriers to wildlife movement between areas of higher value habitat. Burapha will need to carefully evaluate potential plantation locations to minimise cumulative impacts to biodiversity.

Biodiversity Cumulative Impacts

Forest clearance throughout Vientiane Prefecture and the Provinces of Vientiane, Xayabouly, and Saysomboun are expected to have a **Moderate** cumulative impact on the availability of terrestrial habitat and forest resources.

Burapha's contribution is expected to be **Low**, given the temporary conversion of only degraded / unstocked forests.

11.2.3 Hydrology

Research has identified that stormwater runoff generally increases following the removal of forests. In extreme storm events and following removal of a significant proportion of vegetation within a given catchment, increased runoff may enhance flood events. Forest canopies intercept rainfall, some of which is readily evaporated in tropical climates. Infiltration rates are also higher under vegetation and litter cover in forests as a consequence of soil surface protection and high macroporosity.

Extensive research has documented the changes to the hydrograph following vegetation clearance. Hewlett, J.D. & Helvey, J.D. (1970) found increases in surface water flow ranging from 11-22% in a paired catchment study. Mumeka (2009) found peak flows increased by as much as 100% and the time to peak flooding decreased following conversion of forest to agricultural land in Zambia. Ruang-panit (1985) found average surface runoff increased from 2.5 m³/ha to 4.7 m³/ha from forests with canopies with 80-90% crown cover and 20-30% crown

cover, respectively in a tropical rainforest. Hewlett and Hibbert (1961) found modal and maximum yield increases of 2.5 and 4.5 mm yr⁻¹ respectively for each percentage fall in forest cover.

Modelling conducted for this study (refer to Section 7.3) estimates a range of 11% to 51% runoff increase during the first rainy season following forest clearance (refer to Table 11-4; Figure 11-3).

Table 11-4 Modelled surface water runoff in forested and cleared areas in central Lao PDR

Runoff Percentile	Forested Runoff	Cleared Runoff	Percentage Flow Increase
10%	0.3	0.3	11%
25%	0.5	0.8	51%
50%	1.5	1.8	26%
75%	3.2	4.2	33%
90%	4.9	6.6	33%
Max	12.6	16.8	33%
Annual Runoff	790.9	1070.2	35%

Cumulative impacts from project developments that require significant vegetation removal may include:

- Increased likelihood and intensity of flood events during the rainy season;
- Increased erosion and sedimentation resulting from higher surface water flows; and
- Benefits to hydropower projects due to increased availability of surface water for electricity generation.

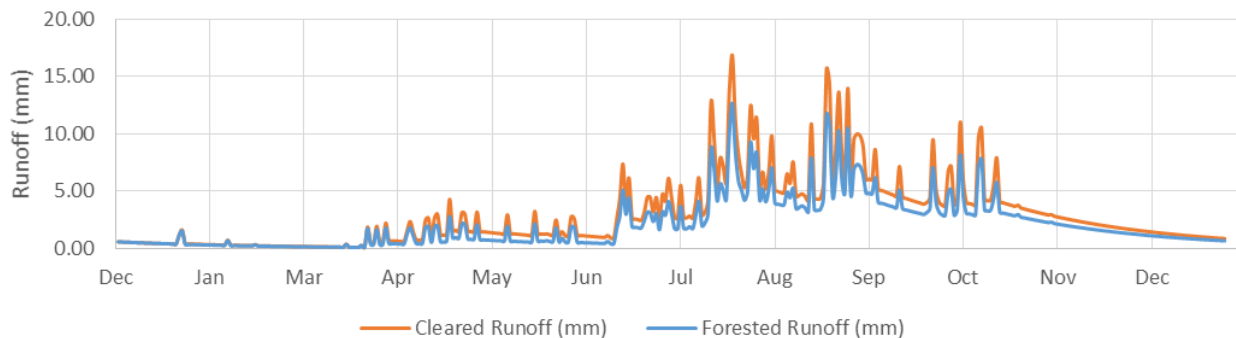


Figure 11-3 Modelled runoff in forested versus cleared catchments, central Lao PDR.

Cumulative impacts - hydrology and hydropower generation

Forest conversion throughout the Project Provinces is expected to increase downstream surface water flow following storm events, potentially leading to enhanced flooding. The Burapha Project contribution is expected to be **minor**, given the rapid establishment of vegetation within a year of clearance.

Hydropower projects may benefit from increased flow. Burapha's contribution is expected to be **minor**.

11.2.4 Erosion and Sedimentation

Erosion of soil surfaces and sediment transport to receiving water will increase with vegetation removal. When surface cover is removed, raindrop impact destroys surface aggregate structure, loosens fine soil fractions, and increases soil erodibility (refer to Table 11-5). The cumulative reduction in canopy cover resulting from ongoing industrial / agricultural developments throughout the Project Provinces is expected to result in increased soil losses and sediment loading in receiving waters.

Table 11-5 Relationship between canopy cover and soil erosion (modified from Ruang-panit, 1985)

Crown Cover (%)	Soil Erosion (kg / ha-1)	
	Total*	Average*
20-30	652.8	15.9
40-40	512.3	12.5
50-60	456.9	11.1
60-70	372.5	9.1
70-80	298.0	7.2
80-90	285.1	7.0

*Calculated from 41 runoff-producing storms totalling 1,127 rainfall)

Annual vegetation removal for agriculture and plantation forestry may cumulatively increase suspended sediment concentrations in receiving waters throughout the first rainy season following site clearance (in particular). Unsealed roads, soil stockpiles, vehicle / equipment laydown areas and other unsealed surfaces commonly associated with mining, hydropower development, and construction activities promote erosion and sedimentation of waters throughout the Project Area. Unsealed roads in rural Lao are also seasonal contributors.

Cumulative impacts will be most pronounced from agricultural activities or other developments that do not convert vegetation more impervious surfaces. Increased sedimentation of watercourses will be most pronounced during the first rainy season following vegetation removal and throughout each rainy season for unsealed roads, which are common throughout the Project Provinces.

Cumulative impacts may affect:

- Hydropower reservoir water holding capacity;
- The quality of aquatic habitat; and
- Visual amenity.

Erosion and Sedimentation Cumulative Impacts

Cumulative impacts to surface water quality resulting from erosion and sediment transport from areas cleared of vegetation is expected to be **Moderate**. This is a growing problem in Lao PDR as more areas are cleared.

Burapha Project expansion will add to erosion and sedimentation in applicable catchments. The additional input from the plantations will likely be **minor**, given the rapid establishment of vegetation within a year of planting.

11.2.5 Air Quality

Controlled burns for plantation site preparation will likely coincide with regional slash and burn activities for upland agriculture. Though impacts to air quality from the Burapha Project will be low, the projects / agricultural activities will cumulatively contribute to air quality pollution during the dry season.

Fires are common in Lao PDR from January – March, with the majority ignited to clear vegetation for agricultural site preparation. The image below, taken by the Moderate Resolution Imaging Spectroradiometer on NASA's Aqua satellite captures smoke emitting from extensive fires throughout Southeast Asia, which have been marked by red dots for easier identification (Figure 11-4).



Figure 11-4 Fire and smoke in Southeast Asia, March 2014 (NASA)

Extensive burning for agricultural practices may cumulatively provide annual nuisance level impacts and in extreme cases is a threat to human health. Smoke from fires ignited to clear vegetation / slash in southeast Asia have contributed to cases of acute or chronic respiratory disease (Kimmel, 1999) and on the extreme end, fatalities (e.g. in Indonesia, 2015) (CNN, 2015). No data for the cumulative impacts of haze from annual burning in Lao PDR was found for this assessment.

Air Quality Cumulative Impacts

Controlled burns for agricultural site preparation and plantation establishment will contribute to air quality impacts from approximately January – March each year. As Burapha may clear as much as 15,000 ha per year (at least 10% of vegetation uncleared in each unit), its contribution will be moderate. However, burning for Burapha site preparation will only be conducted prior to the first rotation (once-off per site for the length of the lease period).

Cumulative impacts to air quality resulting from agricultural / plantation site preparation are expected to be **High** during dry season months, while Burapha’s contribution is expected to be **Low**.

11.2.6 Wildfire

Eucalyptus forests are prone to intense wildfire when ignited. Most Eucalyptus species have evolved to depend on fire for reproduction and competitive advantage. The leaves produce a highly combustible oil; leaf litter and bark often decays very slowly due to concentrations of phenolics providing additional highly combustible material; and crowns are not dense – allowing sub-canopy plant establishment (additional fuel loading). The fire regime is very different from the vegetative communities of Lao PDR and very different to what Lao people are likely accustomed to.

Implementation of large Eucalyptus plantations or a number of smaller plantations in close proximity to each other may cumulatively enhance the likelihood of large scale wildfire that damages ecological values in adjacent forested area and provides risk for community health and safety.

Wildfire Cumulative Impacts

Project expansion will contribute to greater potential for wildfire. Cumulative impacts of fire on ecology and community health and safety are expected to be **Low** given Burapha's management and mitigation strategies for controlling the spread of wildfire.

Chapter 12 | Stakeholder Consultation



Chapter 12 | Stakeholder Consultation

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12. STAKEHOLDER CONSULTATION AND PUBLIC INVOLVEMENT

Public consultation and disclosure is a *'tool for managing two-way communication between the project sponsor and the public with the goal of improving decision-making and building understanding by actively involving individuals, groups, organisation with a stake in the project'* (IFC, 1998). It is a core aspect of GOL's environmental and social legislation, and a key requirement of many international financing institutions. In addition to these regulatory obligations, an open and consultative approach makes good business sense by reducing costs, reducing risks, and enhancing reputation and commercial opportunity.

Throughout the ESIA process, formal and informal consultations were undertaken with national, provincial and district government officials, as well as local communities that are participating or otherwise may have been affected by Project implementation. Informal consultation has included regular discussions and the dissemination of Project information to local residents and government staff. Formal consultations have included meetings with relevant government authorities and environmental and socio-economic studies at the village level. Structured consultation workshops were also conducted with government, communities and other stakeholders to present the draft ESIA, share information about the Project, and obtain feedback from Project stakeholders.

This chapter summarises the consultation undertaken and the associated outcomes before and during the drafting of the ESIA. Strategies for ongoing consultation throughout the life of the Project, as well as a description of the proposed grievance mechanism, are also discussed.

12.1 Objectives

The overall goal of public consultation and disclosure for the Burapha Agroforestry Project is to improve decision-making, build understanding to ensure the long-term viability of the Project, and to enhance potential Project benefits.

12.1.1 Public Consultation

The specific objectives of stakeholder consultation for the Project are to:

- Build two-way communications between Burapha, the affected communities and other Project stakeholders for the ESIA process;
- Ensure that Project affected communities and other stakeholders are well informed of the Project, its environmental and social impacts, and proposed management measures;
- Collect relevant information on the Project Area from key stakeholders for use in the ESIA and associated management plans as well as development of the Project;
- Ensure stakeholder feedback on the Project and its impacts is gained through simple and effective communication processes; and
- Promote inclusive and informed decision-making on the development and management of the Project.

Consultation with key stakeholders in the development of the Project is critical to its success. Stakeholder consultation should be conducted throughout the life of the Project, including during construction and operation. Ideally, a good consultation process will be (IFC, 2007):

- Targeted at those most likely to be affected by the project;
- Early enough to scope key issues and influence the Project decisions to which they relate;

- Informative, as a result of relevant information being disseminated in advance;
- Meaningful to those consulted because the content is presented in a readily understandable format and the techniques used are culturally appropriate;
- Two-way so that both sides have the opportunity to exchange views and information, to listen, and to have their issues addressed;
- Gender-inclusive through awareness that men and women often have differing views and needs;
- Localized to reflect appropriate timeframes, context, and local languages;
- Free from manipulation or coercion;
- Documented to keep track of who has been consulted and the key issues raised;
- Reported back in a timely way to those consulted, with clarification of the next steps; and
- Ongoing as required during the life of the project.

The IFC identifies eight key components of good stakeholder engagement, as illustrated in Figure 12-1.



Figure 12-1 Key Components of Stakeholder Engagement

Source: IFC 2009

12.1.2 Disclosure

Adequate disclosure regarding the details of the Project to stakeholders has been maintained throughout the ESIA process. Burapha's communication policy includes the delivery of information that is timely, transparent, accurate and based on facts, and to advocate and open dialogue with stakeholders. Key aspects of ensuring adequate disclosure include:

- Making information available regarding the Project at the Burapha office in Vientiane;
- Providing a description of the Project at the village level during socio-economic surveys, technical studies and formal consultations;
- Providing local communities with opportunities to ask questions about the Project during all consultations undertaken; and
- Providing handouts describing the Project at village, district, provincial and central level consultations in both Lao and English languages.

12.2 Stakeholder Identification

Lao legislation defines stakeholders as *"any person, legal entity or organisation who/which are interested in, involved in or have interests in an investment project, in an activity or a matter (related to the project) because they are involved in or (are likely to be) affected by the investment project"* (MONRE, 2010). The following section provides an overview of key Project stakeholders.

Villages in the Project area

The concession area includes 35 'Project affected villages' across Vientiane Prefecture, Vientiane, Saysomboun, and Xayabouly provinces. Project affected villages are defined as those villages that may have individual or communal land, assets or livelihoods affected as the result of a Project. Villages in close proximity to the Project area also need to be considered as they may experience indirect impacts or benefits from the Project.

Government of Lao PDR

The Government of Lao PDR stakeholders include:

- Central Government line agencies (particularly MONRE and Ministry of Planning and Investment);
- Vientiane Prefecture, Vientiane, Saysomboun, and Xayabouly Provincial governments and line agencies; and
- District governments and line agencies for districts in the Project area.

Other Stakeholders

Other stakeholders identified for the Project include:

- Residents of villages in close proximity to the Project area;
- Residents of Vientiane Prefecture, Vientiane, Saysomboun, and Xayabouly Provinces;
- Private companies operating in close proximity to the Project area; and
- NGOs and aid projects working in close proximity to the Project area.

A detailed analysis of Project stakeholders is provided in the ESIA *Public Consultation and Disclosure Plan* and in the ESMP *Community Relations Plan* which will continue to evolve over the life of the Project.

12.3 Consultation Process and History

A series of initial consultations have been conducted during the ESIA period (refer to Table 12-1). These include meetings with central, provincial and district level representatives; village meetings and surveying; technical studies and site visits. The purpose of these engagements was to introduce the Project; collect information on the Project area; and seek feedback from key stakeholders.

At each consultation, a brief description of the Project was provided using the Project information sheet. Participants were given an opportunity to provide comments, advice and information relevant to the Project. Standard forms were used to record discussions.

Table 12-1 Summary of Consultations Conducted during the ESIA

Date	Consultation	Stakeholders
Kick-Off Meeting		
21 March 2016	Central meeting (ESIA kick-off)	Department of Environment and Social Impact Assessment, Ministry of Natural Resources and Environment
Initial ESIA / Scoping Study Consultations		
1 April –22 July 2016	Provincial Meetings	Provincial Cabinet Office; Provincial Department of Natural Resources and Environment (Head of Forest Resource Extraction Section and Deputy Head of Resettlement Section), Provincial Department of Industry and Commerce, Provincial Department of Agriculture and Forestry, Provincial Department of Planning and Investment
23 March-21 July 2016	District Meetings	District Administration Office, District Office of Planning and Investment, District Office of Natural Resources and Environment, District Office of Industry and Commerce, DONRE
13 June -26 August 2016	Village level meetings and village socio-economic and land use surveys	Village authorities and other village representatives.
ESIA Field Studies		
16-19 May 2016	Biodiversity Technical	Focus group meetings with a selection of community members in Ban Houay Deua, Ban Nongkhone, Ban Phonmouang, Ban Bor chan, Ban Phone Ngeun, Ban Phonsoung, Ban Xor, Ban Taohai, Ban Nampa, and Ban Natoung
25-26 August 2016		Ban Meuangpa, Ban Na kang, Ban Na khan, Ban Natoung
13-20 June 2016	Village level focus groups and household surveys	Focus group meetings with a selection of community members in Ban Nakunthoung, Ban Khon Keo, Ban Phone Ngeun, Ban Dansavanh, Ban Nongkohne, Ban Van mon, Ban Taohai, Ban Phonmouang, Ban Phone Ngeun, Ban Naphong, Ban Bor Chan, Ban Phonsavanh, Ban Saen Udom, Ban Uana, Ban Hin Ngon, Ban Xor, Ban Khouay, and Ban Jouay Deua, Ban Viengthong
1-19 July 2016		Ban Moung Saum,
25-26 August 2016		Ban Na Khan, Ban Na Toung, Ban Na Kang, Ban Nampa
16-19 May 2016	Cultural heritage and archaeology consultations	Focus group meetings with a selection of community members in Ban Houay Deua, Ban Nongkhone, Ban Phonmouang, Ban Bor chan, Ban Phone Ngeun, Ban Phonsoung, Ban Xor, Ban Taohai, Ban Nampa, and Ban Natoung

Date	Consultation	Stakeholders
25-26 August 2016		Focus group meetings with a selection of community members in Ban Meuangpa, Ban Na kang, Ban Na khan, Ban Natoung
Draft ESIA Formal Consultations		
6-7 October	Village level consultations	Village level consultation meeting to present findings of the ESIA and invite feedback / comment
To be confirmed	District level consultations	District consultation meeting to present findings of the ESIA and invite feedback / comment
To be confirmed	Central / Provincial level consultations	Central level consultation meeting to present findings of the ESIA and invite feedback / comment

Source: Earth Systems, 2016.

12.3.1 ESIA Kick-off Meeting

A formal ESIA kick-off meeting was held with Central GOL on March 21, 2016. The meeting with Mr. Thavone Vongphosy (Deputy Director General, Department of Environmental and Social Impact Assessment), was undertaken to gain appropriate permissions and ensure early engagement and participation of Central Government stakeholders in the environmental and social impact assessment process of the Project. The objective of the meeting was to present an overview of the Project and initial findings of feasibility design and environmental / social fieldwork activities, and source feedback and advice from Central Government stakeholders.

12.3.2 Initial Government Consultation

After the ESIA kick-off meeting, initial consultation meetings were conducted with the District governments between 23rd of March and 27th of April 2016; and with Provincial governments between 1st of April and 13th of May 2016. The objective of the meetings was to present information on the Project and the ESIA process, obtain feedback, coordinate involvement of line agencies, and discuss availability of relevant information. At each meeting, a brief description of the Project was provided (using the Project information sheet) and participants were given an opportunity to provide comments, advice and information relevant to the Project. Standard forms were used to record discussions.

In addition, specific information gathering meetings were held with key line agencies. Secondary information to support the ESIA such as census data, land allocation information and development plans were collected and arrangements were made for further information requests as required. Government agencies visited included the District Offices of Natural Resources and Environment (DONRE), District Offices of Industry and Commerce (DOIC), District Agriculture and Forestry Offices (DAFO), and District Planning and Investment Offices.



Plate 12-1 Government consultation in Saysomboun Province

12.3.3 Socio-Economic and Land Use Baseline Surveys

Village level surveying was conducted between March and August 2016. General information from Project affected villages was collected through detailed interviews with village authorities. Depending on availability in each village, the village level interviews were attended by a range of representatives including village chiefs, village elders as well as village representatives for security, land and tax, education (primary school teacher), village public health staff, the Lao Youth Union, the Lao Women's Union (LWU), the Lao Front for National Construction (LFNC), and other interested villagers. A fixed questionnaire was used which covered a broad range of topics. Participatory village mapping exercises were conducted to identify key physical, biological and social features of the village. Representatives of the village joined the survey teams during field observations. Village leaders and other village representatives were also asked to provide initial feedback about the Project.



Plate 12-2 Consultation in Ban Muangsoum



Plate 12-3 Village mapping in Ban Borchan

12.3.4 Focus Group Discussions

Separate focus group discussions were held in each village with members of the general village population (separate male and female group discussions) to obtain additional information on natural resource use,

employment, and industrial activity in the Project area and general village opinions regarding the Project. These were conducted separate from village socio-economic and land use baseline surveys to reduce the chance of bias from village authorities.

12.3.5 Other Specialist Studies

Several other consultations were also conducted as part of the specialist technical studies conducted for the ESIA. These consultations are described below.

Biodiversity Technical Study

Local knowledge surveys and focus groups were conducted for the Biodiversity Technical Study which included both terrestrial and aquatic biodiversity and resource use. The focus groups were conducted in villages across the four provinces from June through August 2016. The survey team was comprised of Earth Systems (Australia), Earth Systems (Lao PDR), and Dr. Pheng Phengsintham from the Department of Biology, National University of Laos. Representatives from each village joined the team during site investigations for flora, fauna and forest resource use in the area. An official from the Districts' Office of Natural Resources and Environment (DONRE) assisted during village consultation and field observations. Consultations were also conducted with representatives from the Districts' Agriculture and Forestry Office (DAFO) and the Provincial Agriculture and Forestry Office (PAFO).

Archaeology and Cultural Heritage Study

An Archaeology and Cultural Heritage Study was conducted by Mr Sisomphone Soukhavongsa, a specialist from the Ministry of Information, Culture and Tourism and the Earth Systems team. The study was based on local knowledge focus group meetings villages across the four provinces from June through August 2016. Villagers were invited to show any objects with prehistoric, archaeological, historical or cultural values they have collected and to relate some of their oral traditions (i.e. folk tales, legends, myths, sayings) concerning their landmarks and/or cultural objects.

Information was sourced from the District and Provincial offices of Information, Culture and Tourism to help identify sites and objects of local significance.

Health Baseline Study

Health baseline data was collected from officials at the District Health Offices, and District hospitals. Additional information on health in the Project affected villages was collected during village socio-economic baseline surveying.

12.3.6 Formal ESIA Consultations

Village Consultations

Formal village consultations for this ESIA were conducted from March 20-30, 2017 with village authorities and village representatives in the following villages as present in Table 12-2.

Table 12-2 Formal Villages Consultations for ESIA

Date	Stakeholders
20 March 2017	Ban Nakhanthoung (Xaythany District), Ban Dansavan (Keo Oudom District), and Ban Saen-Oudom (Xaythany District)
21 March 2017	Ban Houaydeua, Ban Saka (Phon Hong District), and Ban Hin Ngon (Hin Heup District)
22 March 2017	Ban Phon Ngeun, Ban Borchan, and Ban Khonekeo, (Hin Hep District)
23 March 2017	Ban Namthome, Ban Phonmouang (Hin Hep District) and Ban Sor (Sangthong District)
24 March 2017	Ban Na-An, Ban Nakang, Ban Nakang and Ban Phonthong Neua (Hin Heup District)

Date	Stakeholders
25 March 2017	Ban Kouay (Sangthong District)
26 March 2017	Ban Phonmouang (Hin Hep District)
27 March 2017	Ban Don-lan (Xaythani District)
28 March 2017	Ban Hintit (Hin Heup District) and Ban Hatkieng (Xaythany District)
30 March 2017	Ban Natoung and Ban Nakhan (Paklai District)

Source: Earth Systems 2016

District Consultations

To be completed once consultations are conducted

Table 12-3 Formal District Consultations for ESIA

Date	Stakeholders	Departments

12.3.7 Provincial and Central Government Formal ESIA Consultations

To be completed once consultations are conducted

Table 12-4 Formal District Consultations for ESIA

Date	Stakeholders	Departments

12.4 Consultation Outcomes

12.4.1 ESIA Kick Off Meeting

Key feedback obtained during the meeting with MONRE are outlined in Table 12-.

Table 12-5 MONRE: Key comments

Comment	How this is Addressed in the ESIA	ESIA Report Section Reference
<ul style="list-style-type: none"> Need to ensure that land acquired for the Project does not overlap with concession land from other projects. 	<ul style="list-style-type: none"> Land acquisition for the Agroforestry Project will be conducted in consultation with applicable GOL authorities. 	ESIA Report (Volume B), Chapter 3 and ESMMP
<ul style="list-style-type: none"> Need to coordinate with the Department of Forest Resources Management of MONRE to check that the Project area does not interfere with National Protected Areas. 	<ul style="list-style-type: none"> Coordination with MONRE Department of Forest Resources Management to cross check latest available information. 	ESIA Report (Volume B), Chapter 8
<ul style="list-style-type: none"> Burapha needs to sign concession agreement with MONRE before operations begin. The Districts do not have the right to approve the Project. 	<ul style="list-style-type: none"> Burapha has been informed on this point. 	Not applicable

Source: Earth Systems 2016

12.4.2 Initial Government Consultation

The outcomes of Provincial and District consultations for the Project are summarised in Section 12.3 together with relevant ESIA actions. The minutes and participant register from this meeting are provided in the PCDP (Volume D). Table 12- outlines the key feedback obtained during the meeting with Provincial and District government authorities.

Table 12-6 Provincial and District Government – key comments and relevant ESIA actions related to agroforestry operations

Comment	How this is Addressed in the ESIA	ESIA Report Section Reference
<ul style="list-style-type: none"> Saysomboun Province has only just been established, and will need more in-depth consideration as much of the information may not be readily available. 	<ul style="list-style-type: none"> Earth Systems will review current PONRE data and will reach out to specific PONRE departments if other data is needed. 	Not applicable
<ul style="list-style-type: none"> The need for close coordination with local authorities especially on land acquisition activities, so that land is acquired legally from GOL as well as from district and village levels. This also applies to land acquired from other projects. 	<ul style="list-style-type: none"> Ongoing consultation with government agencies involved in land management. 	Not applicable
<ul style="list-style-type: none"> Information must be accurately based on actual surveys and shall not rely solely on secondary data from Burapha itself, especially on land acquisition reports. 	<ul style="list-style-type: none"> Conduct of extensive consultations at the village, district, provincial and central level including socio-economic, biodiversity, archaeology and cultural heritage, noise and water quality studies. 	ESIA Report (Volume B), Chapters 4-6
<ul style="list-style-type: none"> Information should be collected to gauge whether local livelihoods have improved within the Project area. 	<ul style="list-style-type: none"> Data is being collected during the conduct of the ESIA that will provide a baseline against which to 	ESIA Report (Volume B), Chapter 6

Comment	How this is Addressed in the ESIA	ESIA Report Section Reference
	assess changes to livelihoods from Project implementation.	
<ul style="list-style-type: none"> We agree that the Project should go ahead because it will create employment opportunities for villagers. However, there is a need to conduct a detailed land survey in the proposed Project area to assess social impacts. 	<ul style="list-style-type: none"> Technical study / survey on land use including site investigations and ongoing consultation with government agencies and other organisations involved in land management. 	ESIA Report (Volume B), Chapter 6
<ul style="list-style-type: none"> Burapha should develop fire management measures for their plantations. They should be clearly defined. 	<ul style="list-style-type: none"> A fire management plan will be developed in the ESMMP. 	ESMMP (Volume D), Thematic Plan 7
<ul style="list-style-type: none"> The need to consider cumulative impacts of the area (i.e. impacts from Nam Lik 1 Hydropower Project). 	<ul style="list-style-type: none"> ESIA will include a cumulative impact assessment. 	ESIA Report (Volume B), Chapter 11
<ul style="list-style-type: none"> What are the potential benefits for local people, company and the GOL from the Project? The ESIA report should provide clear information on economic and social benefits and impacts. 	<ul style="list-style-type: none"> This will be addressed in the Project Benefits evaluation. 	ESIA Report (Volume B), Chapters 1 and 9
<ul style="list-style-type: none"> Protected forests are included in village lands. There has not been a proper detailed forest-land allocation. This needs to happen first in order for the Project to move forward. 	<ul style="list-style-type: none"> Burapha has been informed and is aware of this issue. 	ESIA Report (Volume B), Chapter 8
<ul style="list-style-type: none"> Land assessments need to include proposed plantation locations, land holding status, and types of land and forest. The planted areas need to include details on areas, planting year, and land holding status. 	<ul style="list-style-type: none"> Burapha has been informed on this point. 	Not applicable
<ul style="list-style-type: none"> If villagers don't have land use documents, will the State give them legal rights over the land? How will local communities get involved in the Project plantation development if the State does not issue land use documents for villagers. 	<ul style="list-style-type: none"> Ongoing consultation with government agencies involved in land management. 	Not applicable
<ul style="list-style-type: none"> Plantations along mountain valleys are vulnerable to soil erosion and water contamination from the use of chemicals in the plantation areas. 	<ul style="list-style-type: none"> The ESIA will include mitigation and management measures for these types of potential impacts. 	ESMMP (Volume D), Thematic Plans 1, 3 and 8
<ul style="list-style-type: none"> Burapha needs to follow the correct investment application process for the GOL, including proper land acquisition paper work and environmental compliance certificates. 	<ul style="list-style-type: none"> Burapha has been informed on this point. 	ESMMP (Volume D), Thematic Plan 10
<ul style="list-style-type: none"> Earth Systems will need to present the approval letter from MONRE on the TOR and scope of work before conducting ESIA activities. 	<ul style="list-style-type: none"> This has been actioned. 	Not applicable
<ul style="list-style-type: none"> There is great concern over the Dominion Exploration area and how Burapha has interacted with it in the past. 	<ul style="list-style-type: none"> Burapha has been informed on this point. 	ESMMP (Volume D), Thematic Plan 10

Comment	How this is Addressed in the ESIA	ESIA Report Section Reference
<ul style="list-style-type: none"> Burapha or Earth Systems needs to provide the Prime Minister's approval letter to give green light for Burapha to expand the plantation. 	<ul style="list-style-type: none"> Burapha has been informed on this point and it has been actioned. 	Not applicable

Source: Earth Systems 2016

12.4.3 Socio-Economic Surveys and Other Specialist Studies

During village level socio-economic surveying, village leaders and other village representatives were provided with an opportunity to express their thoughts regarding the Project. Feedback from these initial consultations and relevant ESIA actions are summarised in Table 12- below.

Table 12-7 Summary of Village Level Feedback

Feedback / Queries	How this is Addressed in the ESIA	ESIA Report Section Reference
<ul style="list-style-type: none"> Queries / requests regarding potential benefits and community development. Request for villagers to be prioritised in the recruitment process. Request for Burapha to continue to invest in infrastructure for the villages, i.e.: bridges, schools, roads, water infrastructure, temples and health care centres in affected villages, especially infrastructure also used for logging. Request that Burapha continues to communicate with village chiefs and committees throughout the duration of the Project, either monthly or yearly. There are requests to increase pay. 	<ul style="list-style-type: none"> Burapha has been informed on these issues and a community development plan is included in the ESMMP. 	ESMMP (Volume D), Thematic Plans 12 and 13
<p>Queries and comments regarding potential impacts and mitigation measures include:</p> <ul style="list-style-type: none"> There is concern about chemical contamination from water runoff from the plantations; There is a concern about fire spread in the plantations; Request for Burapha to pay back land tax and wages for families that are past due. Request for Burapha to properly manage land titles when leasing land. 	<ul style="list-style-type: none"> Burapha has been informed of tax and wages issue. Other issues are assessed in the ESIA and addressed in the ESMMP. 	ESMMP (Volume D), Thematic Plans 3, 4, 7, 8 and 10
<p>Queries and comments regarding land acquisition:</p> <ul style="list-style-type: none"> There are questions about exactly what land will be leasing, and what will the exact plantation boundaries be? Will the villagers be fairly compensated for individual land? How will villagers get to the plantation site if it is far away? Request that land that is acquired be marked clearly. 	<ul style="list-style-type: none"> Land acquisition and compensation is addressed in the ESIA and ESMMP. 	ESIA Report (Volume B) Chapters 6 and 9, and ESMMP (Volume D) Thematic Plan 10

Feedback / Queries	How this is Addressed in the ESIA	ESIA Report Section Reference
<ul style="list-style-type: none"> Villages and villagers should be regularly informed about the Project progress and activities, and potential new impacts. 	<ul style="list-style-type: none"> Addressed in the ESIA, PCDP, and the ESMMP Community Relations Plan 	ESIA Report (Volume B) Chapter 13, PCDP (Volume D), and ESMMP (Volume D) Thematic Plan 13

Source: Earth Systems, 2016.

12.4.4 Village and District Formal Draft ESIA Consultations

Village Consultations

Table 12-8 summarises key arising issues raised by village authorities and representatives during village level consultations from March 20-30, 2017.

Table 12-8 Summary of key issues raised at Formal Village Level Consultations

Feedback / Queries	How this is Addressed in the ESIA	Section Reference
<p>Employment: The need to carefully consider and work closely with village authority regarding the plantations' rotation and throughout project period for the following employment issues:</p> <ul style="list-style-type: none"> Hiring labour from outside the village/contract; Opportunities distribution (to avoid bias/preference placing by some village representatives / managers to certain groups of people or close relatives only). Engagement of the poor and vulnerable HHs; Different labour arrangements between individual versus communal plantations; Using machinery instead of villagers; and Providing transportation alternative for villagers to plantations that locate far away from villages. 	<ul style="list-style-type: none"> Review and update Burapha's Employment policies, including the Code of Conduct, Human Resource Policy, Burapha Employee Handbook, Employee Representatives Manual, and in signed contracts as well as Corporate Environmental and Occupational Health & Safety System (CEOHA) and Free, Prior, and Informed Consent Policy.; Review and update communication and a grievance redress mechanism; and Monitoring for the effectiveness of above-mentioned measures in ESMMP. 	Chapter 9; ESMMP
<p>Reimbursements, compensation and land taxes: The need to:</p> <ul style="list-style-type: none"> Consider reimbursement for villagers who manage plantation plots and pay for land taxes (what are the terms written in the leasing contract/ agreement?); and Closely coordinate with government and village authorities regarding fair reimbursement of wages and compensation methods for land loss (i.e. for road construction) including for those with uncertified land without creating any corruption loopholes. 	<ul style="list-style-type: none"> Review and update reimbursement agreements and compensation framework for loss of land, assets and livelihoods; Review and update a grievance redress mechanism; and Continue program of ESIA consultation with government agencies including formal central and provincial consultation once draft ESIA and ESMMP have been completed. 	Chapters 7 and 9 and Chapter 12 (section 12.5-12.6)
<p>Burapha's Agroforestry model (intercropping): The need to carefully and effectively:</p> <ul style="list-style-type: none"> Disseminate knowledge/technique and knowhow for intercropping and animal grazing practices (applicable and non-application aspects i.e. practicing on more flat versus steep areas) in intercropping areas throughout plantations' rotation; and 	<ul style="list-style-type: none"> Review and update Burapha's Agroforestry model, including to update communication and dissemination approach, and contents to present; and Monitoring for the effectiveness of above measures in ESMMP. 	Chapters 7, 8 and 9;

Feedback / Queries	How this is Addressed in the ESIA	Section Reference
<ul style="list-style-type: none"> Maintain fire buffers zone in plantations to prevent wildfire. 		
<p>Land selection and land acquisition: The need to comprehensively consider the following during land selection and land acquisition processes during expansion of plantation areas to avoid:</p> <ul style="list-style-type: none"> Creating of unwanted conflicts at village and district level; and Acquiring protected and valuable lands. <p>After the land acquisition, the Company should effectively determine plantation's boundary.</p>	<ul style="list-style-type: none"> Review and update Burapha's Land Acquisition Manual include Land Selection Criteria; Good Faith Negotiation Policy (GFN) practicing; FPIC (Free, Prior and Informed Consent) practicing; Comprehensive Land Survey practicing includes: information meetings, mapping and site survey; Monitoring for the effectiveness of above measures in ESMMP. 	Chapters 3, 7, 8 and 9,
<p>Land use and allocation: The need to consider concerns regarding land use and allocation as:</p> <ul style="list-style-type: none"> Villagers have experienced more pressure on limited land use for other agricultural practices and loss of NTFPs/TFPs collection areas and grazing land; and In communal leased land, villagers are not aware/be informed of how land is being allocated for intercropping. 		Chapters 7 and 9
<p>Soil quality: The need to consider the appropriate approach (i.e. machinery) and time (not before rainy season start) to initiate land preparation and soil disturbing activities (i.e. roads construction/improvement) to:</p> <ul style="list-style-type: none"> Avoid loss of topsoil nutrient and prevent erosion and sediment to nearby receiving waters/streams). Prevent soil to become even less suitable for intercropping due to poor soil nutrients 	<ul style="list-style-type: none"> Technical studies on hydrology and water resource use including site investigations and ongoing consultation with engineering team, government agencies and other organisations involved in water resource management; Implementation of storm water, erosion, and sediment control measures; and Monitoring for the effectiveness of above measures in ESMMP. 	Chapters 7 and 8
<p>Water quality and level in the streams/watercourses: The need to consider issues of</p> <ul style="list-style-type: none"> Lower water level at the streams during that are located in adjacent to the plantations in particularly during dry season; and Erosion and sediment from soil disturbance activities to receiving watercourses. 		Chapter 7
<p>Use of chemical/fertiliser in the plantations: The need to consider a comprehensive approach for chemical/fertiliser storage and handling / application to avoid discharging/leaching of these compounds from plantations to nearby watercourses. Concerns include:</p> <ul style="list-style-type: none"> OH&S of workers who work in the camp side and drink boiled water from watercourses/streams near the plantations which could be contaminated from chemical use; and Whether is it safe for livestock to graze in plantation's areas. 	<ul style="list-style-type: none"> Review and update of Burapha Standard Operating Procedures and Work Instructions for chemical / fertiliser storage and handling; To review and refine Emergency Preparedness and Response Plan to incorporate international best practices for transport, storage, handling / application of hazardous materials and appropriate disposal of hazardous waste and protocols for responding to an accidental discharge; and 	Chapters 7, 8, and 9

Feedback / Queries	How this is Addressed in the ESIA	Section Reference
	<ul style="list-style-type: none"> Monitoring for the effectiveness of above measures in ESMMP. 	
<p>Communication gap: The need to effectively consider and address how</p> <ul style="list-style-type: none"> Information can be exchanged between Village representative/ manager/ coordinator from Burapha and village authorities/ committee in particularly on labours recruitment and intercropping practices; Village Development Fund is being used/distributed. Some villagers have no idea if their villages are to receive the fund. 	<ul style="list-style-type: none"> Review and update a grievance redress mechanism; Review and update communication and dissemination approach; and Monitoring for the effectiveness of above mentioned in ESMMP. 	<p>Chapters 9 and 12 (see sections 12.5-12.6)</p>

Source: Earth Systems 2016

District Consultations

To be completed once consultations are conducted

Table 12-9 Summary of key issues raised at Formal District GOL Consultations

Feedback / Queries	How this is Addressed in the ESIA	Section Reference
•	•	
•	•	
•	•	

Source: Earth Systems 2016

12.4.5 Provincial and Central Government Formal Draft ESIA Consultations

To be completed once consultations are conducted

Table 12-10 Summary of key issues raised at Formal Provincial and Central GOL Consultations

Feedback / Queries	How this is Addressed in the ESIA	Section Reference
•	•	
•	•	
•	•	

Source: Earth Systems 2016

12.5 Continuing Consultation

Burapha will be expected to continue formal and informal consultation with stakeholders as the Project carries out plantation development. Procedures for grievance management throughout the Project life have been outlined in the ESMMP (Volume D), which are designed to provide an open and transparent channel for communication between the community and the Company.

The Stakeholder Engagement and Community Relations Plan (CRP) (Volume D) will provide a framework for consultation and information disclosure for the implementation of the ESIA processes throughout the plantation development phases of the Project. The CRP has been developed using international best practice

and Burapha's existing Operational Manual for communications (2012), which sets out methods of communication as well as roles and responsibilities for information dissemination.

12.6 Grievance Management

The first step in conflict resolution is conflict avoidance. Conflict avoidance is a key goal of the stakeholder consultation process for the ESIA and for the ongoing community engagement program. Regular consultation and engagement with local community members will effectively reduce the occurrence of disagreements and conflicting positions.

Despite following best practice community engagement, grievances may arise throughout the life of the Project, and it is important that these are dealt with in a fair and transparent manner before they escalate (for employees or affected communities). The phases of conflict development and appropriate interventions are summarised as follows:

- Conflict avoidance → Consultation and participation in planning, decision making;
- Simple disagreements → Informal negotiation, discussion and mediation;
- Early conflict development → Reference to Village Grievance Committee;
- Conflicting positions taken → Reference to Grievance Committee at District level;
- Conflicting positions hardened → Reference to Grievance Committee at Provincial level; and
- Intractable conflict → Refer conflict to National Court.

Burapha has recently developed a Standard Operating Procedure (SOP) for grievance management (**BAFCO-SOP-HR-03**) that provides:

- An informal procedure for full-time and casual employees to communicate grievances to the Company;
- A formal procedure for communicating grievances to the Company (written reports / statements), and a protocol for dispute resolution (measures and outcomes); and
- A formal procedure for communicating grievances directly through the GOL.

The Grievance Redress Mechanism for communicating through the GOL is as follows:

- *Step 1 - Village level:* Peoples contact village authorities. Village authorities consult with a Burapha representative and voice their issues. Public meetings with village authorities, Burapha staff, and the aggrieved individual (unless anonymous) meet and record the grievance. If within 15 days of lodging the grievance, participants cannot reach an amicable agreement, the complaint can be forwarded to the District Level.
- *Step 2- District Level:* An appointed District Level authority provides a recommendation within 15 days. If affected peoples are not satisfied with the response, it is forwarded to Provincial Level.
- *Step 3- Provincial Level:* Same process as District level. If unresolved, forwarded to Central Level.
- *Step 4- Central level:* As a last resort, the complaint is lodged with the Court of Law, whose decision would be final.

Burapha also has an established SOP for dispute resolution (**BAFCO-SOP-010-Dispute Resolution**) to account for complaints arising from affected communities (as opposed to employees). This procedure is designed to provide an open and transparent channel for communication between the community and the Company. It has been developed to meet the requirements of the FSC Forest Management Standard utilising the Global Forestry Services (GFS) Forestry Support Program, and is summarised below.

Principles

According to the FSC Dispute Resolution System, the principles of Burapha's Grievance Mechanism will be:

- Disputes will be resolved by firstly discussing and negotiating or through mediation. Formal procedures, including committees, should only be adopted as a last resort.
- Disputes will always be addressed at the lowest level possible (only escalated as last resort) and stakeholders are strongly encouraged to follow this principle.
- A person or organisation, who is the subject of a complaint, will be given adequate notice about the proceedings (including details of the complaint).
- A person making a decision will declare any personal interest they may have in the proceedings (i.e. conflict of interest).
- A person who makes a decision will be unbiased and act in good faith. Therefore, decision-makers cannot be one of the Parties to the Complaint or Appeal, nor have an interest in the outcome.
- Proceedings will be conducted with fairness to all the Parties to the Complaint or Appeal.
- Each party to a proceeding is entitled to ask questions and contradict the evidence of the opposing party.
- A decision-maker will take into account relevant considerations and mitigating circumstances, and ignore irrelevant considerations.

Communication

Burapha's grievance mechanism, *BAFCO-SOP-010-Dispute Resolution*, prescribes a proactive approach to conflict avoidance by promoting regular formal and informal communication to minimise areas of conflict arising from the Project. Types of communication include:

- Establishment of a Conflict/Dispute Resolution Committee that includes both the management and adequate representation of all critical groups of the community including women. Committee meetings should be held regularly about every 3-4 months;
- Consultation on forest resource usage by communities;
- Ongoing consultation on village level socio-economic development;
- Communication on the establishment and progress of any social programs; and
- Provision of relevant information on the type, scope, potential impacts and timing of operations to affected local communities.

Conflict Management and Dispute Resolution

The Conflict Management and Dispute Resolution is a 4-step process outlined as follows:

1. All conflicts or disputes shall be raised formally within the Conflict / Dispute Resolution Committee:
 - » The Committee shall try to resolve the conflict through consensual negotiation;
 - » All information relating to the conflict (meeting notes, maps, photos, agreed corrective actions etc.) shall be recorded for company records and distribution to relevant stakeholders; and
 - » Corrective actions, where applicable, are agreed upon by the Committee.
2. Any conflict that cannot be resolved by the Committee needs to be raised with the Company's District Manager. The District Manager shall consider the records / results of the Committee resolution process and propose a resolution.

The parties directly involved in the conflict shall then have the opportunity to meet and discuss the issues directly with the Company's District Manager in efforts to come to an agreement. This meeting should be facilitated by an independent third party mediator.

3. Conflicts that still cannot be resolved are then referred to the Company's Regional Director. The process at this step is the same as step 2.

4. Any conflict that cannot be resolved in steps 1-3 is then referred to the civil court system in Lao PDR. The party raising the unresolved conflict shall be responsible for their own representation in the Lao PDR Court system.



**Chapter 13 | Management and
Monitoring**



Chapter 13 | Management and Monitoring

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13 ENVIRONMENTAL MANAGEMENT AND MONITORING

13.1 Environmental Management System

An **Environmental and Social Management and Monitoring Plan (ESMMP)**, Volume D) has been prepared based on the requirements of relevant Government of Lao (GOL) legislation, the Environmental Impact Assessment Guidelines (2012), and in accordance with the requirements of ISO 14001:2015 for Environmental Management Systems. This chapter summarises key aspects of the **ESMMP** to be implemented during Project Construction (i.e. Land Identification and Acquisition and Plantation Establishment) and Operations (i.e. Plantation Management) based on currently available Project information

Burapha is committed to fulfilling its corporate, environmental and social obligations while conducting its business. The Company has developed an Environmental and Social Management Systems (ESMS) composed of Policy documents, Operations Manuals, Standard Operating Procedures (SOPs), and Work Instructions (WIs) to ensure adherence to Lao PDR statutory compliance and international best practice (refer to Figure 13-1).

Examples of these documents include:

- Code of Conduct;
- Occupational Health and Safety Policy;
- Land Acquisition Policy;
- Communications Policy; and
- Human Resources Policy.

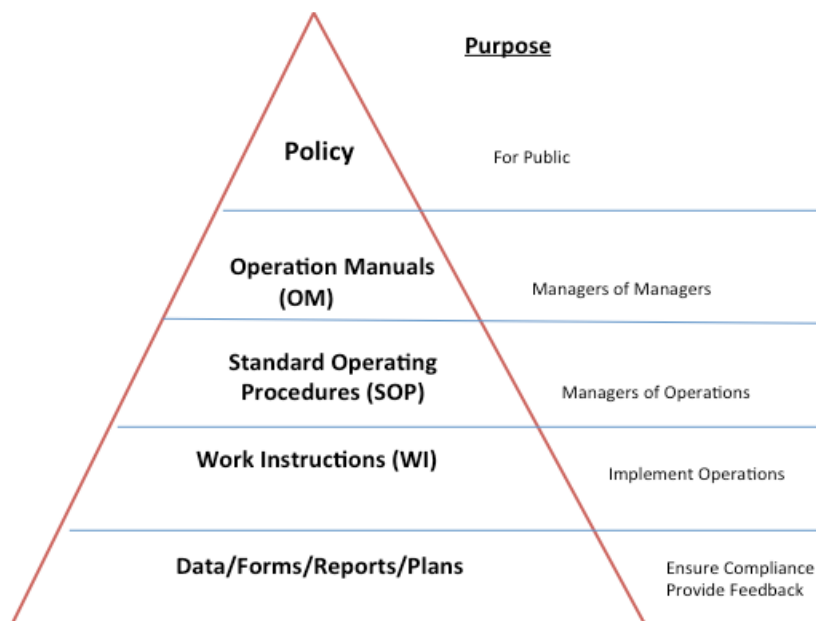


Figure 13-1 Burapha document hierarchy

The majority of Burapha’s environmental and social management commitments and methodologies for compliance are described in existing Standard Operating Procedures (SOPs) and Work Instructions (WIs), and have been incorporated into the Project **ESMMP**, where appropriate.

As the Company proposes to considerably expand the scale of its agroforestry operations, it will implement the **ESMMP** to comply with national statutory requirements and the rigours of international best practices for the plantation forestry industry. Burapha's core principles such as those for land acquisition, agroforestry, and corporate social responsibility will apply for the proposed Project expansion.

13.1.1 Responsibilities

Internal Parties

All Burapha staff and contractors are responsible for mitigating environmental and social impacts by implementing measures identified in the **ESMMP** and this ESIA. Specific responsibilities of key staff are described below.

Chief Executive Officer

The implementation, management and continued improvement of the **ESMMP** will be the overall responsibility of the Chief Executive Officer.

Deputy Chief Executive Officer

Operational implementation of the **ESMMP** will be supervised by the Deputy Chief Executive Officer (DCEO) who will support the Community, Social, and Environmental Compliance (CSER) Auditor. The DCEO will be responsible for ensuring that all personnel and contractors comply with the regulations and procedures set out in the **ESMMP**, and to carry out their work in a manner that prevents and minimises the environmental and social impacts.

CSER Auditor

The day-to-day implementation of the **ESMMP** and associated monitoring / reporting will be the responsibility of the CSER Auditor, overseen by the DCEO and / or the Human Resource Department, with support from technical staff and officers.

External Parties

FSC and / or PEFC (Independent Monitoring Agency)

FSC and PEFC are global organizations that have been established to promote responsible forest management worldwide. An FSC or PEFC accredited body will assess the Project for forest management certification and conduct audits of Forest Management Units against relevant standards. The auditor will prepare audit reports, when applicable.

Ministry of Natural Resources and Environment

MONRE is the central governing agency overseeing matters relating to environment, land, forest, water, air, and biodiversity. MONRE is the GOL agency responsible for monitoring the overall environmental and social performance of the Project.

Key responsibilities of MONRE include:

- Applying GOL policies applicable to the Project;
- Enforcing supervisory role during Project construction;
- Overseeing Independent Monitoring Agency (IMA) reporting, as applies;
- Reviewing Project reports, monitoring data and revisions and updates to the **ESMMP**;
- Coordinating GOL responsibilities in the **ESMMP**;
- Establishing other GOL committees as required;

- Monitoring of compensation and community development activities; and
- Monitoring Project compliance with commitments and GOL standards.

Provincial and District Government Agencies

PONRE and DONRE are the lead agencies responsible for the management of land and natural resources at the Provincial and District levels. The Provincial Agricultural and Forestry Office (PAFO) and the District Agricultural and Forestry Office (DAFO) are the lead agencies responsible for the management of agriculture and productive forest resources.

Other GOL Organisational Levels

The Project may require establishing government institutional structures at all levels of Government. The GOL committees required for the implementation of environmental and social measures associated with the Project likely including:

- Provincial Environmental and Social Management Committee (PESMC) – Each Province may establish a PESMC to coordinate environmental and social management activities related to the Project. The committee would include representatives from Provincial and District government
- Village Coordination Committee (including Village Grievance Redress Committee) to coordinate Project development, community development and grievance redress activities for that specific village.

13.1.2 Reporting Systems

Burapha will need to develop the following reporting systems to manage environmental, social and community aspects associated with the Project:

- Quarterly and annual reporting to the Government;
- Quarterly compliance and annual performance reporting to the Burapha Head Office;
- Biennial Sustainability reporting to Project stakeholders;
- Incident and hazard reporting – MONRE will be notified within 24 hours of a significant incident / accident; and
- Internal non-compliance reporting for inclusion in quarterly reports.

Quarterly Reporting

Burapha will need to prepare quarterly reports to summarise its environmental and social performance and significant activities, incidents and events for that period, and key tasks for the next quarter. The report will include:

- Brief presentation of the Company environmental and social management systems;
- Discussion of the Company environmental and social management and monitoring programs,
- Results of ongoing stakeholder engagement;
- Discussion of community development programs;
- Discussion of environmental and social performance relative to commitments and guidelines against continuous improvement targets and key performance indicators (KPIs), with opportunities for improvement identified, non-compliance issues and corrective actions (or lack thereof);
- Progress against planned tasks and key highlights (e.g. targets achieved, preventative measures implemented or processes changed);
- Any significant grievances; and

- Any significant incidents that have occurred including cause of incident and corrective actions.

The report will be approved by the CEO and submitted to MONRE and other project stakeholders (as required) on a quarterly basis.

Annual Reporting

Burapha will need to prepare an Annual Report summarising business and sustainability performance for each calendar year. The report is expected to include:

- Collation and evaluation of quarterly reports;
- Detailed discussion of performance relative to commitments with focus on:
 - » Longer lead indicators;
 - » Community development programs; and
 - » Overview of significant findings of audits and facility inspections.

The findings of audit reports and recommendations for continuous improvements will be presented to the CEO and the GOL in the Annual Report.

Sustainability Reporting

Burapha will develop a biennial Sustainability Report summarising business and environmental and social performance for operations. The GRI Sustainability Reporting Guidelines will be used to guide the preparation of the report to the extent possible. The Sustainability Report will be submitted to the Board of Directors and likely be made available on the Company website.

Incident Reporting

An incident is defined as any event that impacts or may potentially impact the safety, health, environment or community, or any activity resulting in regulatory non-compliance or the breach of Company policies, standards or commitments. The following situations will constitute an incident:

- Injury;
- Accident or near miss;
- Chemical spill;
- Spills of fuel or oil greater than 50 L within workshop areas and bunds (safety event);
- Spills of fuel or oil outside of workshop areas and bunds (environment event);
- Near-miss environmental incidents;
- Fires;
- Biodiversity incidents - e.g. wildlife trading, forest harvesting, injured or dead animals within the operational areas; and
- Community incidents - primarily related to community grievances.

Environment or community-related incidents or issues will need to be reported by the Project workforce, including contractors to their direct Supervisor. The Supervisor is responsible for reporting the incident to the CSER Auditor. All incidents will be reported as soon as practicable to the CSER Auditor and within 24 hours of incident occurrence.

The CSER Auditor will track all incidents in the Incident and Accident Register. This register will capture near misses, incidents, and community complaints through the Grievance Mechanism, recommended corrective actions, timelines for completion of corrective actions, and efficacy of corrective actions.

The CSER Auditor will generate an Incident Report for all serious incidents (injuries, discharges exceeding regulatory guidelines). At a minimum, the following details will be required for incident reporting:

- Description of the event and its causes;
- Risk rating of the event;
- Description of corrective and preventative actions;
- Description of repairs, clean-up or other remedial measures;
- Actual or estimated costs of repair, clean-up or other remedial measures.

Corrective and remedial actions must be identified, documented, and implemented in a timely manner and followed-up to ensure the issue is addressed appropriately.

In the event of environmental monitoring results exceeding the limits specified by Lao legislation, the relevant Government Authority is to be notified of the exceedance within the specified notification timeframes with details of the corrective and remediation actions identified and to be initiated.

Non-Compliance Reporting

Non-Compliance Procedure

When monitoring identifies non-compliance with management measures identified in the ESMMP or Company Policies, an internal non-compliance report will need to be prepared. The report will need to include:

- Description of the non-compliance issue;
- Description of corrective action required;
- Identification of person / group required for corrective action;
- Timeline for completion of corrective action; and
- Measures required to reduce the likelihood of similar non-compliance events in the future.

Non-Compliance Communication

The provisions for a non-compliance procedure will need to be included in the Project tender documents and contracts for construction contractors as well as clearly communicated to the Project workforce via the initial site induction and general training.

13.2 Monitoring

The implementation of an appropriate monitoring strategy as part of the **ESMMP** is important to ensure that existing management measures are effective, and to identify the need for improved or additional measures.

The environmental monitoring program will include eight categories of monitoring:

- Land identification and acquisition monitoring;
- Site preparation / plantation establishment monitoring;
- Operations monitoring;
- Routine monitoring;
- Community engagement and social monitoring;
- Decommissioning surveys; and
- Investigation monitoring.

Burapha will need to document monitoring protocols, including monitoring locations, parameters, equipment, frequency, and QA/QC. To ensure that monitoring is successful and efficient, all relevant employees will need to be trained by an experienced person in the use of:

- Appropriate techniques, including use, calibration and maintenance of field monitoring equipment; sample collection, labelling and transport;
- Review and interpretation of field data and monitoring results; and
- Record-keeping and reporting procedures, including using standard forms and entering data into the environmental management databases.

A detailed *Environmental and Social Monitoring Manual* or individual SOPs for monitoring will need to be developed for the Project consisting of a compilation of specific procedures for monitoring each environmental and social aspect, including monitoring locations, frequency, parameters and equipment.

13.2.1 Land Identification and Acquisition Monitoring

This monitoring will comprise:

- *Site Surveying* - Monitoring during site *Reconnaissance Surveys* and *Detailed Land Surveys* will be conducted to determine whether the area meets Company criteria for industrial plantation development and will include preliminary measures to identify *Special Management Areas* and *High Conservation Values*, including internationally and nationally threatened species and habitat; and
- *Land Acquisition Monitoring* - Monitoring by the CEO to ensure that the Company has complied with the *Burapha Land Acquisition Manual* and associated *Land Selection Criteria*, Company FPIC Policy, national law, and certification requirements throughout the process of land acquisition.

Site Surveying

These surveys will include all data collection from current Burapha Reconnaissance Surveys (RS) and Detailed Land Surveys (DLS). The following will be added to the DLS:

- Identification of UXO risk based on relevant databases.
- Preliminary identification and marking (GPS and photographs) of likely SMA, including:
 - » Seasonal and perennial stream, areas with slopes >35°; natural forested areas (>20% canopy of native species taller than 5m with diameter (dbh) >10cm); threatened flora; sensitive ecosystems (wetlands) within area of influence.
- Preliminary identification of current access roads and adequacy of stream crossings for access and erosion control.

Land Acquisition Monitoring

The CEO and applicable Land Department Manager and HR Manager will conduct a once-off monitoring exercise for each village / plantation unit, to ensure that the required processes for land identification, acquisition and environmental and social baseline data collection have been completed adequately, including review of:

- Site evaluation against Land Selection Criteria;
- Field reports from RS and DLS;
- Mapping (including participatory mapping with village);
- Agreements and approvals;
- Meeting minutes and data reporting from consultation with village committees and District officials;
- and review of relevant document repositories and information databases.

Land identification and acquisition monitoring will inform the development of environmental and social baselines, risk and impact assessments, and development of site-specific management and mitigation.

13.2.2 Site Preparation / Plantation Establishment Monitoring

Pre-Clearance Monitoring is required prior to any site disturbance per plantation unit, and *Vegetation Clearance Monitoring, Controlled Burn Monitoring; and Herbicide Application Monitoring* during plantation establishment.

This protocol assumes plantation establishment in areas without risk for UXO (refer to UXO clearance below for moderate to high risk areas identified during land acquisition). In areas with risk, UXO clearance monitoring (below) will be required in advance of ground disturbing activity.

Pre-Clearance Monitoring

The CSER Auditor and / or appropriately qualified personnel will survey the site prior to any vegetation clearance to ensure that areas designated for vegetation retention are properly delineated and marked and staff are appropriately equipped for upcoming work. This will include:

- Surveying streams, topography, and forests to ensure that areas that meet criteria for SMA are marked with flagging and / or GPS coordinates at appropriate buffer distances;
- Surveying sites for threatened flora;
- Applying flagging for SMA where inadequately marked and collecting GPS waypoints, photographs of additional SMA;
- Checking for completion of OHS commitments, including availability of suitable PPE, records for training; and records for equipment maintenance.

Clearance Monitoring

Burapha will conduct environmental and social monitoring during the plantation establishment phase to ensure the design controls are effective and proposed management measures are implemented. Corrective actions will be prescribed as required.

This 'spot check' will include:

- Monitoring of vegetation clearance to ensure that SMA are not encroached upon;
- Survey of all management and mitigation measures to ensure implementation according to proposed design and timelines;
- OHS monitoring to ensure management measures are implemented (PPE provided and utilised, trained personnel on-site, etc.).

Where an issue, incident or non-conformance is observed and documented at a particular site, the inspector will note the issue and develop a Non-Compliance / Corrective Actions Report for submission to management. Follow-up monitoring is then required to ensure corrective actions have been completed (refer to Investigations Monitoring, below).

Controlled Burns

A suitably qualified employee will conduct monitoring prior to controlled burns to survey for the following:

- Firebreaks are implemented in appropriate locations and are adequately sized;
- Neighbouring communities notified of planned burn date / time;
- Company fire-fighting equipment on-site;
- Appropriate PPE disseminated.

Herbicide Application

Appropriate Burapha personnel will monitor herbicide application during the first day of implementation at a site, to ensure:

- Management for temporary storage, mixing, etc. are conducted according to Company Policy (e.g. bunding, distance from watercourses, etc.);
- SMA are avoided (and staff understand obligations for avoidance);
- Weather conditions are appropriate (no rain or forecasted rain);
- Appropriate herbicides / herbicide application rates.

UXO Clearance

For all areas where risk assessment for UXO indicates reasonable potential for impacts, UXO clearance will be conducted prior to ground disturbing activities (road construction, vegetation removal, etc.) Monitoring will be comprised of senior Burapha management reviewing documentation from certified UXO Clearance Contractor to ensure clearance has been conducted to national standard.

13.2.3 Operations Monitoring

The Burapha CSER Auditor will monitor key operational activities (e.g. thinning, fertilising, weeding, harvesting, etc.) to ensure management and mitigation measures are implemented and are achieving their desired results. This will comprise a 'spot check', whereby the monitor will observe operational activities for implementation of management and mitigation measures, and move on to the next plantation where operational activities are being undertaken.

13.2.4 Routine Monitoring

Routine monitoring is comprised of monthly monitoring at the sawmill / nursery and semi-annual monitoring for each plantation unit.

Sawmill and Tree Nursery

Routine monitoring will be conducted monthly to ensure all management and mitigation measures identified in the Site Specific and Thematic Management Plans (refer to appendices) are effectively implemented. The monitor will have a checklist for items to survey and will provide comments where necessary (e.g. non-compliance or potential measures for improvement).

Discharge

Discharge monitoring at the nursery will be conducted annually at the nursery during the rainy season. The following will be measured in effluent (water drainage from nursery) and receiving water (Houay Som) and will include assessment of:

- Field parameters (pH, EC, ORP, Turbidity / TSS);
- Nutrients (total Kjeldahl nitrogen, total phosphorous, Cations and anions (Cl, SO₄, Ca, Mg, Na, K); and
- Select herbicides (Glyphosate, Metsulfuron) and additional applicable pesticides (e.g. Funguran / Termicide or applicable analytes).

Samples will be sent to an accredited laboratory capable of conducting analyses to applicable detection limits.

Plantations and Work Camps

Semi-annual monitoring will comprise one event in the later stages of the dry season and a second event during the rainy season.

Dry Season

Monitoring will focus on the completion of management and mitigation measures that should be implemented / upgraded / in-place prior to the onset of the rainy season, such as:

- Firebreak maintenance;
- Weed inspection;
- Observation and photographing on HCV / HCVF; and
- Visual observation of implementation and effectiveness of all management measures provided in thematic and site-specific management plans (refer to appendices).

Rainy Season

Routine monitoring during the rainy season will similarly be conducted to ensure management and mitigation measures are in place, but will focus on their effectiveness with respect to minimising rainy season impacts, such as:

- Access road conditions, effectiveness of associated controls, and maintenance requirements;
- Work camps, associated management and mitigation measures, and maintenance requirements.

Annual water quality monitoring (rainy season) will comprise selecting of five (5) representative sub-sample plantations to assess:

- Field parameters (pH, EC, ORP, DO); and
- Turbidity or total suspended solids upstream and downstream of the plantation in a stream that dissects the unit.

During the first rainy season after plantation establishment, the same five (5) streams will be monitored for nutrient inputs, within 1-5 days of the first major rain event following fertiliser application, with the following analysed by a suitably accredited laboratory:

- Field parameters (pH, EC, ORP, DO, Turbidity / TSS); and
- Nutrients (total Kjeldahl nitrogen, total phosphorous, cations and anions (Cl, SO₄, Ca, Mg, Na, K).

13.2.5 Social Impact Monitoring

Social impact monitoring is required to identify and quantify the direct and indirect impacts of the Project on the surrounding community. Social monitoring will ensure that existing management measures are effective, and the need for improved or additional measures are identified.

The Project social monitoring will need to include:

- Monthly monitoring of:
 - » Local workforce statistics (including employment by contractors);
 - » Local goods and services procured by the Operation;
 - » Road accidents involving employees and contractor vehicles and local residents; and
 - » Reported grievances and resolutions
- Biennial monitoring of:
 - » Local attitudes toward the Project;
 - » Socio-economic, income and livelihood changes in the vicinity of the Project area; and
 - » Population growth and in-migration in the areas in the vicinity of the Project area

- Annual monitoring of:
 - » Project agriculture development activities (i.e. intercropping);
 - » Community Development Fund activities.

All community grievances logged with the company will be addressed at monthly management meetings. Results of grievance investigations and the progress of corrective actions will also be tracked and recorded.

13.2.6 Investigation Monitoring

Burapha will need to carry out investigation monitoring as necessary to determine the occurrence, nature and extent of possible impacts following an environmental incident (oil spill, etc.), or to verify/refute third-party claims of environmental impact.

13.2.7 Decommissioning Monitoring

For plantation decommissioning, Burapha will conduct a once-off post plantation decommissioning monitoring exercise to assess the achievement of closure completion criteria. The monitoring framework will be contingent on the post-concession land use determined through consultation with the GOL and Village authorities.

Plantation Hand Over

In the event that Burapha will hand over plantation assets (trees, road infrastructure, etc.) to the GOL or village, the following monitoring will be required prior to the transfer:

- Assessment of remaining facilities such as work camps to identify potential remediation requirements and maintenance requirements;
- Assessment of soil fertility (cations and anions);
- Assessment of road infrastructure to identify maintenance requirements, efficacy of erosion and sediment control facilities, etc.

Remediation of Plantation Areas

If plantation areas are returned to natural forest communities or land reserved for agriculture, Burapha will need to ensure tree stumps do not coppice sprout following the final harvest. This will likely require 'painting' stumps with an appropriate herbicide (e.g. Metsulfuron). Monitoring will require:

- Observation of herbicide application to ensure it is conducted according to plan (OHS and water quality measures); and
- One follow-up monitoring event after one growing season to determine whether a foliar herbicide application is required (e.g. Glyphosate).

13.3 Emergency Response

In line with Burapha's ***Emergency Response and Preparedness SOP*** (2017) and the ***ESMMP***, specific measures will need to be implemented to minimise the likelihood of emergencies and ensure trained staff are available and have the appropriate means to respond.

Emergency response to an environmental incident will require key actions to be undertaken in the following sequence:

1. Protection and rescue of human life;
2. Minimisation of the area impacted by the incident;

3. Protection of the environment, plant and property;
4. Rendering the area safe in which the emergency has occurred;
5. Restoration of all disrupted services; and
6. Decontamination and rehabilitation of the incident scene and surrounding area.

An accident and incident reporting will also be established for the Project in line with Company procedure.

13.3.1 Assessment of Risk and Priority

Assessment of fire risk and priorities will follow a general order of:

- Ignition sources (e.g. naked flames, lightning);
- Fuel report (e.g. timber density, forest litter depth and cover);
- People at risk.

Those ignition and fuel sources at most risk of igniting will be of highest priority for mitigation. People at most risk, such as those closest to potential ignition point and those least able to act and/or flee (e.g. elderly, children) will be of the highest priority.

13.3.2 Fire Risk Management

Fire risk management will involve:

- Evaluate the risk;
- Reduce and remove the risk;
- Take actions to protect premises, people and other assets;
- Record fire hazards and management measures to reduce risks;
- Plan to manage fire as per the Emergency Preparedness and Response Plan;
- Train all personnel in the Plan and actions to take in the event of a fire;
- Review the Plan and its measures.

13.3.3 Spill Risk Management

Management and control of spill risk will include:

- Isolation and storage (e.g. ensure material is properly contained/isolated);
- Implement engineering controls (e.g. bunding);
- Containment of spill.

Spill risk management is outlined in the *ESMMP*, and should be detailed within the Emergency Preparedness and Response Plan.

13.4 Management and Mitigation Program

Proposed management and mitigation measures to avoid or minimise the potential for Project-related environmental and social impacts have been documented in a detailed *ESMMP* (Volume D). The *ESMMP* provides a framework for documenting the environmental management processes and procedures within an Environmental and Social Management System (ESMS). The *ESMMP's* key functions are to:

- Provide a link between policy and implementation and acts as a planning document;

- Project environmental and social values in vicinity of the Project; and
- Summarise environmental and social commitments and provide management measures and monitoring programs to be undertaken to achieve these commitments.

The **ESMMP** is a dynamic document and will need to be reviewed and updated to ensure that the Project implements the most appropriate and measures.

Priority and continual improvement targets are set out in the **ESMMP**. These targets will be used to guide the environmental and social work program until the next revision. The targets are relevant at the time the document is prepared and may be amended to reflect progression / refinement of the Project, changes in activities or environmental and social conditions, and key issues that arise, or changes in industry best practices.

In accordance with regulatory requirement, the **ESMMP** will need to be updated to incorporate any significant changes or at least every three years. This will ensure that the **ESMMP** stays current as the Project evolves.

13.5 Budget for Environmental and Social Management and Monitoring

Burapha will need to ensure sufficient resources are provided for the successful implementation of the environmental and social management and monitoring of the Project as identified in the **ESMMP**. The Company will need to ensure that applicable contractors include sufficient resources for the environmental management of their activities.

Burapha has already invested significant expenditure on environmental and social management and monitoring for its current agroforestry operations. The proposed forestry expansion will lead to a significant increase in the overall environmental and social management-operating budget.

13.5.1 General Environmental and Social Management

Burapha will provide a budget estimate for annual environmental and social monitoring that will be included in the Final ESIA and **ESMMP**.

13.6 Auditing

Burapha will need to establish an audit program and procedure to specify the requirements for evaluating the overall implementation and effectiveness of the EMS and Project **ESMMP** framework. The audit program will consider GOL compliance and other Project commitments including certification schemes such as the FSC Forest Management and Chain of Custody and ISO 14001:2015 Environmental Management Systems.

Audits of the Project **ESMMP** and associated management systems will need to be undertaken internally and externally on a periodic basis. The audits will assess:

- Compliance with the Project's legal and other obligations (including international certification requirements)
- Workforce awareness, competence and compliance with the EMS, **ESMMP** and associated plans and procedures;
- Performance of managers and operators in implementing, maintaining and enforcing the **ESMMP** and associated plans;
- Adequacy of the EMS, **ESMMP** and associated plans with respect to the scale and nature of anticipated impacts and current development stage of the Project; and
- Suitability of allocated resources, equipment and budget for implementation of the **ESMMP**

Internal audits should be undertaken every 12 months, while external audits will be required at least every 3 years to inform the review and update of the Project's **ESMMP** in accordance with GOL requirements (see Table

13-1). All audit recommendations will be discussed with the relevant division managers as appropriate and corrective actions will be documented and progress towards resolution. If significant findings involving key stakeholders are identified, the audit reports will be submitted to MONRE.

Table 13-1 External Audit Requirements

Audit Requirements	Env. Compliance (GOL)	FSC – PEFC Certification	ISO 14001:2015
Certification Audit	Every 3-years	As applies	Every 3 years
Surveillance Audits	-	Annual	Annual

13.7 Continuous Improvement

Continuous improvement of the various management systems will need to be an ongoing effort to ensure the Project is implemented appropriately and effectively. These efforts can seek ‘incremental’ improvement over time or ‘breakthrough’ improvement all at once.

Continuous improvement of social, environment, and health, safety and security matters associated with the Project will need to be managed by the Company’s CSER Department and be based on the ‘Plan-Do-Check-Act’ model. The model broadly follows an iterative process for continuous improvement as follows:

- *Plan*: Identify an opportunity and plan for change.
- *Do*: Implement the change on a small scale.
- *Check*: Use data to analyse the results of the change and determine whether it made a difference.
- *Act*: If the change was successful, implement it on a wider scale and continuously assess your results. If the change did not work, begin the cycle again.

13.8 Management Review

The Project will require a formal management review program that includes a full review and update of the Project’s **ESMMP** and EMS at least every 3 years during operations (or when major revisions to the Plan are required) and annual progress reviews during the 3-year cycle.

The following instances typically trigger major revisions:

- Significant changes in legislation, policies or standards applying to the Project;
- New information available about the Project’s impacts that indicate impacts are either greater than anticipated or at an unacceptable level, i.e. via environmental or social monitoring data or grievance mechanism;
- Changes in Project scope, design, or work methods;
- Insufficient or inadequate measures for mitigation, i.e. environmental performance does not meet acceptable levels despite implemented controls;
- Measures of the **ESMMP** or conditions for the Project deemed unnecessary or ineffective in mitigating the adverse impacts;
- New techniques or technologies available that meet the definition for ‘best available techniques’, and would significantly reduce the impacts or increase the benefits of the Project; and
- New best practices available that would reduce the impacts without commercially significant extra cost.

The formal review will need to be led by the Project’s senior management and will include:

- Review of the Project's context, compliance obligations and significant environmental and social aspects using the risk methodology outlined in Chapter 8 of the **ESMMP**,
- Review of the Project's performance against its environmental and social objectives and the achievement of priority actions and targets; and
- Revision of the Project's **ESMMP** and priority actions and targets.

All major revisions to the **ESMMP** will be provided to MONRE for review and approval.



Chapter 14 | Conclusions

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14 CONCLUSIONS

Expansion of the Burapha Agroforestry Project will provide the volume of raw material necessary to implement planned wood processing facilities in Central Lao PDR, each of which are necessary for the Company to meet its objectives to establish a sustainable plantation forestry operation capable of supplying finished products to meet the growing demand for wood products in the region, and globally

The development of 55,000 ha of Burapha *Eucalyptus* and *Acacia* plantation (total land area of 68,750 ha) will lead to benefits for Lao PDR and local communities. These include:

- Employment for local communities;
- Community development support and agricultural initiatives;
- Increased cash income within the region;
- Export income for Lao PDR; and
- Training and capacity building.

Key aspects will require careful management to ensure impacts are minimised. These include:

- Careful selection of plantation growing areas to ensure biodiversity protection and community land requirements are respected;
- Community and occupational health and safety with respect to fire and transport accident risks; and
- Management of operational areas to protect from erosion and general water quality impacts.

The ESIA concludes that with the implementation of environmental and social safeguards as identified in the ESMMP the plantation can provide benefit to the surrounding communities and Lao PDR without significantly impacting the surrounding environment.

14.1 Assessment of Key Impacts and Opportunities

The following sections summarise the key benefits and potential impacts anticipated with Project implementation (i.e. low risk / low impact issues are not included).

14.1.1 Economic Development and Employment

At the National and regional level, the Project will support the Government's socio-economic development goal of continued strong and inclusive growth in association with human resource development, social development and effective protection and sustainable use of natural resources (8th NSEDP 2016). The Project will bring significant foreign capital into Lao PDR and Project expansion is expected to make a significant contribution to GOL tax revenues, including Company profit tax, employee income tax and value added tax as well as fees associated with plantation certificates, harvest, transport, and export.

At the local level, the Project is seeking to maximise economic development opportunities through agricultural development, full time and casual employment opportunities, spin-off business, community development and smallholder plantation forestry development. If managed effectively, these activities will contribute to economic development in rural communities across the Project area. Employment opportunities will need to be prioritised for local communities and distributed equitably to maximise the ability of households from all groups / genders to take up employment opportunities and benefit from associated incomes.

14.1.2 Land Acquisition and Use

The Project does not involve any involuntary displacement or resettlement and seeks to minimise adverse social and economic impacts from land acquisition through implementation of the Company's land identification and acquisition process and agroforestry model.

Key risks associated with the Project's land acquisition process include (i) potential inadequacy of the land acquisition consultation process; (ii) land ownership / tenure disputes; (iii) potential inadequacy / inequity of land compensation; and (iv) changed community perceptions over the lease period. These are expected to be managed through effective implementation of the Project's land acquisition process, including a Free, Prior, and Informed Consent approach and adherence to Company *Land Selection Criteria*.

Land availability within potential Project villages is a key issue. To maximise the benefits of the Project's agroforestry model, Burapha is seeking enough land to allow for division of the area into several plots and staged development / multiple rotations to provide more consistent labour and intercropping opportunities.

14.1.3 Forest Resource Use and Ecosystem Services

Project expansion may directly and indirectly impact the availability of NTFP and TFP resources across the Project region. Special Management Areas (SMA) will be protected for natural regeneration and succession to provide for the development of multi-layered and structured forest communities within plantation boundaries. SMA include riparian buffers, areas with steep slopes, existing forested areas within plantation lease / concession areas, and high conservation value species / areas. SMA will continue to supply communities with NTFP (though not TFP as tree harvest will be prohibited in SMA).

The percentage of degraded forest land converted and the amount of remaining forested land within Project village boundaries will likely be a key determinant for potential impacts on forest resource based livelihoods. Successful implementation and adoption of the intercropping model, Project employment, and development initiatives are expected to mitigate loss of forest resource based livelihoods.

14.1.4 Agriculture

Agricultural development within the Project plantation areas is an integral part of the Project's Agroforestry model and is intended to mitigate for the loss of swidden agriculture land and associated food security and livelihoods.

14.1.5 Occupational Health and Safety

Work in plantations, sawmills, and nurseries present a number of hazards that may lead to injury, illness, or death in the absence of suitable management and monitoring. OH&S risks cannot be entirely avoided. However, with the diligent implementation of management and mitigation measures the likelihood and consequence of OH&S impacts can be mitigated.

Requirements for training, personal protective equipment, safe working environments, regularly maintained equipment, etc. will need to be as robust for contractors and the casual workforce as per full-time Burapha employees. Regular monitoring of operations; reporting of OH&S incidents; and the development of an effective corrective actions procedure are considered necessary to maintaining a safe working environment.

14.1.6 Ecology

Terrestrial Habitat, Flora, and Fauna

The removal of vegetation for site preparation and short – moderate duration replacement with *Eucalyptus* or *Acacia* plantations is expected to have a moderate impact on the regional availability of terrestrial habitat and a low impact on flora biodiversity or species of conservation significance. As the Project area expands, the most

significant risks for terrestrial fauna are likely potential indirect impacts, including: habitat loss, barriers to movement, increased access for hunters and associated legal or illegal hunting.

Burapha will partially offset impacts to habitat by requiring that vegetation is left intact on a minimum of 10% of each plantation unit in Special Management Areas. This will largely be accomplished through retaining natural vegetation in riparian buffers, on steep slopes, in patches of natural forest within management units, and areas identified as High Conservation Value Forest. These areas will be protected to allow natural successional processes and ultimately development of multi-layered and structured native forested area. Riparian buffers will provide key migratory pathways to minimise fragmentation of habitat.

Protection Areas

Burapha is committed to avoiding International, National, Provincial, District and Village Protection and Conservation Areas as the Project area expands. The greatest risk for encroachment into Conservation and Protection areas is at the village level. Villages and District authorities have been found to irregularly impose restrictions on harvest and conversion of these areas to agricultural lands and in some cases plantation forests. In many villages across the Project Provinces, Village Conservation / Protection Areas are now fallow, having been incorporated into the swidden agriculture rotations. The results of the Land and Forest Allocation Program and the Participatory Land Use Planning process are irregularly followed by villages and often not enforced by District or Provincial Authorities.

Avoidance of protection and conservation areas will require robust consultation activities with applicable GOL authorities and due diligence during consultation with villages and District Authorities.

14.1.7 Invasive Species

The implementation of *Eucalyptus* and / or *Acacia* plantations provides some risk for establishment and spread of non-native invasive plants, namely: (i) introduction or spread of invasive weed species; (ii) the potential for the spread of the *Eucalyptus* / *Acacia* beyond plantation boundaries; and (iii) domination of plantation trees following the end of the concession period.

While the first two potential impacts are considered low risk and easily managed, the Burapha strategy for decommissioning will need to be addressed. As the Burapha *Eucalyptus* plantation trees rapidly coppice sprout following harvest, there is significant unmitigated risk that the stands will dominate the canopy in perpetuity following the end of the concession / lease agreement, which would alter the species composition and quality of habitat in the long-term. It is anticipated that a suitably effective and nationally / internationally acceptable herbicide will need to be applied to cut stumps (e.g. Metsulfuron) to prohibit regeneration of *Eucalyptus* stands following the final harvest, and likely follow-up monitoring / Glyphosate application after one growing season.

14.1.8 Water Quality

Sedimentation

The clearing of vegetation for plantation establishment and the use of unsealed access roads combined with heavy seasonal rains and often dispersive soils presents a high risk for erosion and sediment transport to receiving waters with potential for moderate impacts to surface water quality and aquatic habitat.

As the Project area expands, Burapha will need to implement more robust management for stormwater, erosion, and sediment controls (particularly on unsealed roads near watercourse crossings) and implement effective measures for riparian vegetation retention.

Fertilisers, Pesticides and Other Chemicals

Burapha operations (nursery and plantations) require the use of several potentially hazardous materials, including pesticides / herbicides, hydrocarbons, and fertilisers. If improperly managed, these materials may pose a threat to community and occupational health and safety; water and soil quality; and biodiversity.

Diligent application of management and mitigation measures are required to avoid potential impacts. Burapha has Standard Operating Procedures / Work Instructions for chemical storage and handling and have refined their *Emergency Preparedness and Response Plan* to incorporate international best practices for transport, storage, handling / application of hazardous materials and appropriate disposal of hazardous waste as well as protocols for responding to an accidental discharge.

14.1.9 Hydrology

The potential impacts of industrial *Eucalyptus* plantations on surface and groundwater hydrology are complex and will vary according to the phase of operations, as follows:

1. Surface water runoff and groundwater storage is expected to increase for the first 0 – 2 years following vegetation clearance. Preliminary modelling indicates that clearance of fallow forest is expected to increase annual runoff and peak flow runoff from the plantations. Given the relatively small size of plantation units relative to stream catchment area, changes to the hydrograph are expected to be minor and localised in nature, and are not likely to significantly contribute to regional flooding.
2. Surface flow and groundwater storage may decrease from years 4 – 7 of the plantation rotation. Much of the research on hydrology in *Eucalyptus* plantation forestry indicates that evapotranspiration is likely to increase relative to the fallow forest the plantations replace after three to four years of establishment, with a corresponding reduction in streamflow / groundwater recharge. The average decrease in surface water flow in literature reviewed for this ESIA indicates that the changes in hydrology will be minor and localised, provided plantations continue to occupy a relatively small proportion of total catchment area.

14.1.10 Wildfire

Given the propensity of *Eucalyptus* forests to burn, there is significant risk that fires ignited near or within plantations will become wildfires potentially threatening community and occupational health and safety, community assets, terrestrial / aquatic ecology, and Company assets. Burapha employs a number of management measures to minimise the risk for ignition of plantation trees; minimise the risk for the spread of wildfire if ignited; ensure capable and trained personnel have the means to fight fires; and ensure communication protocols with emergency responders and local communities are suitable in the event of wildfire.

The Company has developed an *Emergency Preparedness and Response Plan* that articulates prevention measures; preparations; communications for first response, evacuation protocol, medical attention procedures; and training / resources to fight fires. The risk for wildfire is cannot be entirely mitigated. With diligent application of management measures, with potential for impacts considered moderate.

14.1.11 Air Quality

Sawmill

The manufacture of wood products results in the generation of fine airborne wood particles and dust at the Burapha sawmill. With design controls already implemented, and routine maintenance for equipment and dust extraction systems, the health and safety of the workforce is expected to be suitably protected given provision of appropriate PPE.

Nursery

Some of the chemicals utilised at the tree nursery provide a significant health and safety risk if inhaled. Burapha will need to review MSDS and product labels to ensure that PPE provided is commensurate with risks. Personnel need to be informed of risks to ensure that management measures are adhered to and trained to avoid potential impacts. With provision of protective equipment and routine informal and formal monitoring, impacts to health and safety are not anticipated.

14.1.12 Noise

Sawmill

Significant noise is generated at the Burapha sawmill in Nabong. Wood splitters, saws, etc. generate sound levels that exceed safe emissions in the absence of proper hearing protection. The Burapha *OHS Policy and Principles Manual* clearly articulates Company commitments to providing appropriate PPE. Burapha will need to diligently require the use of hearing protection at the sawmill for all staff. Ongoing provision of PPE; informing staff of risks associated with unmitigated noise levels emitted at the sawmill; requiring the use of hearing protection; and routinely monitoring staff to ensure PPE is used appropriately will effectively mitigate the occupational health and safety risk.

14.2 Monitoring and Reporting

The ESIA has outlined the likely environmental and social impacts based on the Project model and has outlined a management and monitoring program consistent with Lao PDR legislation and international industry best practices for industrial tree plantation operations. The proposed management strategy during land identification and acquisition, plantation establishment, plantation management, and decommissioning phases of the Project has been documented in the ***Environmental and Social Management and Monitoring Plan***, a separate stand-alone document (Volume D). In accordance with regulatory requirements, it is expected that the ESMMP will be updated as required to incorporate any significant changes during the life of the Project.

14.2.1 Monitoring

The implementation of an appropriate monitoring strategy as part of the ESMMP is important to ensure that existing management measures are effective, and to identify the need for improved or additional measures. The environmental monitoring program for the Project will include seven categories of monitoring:

- Land identification and acquisition monitoring;
- Site preparation/ plantation establishment monitoring;
- Operations monitoring;
- Routine monitoring;
- Community engagement and social monitoring;
- Decommissioning surveys; and
- Investigation monitoring.

14.2.2 Reporting

The Burapha environmental and social compliance officer will develop Quarterly Monitoring Reports for submission to senior Burapha management and an ***Annual Environmental and Social Monitoring Report*** that records the results of monitoring and identifies adaptive management strategies, where required for submission to MONRE and other applicable external stakeholders.

Chapter 15 | References



15 REFERENCES

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