VISIT TO UZBEKISTAN

July 28 – August 3, 2009

SCIENTIFIC REPORT

Presented By

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With technical support from

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C O N T E N T S

1. GENERAL BACKGROUND

July 28, 2009 - Meeting with Dr. Kristina Toderich, Regional Representative of the International Center for Biosaline Agriculture for Central Asia and Caucasus (ICBA-CAC) at the sub-office of ICARDA in Tashkent. She gave an overview of the Agrarian Sector development, changes and opportunities in the region, with special focus on Uzbekistan.

Uzbekistan with a population of about 26 million, of whom 60% are living in rural areas, is a landlocked country, heavily dependent on irrigated agriculture. Uzbekistan used to be the main producer of cotton (41%) and grains (42%), as well as one of the largest suppliers of fresh and processed fruits and vegetables to other parts of former Soviet Union. Since independence in 1991, the Government's search for self-sufficiency in wheat under mandatory state orders, has so far, had the largest effect on crop diversification and changes in crop production.

It is mandatory for the Uzbek farmers to grow cotton and wheat, which are still state order crops, occupying over 80% of their land. They are required to sell the entire cotton crop and 50% of the wheat to the Government, at prices far below the fair market value.

A sharp decrease in cotton yield was observed over the last few decades, when the average yield of raw cotton was reduced to half. The main reasons for the decrease in crop productivity were poor functioning of irrigation infrastructure (pumping stations and drainage collector systems) and deterioration in soil fertility, apart from depletion in soil productivity and scarcity of water resources particularly in the middle stream of both the Amudarya and Syrdarya river basins. Lack of water controlling instruments for flow rate, accumulation of erosion sediments in the drainage systems, inappropriate watering as per the requirement of crops and loss of surface water, still pose a challenge in the region.

The prevalent mono-cropping system of cotton and wheat arable lands in many parts of the country is in a degraded condition. Intensive surface irrigation is causing soil erosion, loss of organic matter, salinisation and water logging, which greatly reduce not only the sustainability of agriculture, but also the long term security and income of poor rural communities.

Agriculture is now mainly carried out by smallholder farmers. A traditional farming system was prevalent from the time of the Soviet Union, when *Kolkhozes* (collective farms) or *Sovkhozes* (state farms) used to function. After the collapse of the Soviet Union and after independence, generally, since the last 10-12 years, these modes of agrarian farming systems have gradually disintegrated from collective farms through *shirkats* (Cooperative) farms to private farms. *Shirkats* have been responsible for on-farm water management on their territories.

The National Action Plan needs to address the farmers and agro-pastoralists as the main land users, in order to demonstrate the feasibility of the technologies, enable technology adoption in a participatory process, increase awareness and provide information for regional out-scaling of successful measures. Lack of competition in cotton financing and processing and absence of freedom of choice for farmers, have resulted in a steady decline in farm productivity and profitability, mostly of cotton and wheat. Therefore, the farmers have lost interest in agricultural development and a majority of them are migrating in search of alternative jobs. Consequently, their families and children are unable to receive good education and health assistance.

Livestock rising has also suffered considerable damage because of a decline in yields and a reduction in areas for forage production. The cattle population has reduced by 76%, sheep and goats by 64%, and poultry by 95%. Earlier, a majority of the animals belonged to the public sector, such as collective farms, state farms etc, but after 1991, a significant part of the livestock are maintained by the households. Parallel for the last few decades, has been the production of meat in agricultural enterprises, which has reduced by 88%, milk by 84% and eggs by 98%. Dairy production has also been significantly affected.

2. VISIT TO PROGRESSIVE FARMS

July 29, 2009 - Visit to one of the 'Bright Spot' Private 'Said Ovul Farm' in Tashkent Region

Mr. Mamatkul Salyamov, Chairman, Said Ovul Farm, Urtachirchinskii District, 102300, Tashkent region, Republic of Uzbekistan; Telephone: 233 29-79; 233 41-99: Fax: 23394-92; Email: saidovul@inbox.ru ; Mobile: 470-1200

 

With Mr. Salyamov in cotton and wheat fields

Mr. Salyamov is 71 years old and had been a Deputy Minister of Uzbekistan. For many years, he worked as a construction engineer and built a series of strategic buildings in the Republic of Uzbekistan. He started his farming activity after retirement. In the beginning, he rented 35 ha of land from the Government for a period of 50 years, as per the Government policy. Factually, since 2005, farmers in Uzbekistan have the right to lease minimum 35 ha to 100 ha of lands for a period of 50 years from the Government. The state is the main owner of the land. No private land, except small lands of about 0.003-0.2 ha, is available for housing. The householders usually cultivate fruit trees, vegetables, landscape greening or flowers in their backyards.

It is mandatory for the private farmers, who nowadays dominate the areas, to take guidance from the State and to cultivate cotton (40%), wheat, barley or other cereals (40%) while only about 20% can be used for growing crops of their choice. They have to make a prior commitment with the Government to report the yield of the state order crops such as cotton and wheat.

The Government in return, has the responsibility of providing fertilizers and fuel at a reduced price as a component of the loan. Usually, the farmer has to pay tax for the land use and also on the income. The Government is taking the responsibility of providing the farmers with irrigation water without any charges and taxes. About 80% of the cropping area is under irrigation.

Based on the above commitments, the farmer has to sell 75% of the grain and cotton produced at a fixed price to the State and 25% at the market price. The farmers receive requisite loan at 3% interest. The Government recovers more than the cost of irrigation services through repressed prices of cotton and wheat. However, instead of using these funds mainly to

maintain and improve the quality of irrigation and drainage, most of these funds are diverted for other purposes.
The prices set by the Government for cotton and wheat is a major instrument of net indirect taxation on agriculture and an important source of revenue. The price of cotton is projected to decline over the next three years, which will reduce the Government budget revenue by about 8.5% annually. Increasing current taxes further, is likely to maintain the revenue. Application procedures of bank credit for growing cotton and wheat are complex, while commercial lending is insignificant. Inadequate financial resources do not allow farmers to initiate large-scale rehabilitation of salt prone/degraded lands, maintaining and reconstruction of drainage collector system, land planning and its use among main land users. Many farmers who are not able to produce better cotton yield, have surrendered the land to the Government.

Small lands which were surrendered by other farmers have been taken up for cultivation by Mr. Mamatkul, who presently, has cultivated 1300 ha. He is occupied in agricultural activity for the last 14 years and has found it to be profitable. Among them, 1000 ha is irrigated. He is engaging 300 labours. He grows cotton (220 ha), wheat and barley (300 ha), rice (130 ha), vegetables (200 ha), forage and rain-fed crops (300 ha) and fruit trees and grapes on the remaining portion of the land. He uses special mechanical technology for weed control by deep ploughing in summer (temperatures ranging from 38^0 to 42^0 C) after harvesting of wheat, to destroy the weeds. For controlling *Aegilops litoralis* creeper, a vegetative propagative graminous weed, he uses herbicides. Once in 4 years, he also applies farmyard manure at 20 tons/ha. He has purchased two combines for wheat harvesting from Russia at a cost of $220,000. The average cotton yield is 4.7 t/ha, which is far above the national average and makes agriculture a profitable activity.

He is also engaged in wheat seed production, storage and sale to the Government and to the market. He also informed that a new drought/frost tolerant variety of wheat has been introduced from Kazakhstan, which is characterized by high content of protein and grain quality. Due to the climatic conditions of Uzbekistan, improvement in the quality of grain by enrichment with microelements (Zn, Fe) is necessary. A local early maturity variety is being tried to be released to avoid the hot summer during the harvest period, which has adverse effect on the quality of grain. He has set up a floor mill for processing of wheat grain with a capacity of 10000 tons/ year.

He has 100 cows which are in milk. He prepares silage forage for cattle and small ruminants for the winter season. He is planning to take up milk processing. He is maintaining small ruminants (goats and sheep) for meat production. Presently, he is selling live animals and is planning to start a factory for production of sausage and other meat products. All the agricultural wastes are converted into farmyard manure.

Local breed of sheep with fatty tail

Mulberry in tree form

Sericulture has also been undertaken, by engaging women in this activity. The average salary is about $40-50 per month including daily meals and assistance for agricultural products.

July 29, 2009 Afternoon - Meeting with the Farmers' Association of the Republic of Uzbekistan (Mr. Atabek Ibragimov)

The main objective of this organization is to coordinate the farming system in 13 administrative regions of Uzbekistan including the autonomous Republic of Karakalpakstan – a minority of Uzbek speaking people, located in the delta of the Syrdarya and Amudarya river basins.

Based on the information given by Mr. Atabek Ibragimov, approximately 105,000 farms are functioning in the Republic of Uzbekistan while 13 branches of the Farmers' Association are functioning at the district level.

The Farmers' Association of the Republic of Uzbekistan is engaged in providing new/innovative technologies to the farmers to bring in new methods of cultivation and technology for seed production and seed multiplication. They also print handouts in local languages, organize workshops and seminars for farmers, field days and farmers' fairs. There are some opportunities to support farmers to obtain grants to travel abroad to gain knowledge in modern agricultural technologies. They facilitate capacity building and knowledge sharing between 'bright spot' farmers (successful farmers) and International agricultural institutions, as the current linkages between farmers, academic and scientific research institutes, are poor.

July 29, 2009 - Visit to 'TANO' Pedigree Cattle and Dairy Farm at the Upper Chirchik District, Tashkent region

This Dairy Farm was founded in 2007 by a special declaration of the President of the Republic of Uzbekistan, Islom A. Karimov, to establish a Cattle farm for demonstration and to bring modern technologies to Uzbekistan. This model Dairy Farm was established by bringing 150 Holstein Friesian cows from Netherlands and 150 HF cows from Germany. These animals have now become acclimatized to the local climate. Presently, there are 210 cows, of which, 120 cows are in milk and the rest are pregnant. The fat content in milk is 4.6%, which increases up to 5.0% in winter. The farm supplies good quality breeding bulls to the farmers. They also have a feed mixing and dairy unit. The milk produced, is sold through retail outlets and local shops. They also have experience in forage production and livestock feeding system for the late autumn-winter seasons.

3. VISIT TO PLANT BREEDING STATION

30.7.2009 - Visit to the Zangyota Corn Center at the Uzbek Scientific Production Centre for Agriculture, Ministry of Agriculture and Water Economy of the Republic of Uzbekistan

Dr. Alexander Masseno, the Chief of this organization, gave an introduction of the activities and achievements of the center.

This cereal breeding center was established in 2007 as the base of the Experimental Station of the Institute of Animal Husbandry, which has been functioning since 1986. The main activities of this center relate to the evaluation of new drought and salt tolerant germplasm of a unique collection (gene pool) of corn (Zea maize), sorghum (Sorghum bicolor, *S. sudanensis*) and pearl millet (*Pennisetum glaucum*), both from Uzbekistan, Russia as well as from ICBA and ICRISAT.

Corn is grown for grain and fodder. Fertilizer application rates are 120 $kgha^{-1}$ nitrogen (N), 90 $kgha^{-1}$ phosphorous (P) and 40 $kgha^{-1}$ potassium (K) and are manually applied in equal splits prior to seed bedding and irrigation. Irrigation is carried out through furrows of 30 cm depth and 40 cm width, four times during the growing season - 15 and 30 days after planting

(DAP) to advance the shooting phase, 90 DAP (prior to flowering) and 110 DAP (after flowering). The amount supplied is sufficient to maintain 75% of the field capacity throughout the vegetation season. The irrigation water salinity averaged from 1190 up to 2300-5100 mg l^{-1}. The average ground water table during the plant growing season, varied from 0.65 m (late March) to 2.58 m (late September).

Nowadays, 7 tall (more than 3.0 m) high productive hybrids of corn, mostly for grain production have been selected by the staff of this experimental center and released, to become widely multiplied under dryland conditions in Uzbekistan.

A total of 29 sorghum and 87 pearl millet lines from ICBA and ICRISAT are being evaluated and the promising varieties, both for grain and forage are selected. Two multi-cut sorghum varieties were up scaled on farmers' fields. Various activities on breeding, purity, seed production and multiplication of these three main cereals have been initiated at this center.

Sorghum

The ability to produce grain, stover and total DM on various salt affected soils differed significantly among evaluated improved lines and cultivars, which varied from 67.0- 94.3 t ha^{-1} with equivalent dry matter production levels ranging from 12.0 to 30.21 t ha^{-1} at a plant density of 42.0-90.0 thousand ha^{-1}. Similarly, the above mentioned top-yielding lines of sorghum were identified which exhibited grain yield increases over local varieties in the range of 2.0-2.5 times. The average grain production of top yielding accessions, varied from 5.8 to 7.4 t ha^{-1}.

The majority of slow growing and medium/late maturing accessions of sorghum, namely ICSV 112, ICSV 745, SP 39105, SP 47105, ICSV 682, SP 172, SP 47529 are characterised by thick succulent stems and long (28-39 cm) and ramified panicles that make these varieties useful both for forage (silage) and grain production. Significant differences were observed in biomass and grain yield of fast growing and early maturing sorghum Grif 619 and IS 29781 varieties/lines. The effect of soil salinity on biomass, stover and grain yield in the top yielding dual-purpose sorghum varieties, occurred during tillering and flowering stages.

They are suggesting that by adopting early maturing varieties under high plant density, sorghum and pearl millet can be made into valuable feed, stover (dry stalk after grain harvest) and forage crops. It can also easily fit into intercropping production systems with low canopy crops such as soybean and other legumes. By providing a dense cover to the salt-affected lands, they can also contribute to the improvement of the soil and moisture holding capacity, which is necessary when crop rotation systems are being designed.

Pearl millet

Almost all the selected (locally bred) varieties, reached flowering and reproductive maturity stage in 60-63 days. The most promising dual-purpose pearl millet is Uzbek 100 – early maturing, thin-stemmed with a long panicle. Accumulation of green biomass positively correlated with the height of the plants and increased with the application of fertilizer and irrigation.

Local multicut Pearl millet variety

Multi-cut pearl millet varieties: Improved local breeding lines named K-1; K- 2; K-4 and K-6 were given two cuts: 1- an average of forage green biomass 3.2 t ha-1

Salt-tolerant fodder beet (*Beta vulgaris*, variety 'Uzbekistan-100' are multiplied on a large scale on experimental plots at this center and the best quality seeds are distributed among the local farmers.

4. VISIT TO SALINE SOIL RECLAMATION PROGRAMME

Saline Soil Reclamation Experimental Station, Akaltyn, Institute of Cotton production, Syrdarya Province, Uzbekistan

Plant Species and Experimental Design: Dr. German Bezborodov and Dr. M. Djumaboev took us to crop fields grown under high saline soils with a heavy texture. Water logging and sodic alkaline salinization are major problems affecting all cotton and wheat growing areas of the middle stream of the Syrdarya river basin, which is a huge burden on the resource-poor farmers, who are located in the most degraded lands in this region with a per capita income 30% lower than the national average and unemployment levels over 40%. Awareness of the farmers on soil and water conservation and management of marginal lands is also very poor. Measurement for reclamation of salt-prone marginal lands, quantity of water for the crop and irrigation scheduling are still based on conventional approaches.

Cotton on saline land

Mulching for saline soil reclamation

In this area, the cultivation of most of the agricultural crops requires high inputs of chemical fertilizers, costly leaching and intensive drainage. This strategy, however, increases the risk of accumulation of salts in the root zone and consequently, increase in secondary salinization (caused by human beings) of farmers' lands. Therefore, the single way to reclaim such lands is by soil leaching which has to be repeated every cropping season to avoid build-up of high toxic salts at the upper soil profiles.

Experiments have been carried out since the last 10-12 years by testing of various native and introduced crops, by use of agricultural management practices and irrigation technologies. During June-September, the ground water remains very shallow (0.7 m) with water having alkaline pH (8.8-8.92). Chloride and sulphate are the dominant ions. Drained water showed salinity ranging from 5380-5580 ppm, whereas that of irrigation water was 2160 to 2280 ppm. The total volume of water applied for the crops during the growing season was 2925 m^3/ha. The soil of the experimental site is silty / clay loam at different depths of the profile. Chemical analyses of soil showed higher concentration of Ca^{2+} followed by Na^+ among cations, and Cl^-, SO_4^{2-} and HCO_3^- among anions.

Growth and productivity of salt tolerant plants

Among the 21 different species grown, only 10 were able to establish to give growth and yield data. The local variety of maize showed better growth and biomass as compared to varieties Men-JR-23 and SP-38330944. Among Sorghum varieties, the long duration (3 months) variety produced higher fresh and dry biomass followed by local varieties.

Trials of introduced and domesticated native wild forage halophytes, have been established in 2009. Among them, *Kochia scoparia*, *Helianthus tuberosus* and annual *Atriplex nitens* showed the best performance.

The scientists achieved promising results on the evaluation of various irrigation technologies for cotton cultivation.

July 30, 2009 - Visit to Galaba Shirkat Farm

Galaba Shirkat farm is located in Bayaut district of Syrdarya province of Uzbekistan. The total irrigated area is 3115 ha. The soil is silty loam, by mechanical composition, moderate loamy in the top 0-50 cm layer and heavy loamy below. Salinity type is chloride-sulphate. Over 1500 ha of land of the farm is abandoned due to problems of salinity and water logging. The ground water has salinity at 5-6 g/l at 1-1.5 m depth. Irrigation water has salinity at 1-1.3 g/l. With a view to reclaim these saline lands, licorice was introduced on 100 ha. Wheat and alfalfa system are also under test on 3 ha to reduce the shallow saline ground water table. The Farmer Licorice Alliance has been established in 2007 and presently, more than 20 farmers have retained keen interest in reclamation of saline soils by introducing and cultivating salt loving halophytes and salt tolerant crops – a prototype of phyto-remediation technology. The leader of the Farmer Alliance is 51-year old Tursunboy Ovizov, an energetic and creative farmer.

Dr. Habib Kushiev, Head, Department of Biology of the State Gulistan University, arranged a meeting between farmers in the Licorice Alliance regarding licorice production as a means of rehabilitation of abandoned saline lands and up-scaling of this technology among the farmers in the Syrdarya river basin, where more than 70% of the old irrigated agricultural lands are wasted and abandoned by farmers.

Licorice shrub, Russian olive in background

Sunflower on reclaimed soil

A stand of licorice, established by farmers in land abandoned due to high level of salinity, ready for harvest of the above ground biomass (a. at the first and third years of vegetation) for fodder (and b. at the 4-5 year old roots ripped for harvesting of rood dry matter yield). At the end of four years, experimental plots of licorice have been returned to the traditional moderately salt tolerant crops like sunflower "Luchafarul' variety and later on, to wheat and cotton cultivation. Species of Russian olive tree is also tolerant to high level of salinity.

The foliage of licorice is a high quality fodder with a protein content of 12% and with a dry matter yield ranging from 3.66 to 5.11 t ha^{-1}. Its root has many medicinal properties with a dry root dry matter yield of 5.11-8.55 t/ ha, at the end of 4 years after planting. Roots are used in the preparation of herbal medicines and soft drinks.

5. VISIT TO DESERT AREA

July 31, 2009 to August 2, 2009 - Visit to Kyzylkesek site, Madaniyat Sherkat Farm, Kanimekh district, Navoi region

Farmer: Adylbek Jalgasbaev (family of 5 members: father Abdy aka, wife Mayramgul and two children, Marat and Marjon). There are 8 families living in the desert area. One artisan well installed by the Russian administration, provides hot water (high sulphur content), which is used for cultivation of melon and water melon. They also maintain crossbred cattle, goats and sheep for supplementary income. The mode of transportation is either walking or use of donkeys. These tribal families lead a very simple life.

To improve the income of these families through improved agriculture, ICBA in collaboration with ICARDA sub-office for Central Asia and Caucasus and Uzbek Research

Institute of Desert Ecology and Karakul Sheep Breeding, have initiated many scientifically-based and practically useful interventions. These include introduction of new crops and wild forage or multipurpose halophytes, improved agricultural practices and reduction in soil salinity. An additional study has been initiated on saline sandy soils at Kyzylkesek Farm in Central Kyzylkum Desert of Uzbekistan at the Experimental Station of the Institute of Desert Ecology and Karakul Sheep Breeding. The focus of this activity is to assess the feasibility of domesticating wild halophytes which can be used for oasis arid fodder production.

First Stage of Saline Soil reclamation (high saline soil with EC at 10-16 dSm^{-1})

The potential of forage halophytes for rehabilitation/reclamation of high saline prone or waterlogged soils are tested and suggested to be widely used for the rehabilitation of salt prone sandy desert rangelands:

Among them are:

Ceratoides ewersmanniana, Kochia prostrata, Salsola orientalis, Salsola sclerantha, Climacoptera lanata,Halothamnus subaphylla, Glycyrrhiza glabra, Agropyron desertorum, Atriplex nitens, Atriplex undulata (perennial semishrub), *Atriplex canescens* (perennial semishrub), *Kochia scoparia, Suaeda salsa, Amaranthus reflexus* (used as forage and grain)

These species have been shown to be highly productive with excellent digestibility, palatable to animal and highly nutritious. With proper screening and evaluation, all the above species can become an integral component in agro-pastoral farming and livestock production systems under saline arid environment.

Formation of Saline lands

Emergence of Halophytes

Stages of Saline Soil Reclamation

Pure *halophytic pasture with predominance of species of genera Suaeda salsa* (Left) and Salsola (Right) – **a first stage of saline prone soils**

Wet solonchaks with *Salicornia herbaceae* (left) and the same biotope improved by planted stands of *Kochia scoparia* (right)

Natural pasture with thorny bush (*Alhagi pseudoalhagi, Astraceae)* used as haymaking forage for winter use

Second stage of Saline soil reclamation

Agro-silvi-pastoral model

The leading species among 21 screened native and introduced tree and shrub species with regard to survival rate, growth characteristics and adaptability to saline natural environment in Uzbekistan, proved to be *Haloxylon apphyllum, Tamarix hispida, Hippophae ramnoides*, *P. euphratica* and *P. nigra var. pyramidalis*, *Salsola Paletzkiana, S. richteri*, followed by *Atriplex undulata*, *Elaeagnus angustifolia (Russian olive tree), Acacia ampliceps* (except its low frost tolerance), *P. euphratica* and *P. nigra var. pyramidalis, M. alba, Morus nigra,* on loamy hydromorphic soils. Fruit species, such as *Cynadon oblonga, Armeniaca vulgare, Prunus armeniaca, Diospyros virginiana* (*persimmon)* and wild spices of genera *Malus* and *Prunus* on saline loam sandy deserts soil, though desirable from the farmer's financial viewpoint, showed low bio drainage potential.

High productivity of *T. androssowii, T. hispida, Salix babylonica, Haloxylon aphyllum, Elaeagnus angustifolia* and *Atriplex undulata* makes them the most promising candidates for afforestation of highly degraded saline habitats, with immediate economic benefits. However, species of genus *Tamarix,* spp. and *Elaeagnus angustifolia and Salix* are often referred to as aggressive colonizers, since they tend to invade natural habitats and push out other less salt tolerant species. All these species showed a high ability to self-propagate by vigorous sprouting, and thus, intensive control is recommended. The most promising species for the reclamation of sodic alkaline wet saline soils (waterlogged soils) can be *Elaeagnus angustifolia*.

Russian olive tree (*Elaeagnus angustifolia)* – a fast growing tree on saline prone soils.

Russian olive tree or Dzhida in Uzbek is a fast growing wild fruit and fuelwood tree. Its fruits are consumed as delicacies as they are rich in sugar. It is a local medicine for respiratory and digestive problems. It is found on the flood plains or wet solochaks, usually on the river or channel beds and makes a nonspecific stand by having a major bio-drainage effect by regulating the level of the water table and by decreasing mineralization. Both wild and cultivated cultivars of this tree are well propagated vegetatively and can be cultivated by farmers to increase their income.

Atriplex nitens (saltbush)

Alley crop of *Alhagi pseudoalhagi* and melon

Improved pastures with *Haloxylon apphyllum (left) and Tamarix hispida* trees (right)

Planting herbaceous fodder crops within the interspaces of fodder salt tolerant trees and shrubs on intensive agro-forestry plantations could solve the animal feeding problem on the degraded (both by overgrazing and salinity) desert and semi-desert marginal areas.

Salt tolerant Energy crops

Sweet-stem sorghum (*Sorghum bicolor*)

In 2007-2009, demonstration trials on evaluation of performance of sweet-sorghum varieties were established within the framework of the collaborative ICARDA/ICBA/ICRISAT project at the Zangyota Experimental Fields.

Academician Masseno, suggested that stalks for sugar extraction can be harvested 4-5 weeks before seed maturation. In addition, sorghum varieties were analyzed for sugar content at the flowering stage. The highest sugar content of 10 to 15 % was observed with varieties SP 47513 (15.2%); Sorgo Orangevoe 160 (12.6%); ICSV 112, ICSV-707 and SP-47529 (about 11%), E -36-1 and S-35 (10%). The highest yield of fresh biomass that produced about 68% of juice and almost 8.5 t ha^{-1} total sugar was obtained for Uzbekistan-18 variety, followed by Karakalpakskiy (6.5 t ha^{-1} total sugar) and Orangevoe 160 (4.1 t ha^{-1} total sugar) as local varieties and Sugar Graze, ICSV 745, ICSV 112 among tested three local and 2 improved lines from ICBA, could be successfully used for ethanol production.

***Helianthus tuberosus (L)*:** Two salt tolerant local varieties of *H. tuberosus* (locally named topinambur) showed good performance under saline environments in Uzbekistan. The above-ground biomass can be used as forage (both as hay and silage) for all kind of animals, while tubers are used for extraction of ethanol.

Helianthus tuberosus, local Novinka *variety*

Native dual-purpose species of *Sorghum vulganensis* (left) *Sorghum sernum* (right)

Third stage of Saline Soil Reclamation

Three-year evaluation of various salt tolerant improved lines of sorghum and pear millet from ICBA showed these dual purpose (grain and fodder) nutritious cereals with limited irrigation and marginal low quality water, were taken up as first crop (seed sowing at the end of February) and/or as a second crop after early legumes, winter wheat and barley.

Dwarf forms of pearl millet of ICBA germplasm have a low plant height and are characterized by thin-stemmed delicate forage. Adoption of early-maturing varieties under high plant density, pearl millet could be made into a valuable feed, stover (dry stalk after grain harvest) and forage crop. It could also easily fit into an intercropping production system in early spring-summer with low canopy crops, like soybean and other legumes. By providing a dense cover to the salt-affected lands, they can also contribute to soil improvement, moisture holding and green manure.

Alfalfa seed multiplication trial and water melon field at the Kyzylkesek site

Last stage of Saline Soil Reclamation

Vegetables and sugar beet, which are tolerant to low and moderately soil salinity were recommended at 3-4 years of saline soil reclamation alternated by strips of aboriginal halophytes.

Sugar beet (*Beta vulgaris*) as fodder and for seed production crops and vegetable evaluation trial (first experiments under saline sandy desert conditions)

Seed multiplication of Alfalfa for "farmer to farmer" distribution

Seed multiplication of high productive and adaptive varieties for poor-nutrient and salt stress environments in a small-scale farming system was initiated by ICBA. After four years of evaluation, ICBA introduced two salt tolerant varieties of alfalfa (*Medicago sativa*) - Eureka and Skeptre, which were found to out-perform the local variety Kyzylkesekskaya (Uzbekistan). Salt tolerant alfalfa germplasm which was introduced, showed rapid germination, high seed production and excellent regenerative capacity. These two varieties were superior to the local varieties by length of generative sprouts, number of flowering buds, size and number of pods and seeds per one pod, which, in combination, demonstrate higher seed productivity of introduced germplasm. Fresh biomass production at the third year was 23 t ha^{-1} for Eureka variety and 20 t ha^{-1} for Sceptre. These levels of biomass production under saline soils (EC range of soil varied 1.6-9.1 dS m^{-1} and ground water 5.6-21.1 dS m^{-1} respectively), were 1.5-2.5 times higher than the local varieties. In addition, alfalfa varieties introduced, have excellent re-growth capacity (at least 2-3 cuts throughout the vegetation season). Trials for seed multiplication, established in 2007 at the Kyzylkesek site, are well monitored and are now a source of production of high quality, pure seed material for further dissemination through a 'farmer-to-farmer' mechanism. Farmer Adylbek is able to produce about 300 kg of good quality seeds every year, without any farm machinery.

August 2, 2009 - Gulistan State University Experimental Station, Syrdarya region

This is a part of the Hungry steppe ' Mirzachuli', where reclamation started since 1960 by Soviet Scientists. The Scientists working here are Dr. Habib Khushiev and Dr. Tadjiddin Kuliev who are specialists in Plant Biology and Agronomy.

Studies are being carried out in collaboration with the Gulistan State University where oil and fodder crops are being assessed along with alfafa in pure and mixed cropping system. In addition, a study using the aquatic weed Azolla (*Azolla karoliniana*) as a possible organic fertilizer source, is being assessed under a maize and sorghum cropping system.

Among *Atriplex* species, the highest seed germination (approximately 89%) under field condition was observed in *Atriplex undulata*, which showed a rapid growth rate and accumulation of biomass. The biomass produced in 1.5 years was 5.6 kg /m^2 and was readily browsed by cattle and small ruminants. In addition, plant height and plant diameter (D1) ratio of *Atriplex undulata*, in respect of different types of reproduction, showed that plants grown through vegetative propagation, resulted in better establishment. This method will be more convenient for farmers.

A regional gene bank of salt tolerant crops and wild halophytes has been established by ICBA and ICARDA in 2007 at the Gulistan State University, where more than 300 species are documented and collected.

6. RECOMMENDATIONS

Saline soil reclamation has been very well demonstrated by the scientists of ICBA and National Agricultural Research Team across Uzbekistan. While appreciating the work, the following recommendations can be made:

1. **Convergence with Livestock Development:** The studies have successfully brought out the scope for introducing various shrubs and salt tolerant crops. They have also developed an ecological succession (multi-stages technologies of rehabilitation on saline prone soil) to gradually reclaim the saline soils. However, linking of the saline soil reclamation programme closely with livestock development will have added benefits as there will be high value addition to biosaline forage production under the programme. A simple technology for post harvest management of forage production (feed blocks) under saline environments of Kyzylkum desert has been suggested for local agro-pastoralists.

   Uzbekistan has good livestock, particularly cattle, sheep and goats with demand for milk and meat. However, there is no policy on livestock development and no systematic breeding programme. There is scope for promoting dairy husbandry, using frozen semen of proven sires for carrying out the breeding activities. This would immensely improve the milk yield and profitability of the farmers.

2. **Cotton Cultivation on saline Soils:** Cotton is a mandatory crop expected to cover 40% of the total cropping area. However, the crop has not been performing well due to high salinity. There is scope for improving the productivity of cotton crop through introduction of sprinkler irrigation and sub-surface drainage and application of farmyard manure and vermicomposting. There is also scope for introducing alternative crops like soybean on a pilot scale.

3. **Community Development in Desert Region:** ICBA and ICARDA have been working at Kyzylkesek site, Madaniyat Sherkat Farm, Kanimekh district, Navoi region with the local community for validating various agricultural production technologies and to promote various income generating activities. As a result, a few families living in this hamlet are able to earn their livelihood, mainly through cultivation of melon and water melon. They are making use of the improved agricultural practices and water from the arteisian wells with hot mineralized water, which were drilled during the Russian period.

Earlier these wells were discharging hot water, rich in sulphur, not suitable for normal crop production, due to high salinity in the soil as well. Systematic bio-saline reclamation programme initiated by ICBA, could improve the soil productivity. Initially, the communities were involved in cultivating salt tolerant halophytes during the first few years. Subsequently, crops such as melon, water melon, alfalfa, maize, sorghum, pearl millet, etc were introduced. They have also been maintaining goats, sheep and cattle for supplementary income. These farmers have started taking the benefits of improved agriculture, mainly with the support from ICBA and ICARDA. However, in the long run, they need a reliable infrastructure for backward and forward integration to sustain their livelihood, particularly after the termination of the ongoing projects of ICARDA and ICBA.

With a view to extend the benefits of the technologies promoted by ICBA to larger sections of the communities living in the desert region of Kamimkh district in Navoi region and to ensure long term sustainability, it is recommended to promote People's Organizations (POs) of the local communities and to establish linkage with various Development Organizations such Agricultural Ministry, Financial Institutions and market outlets.

Following steps are recommended for wider adaptation of successful technologies:

- Creating awareness among the members of the local communities about the scope for agricultural development in desert areas, particularly where water from artesian wells are available.

- Organizing the local communities through formation of Self Help Groups (SHGs) of women and men belonging to homogeneous socio-economic status. While women SHGs, each consisting of 10-20 members, can take care of savings, micro-finance, capacity building through field visits and training, and initiation of income generation activities such as sheep and goat rearing, dairy husbandry, poultry, vegetable cultivation and food production and processing, etc, they can also initiate socio-economic development activities such as community health, particularly maternal and child nutrition, immunization, establishment of first aid medical facilities, starting of kindergarten, organising transport for school children, etc. The SHGs of men may work on planning for various agricultural and non-farm development activities, procurement of agricultural inputs and equipments for cultivation of lands, facilities for efficient irrigation, procurement of agricultural inputs and marketing of the produce. A village level Planning Cell can also be established to prepare village level plans and development of infrastructure such as roads, transportation, irrigation systems, housing, etc, which are required to improve their efficiency and quality of life.

- While promoting these activities, ICBA and ICARDA can appoint the social workers / organizers who can initiate various activities and establish linkage with different National and International Agricultural Research Institutions as well as local Government Agencies engaged in agricultural development. As these activities require huge financial resources, ICBA and ICARDA may establish dialogue with the Agriculture Ministry in Tashkent and at the regional office of the Agriculture Department at the district and provincial levels. Indeed, it will be a major achievement if Officers of the Agriculture Ministry visit the project site and incorporate many of the activities as a part of their development programme. While technology can come from the Agriculture Department and International Organizations, the members of the POs can be linked with financial institutions for availing required credit at a concessional rate as per the norms of the Government of Uzbekistan. With strengthening of POs and forward and backward linkages, the desert communities can lead a sustainable livelihood.

4. **Transfer Technologies to India:** Various practices of biosaline agriculture adapted in

Uzbekistan, are useful for reclamation of sodic soils in India. Introduction of halophytes, followed by salt tolerant shrubs and perennials for reducing the salt content and to improve the soil productivity before cultivating normal food and cash crops seems to be an excellent strategy to popularize sodic land development in India. However, the selection of suitable plant species for introduction at various stages of reclamation is essential.

- Fortunately, Uzbekistan has an extreme climate of cold winter (below 0^0 C) and hot summer (above 42^0 C) to which these species have well adopted. Therefore most of the species listed above in this report may survive under tropical and sub-tropical climate in India. Among these species, halophytes are slow growing while species such as *Atriplex,* sugar beet and Licorice are not only fast growing but also provide nutritious fodder for livestock. As these species are also propagated from seeds (licorice is widely propagated by root suckers), it is advisable to initiate some studies to evaluate the impact of cultivation of these species on a small scale and study the effectiveness, economics and acceptance by farmers on a wider scale. We need to import the above seeds through official channels from ICBA. Simultaneously, salt tolerant halophytes grown in India can also be collected for studying their adaptability to various degrees of salinity and their utility.

- Seeds of various other crops, particularly multi-cut pearl millet and sweet sorghum may also be imported, to compare their performance with locally available varieties.

- These trials can be initially laid out on a small area of saline land at BAIF's Central Research Station at Urulikanchan, near Pune. Based on this study, a suitable project proposal can be prepared for wider replication.

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Appendix

Visit of Dr. Narayan G. Hegde, Trustee, BAIF

to International Center for Biosaline Agriculture (ICBA) and ICARDA, Tashkent, Uzbekistan

Travel Schedule: 28.7.2009 to 3.8.2009

--28.7.2009 Arrival in Tashkent: Brief meeting and Dinner hosted by Dr. Kristina Toderich

29.7.2009
9.00 - 9.30 Meeting at ICARDA office
930 - 13.00 Visit to Said Ovul Fram
14.00 - 15.30 Visit to Farmer Association
15.45 - 18.00 Visit to Pedigree Cattle Farm and TANO Dairy at Upper Chirchik District

30.7.2009 Tashkent – Samarkand
8.00 - 9.00 Visit to Zangyota Scientific and Cereal Production Center, Tashkent region

10.00 - 11.00 Visit to Saline Soil Reclamation Center, Akaltin, Syrdarya Province, Uzbekistan

11.30 – 14.00 Visit to Galaba Farm: Saline soil reclamation through Licorice

14.00 - 15-00 Lunch at the Gulistan State University, Syrdarya region

18.00 Arrival in Samarqand and Halt

31.7.2009 Travel to Central Kyzylkum and halt at Desert Station

01.8.2009 Visit to ICBA Experimental Fields at Madaniyat Sherkat Farm, Central Kyzylkum

Evening - Arrival in Bukhara

2.8.2009 Travel from Bukhara to Tashkent
Visit to Gulistan State University Experimental Station, Syrdarya region

3.8.2009 Summing up; Departure for India