ADB TA 6357: Central Asian Countries Initiative for Land Management Multi-country Support Project

CACILM Multicountry Partnership Framework Support Project on

Sustainable Land Management Research

ADB TA 6357

HALF YEARLY REPORT

(July - December, 2008)

International Center for Agricultural Research in the Dry Areas

CAC Regional Office, Tashkent, Uzbekistan

SLMR Results from July –Dec 2008

Sustainable land management research was initiated in five Central Asian countries to validate technologies that improve the ability of ecosystems or landscapes to support and sustain livelihoods functions and services attributed to these ecosystems. The studies were initiated in July 2007. In the first winter cropping season, wheat crop was planted. The results of the winter 2007 trials have already been reported in first annual report available at CACILM website:
http://www.icarda.org/cac/files/slmr/ADB_TA_6357_SLMR_1st_Ann_Rep_July%202007_July%202008-Eng.pdf
http://www.icarda.org/cac/files/slmr/ADB%20TA%206357_SLMR_1st%20Ann%20Rep_July%202007_July%202008_RUS.pdf
During 2008, experiments were conducted with crops such as cotton , maize and several other fodder crops. Here results of the research studies conducted to tackle land degradation problems during the period July- December 2008 have been reported. Different NRM technological options appropriate to site specific situations were field validated at 10 locations in the five Central Asian countries. The research sites provided by the national partners are located in the irrigated, rainfed range and pasture lands and the dryland desert ecologies representing nearly one-fourth of the geographical area of the 5 Central Asian republics.

A. Regional activities of ICARDA- SLMR (GIS and SEP Research):

Salient accomplishments : Development of common methodologies:

- Green Seeker Optical sensor technology was evaluated abd it was observed that normalized difference vegetation index (NDVI) is a useful indicator indirectly obtaining information on productivity potential and potential yield of the crops and has been found to be sensitive to green biomass. A strong relationship between actual grain yield in winter wheat and the expected yield as determined from NDVI was observed.
- Using the optical sensor, 36 chickpea cultivars were evaluated for vigor , weed competitiveness and yield potential. Fifteen winter wheat accessions are being evaluated in a field trial for their potential for green fodder and grain and straws. Presto winter wheat cultivar produced the highest green fodder in 63 days, this cultivar is also being evaluated for its regeneration ability and grain yield along with other wheat accessions.
- The GreenSeeker optical sensor has also been found to be an important tool for efficient management of fertilizer nitrogen (N), analysing spatial variability and factors limiting production.
- Using the pre-tested socio-economic survey templates and predetermined sample size, full scale socio-economic surveys for impact assessments have been launched in all the five countries. Field surveys have been competed for Uzbekistan, Turkmenistan and Tajikistan and data are being analyzed.

- Under the socioeconomic program, drivers (socio-economic & bio-physical) of land degradation were analyzed.A comprehensive document (Russian, 79 page) titled '**Land degradation in Central Asia: A Review**' has been placed on the website for general reading. English translation will be available after some time.

  http://www.icarda.org/cac/files/slmr/land_degradation_in_CA_dtaft_ru.pdf

- **Research Prospectus:A Vision for Sustainable Land Management Research in Central Asia has been developed by ICARDA-CAC and is available on the server.**
  http://www.icarda.org/cac/files/slmr/Research%20Prospectus%20-SLMR-Eng.pdf
  http://www.icarda.org/cac/files/slmr/Research%20Prospectus_SLMR_Rus.pdf

- A one-week Training program on use of Optical Sensor technology was organized together with the ZEF/UNESCO project in Urgench, Uzbekistan in August 2008 to strengthen the capacity of the national partners.

- A Farmers' Association from Georgia showed keen interest in raised bed planting and the Laser assisted precision land leveling. Indian scientists showed keen interest in relay cropping technology for timely planting of winter wheat in standing cotton crop.

- Participated in a number of field days and travelling seminars to accelerate the pace of adoption of Laser land leveling in s and sloping lands.

- **Issues Handled**

- Caliberation of Optical Sensor for In-season yield predictions and N management, spatial variability in salinity.

- Enhancing availability of green fodder through Dual purpose cereals

- Germplasm screening

- Socio-economic surveys and synthesis on the Land degradation problems in Central Asia

B. National research program activities July 07-2008:

Kazakhstan

- Short flooding and flushing of salts proved useful in improving rice yield and saving 5% irrigation water.
- Direct dry seeded rice technology for raised bed system was introduced to reduce crop lodging, saved 100 kg seeds/ha, and more than 15% irrigation water. Yields were at par with traditional rice culture.
- Rice plant prefers ponded water conditions. Studies confirmed that rice cultivation in Kyzylorda, located in the tail-end portion of the basin, promotes salt leaching. Removal of drainage congestion can further improve salt removal.
- Medium duration rice cultivars (Lider and Amber from Russian Federation) performed best and yields more than the tradtional rice cultivars.
- Plant growth promoter - sodium humate and Mers (developed in Kazakhstan) were tested. Both the growth promoters were found effective in improving the productivity of rice crop by nearly one ton/ha.
- Farmer field days organized were well attended by management and farmers
- Normal fodder life-line for the livestock in Janatas deserts is *Safora*, *Artemisia diffucia* and *Ceratocarpus erenarius*. Initial results suggest that new introductions such as *Kochia prostrata, Agropyron fragile, Calligonum caputmedusae, Calligonum eriopodum, Eurotia ceratoides* and *Salsola richteri can* prove useful

Research Issues Tackled- Kazakhstan

- Develop direct seeded rice technology for improved yields and irrigation water management for control of salinity , improved rice cultivars and growth promoters
- Developing seed systems for Chickpea and fodder crops
- Identify cultivars to improve water productivity and management of saline environments in down-stream areas

- Diseemination of SLMR technologies

Kyrgyzstan

- Winter variety of barley "Manas" yielded 4.92 t/ha. Winter wheat variety "Intensive" was found best (4.46 t/ha) under field conditions.
- Herbicide molecules (Stomp @ 5 L/ha pre-emergence ; and Dialen @ 1 L/ha post emergence) were found suitable in control of weeds in maize production .
- It was observed that blended water supplies (fresh and drainage water (2dS/m) in 1:1 ratio) had little effect on yield of even a salt sensitive crop like maize.
- Laser technology was introduced for land leveling and it is finding favor with the farmers..
- Farmers Field day were organized. The event was widely televised across the nation by three TV channels. Newspapers also published column on the new SLMR technologies, particularly the multicrop planters, the plastic chutes and the precision land leveling system. .

Research Issues Tackled

- identification herbicide molecules for weed management in maize
- Conjunctive use of saline water in crop production for c
- Introduction laser land leveling and bed planters for efficient use of inputs
- Diseemination of Information and scaling up

Tajikistan

- Reverse terraces when mulched with hey significantly increased the productivity of the grape fruits (> 1ton/ha). Hey mulching improved the fruiting in wines planted on levee and side slopes.
- Compared to chickpea, wheat crop combined well with walnut in agri-horti-system on sloppy lands .
- Planting the bottom and slopes of gullied ravines provides surface cover such as to reduce erosion of soils. Wild cherry-Cerassuss as reported effective in gully plugs
- Wheat variety "Navruz" and Barley variety "Chenad-345" were found more suited to mildly saline situations of the Vaksh valley.
- Alternate furrow irrigation can save 30-40 % irrigation water in cotton planted on the 90cm wide raised beds. Under saline situations, transplanting of cotton seedlings may prove very useful to avoid late planting and reduce seedling mortality in intial salt sensitive growth stages and meet acute irrigation water shortages for salt leaching at planting time.

Research Issues Tackled

- Identify cereal crop cultivars for saline environments (wheat, barley)
- Vegetative gully plugs for control of soil erosion in sloping lands
- Skip irrigation and transplanting of cotton seedlings in saline environment
- Rationale use of agri-horti systems on sloping lands (> 10 percent slopes)

Turkmenistan

- A shelter-belt, 1400 m long using tree species is being created along the periphery of the irrigation farm lands to stop shifting sands encroach the cropped lands.

- Laser assisted precision land leveling technology was introduced to improve uniformity in water application, crop stands and yields. Early indications are that the laser land leveling technology seems to be finding favor of the farmers.

Research Issues Tackled

- Establishment of cotton crop through water management (pre- and post sowing irrigation)
- Improve surface cover of tree plantations on hilly slopes using Pigeon pea
- Raise shelter belts to manage shifting sands- evaluate native trees species for cold , drought and salinity tolerance
- Introduce laser land leveling and multicrop raised bed/ zero-till planters

Uzbekistan

- Shallow but relatively less saline (~ 1.5 dS/m) ground water table can meet nearly 80% of the evapotranspiration demands of the maize crop.
- Saline irrigation followed by fresh water saves canal supplies and improve leaching efficiency and similar crop yields.
- Intercropping of Mash (mung beans) with maize or cotton can provide additional benefits of nearly USD 600/ ha.
- Mungbean cultivar "Marzon" performed better than all other cultivars .
- Fodder availability for livestock can be substantially improved in desert areas by growing Pearl millet cultivar (Aip 13150). *Kochia scoparia,* highly tolerant to drought and salt stresses.
- Results showed that melons can be grown with saline irrigation (ECw 4.6 dS.m) to provide additional income to the farmers. Near the watering points, farmers can easily harvest more than 20t/ha of fruits and generate some flexible capital for firther improvement on their farms.

Research Issues Tackled :

- Diversification of cotton-wheat systems through inter-cropping with mungbean
- Conjunctive use of saline water in crop and vegetable production (in irrigated and desertic lands).
- Identification of fodder crops for the sandy soils in Kyzylkum deserts
- Identify Mungbean cultivars sutiable for intercropping in cotton and maize.
- Introduce laser land leveling, multicrop planters and dissemination.

Summary of Dissemination of SLMR technologies

#	Dates	Activity	Participants
1	2.8.2008	New technologies of rice growing, Kaptagai" in Shiely district of Kyzylorda	First Deputy Akim of Kyzylorda, Deputy Akim of the Shiely district specialists from Agric. Dept. Kyzylorda and Shiely, representatives investment firm "Dihan" and Farmers, Dikhan, (60)
2	2.8.08	TV and Print Media	Akims and other interviwed after field visits
3	25-26 .8.08	Radio /TV talks on field Days and DSR	Raj Gupta, Bakiryly K,

		technology	Djamantikov Kh. (Kazakh scientific research institute), Dr. Otarov from Almaty
4	14.9.2008	Dr. Karlikhanov K interviewed by National Telechannel «Khabar> on SLMR technologies	Dr. Karlikhanov, Director
5	3-9-2008	Newspaper Report - Syr boiy № 183 (17501) dated September 3, 2008- Is the new method of rise cultivation capable of increasing rice productivity»	Director of the Kazakh Scientific Research Institute of Rice Growing

Uzbekistan

#	Dates	Activity	Participants
1.	29-7- 2008	Farmer Filed Day in Jizakh	farmers, irrigation specialists and WUA specialists (Total 65)
2.	2-9-2008	Field Day organized in Kyzylkum desert	Director, Republic center for agriculture electrification - Prof. Rabbimov, ICBA - Director, UzNIIKEP- S.Yusupov, Deputy Chairman of the Uzbekkarakul company - M.Narziev, Chairman of the Navoi Karakul -A.Ashurov, heads of the farmer holdings, farmers, dehkans, scientists of SANIIRI, UzNIIKEP – in total 38 persons, National Secretary of Kassilyu program, Hakim of the district,
		TV and News Paper reports	Field days were covered by 'Pravda Vostoka'
		• Technology flyers developed • Posters developed	-11 - 5
		Impacts	• Seed rate for winter wheat reduced by 50kg • Diversification policy announced
	Krygyzstan		
	10/11-7-08	Field days on raised bed planter	
		Field days on laser land leveling	
		TV and Media reports	The field days were covered by 3 TV channels and several News papers
		Tajikistan	
	4/5-6-08	**Field days organized**	Hukmat participated in the travelling seminar (38 participants).

SLMR Publications:

1. Отаров А. Современное экологическое состояние почвенного покрова Шиелийского массива рисосеяния. V-ая Международная конференция «Проблемы экологии агропромышленного комплекса и охраны окружающей среды», г. Кызылорда, 10-12 апреля 2008 г.

2. М.А.Ибраева Гумус рисовых почв Акдалинского массива орошения. V-ая Международная конференция «Проблемы экологии агропромышленного комплекса и охраны окружающей среды», г. Кызылорда, 10-12 апреля 2008 г.
3. Otarov, V. Ibraeva, G. Aidarkhanova, A. Saparov. Ecological monitoring of agrocenosis in different areas of Kazakhstan. // Journal Ecolog8 & Safety. International Scientific Publications, Vol. 2, Part 2. Published by Info Invest, Bulgaria, 2008, ISSN 1313-2563, p. 20-29.
4.Karlikhanov,K. Study of the raised bed cultivation of rice // Materials of the Vth International Conference on « Ecology problems of the agrarian and industrial complex and environment preservation», II volume
5.Tulkun Yuldashev, Nazar Ibragimov, Yulduz Djumaniyazova, Zakir Khalikulov, Khalima Atabayeva, Feruza Khasanova, Jonibek Khudaikulov, Ikrom Karabaev, Dilafruz Tursunova, John P.A. Lamers, Christopher Martius and Raj Gupta.(2008). Use of optical sensor (GreenSeeker): An innovative tool for screening germplasm, predicting biomass and grain yield and management of fertilizer nitrogen. Intern. Conference on Natural Resource Conserving Agro-technologies. Dec 5-6, 2008. Tashkent, Uzbekistan.

Extension Materials.

- Portable plastic chutes for Irrigation in the flat lands, ADB, ICARDA, SANIIRI;
- Laser assisted land leveling, ADB, ICARDA, SANIIRI;
- Planting cereals crops in standing cotton, ADB, ICARDA;
- Technology of planting winter wheat on raised beds, ADB, ICARDA;
- Resource conserving technology of irrigating cereal crops in Mirzachul desert area, ADB, ICARDA;
- Planting of cotton on raised beds and furrows, ADB, ICARDA.
- Simultaneous planting of legumes and cotton crops
- Planting Mungbean into maize
- Productivity of winter wheat planted on raised bed

Abridged Work Plans- SLMR activities (July –Dec 2008)

A. ICARDA Components

GIS Components	Qr3, 2008	Qr4, 2008	Expected results	Outcomes
1. Library searches for soil, climate and geological data bases	**X**	**X**	• Data enrichment	
2. Soil map compilation for CA and transformation into GIS layer format .	**X**	**X**	• Maps based on enriched data base	
3.Digitization and integration of CACILM site GIS projects	**X**	**X**	• CD is available	
4. Interpretations and synthesis		**X**	• Reports	• Mainstreaming of SLMR results into respective national program frameworks
Socio economic and policy research				
5. Full scale livelihood surveys launched in all SLMR sites	**X**	**X**	Impact of land degradation on rural livelihoods and farmers' coping strategies against land degradation evaluated	• Mainstreaming SLMR options for improved livelihoods and reduced land degradation
6. Ex-ante analysis of the SLMR technologies		**X**	• Report	

Developing a methodology for screening of improved winter wheat, triticale, barley and chickpea germplasm- for vigor and weed competitiveness.

Dual-purpose (green fodder and grain+ straw fodder) cereals and legumes can form an important component of the strategy for doubling the productivity of crop-livestock in Central Asia, and for rehabilitation of the degraded lands that directly influence the income generation potential and livelihoods of poor rural communities and farmers.

In order to enhance green fodder availability during harsh winter season for the livestock, 15 winter wheat cultivars, collected from the CIMMYT-ICARDA Joint Wheat Program based in Turkey are being evaluated for dual purpose (green fodder, grain + straws). In another trial winter wheat, barley and triticale, improved cultivars from Uzbekistan, are being compared for their performance for dual purpose. All the crop cultivars were planted in raised bed-furrow irrigated system for their yield performance, early- and mid- season vigor (competitiveness to weed) and ability to tolerate cold and salinity stresses. The study is being conducted in Tashkent Agrarian University experimental site with the objective to evaluate yield potential of autumn planted winter wheat cultivars, multiply seed for further research, and evaluate plant vigour during crop season so that selected cultivars are competitive to weeds and are suitable for getting fodder as well as seeds in autumn season plantings.

The crop cultivars were planted in randomized complete block design on 2 planting dates (20th of September 2008 and 10th of October 2008)in a non-saline soil (EC=10-13 ms/m). Early planted winter wheat was cut for green fodder on 12th November 2008 and later planted crop will be cut in March 2009. GreenSeeker Optical sensor was used to determine NDVI values at 7-day interval from germination.

Chickpea (6cultivars: FLIP 01-50C, FLIP 03-63C, FLIP 04-18C, FLIP 04-31C, FLIP 04-35C, Uzbekistansky 32) identified last year for early vigor and high yield potential were sown on Nov14, 08 to study their performance during the cold winter season of 2008-09. Results will be reported when become available.

Dual Purpose Winter Wheat

For the 15 winter cultivars planted in three replications. The plot size was 2.8 m^2 (1.4×2.0=2.8 m^2) for each cultivar (due to small seed quantities). Total number of subplots was 15×3×2=90. Typical plant (NDVI) growth curves /dynamics of the cultivars are shown on Figure1 for all the winter wheat accessions. The plot size for each of the improved Uzbek winter, barley and triticale crop cultivars was 1.4m×5.0m (7.0 m^2), replicated four times.

Photo 1. Dual purpose cereal crops, harvested for green fodder as proxy for grazing by livestok.

A. Assessment of dual purpose potential of winter wheat, barley and triticale crops

The green biomass values monitored on 12th November for the three cereal crops is given in Table 1 and the typical plant (NDVI) growth curves /dynamics in Figure 1.

Table 1.Fresh biomass of winter wheat, triticale and barley planted in September and cut in November 2008

Crop	Cultivar	Fresh biomass, gram/ 3.85 m^2	Average Green fodder biomass, t/ha
Winter wheat	Kroshka	2112.5	5.49
Triticale	Pragserebristyi	2757.5	7.16
Barley	Bolgali	4495.0	11.68

*Presto&Izgi winter wheat planted 10 days latter (20th September) had given fodder yields of 12/8 tons/ha.

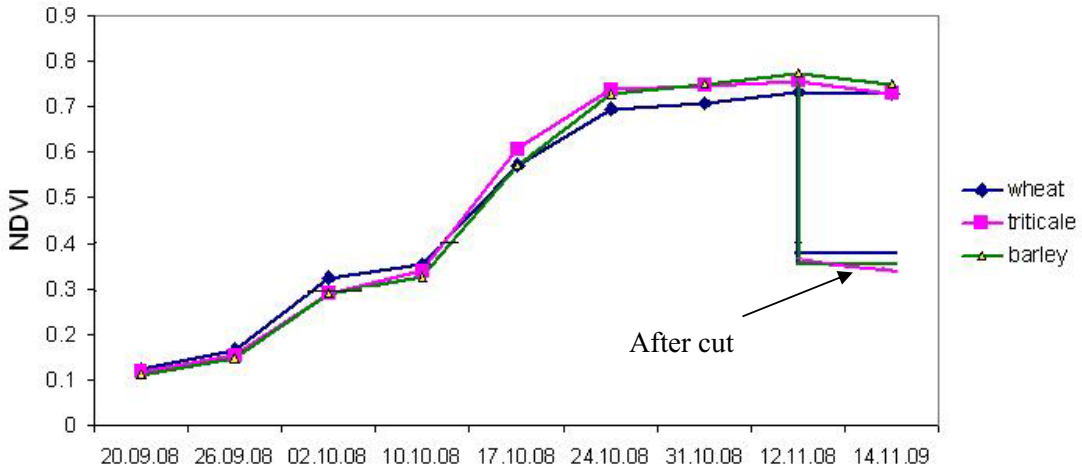


Figure 1. The NDVI values of winter wheat, triticale and barley cultivars at TAU site

Regeneration of wheat after cutting

The maximum fresh biomass was in barley (11.68 t/ha) followed by triticale (7.16 t/ha). Winter wheat produced the minimum fresh biomass (5.49 t/ha). The results indicate that green biomass availability from the selected improved Uzbek wheat , barley and triticale crops if grown for dual purpose to enhance fodder availability, will be in the order: Barley > Triticale > Wheat . These crops have high plant density which also facilitates cutting/ grazing during late autumn for initial winter season. Cutting of winter wheat, barley and triticale crops for fodder reduced the NDVI values. It was observed that NDVI variations between crops were reflected through the number of tillers (3-5) when the crops were cut for green fodder.

B. Correlation between green fodder biomass and NDVI measurements

The relationship between green biomass and NDVI for the three cereal crops is given in figure 2. The correlation coefficient at 44 day after emergency (DAE) of triticale, barley and winter wheat crops (Figure 2) was (r, 0.79). The correlation coefficient between Biomass and NDI was (r, 0,75) almost the same at 34 day after emergency (DAE) of 15 winter wheat cultivars (Figure 3).

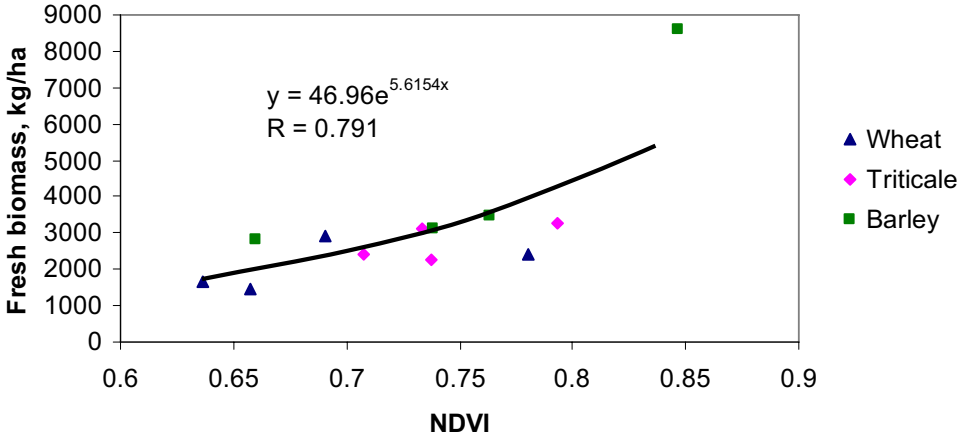


Figure 2. Fresh biomass as function of NDVI of triticale, winter wheat, barley crops at 44 day after emergency (DAE) in Tashkent Agrarian University, experimental site), Uzbekistan.

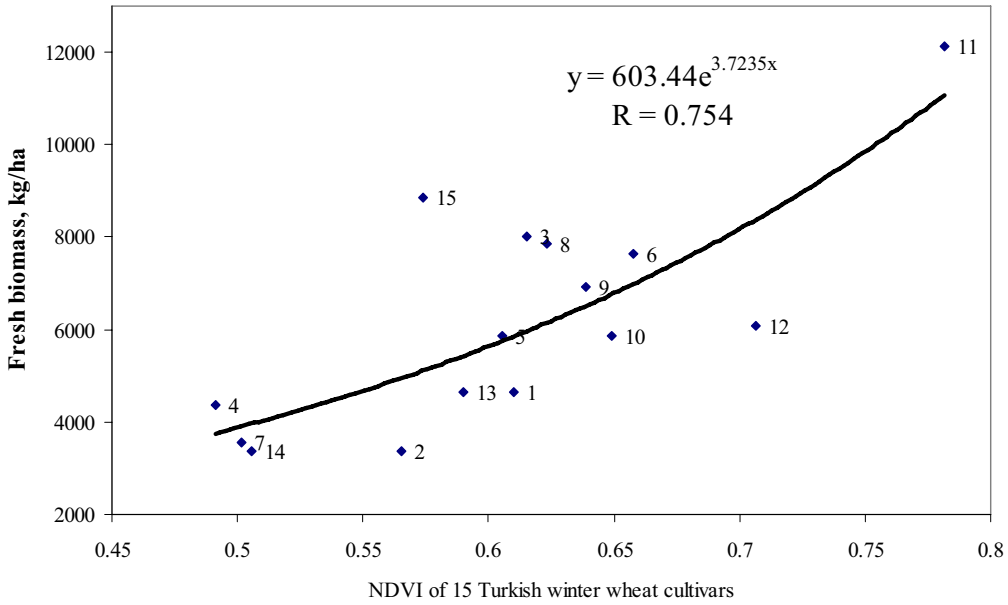


Figure 3. Fresh biomass as a function of NDVI of 15 Turkish winter wheat cultivars received from CYMMIT at 34 days after emergency (DAE) (Uzbekistan, Tashkent Agrarian University experimental site). The number indicate the accession of winter wheat cultivar.

C. Evaluation of the 15 winter wheat accessions

The NDVI indices show that there were wide variations in early growth vigor of the winter wheat cultivars. The varieties that are more vigorous in early growth stages compete with weeds more efficiently (weeds removed manually before NDVI measurements). Results are presented in figure 3 and green biomass yields obtained on 12th Nov. 2008 are given in Table 2 The initial results suggest that it is possible to improve green fodder / hay availability for the livestock during winter season and double the crop-livestock productivity in Central Asia. It was observed that winter wheat cultivar such as 'Presto' has excellent early vigor and can provide green fodder more than 10tons/ha for livestock. In this experiment, wheat cultivars after cutting for green fodder are being evaluated for their regeneration capacity in cold winter and (grain + straw) yield potential. Additional results will be available by end of crop season. The new germplasm will be subjected to winter cycle for devising a right strategy for combining the newly identified dual purpose wheat cultivar for its relay cropping in cotton-wheat system in Central Asia.

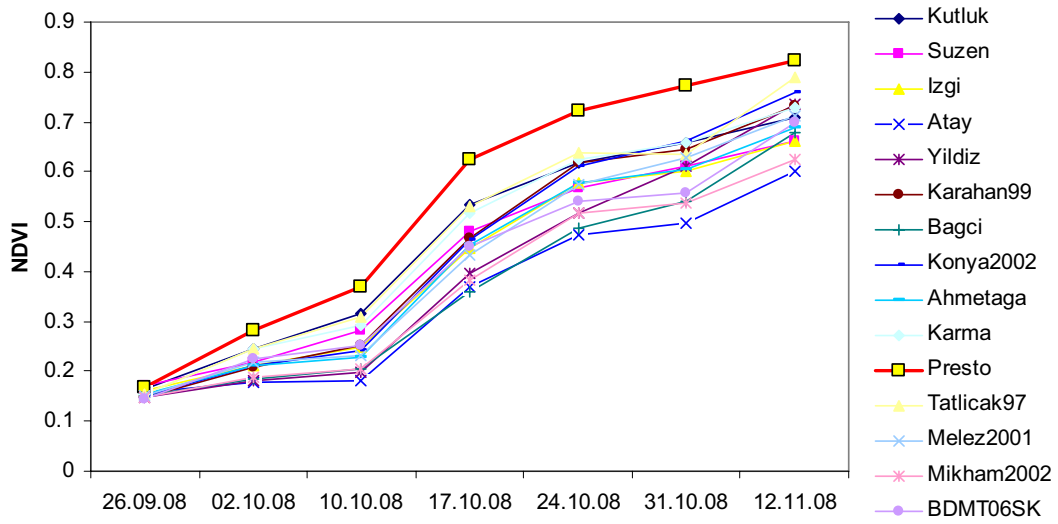


Figure 4. Dynamics of NDVI of winter wheat cultivars at TAU site, Uzbekistan

Fresh biomass of selected CIMMYT-ICARDA winter wheat accessions/ cultivars ranged between 3.36-12.14 t/ha with maximum fresh biomass. Whereas "Presto" variety yielded the maximum biomass (12.14 t/ha) and minimum green fodder was obtained (3.36 t/ha) from "Mikhan" and "Suzen" cultivars.

Table 2. Fresh biomass of 15 winter wheat cultivars at Tashkent Agrarian University site

Cultivar No	Variety	Fresh biomass, gram/1.4 m^2	Fresh biomass, t/ha
1	Kutluk	650	4.64
2	Suzen	470	3.36
3	Izgi	1120	8.00
4	Atay	610	4.36
5	Yildiz	820	5.86
6	Karahan99	1070	7.64
7	Bagci	500	3.57
8	Konya2002	1100	7.86
9	Ahmetaga	970	6.93
10	Karma	820	5.86
11	Presto	1700	12.14
12	Tatlicak97	850	6.07
13	Melez2001	650	4.64
14	Mikham2002	470	3.36
15	BDMT06SK	1240	8.86

Calibration and use of Optical canopy sensors (Green Seekers) for measuring crop development, comparing crop management practices for SLM and efficient nitrogen management.

An experiment is in progress at Uzbek Cotton Growing Research Institute's experimental farms in Tashkent to develop farm advisory for N management in winter wheat using optical sensors - GreenSeeker^{TM} (hand held optical sensor Model 505, NTech Industries, Ukiah, CA, USA)..The six treatments (amount of nitrogen in kg/ha of active component) included - 0, 50, 100, 150, 200, 250 kg N/ha were quadruplicated in 5 m x 3.6m size plots.

Similar experiments were also initiated in other countries to have a more robust N Calculator for the winter / spring wheat, grown in both irrigated and rainfed conditions of Central Asia. Collaborators were given the choice to have six N levels as per local soil conditions and each N level be applied in a minimum plot size of $9m^2$. Nitrogen will be applied into 2 splits as basal, at planting time and the balance of N at F3/F4 stage to winter wheat. It is planned to take NDVI measurements on different dates after emergence (DAE). Note the emergence date correctly or else use date of planting/ sowing date. Count the vegetation period from the emergence or planting date, taking into account only the vegetation period (Growing Degree Days (GDD) > 0 , where GDD refers to

GDD = (Tmin + Tmax)/2 – 4.4°C>0 , where Tmin, Tmax are minimum and maximum air temperature expressed in ^{o}C respectively .

In-Seasonal Yield Prediction for Yield of Winter wheat.

An experiment was initiated at the Uzbek Cotton Growing Research Institute with six graded doses of N (0-250 kg N/ha , with 50 Kg/ha incremental dose). Each treatment occupied 18 m^2 and was replicated four times. To validate the N responses , N-rich strips were established along with the traditionally planted wheat in standing cotton in the four (4) farmers fields. Periodically NDVI measurements were taken in farmer fields and also in the N-rich strips for validation of the N-calculator.

The trial was also conducted in Kyrgyzstan and Turkmenistan. The NDVI was monitored at different growth stages and the data were pooled together to develop a N response curve for the winter / spring wheat, grown in both irrigated and rainfed conditions of Central Asia. In this trial N was applied into 2 splits as basal, at planting time and the balance of N at F3/F4 growth stage to winter wheat. The vegetation period from seedling emergence to physiological maturity (Growing Degree Days (GDD) was calculated from climate data as:

$GDD = (T_{min} + T_{max})/2 - 4.4°C > 0$,

Where T_{min} and T_{max} refer to minimum and maximum air temperature both expressed in ^{o}C . Hence, the cool snowy period when air temperatures are below 4.4°C, are not accounted for as a vegetation period. In Season Estimated Yields (INSEY) were computed as :

$$INSEY = NDVI_{i=0;n;\ D=0,n} / DAE$$

where DAE refers to days after emergence (DAE). Response index of NDVI (RI_{NDVI}) and of yield to N fertilizer doses was computed as:

$$RI_{N=50;\ 100;\ 150;\ 200;\ 250} = (NDVI_{N=50;\ 100;150;200;250;\ F4(F6)\ stage}/NDVI_{N=0;\ at\ F6\ stage})$$

$$RI\ yield = (Yield_{N=50;\ 100;150;200;250}/Yield_{N=0})$$

Where $NDVI_{N=50;\ 100;150;200;250}$ refers to the NDVI of each N treatment and replication on F4 (F6) stage (F4-rainfed winter wheat, F6-irrigated winter wheat). Yield $_{N=50;\ 100;150;200;250}$ refers to wheat yield at N application rate of 50; 100; 150; 200; 250 kg/ha and $Yield_{N=0}$ refers to wheat yield at no fertilizer N application.

Development of Nitrogen calculator

The procedure for developing a Nitrogent Calculator provided during the training program organized jointly with ZEF/UNESCO, Urgench , is already available at ICARDA web site http://www.icarda.org/cac/files/slmr/GS%20Training%20course%20Report_Urgench-2008%20+%20BG.pdf

Establishment of Nitrogen Rich strips for validation of N response and provide Greenseeker optical sensor based Farm advisory service.

In order to validate the N responses, N –rich strips have been established on 4 farmers fields to take NDVI measurements . These farmers will also be allowed to practice their traditional N managment practice in winter wheat as usual. The NDVI measurements will be taken at F4-5 stage of wheat in N rich strip and conventionally N fertilized plots. Using the N Calculator developed at experimental sites, the Farmers will be advised to apply N to meet in-season crops demands for nitrogen. The procedure has been detailed at web site indicated earlier for field validation of the N- calculator

Preliminary results

Winter wheat crop was relay planted into standing cotton crop by participating scientists in different countries. Weekly NDVI measurements taken in Uzbek Cotton Growing Institute indicated that cotton stubles interfered with the NDVI measurements for the winter wheat. crops and it proved desirable to remove cotton sticks for proper NDVI measurements and calibration of the Sensor. Typical NDVI measurements taken in graded N fertilized plots on 25 October are shown in figure 5.

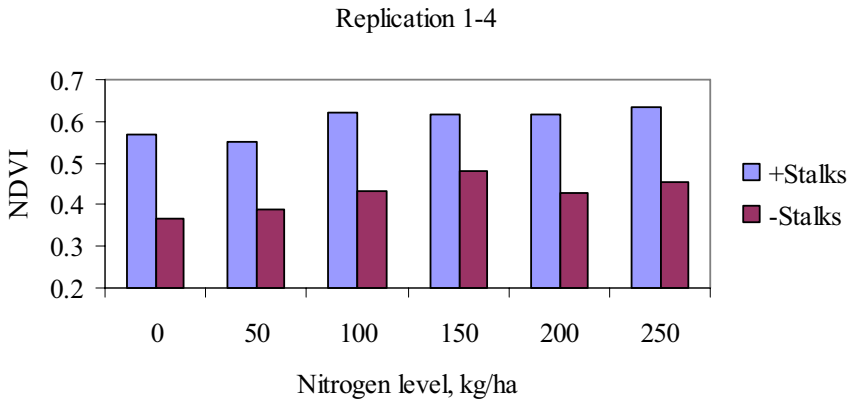


Figure 5 Effect of cotton stalks and Nitrogen level on NDVI of winter wheat at experimental plot on 25 October

At the end of the season when results are received efforts will be made to clean and pool the multi-location data for different wheat cultivars, irrigated and rainfed wheat crop grown in spring and winter season to develop a single N calculator for farm advisory service.

Socio-economic Studies

Land Degradation in Central Asia: A Review

The total arable land area of Central Asia is 399.75 million hectares, including 10.219 million hectares under irrigation. Of the total irrigated agricultural lands, 42.4 % are in Uzbekistan, 22.7 % in Kazakhstan (in southern Kazakhstan), 17.2 % in Turkmenistan, 10.6 % in Kyrgyzstan and 7.1 % in Tajikistan. Nearly 77.3 % of the total arable land area is in Kazakhstan and most of this highly dependent on rainfall. This paper reviews land degradation problems of the 5 Central Asian countries. The review structured has been designed in a manner that provides some insights about the complex and dynamic nature of land degradation processes, caused by a variety of biophysical, social and economic, strategic and institutional factors which vary in their relative importance between different republics. The review discusses the biophysical, socio-economic, institutional and political and policy related factors that influence land degradation, and attempts to describe the relative importance of these factors by country. The review suggests that post-independence acreages of farm lands have registered some declines in all the republics. The review suggests that increasing population pressure will need nutritious and more food at less costs . Producing more food, fiber and fuel from shrinking land and water resources may prove a daunting task and our ability to do so will depend on how successfully farmers will be able to adjust and fine tune their agronomic and crop management practices to adapt the on-going climate changes.

The review brings out the following significant conclusions:

- Rural population in central Asia is 55.0 million. Arable land occupies 9.8% of the total area. Although Central Asian countries have common agro-ecological characteristics and land forms in Aral Sea basin they differ in social well beings of their people. There is ample scope for doubling the productivity of crop-livestock in an integrated manner.
- Categories of land resources in the CA countries are almost similar, agricultural holdings consists of the arable lands (irrigated and not irrigated - rainfed areas), pasture and haymaking, lands for hydro economic, the desert and semi-desert lands, foothills and mountain lands.
- soil fertility declines seems to be related to in-appropriate use of land and or completely ignoring of crop rotation systems, and inefficient use of inputs including water.
- Land reforms and land ownerships in Central Asia have been carried out in accordance with specific socio-politico-economic situations developed in each country Land ownership in each CA country differs. Characteristic feature for all countries CA is, that land relations are outdated, farmer is not the land owner enjoying full rights, their rights are limited and are not protected enough,
- Amu Darya, Syr-Darya Rivers and number of small streams running on territories of one or several countries.Water between the CA countries is distributed under the interstate agreement signed by five countries. Water resource managements in the CA countries takes place at two and three levels. In all countries, the basic regulating functions are taken by the state, but at field level, water resources are managed by WUA (Water Use Associations), however their status is not well defined legislatively and hence water resources are not being used effectively.

- Long-term food security will depend not only on increase in agricultural productivity and sustainable land management but also on restoration of regional trade, political and infrastructural stimulation for agricultural production. The centralized markets of ready products and channels of delivery of raw and processed products have disappeared in the region. Local markets are the only basic channels available to small land owners and land users for sale of the goods and serves. Home markets also suffer from monopolism and corruption, administrative and customs barriers, and also product transportation facilities.
- Although institutional changes and market reforms have been taken up in post-independence periods, however, in many cases these reforms are administratively 'decentralized", but centrally command controlled. There is a lack of economic - management market mechanisms.
- In all CA countries the agrarian policy has changed and built under specific agriculture features, however general agrarian policy is oriented on self-reliance and import – substitutions. Such a policy is not always justified as it does not give the chance to use land and water resources effectively, reduces level of specialization and quality of production, raises expenses and the production costs and reduces competitiveness both in external and in home market.

- *Full scale surveys are going on in all the 5 central Asian countries. Surveys have been completed in Uzbekistan, Turkmenistan and Tajikistan. Final reports of the socio-economic and impact assessments of the SLMR technologies will be made available in July 2009.*

Work Plan for Kyrgyzstan (July –December 2008)

Kyrgyzstan	Qr3	Qr4	Expected Results	Outcomes
1. Evaluation of performance of new cultivars (wheat / Barley) suited to different tillage systems for improved water productivity in shallow water table conditions.	**X**		•Identification winter wheat cultivars for raised bed planting by: •Continue zero till winter wheat yield potential is not high (1.85 t/ha).	Farmers adopt new wheat cultivars if the seed systems in place
		X	•Test the two elite varieties of winter wheat •The analysis of agro-techniques of maize cultivation (spring and summer crops) with the use of raised bed planter will be conducted.	Agro-techniques for maize production is used in raised bed planting system with new herbicide molecules
2. Study the effect of different herbicide molecules (pre-and post-emergence) on weeds dynamics, water productivity for increased farm incomes.	**X**	**X**	• Weed management in spring and summer maize crops with the use of different pre- and post-emergence herbicides	Identification of herbicide molecules facilitates more area coverage under maize
3. Studies on the effect of controlled irrigation methods in improving crop -water productivity, and reduce irrigation-induced soil erosion.	**X**	**X**	•Effectiveness of the plastic portable chutes in maize grown on sloping lands . •Role of intercrops and analysis of the water saving, salinity on leveled field.	Plastic chutes become available locally for reduce soil erosion
4. Effect of the conjunctive use of fresh and drainage water on crop yields and soil quality (salinity build-up).	**X**	**X**	• Results on conjunctive use of saline and fresh water become available to meet crop water demands	
5. Evaluate the impact of laser-assisted precision land leveling on water savings, salinity and crop yields in irrigated agro-ecologies.	**X**		• Role of land leveling on yield and water use	
6. Calibration and use of Optical crop canopy sensors (Green Seekers) for measuring crop development, comparing crop management practices for SLM and efficient nitrogen management.	**X**		• N Calibration curve is developed with winter wheat crops	Saving of N in winter wheat, better farmer advisory services
7. Dissemination of results and developing mechanisms for up scaling and scaling out the SLMR options	**X**	**X**	• Field days organized on application of laser land leveling and raised bed planter. The event was widely transmitted via mass media including republican television. LL Demons on farmer fields organized	

Kyrgyzstan: Research Results from July –Dec. 2008

Activity 1. Evaluation of performance of new cultivars (wheat / Barley) suited to different tillage systems for improved water productivity in shallow water table conditions (*Site # 1: Daniyar farmer holding; Site # 2: Kenenbay farmer holding)*

In July 2008 samples of winter cereal crops harvested and the results on plant growth etc. have already been presented in the First Annual Report (July 2007 – July 2008) on page 68. Results on yield data have shown that under the raised-bed planting system , yield of winter variety of barley "Manas" and winter wheat variety "Asyl" were 4.92 t/ha and 3.40 t/ha respectively. Winter wheat variety "Intensive" was better than "Asyl" and its yield was 4.46 t/ha under the farmer's practice..

After winter cereal crop harvesting experimental area was ploughed for the depth of 23-25 cm on June 30, 2008, laser leveled on July 9-10, 2008 and maize was planted using raised-bed planter on July 11-13 for silage. At the time of maize planting nitrogen fertilizer was applied in the rate of N17. During the vegetation period germination stimulating irrigation was applied as well as 3 additional irrigations, cultivation, application of ammonium nitrate in the rate of N30 were applied. Observation over the stubby crops' growth and development has been carried out. Maize was harvested on October 4 at the phase of panicle formation when plants reached the height of 213 cm. Yield of green mass made up 91.0 t/ha.

Activity 2. Study the effect of different herbicide molecules (pre-and post-emergence) on weeds dynamics and biomass, water productivity for increased farm incomes.

In this experiment, during the period between July – September 2008, all the recommended agro-technical measures were adopted to study the effect of herbicide molecules on the weed population and their effect on crop growth attributes. Maize was harvested at full ripening stage. Before harvesting samples of maize corncobs were selected to determine the structure of yield and grain moisture. Since the grain cobs were stolen before the thrashing data only on plant attributes and the green biomass mass yield is presented in the Table 3

Table 3. Effect on herbicides on growth and yield of maize

#	Variations of experiment	Plant density, Thousand plants/ha	Productivity, t/ha		Plant height, cm
			Total Biomass	Including corn cobs	
1	Stomp 5 l/ha pre-germination	83,3	51,6	20,8	213
2	Esteron 0.6 l/ha pre-germination	83,3	49,3	20,5	210
3	Dilaen 1 l/ha after-germination	70,8	46,0	20,3	216
4	Titus 40 g/ha after-germination	64,8	45,3	18,4	213
5	Stomp +Dialen	64,5	45,3	20,7	217
6	Esteron + Titus	62,5	42,7	20,5	211

Results presented in Table (3) indicate that the total biomass (straw plus cobs) was more with use of pre-emergence herbicide stomp or when both pre- and post-emergence herbicides were used for control of several flushes of weeds observed during the growth of maize crop.

Activity 3. Studies on the effect of controlled irrigation methods in improving crop -water productivity, and reduce irrigation-induced soil erosion *(Kenenbay farmer holding)***.**

During the third quarter of 2008 the following researches and works have been carried out on the experimental site:

- Organization and carrying out researches on soil moisture before and after every irrigation using thermostatic-weighing method%;
- Calibration of the water releasing holes on chutes before every irrigation;
- Applying irrigation in accordance with the variations of the experiment;
- Observations over erosive process before and after each irrigation (selection of samples of irrigation water to determine the level of its turbidity as well as to measure the depth of furrow along its length under different water spending);
- Calibration of the humidity sensor under field conditions;
- Observations over weed plants on the field where herbicides Stomp and Dialen were applied before and after maize germination;
- Phenological observations over the growth and development of maize;
- Collection of data for determining biological and factual maize yields on variations of experiment.

Activity 4. Effect of the conjunctive use of fresh and drainage water on crop yields and soil quality (salinity build-up). *Daniyar farmer holding.*

Irrigation of the maize on the experimental site is conducted in three variations: (1) clean (irrigation) water, (2) drainage water, (3) clean water mixed with the drainage water in 1:1. ratio.During the experimentation spending of irrigational water was recorded and observations over the level of underground waters have been carries out. Soil samples have been selected for analyzing salinity formation. At regular intervals indicators of the automatic meteorological station have been were recorded and currently this data is being analyzed.
Plant growth and yield data presented in Table (4) indicate that use of drainage water decreased the yields from 12.5 to 8.6 t/ha. However, mixing the drainage water and canal water in 1:1 ratio, and use of the blended water supplies had just a marginal effect on the yield of maize crop. The results that if the saline (drainage water) is used in cyclic use mode (i.e use of fresh water at salt sensitive growth stages and saline / drainage water use in other stages) even the marginally adverse effect can be neutralized.

Table 4. Effect of use of saline drainage effluents on the yield of salt sensitive maize

#.	Variations	Plant density, thousand plants/ha	Productivity/Yield, t/ha		Plant height, cm	Notes
			total	Including corn cobs		
1	Clean (fresh Quality water)	69,2	64,0	23,3	69,2	12.5
2	Drainage water	62,5	48,0	17,8	62,5	8.6
3	Mixed water (1:1)	64,8	40,0	21,8	64,8	11.6

Winter wheat has been planted on this site after harvest of maize.

Activity 5. Evaluate the impact of laser-assisted precision land leveling on water savings, salinity and crop yields in irrigated agro-ecologies.

At the beginning of July 2008 after winter cereal crops harvesting moldboard plowing was done on Daniyar site for the depth of 23-25 cm; afterwards laser land leveling was conducted and on July 10-12, 2008 stubbly maize was planted for silage with the use of raised bed planter. On a field, with more than 3% slope, laser land leveling was carried out. After precision land leveling the level was just +/- 1 cm. Also laser land leveling was conducted on the neighboring fields in the area of 9 ha.

Activity 6. Calibration and use of Optical crop canopy sensors (Green Seekers) for measuring crop development, comparing crop management practices for SLM and efficient nitrogen management

Observations were carried out over maize plantations in the Daniyar farmer holding:

- Experiment has been laid out in accordance with six variations and three replications;
- Calibration of the Green Seeker has been done on variations of nitrogen application from 0 to 90 kg/ha with 15 kg N incremental step.
- Measurements with the sensor have been carried out after every 15 days;
- Currently the data is being processed.

Activity 7. Organizing trainings and dissemination of technologies. Training courses, farmer days, interviews on radio and television, information published in newspapers.

Researcher Bakyt Asanakunov attended training course on Green Seekers that was organized by ICARDA in August 2008 in Uzbekistan.

Farmer days and reports on televisions

Farmer's Day and Filed workshop was organized on use of raised bed planter during 10 and 11 July 2008 on the fields of Daniyar farmer holdings. On July 10 laser land levelling and raised bed planting of stubble maize were demonstrated to farmers, researchers, agricultural specialist and mass media representatives. On July 11 Field workshop was organized for demonstrating how to adjust laser land leveller and raised-bed planter as well as operation of this equipment in the field was demonstrated.

Information on Farmer's day and Field workshop were transmitted via three republican channels, two radio stations as well as were printed in three republican newspapers.

Work Plan for Kazakhastan (July –December 2008)

Kazakhstan	Qr3 2008	Qr4 2008	Expected Results	Outcomes
1. Evaluate the current status of land degradation in irrigated lands of "Kaptagay" LLC in Shielli massif of Kazakhstan.	X	X	• Identification of critical areas for soil salinity and water table depth (maps scale 1:25000) for land use planning • Recommendations on soil amelioration	• Farmer associations use the land use maps for land development
2. Assessment of the existing soil organic carbon status and potential for carbon sequestration in irrigated lands of "Kaptagay" LLC in Shielli massif of Kazakhstan.	X	X	• Soil fertility maps for rationale use of (NPK) fertilizer nutrients in rice based cropping systems. • Carbon sequestration potential as a result of applied SLM-R techniques	• Farmer associations adopt rationale fertilizer practices in rice systems
3. Studies on the effect of irrigation schedules on rice yield, saving in irrigation water and salinity of the ponded waters and soil profile.	X	X	• Increasing productivity of direct dry seeded rice crops • Saving in irrigation water and drainage volumes for disposal • Economic analysis of production costs	• Direct dry seeded rice technology on wide raised beds is adopted by the farmers
4.Study the effect of different border dimensions on salt- water-salt balances in rice culture for saving in irrigation water and salt buildup.	X	X	• Seasonal dynamics of salts in rice systems to effect savings in irrigation water • Analysis of the economic effectiveness	• WUA change water allocations
5. Evaluate the performance of new rice cultivars developed in Kazakhstan and Russian Federation	X	X	• New Rice cultivars identified for higher yields and tolerance to stresses • Analysis of the economic effectiveness	• New rice cultivars become available to increase biodiversity
6. Calibration and use of Optical crop canopy sensors (GreenSeekers) for efficient nitrogen management	X	X	• Development of a N calculator for farm advisory services and in-season yield predictions Winter wheat would be planted in 2008	• N Algorithms used in farmer advisory in due course
7. Evaluate the performance of different trees, shrubs, grasses, fodder and cereal dual purpose crops in submontane plains, sand massifs, and sands in Abylai area.	X	X	• Identification of fodder species for biotic and abiotic stresses for the livestock • Improving the surface cover to reduce the wind erosion	• Dual purpose cereal crops help reduce fodder • Shortages and prevent overgrazing.
8.Dissemination of results and developing mechanisms for up scaling and scaling out the SLMR options	X	X	• Organizing seminars / traveling seminars, Farmer field days and Radio/ TV talks to promote adoption of SLM-R M practices .	• Better understanding of land degradation and technical options
			•	•

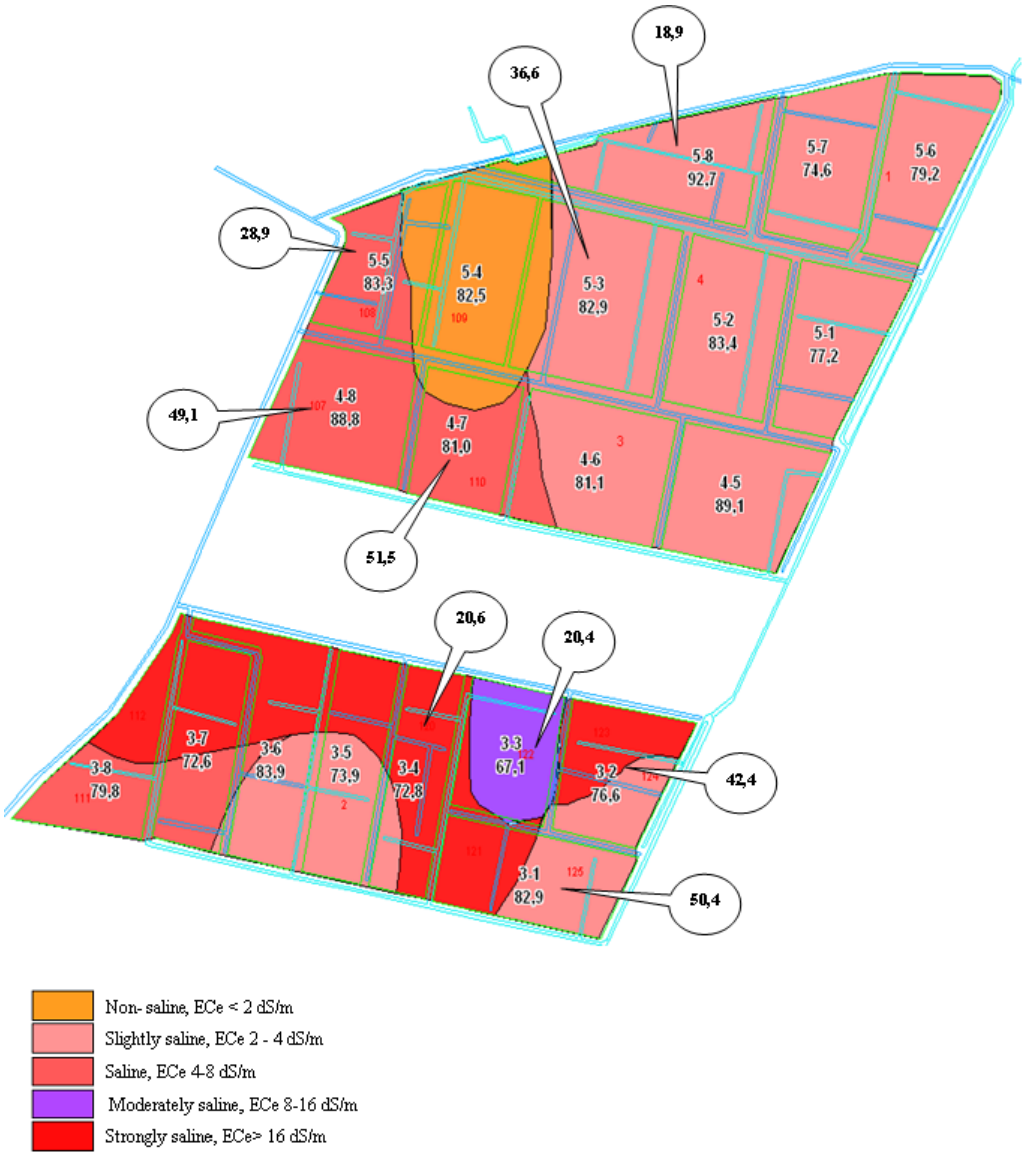
Activity 1. Evaluate the current status of land degradation in irrigated lands of "Kaptagay" LLC in Shielli massif of Kazakhstan, and

Activity 4. salt- water-salt balances in rice culture for saving in irrigation water and salt buildup.

In order to delineate critical soil salinity areas in the farm in autumn 2007, a soil salinity map (1:25000) was developed for the whole territory of the Kaptagay Farmers' holding. Spatial changes in salinity were monitored during the rice season along with rice yield obtained in different fields (Map 1). Farmer association has a practice of rotating the fields for different crops such as to improve soil fertility and reduce biotic and abiotic pressure. In the preparation of this map, a decimal system was used. The numbers such as 3.2 , 4.6, 5.1

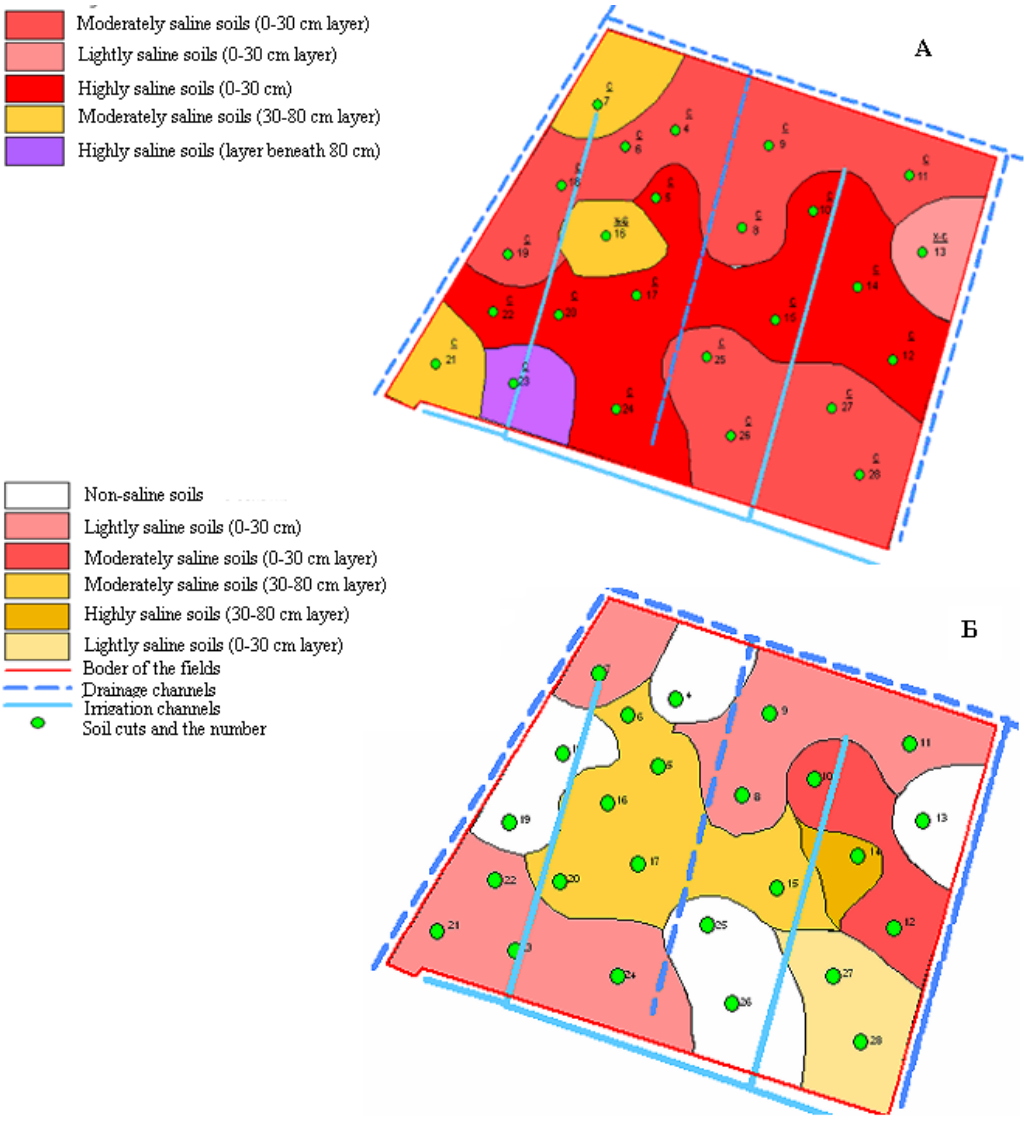
etc. refer to field number (2,6 1) allotted to crop rotations (3, 4, 5) practiced in farmer holdings. The whole numbers below the decimal system refer to size of the field plots.

Rice crop was allotted along the soil salinity contours- ranging from non-saline to highly saline (non-saline, slightly saline, saline, moderately saline and highly saline) as shown in figure (1). The Yields of the rice crop are given within the balloons. Yield data suggested that crop yields decreased as the soil salinity increased. The highest yield (above 5.0 t /ha) was obtained in non-saline (4.7 and 3.1) plots. The minimum rice yield ~ 2t/ha was in plots which were saline (5.8) or strongly saline (3.4, 3.3).



Map 1. Map showing classes of saline soils, rice yields in Kaptagay farmer holding.

Distribution of soil salinity in the farm holding before and after rice crop season of 2008 has been shown in maps (2a and b) respectively. Results show that large portion of the farms was either moderately or strongly saline in the spring/ summer season, 2008 when salinization rates are often high. Rice cultivation shifted the balance in favor of non-saline, slightly saline, saline or moderately saline categories. Together with acreages of salinity classes (table 5), results suggest that water use in rice only helped in some salt leaching and redistribution of salts within the farms rather than resulting in complete removal of salts from the root zone in the farm soils. Rice crops is able to do better than other dry season crops (cotton, wheat etc) in these saline soils, mainly because of ability of rice to tolerate ponded water conditions which results in salt dilution in the rootzone and the fact that some salt removal invariably takes place due to ponded conditions. This is inspite of the congestion in the field drainage system.



Map 2 (a & b). Distribution of soil salinity in the farm holding before and after rice crop season of 2008

The classification of saline or salt –affected soils in to broad categories is based on chemical properties rather than distinct differences in soil morphology. The artificial classification of

soils in particular category based on salt content in upper-30cm and 30-80cm was avoided (but used in Kazakhstan) mainly because salts are highly mobile in nature and can change their position based on season, irrigation regimes, water table situations and climatic conditions at the sampling time.

Table 5 Changes in the area (ha) of different classes of saline soils during rice cultivation .

Broad categories of saline soils	**Spring 2008**	**Autumn 2008**	▲(+, -)
• Non-Saline ECe< 2dS/m	-	7,0	+7,0
• Slightly Saline ECe 2-4dS/m	4.4	12.7	+8.3
• Saline ECe 4-8dS/m	13	8.0	-5.0
• Moderately saline ECe 8-16dS/m (only tolerant crop can grow)	9,9	0.7	-9,3
• Strongly saline, ECe>16dS/m	1,1		-1,1

Therefore, classification is designed here to facilitate discussions of soil and crop management. Data in table (5) above confirm the notion that only a small fraction of this large farm holding get benefit of salt leaching inspite of use of more than 25000m^3 /ha of irrigation water in rice cultivation. These results clearly indicate that the drainage system is congested and require immediate attention for achieving our twin benefits of increasing the productivity of rice and removal of salts from the this tail-end portion of Syrdarya river basin.

Activity 2. Assessment of the existing soil organic carbon status and potential for carbon sequestration in irrigated lands of "Kaptagay" LLC in Shielli massif of Kazakhstan.

Soil samples have been collected at the end of the rice season are being analyzed for soil organic carbon. Results of the chemical analysis of soil samples will become available after few months.

Activity 3 Studies on the effect of irrigation schedules on rice yield, saving in irrigation water and salinity of the ponded waters and soil profile.

In rehabilitation of degraded irrigated lands used for rice production, in Kyzylorda, development of the rational system of irrigation- water delivery and drainage from rice fields is of crucial importance in maintaining the salinity of the ponded water during vegetation period. In order to understand the dynamics of the traditional rice production system, an experiment was conducted on a degraded land, 28 ha in area belonging to farmer holding "Kapragay" situated in the lower part of Syrdaria river. Rice crop was direct seeded following the traditional system of broadcasting seed followed by submergence on May 9,2008 and harvest at the end of August, 08 . Rice crop was harvested in September12-15, 08. Amonium sulphate was applied @ 300Kg/ha at pre-planting and 100Kg/ha ammophos during germination and Azimsulphuron @ 30g/ha was used for post emergence control of weeds. The treatments included two irrigation regimes namely the (i) short flooding, and (ii) permanent flooding. For measurement of irrigation and drainage water, check plots were established to monitor discharge and to assay water quality.

The results presented in Table (6) indicate that permanent flooding and short flooding had a small effect in saving irrigation water . Compared with permanent flooding, short flooding saved only 5% irrigation water (Table 6). Irrigation rates for short flooding were found to be 24200 m^3/ha and 25480m^3/ha for permanent flooding. It may be

mentioned that on an average 10cm depth of water is invariably kept ponded during crop season except in flowering and milking stage (18 day) when depth of ponded water was increased to 15cm. If the results of the raised bed planting trials are combined with flushing technique at appropriate growth stages further savings in irrigation water could become possible. The short flooding improved the grain yields of rice only marginally (100kg/ha).

Table 6. Effect of irrigation regimes on rice productivity and irrigation water used.

Rice irrigation regimes	Salt load within 2 m soil, t/ha	Water salinity in the rice check plots, g/l	Irrigation rate, m^3/ha	Rice yields, quintals/ha	Irrigation water use, m^3/quintals
Permanent flooding, water replaced	176,4	1,32	25400	43,84	579
Short flooding, water replaced	179,1	1,58	24800	44,91	552

The water productivity improved only marginally mainly because the depth of standing water in short flooding was kept almost the same as the permanent flooding. However, for crop production on degraded saline soils flushing of salts/ water replacement is an advisable practice particularly during germination stage when ECiw (salinity of irrigation water) in the rice check plots excceded 2.0 g/l (> 3 dS/m). Infact advantage of flushing depends on the salinity of the irrigation water. In order to compute salt balance/ determine seasonal dynamics of salts soils have been sampled (scale 1:2000) on site (field 8 of the fourth crop rotation) to develop soil salinity maps using *MapInfo Professional*.

Activity 5. Studies on the effect of irrigation schedules on rice yield, saving in irrigation water and salinity of the ponded waters and soil profile. Study of the raised bed rice cultivation.

Using a multicrop Indian raised planter, rice crop was seeded in dry soil in Kaptagay situated in Shiely region. Many agricultural crops including rice can be planted with this multicrop planter, both in raised bed and zero till planting systems. Before planting rice, a five hectare field was tilled, and leveled before to make raised beds and furrows. Fertilizer was applied (ammonium sulphate – 300 kg/ha, ammophos – 100 kg/ha), and mixed with soil by a zigzag harrow, and rolling the soil with the ring shaped roller. Using an Indian raised bed planter, rice crop (cultivar Marjan) was seeded, followed by irrigation on May 10-12, 2008. The raised bed- furrow system was spaced at 90cm interval. The seed rate was varied from 90, 110, 130, and 150 Kg/ ha. For traditional planting (control), rice seed (250 kg/ha) was broadcasted and pressed with a light iron roller to establish the seed-soil contact. Gulliver was applied @ 25 g/ha. During the tillering stage ammonium sulphate was applied at the rate of 200 kg/ha. Major weeds included the reeds and pigeon grass at germination and emergence stages.

The irrigation regimes followed, included (a) 3-5 cm submergence of beds during germination, (b) 10-12 cm during vegetative phase to control weeds, (c) 3-5 cm during tillering (d) 15 cm at flowering and milky stages and (e) terminate watering after waxy stage . Results indicated that increasing the seed rate although increased population of rice plants but it had no effect on the grain yield.

Results on plant density determined after germination and before herbicide application indicated that higher surface coverage by rice (due to increasing rice seed rate) did not

influence population of weeds, possibly due to variable seed bank of weeds in the large sized plots. Plant density of rice at harvest was observed to increase with rice seed rate. It was observed that high plant density reduced the vegetation period possibly due to strong competition for nitrogen. Data in table (7) indicate that there was no advantage of using a high seed rate (250Kg/ha), traditionally used. Yield obtained at seed rate of 90Kg/ha was at par with 250Kg/ha seed rate. Thus farmers can easily save seed to the extent of 160kg/ha

Table 7. Effect of seed rates on density of rice plants and weeds in raised bed system.

Treatments seed rate, kg/ha; (10^6 plants /ha)	Plant density, # plants/m^2			Germination of rice seeds, %	Survival of rice plants, %	Vegetative periods, days	Yields, t/ha
	Rice		# of weeds				
	Emerged	At harvest					
90 (2.7)	70,7	30,7	13,3	26,1	43,2	114	4,90
110 (3.3)	126,2	42,0	11,1	37,9	33,3	112	5,20
130 (3.9)	130,2	46,7	51,6	33,4	35,9	110	5,25
150 (4.5)	159,1	60,0	109,8	35,4	37,7	109	5,16
Control 250 (7.6)	178,2	74,7	21,3	23,4	41,9	109	5,27
HCP_{05}	37,86	11,61					0,46

 # Total weed numbers include the Reeds+ Tuberous reed+ Pigeon grass. It may be mentioned that Pigeon grass was observed as the predominant weed.

Low survival percentage of the germinated rice seedlings suggests that there is an urgent need to improve survival counts through (a) precision land leveling, (b) further reduction in seed rate and (c) reducing the depth of submergence in initial phase before tilling (20-40 days after emergence). It has already been reported that improving the DSR technology on the raised bed can easily save more than can 15% irrigation water (nearly 60-70cm column of water /ha), reduce yield losses due to crop lodging, and avoid the need to apply more N at higher plant population.

Activity 5b. Evaluate the performance of new rice cultivars developed in Kazakhstan and Russian Federation.

Seven rice cultivars four from Russian Federation and 3 from Kazakhstan were evaluated in a field trial in Kaptagay. It was observed that compared with the local check (Marjan), the Russian cultivars (Lider and Amber) gave the highest yield (> 5t /ha). Results presented in table (8) indicate rice productivity can be improved by more than a ton/ ha simply by changing the traditional rice cultivar "Marjan".

Table 8 Performance of rice cultivars

Cultivar	Origin	Yield, t/ha
1. Aru – ultra early maturity	Kazakhstan	3,45
2. Movator –early maturity	Russian	3,65
3. Marjan– medium duration	Kazakhstan	3,75
4. Aral 202 –medium duration	Kazakhstan	4,3
5. Lider – medium duration	Russian	5,2
6. Amber - medium duration	Russian	5,1
7. Rapan - medium duration	Russian	3,45

Activity 5 C. Effect of growth promoters on performance of rice cultivars

It has been observed that use of growth stimulators through seed treatment before planting significantly influenced rice plant density. Without seed treatment, plant density was 42.5 plants/m^2 , With seed treatment (2.5% solution of sodium humate and Mers applied @ 100 ml /ha), plant density ranged from 104.7 to 105.8 plants/ m^2. The yield of rice in control plot without seed treatment was 5.51 t/ha. Treatment of seed with sodium humate yields 6.75 t/ha and with Mers 6.63 t/ha rice paddy. The seed treatment with Mers or sodium humate improved the rice yield by more than one ton/ha (1.1-1.2 t/ha). It may also be mentioned that here that differences between growth promoters was not statistically significant.

Activity 6. Calibration and use of Optical crop canopy sensors (GreenSeekers) for efficient nitrogen management

An experiment has been initiated following a common methodology presented in an earlier section. The detailed results (N response, INSEY, and N calculator etc.) will be presented at the end of the wheat season and efforts will be devoted for developing a unified and more robust N response curve for all the sites .

Activity 7. Evaluate the performance of different trees, shrubs, grasses, fodder and cereal dual purpose crops in submontane plains, sand massifs, and sands in Abylai area.

Experiments were conducted in the Abyalay farmer holding, "Kuralas" farm in Sarysuyskyi district in Jambul rayon of the Republic Kazakhstan. In second half of 2008, weather was very hot (~ 45C) and dry which adversely affected the growth and development of both cultivated and wild species of fodder plants in the pastures. Rainfall was observed in early October but by this time temperatures were approaching < 0C minus due to first snow in the first week of November.Crop phenological observations were collected which revealed that the best survival rate under "Jetykyrka" sub-mountain plain conditions was with:

- Izen plant – *Kochia prostrata* (species BT-1, BT-6, K-121, K-820),
- Teresken seryi – *Krascheninnikovia ceratoides* and
- Chogon – *Halothamnus subapyllus*.

Due to drought like conditions, density of these plants decreased by 40-58% in comparison to that observed in June and ranged from 2 to 7 plants/ square m. (Table 9).Plant survival in sandy soils (Bilal site) was higher than in the submountain zone. In late June, the plant density for Izen was 5 plants m^{-2} which decreased in Nov. 08. High temperature and moisture shortage had an adverse effect on plant growth. Plant height of Izen did not exceed 8-9 cm, Teresken height was 11-13 cm, chogon plants height ranged from 17-21 cm. Due to drought like conditions, the studied species were not able to produce good biomass. Observations over growth and development of Artemisia, keireuk (Salsola Orientalis), jitnyak in natural pastures have indicated that these species developed poorly and did not produce any fruits. Dry biomass ranged from 0.08-0.11 t/ha.

In order to promote saxaul (Haloxylon), chogon *(Halothamnus subapyllus)*, juzgun Calligonum, teresken *(Krascheninnikovia ceratoides)*, Izen (*Kochia prostrata)* and other plants, two seed collection expeditions were organized in July and October, 2008. In July, seed were collected for : juzgun (Calligonum), Astragal, and jitnyak (wheat grass, Agropyron).In October expedition, seed were collected for – Izen, tersken, chogon, saksaul seeds had been collected .

Table 9 – Plant density of fodder plants at Jetykyrka and Bilal sites in Abylay farm.

Site	Planting	Species and entry	Plants density/m^2		
			23.July	29.Sep	18.Nov
Jetykyrka	collection	Kohia prostrata subsp. grisea BT-1	8	7	7
		K-118	1	-	-
		P-2	2	1	1
		P-28	1	1	1

		K-5	1	-	-
		BT-6	4	3	3
		K-121	5	3	3
		K-822	1	-	-
		P-30	2	1	1
		K-131	3	2	1
		K-735	3	1	1
		K-831	1	-	-
		K-820	4	3	3
		Krascheninnikovia ceratoides	5	4	4
		Krascheninnikovia eversmanniana	4	2	2
		Halothamnus subapyllus	3	2	2
Bilal	pure	Kohia prostrata subsp.grisea	4	4	3
		Halothamnus subapiyllus	3	3	2
		Calligonum eriopodum	1	1	1
	mixed	Kohia prostrata subsp.grisea	3	2	2
		Krascheninnikovia eversmanniana	2	2	2
		Halothamnus subapyllus	2	2	2

Seed Multiplication of native fodder shrubs

Collected seed germplasm of (Teresken, Cherkez, Izen, Chogon, Espartset Ferghana, espartset Horasan and saxaul species, mixed Izen, Tersken, Espartset, Astragal Lisovidnyi, Juzgun and saxaul species) were planted in November in Bilal site, where soil moisture regime was more favorable. Total planted area was about 2.2 ha

In order to improve fodder availability, triticale seed (200 kg), received from Krasnovodopad Experimental Station was planted in Karalas farmer holding in Ushata site. The farmer holding was organized in 1997. It is located in mountain zone of Karatau. The area of arable lands in Karalas farmer holding is about 650 hectares. The farm is engaged in cultivation of grain crops and forage production. On a favorable site in the farms triticale was planted for seed multiplication in about 1.5 hectares area. The seed from multiplication site will be planted in Abyalay on a sizeable area to avoid bird damage. In Abyalay farm holding, there are several free flowing / or very shallow artisan wells. The fresh water not used in fodder production only causes water logging and associated problem of secondary salinization. Each artisan well can serve the purpose of irrigating 5-10 ha area. When the triticale, barley and winter wheat is planted near the watering points, these crops can provide sufficient fodder for a herd of 1000 small ruminants during the harsh winter season when fodder shortages acute and ruminants have survive on just the survival ration of 2-4 kg fodder / day which lead to their high mortality rates. In our fodder trials with dual purpose wheat, barley and triticale, the green fodder yields were observed to range from 5-10 tons of green fodder. Few hundred tons of green fodder if produced near the free flowing artisan wells can significantly reduce the fodder shortages for the livestock. The Research team also prepared an *Album titled: " Forage crops of arid zone pastures* ".

7. Dissemination of results and developing mechanisms for scalingup SLMR options.

Seed Multiplication for promoting chickpea cultivation

Results of several earlier trials conducted by ICARDA in Uzbekistan and Kazakhstan have clearly indicated that productivity of winter chickpea is almost double of spring planted chickpea crop. It is therefore, 2000kg of a chickpea elite cultivar released by Kazakhstan was provided to farmers for winter planting.

- Area planted with raised bed Dasmesh planter – irrigated crop 2 ha, weeds is a problem in the field as none of herbicide molecule (Fuzilad Super, Gezagard, Topik, Puma Super, etc.) was available in the area to kill weeds.
- Chickpea was also planted in an other 8 ha of irrigated land within the farmer holding "Nazim".
- In order to avoid weedy problem planting of winter chick pea was planned between 1-7 December, 2008 on a 6 ha rainfed lands near Red Water Fall ACS (Krasniy Vodopad Station). Planting will be done using Kazakhstan planter C3C-2.1.

Remaining 400kg seed will be used to plant 4-5 ha on farmers fields. Planting on their fields will be conducted during 10-14 December, 2008. The major reason of delay in planting is the unawareness of farmers regarding existence of any winter variety of chick pea. It is planned that the farmer holding "Nazim" obtains state license that will allow them to go for seed multiplication of chick pea and produce elite varieties of seeds for supplying to neighboring farmers of the region. Currently chickpea seed is not produced in Kazakhstan.

Farmer field days/ TV,Radio talks, Press Reports and Publication.

#	Dates	Activity	Participants
1	2.8.2008	New technologies of rice growing, Kaptagai" in Shiely district of Kyzylorda	First Deputy Akim of Kyzylorda, Deputy Akim of the Shiely district specialists from Agric. Dept. Kyzylorda and Shiely, representatives investment firm "Dihan" and Farmers, Dikhan, (60)
2	2.8.08	TV and Print Media	Akims and other interviwed after field visits
3	25-26 .8.08	Radio /TV talks on field Days and DSR technology	Raj Gupta, Bakiryly K, Djamantikov Kh. (Kazakh scientific research institute), Dr. Otarov, Almaty
4	14.9.2008	Dr. Karlikhanov K interviewed by National Telechannel «Khabar>	Dr. Karlikhanov, Director, on the SLMR technological options
5	3-9-2008	Newspaper Report - Syr boiy № 183 (17501) dated September 3, 2008- Is the new method of rise cultivation capable of increasing rice productivity»?	Director of the Kazakh Scientific Research Institute of Rice Growing

SLMR Publications:

1. Отаров А. Современное экологическое состояние почвенного покрова Шиелийского массива рисосеяния. V-ая Международная конференция «Проблемы экологии агропромышленного комплекса и охраны окружающей среды», г. Кызылорда, 10-12 апреля 2008 г.
2. М.А.Ибраева Гумус рисовых почв Акдалинского массива орошения. V-ая Международная конференция «Проблемы экологии агропромышленного комплекса и охраны окружающей среды», г. Кызылорда, 10-12 апреля 2008 г.
3. Otarov, V. Ibraeva, G. Aidarkhanova, A. Saparov. Ecological monitoring of agrocenosis in different areas of Kazakhstan. // Journal Ecolog8 & Safety. International Scientific Publications, Vol. 2, Part 2. Published by Info Invest, Bulgaria, 2008, ISSN 1313-2563, p. 20-29.
4. Karlikhanov,K. Study of the raised bed cultivation of rice // Materials of the Vth International Conference on « Ecology problems of the agrarian and industrial complex and environment preservation», II volume,
5. An Album titled: " Forage crops of arid zone pastures " has been prepared by team working in Jambul (Kazakhastan) and Kyzylsek (Uzbekistan).

Work Plan for Tajikistan (July –December 2008)

SLMR Activities: Tajikistan	Qr3 2008	Qr4 2008	Expected Results	Outcomes
1. Effect of Strip cropping on runoff and soil erosion in sloping lands under in agri-horti production system	**X**	**X**	• Winter crops are planted on sloping lands prevent the erosion and surface runoff .	
2. Study the impact of tillage, terrace configurations and snow catching soil moisture conservation and yield of cereal crops and grape fruits, soil erosion in sloping landscapes	**X**	**X**	• Higher productivity of grapes and intercrops and reduced soil erosion	Snow catch practices reduce drought like conditions and improve yields
3. Rationale use of degraded sloping lands for enhancing productivity in low and high rainfall regions.	**X**	**X**	• Crop suitability according to landscape	Biodiversity is enhanced
4. Evaluate the efficiency of mechanical and vegetative measures in control of gully erosion for rehabilitation of degraded sloping lands	**X**	**X**	• Tree species and grasses identified to facilitate gully pugs (phyto-ameliorative measures).	Phyto-ameliorative measures are mainstreamed and promoted by government
5. Calibration and use of Optical crop canopy sensors (Green Seekers) for measuring crop development, comparing crop management practices for SLM and efficient nitrogen management.	**X**	**X**	• Winter wheat crop is planted to develop N Calculator	N algorithms used in farm advisory
6.Promoting communities based nursery raising for plantation in sloping lands.	**X**	**X**	• Tree sapling nurseries are developed and distributed amongst farmers	Farmer associations begin to raise nurseries to enhance availability of the tree / fruit tree saplings
7. Dissemination of results and developing mechanisms for up scaling and scaling out the SLMR options	**X**	**X**	• Booklets, leaflets, digests and recommendations on RCT advanced methods will be prepared and disseminated widely amongst population. Mass media also will be attracted.	Better understanding of the SLM options for reduced land degradation
8. Evaluate the performance of wheat, barley, rapeseed and cotton and Halophytes in saline soils in Vakhsh	**X**	**X**	• Salt tolerance of (wheat, barley, rape seed, cotton and halophytes – winter crops) crops in Vakhsh valley.	New seed systems may emerge
9. Study the impact of land leveling and on salinity and soil moisture patterns and crop performances using EM probe &OS sensors .	**X**	**X**	• Benefits of land leveling in water saving and enhancing productivity.	

Tajikistan Report July 2007 – December 2008

Activity 1. Effect of strip cropping on runoff and soil erosion in sloping lands used under in agri-horti production system

An experiment was conducted in triplicate on a sloping land in Faizabad. The runoff sites is located on slopes with an incline of 8-12% in South-Easternly direction. The size of runoff plots is 400 m^2 (10x40m), the measurements of surface runoff and sediment load wwas planned for the plots in the period of precipitations (March-May) using volumetric method; determination of solid sediments in runoff water collected from tanks/ gully using volumetric cylinders. gully. For registration of quantity of precipitations and intensity of their falling the Tretyakov Precipitation Gauge is mounted at site together with Pluviograph.

Crops (Lentil + spring wheat + Lucerne) were planted in strip plots on the gullied site and different cultural operations were carried out as per recommendations for the different crops namely the winter wheat,mushing (local name, ?), lentils, alfalfa and *Onobrichis.*

During the period between March 2007 –May 2008, Tajikistan faced a serious drought with very little precipitation. Because of famine like situations, non of the spring crop could survive. In winter season of 2007, crops were planted again. The yields of these crops are given in (table 10). However, due to severe soil moisture stress the yields were very low (2.4 – 5.0 quintals/ha). It was observed that productivity of perennial grasses was decreased by two-three times and yielded only 20-25 quintals/ha. In previous years with sufficient precipitation, productivity of two year standing alfalfa and *Onobrichis* was between 70-100 quintals/ha.

Besides the strip plots having the provision of Tretyakov Precipitation Gauge mounted together with Pluviograph, crops were also planted in one hectare area in two plots, nearby the strip plots. The first plot was at a slope of 16-18^0 . Crops such as lentil, spring wheat, and alfalfa were planted in the strips. The upper strip was used for lentil and the lower one for growing alfalfa.

The second plot was at a slope of 6-8^0. Crops were planted in strips following scheme: spring wheat + lentil + alfalfa. In this plot, however the position of lentil and wheat crop was interchanged. All the spring crops were planted in the beginning of March, 2008.

In the first plot (slope, 16-18^0) all crops completely failed due to drought. In the second plot with (slope, 6-8^0) The grain yield of spring wheat was (13 quintals/ha), and of lentil (7,2 quintals/ha) and alfalfa (45 quintals/ha). Yields of the stripped crops are given in Table 10 for gullied and the plot with slope, 6-8^0 degree.

Table 10- Yield of crops planted in strips in a gullied area in Faizabad in 2008

Site/Treatments	Slope	Height, cm	Yield* quintals /ha
Strip plot (gully areas)			
1. Wheat Alfalfa	Top Bottom	45,0 55,0	5,0 23,2
2. Mushung Alfalfa	Top Bottom	60,0 40,0	2,4 21,2
3. Lentil Onobrichis	Top Bottom	28,0 80,0	3,05 24,8
4. Wheat Lentil	Top Bottom	45,0 30,0	5,0 4,0
5. Wheat	-	55,0	10,2
6. Onobrichis	-	85,0	25,5
7. Alfalfa	-	63,0	22,7
Plot 2, Slope, 6-8^0			
1.Spring wheat	-	60,0	13,0
2. Lentil	-	48,0	7,2

* values are mean of four replicates

It may be mentioned here that due to extreme drought in year 2008, no surface runoff and soil loss could be observed from the plots. The rainfall during 2008 was close to 45% of the long term annual precipitation.

Activity 2. Study the impact of tillage, terrace configurations, and snow catching on soil and moisture conservation and yield of grapes in sloping landscapes

Bench terraces are effective soil conservation measures for cultivation of slope lands. In use of sloping lands, slope and the width of the bench (flat part) are two starting points in designing the terrace. In design of bench terraces it must be remembered that the volumes of cut and fill portions are equal to keep construction costs to the minimum. Depend on the slopes the width of the terrace was kept between 2.5 to 5.0 m. Vertical interval (VI), elevation difference between two succeeding terraces can be calculated by a simple equation using slope and the width of the bench.

$$\text{Vertical interval (VI)} = (S.\ Wb) / (100 - SU)$$

Where *S* is land slope in percent (%), *Wb* is the width of the bench, and *U* is the slope of the terrace riser or the side slope. Using the *VI,* height of riser of the terraces (for level terrace, *VI* equals the height of the riser). For reverse sloped terraces, the *VI* needs to add a reverse height to get the total height. The reverse height can be easily calculated by the following equation:

$$RH = Wb \times 0.05$$

Where *RH* is reverse height, *Wb* is width of bench, 5% is the reverse slope. In this experiment we used the terrace for combating soil erosion on sloping lands and use these sloping lands both for annual and perennial horticulture crop such as grapes were grown. The size of plots is 140 m2 (3.5 m in width and 40 m in length), on each plot was placed 20 bushes of vineyard.

The grape experiment was laid out on terrace nearly 3.5m wide terraces created on the slopes. The treatment included (a) Plowing (autumn fallow) – control and (b) mulching of the terraces with the use of grape cuttings or the hays.

Photo2. Performance of grape wines on reverse terrace mulched with hays

Table 11. Yield of grape fruits from plants on levee and side slope of bench terraces with different mulches at Karsang, Faizabad in year 2008.

Variations	Grape wine position	Average Yield per grape plant	quintals/ha	quintals/ha
Plowing (control)	Levee side	4,15	52.0	46,8
	Side slope	3,30	41.8	
Mulching with hey	Levee side	4,70	59.7	56,1
	Side slope	4,18	52.4	
Mulching with grape pruning	Levee side	4,08	51.1	45,9
	Side slope	3,12	40.7	

The results presented in the table (11) above indicate that fruit yield was always lower for wines planted on the side-slopes than those planted close to levees ranging from (7-35%) or on an average 20 percent. Levees of terraces receive more radiation, better lighted and heated than the side slopes of terraces. Also, reverse slope of the terraces and presence of a ditch seems to have helped in snow catch and more soil water storage plus the planting receiving subsurface flows for the upper terrace. The results also indicate that mulching with straws was more by 1000kg/ha than the pruning mulch in conserving stored soil water during fruiting and ripening period. Grape yield on terraces either plowed or mulched with pruning were similar.

Activities 3. Developing Rationale landuse plans for enhancing productivity of degraded sloping lands in low/ high rainfall regions

The physical properties of the soil in experimental plot in the dark gray soils of Fakhrabad massive indicated that bulk density of soil varied between 1.3 to 1.45 g/cm^3 in surface-30cm layer . The $CaCO_3$ varied from 18.6-21.8% and organic matter ~1.25% in the surface-30cm and 0.6- 0.8% in 30-50cm soil. Total soil moisture storage of in the surface 83 cm soil was 1856 m^3\ha.

Treatments were replicated thrice in plots of 30 m2 (.size 3 x 10 m). Under the young walnut sapling transplanted on the terraces, winter chickpea and winter wheat crops were planted either alone or in combination. At booting, height of wheat plants was just 18 cm, and chick pea , 10 cm. Soil moisture in surface-50 cm under winter wheat and chickpea at booting stage was 1310 and 1229 m3\ha as compared to moisture in the control plot - 1158m3\ha.

Table 12. Effect of intercrops (wheat and chickpea) on soil moisture content of dark gray soils (terraced) in walnut plantation at booting and ripening stages

Variation	Soil horizon, cm	Booting stage 23.04.08	Ripeness 10.06.08.
		m3\ha	m3\ha
1.Walnut	0-50	1158,5	306,5
2.Walnut + wheat	0-50	1310	324,2
3.Walnut + chick pea	0-50	1229	295,9

It was observed that when wheat and chickpea were planted under young walnut trees. Plots in which wheat and chickpea was grown, 180 kg of ammonium nitrate was applied. Grain yield of (wheat) was 15.0 quintals/ha (table 12). Yield of chick pea was negligible. Also the national program changed the earlier agreed technical program and also changed the national coordinator. The cost of cultivation on the terraces is given in table 13 .

Table 13 Cost of cultivation (Somoni) of (wheat +chickpea) on terraces at Fakhrabad massive

Agrotechnical measures	Planting expenses,
1. Plowing 1ha	200
2. POL	200
3.Wheat planting, (rate 200kg/ha). Plowing with the tractor on terraces	600
4. Application of nitrogen fertilizers with the rate of 200 kg, niter in march or April	400
5.Wheat harvest from one hectare	50c
6. Total expenditures for 1 ha	**1450**
7. Income:- wheat yield -15 quintals/ha - hey	3000 600
Total income	2150

Activity 4. Evaluate the efficacy of the mechanical and vegetative measures in control of gully erosion for rehabilitation of degraded sloping lands.

Soil and water management plays a key role in achieving long-term sustainable and profitable production in the slope areas , which safeguards the environment and degradation processes. Overgrazing and top-down tillage of high steep slopes for wheat production in the last years lead to gully formation of the loess areas. For their rehabilitation we will test mechanical and vegetative measures in the field conditions. Demonstration of these technologies for farmers will support better use of resources and rehabilitation of degraded areas.

In the examining of the effects of different bushes in rehabilitation of the ravine following treatments were evaluated.

1. Gully, without plantation (control)
2. Gully, plantation of Spanish green weed/ broom (Spanish greenweed)
3. Gully, plantation,Cercis (Siliquastrum) bogryannik/ redbuds
4. Gully, plantation of wild cherry-Cerassuss

At the ends of gullies, overgrown with bushes, gully plugs/ bushing dams were constructed, to collect and detain runoff water from the adjoining sloping micro-watersheds. to facilitate rehabilitation of the vulnerable ravine lands.

Build up in soil organic matter (SOM) content was used a performance criteria for efficiency of the different measures 9 in absence of runoff water and sediment load- drought year 2008). The SOM content in surface-50cm soil was observed to be highest under cherry plantation (1.88%). The SOM under Spanish broom and redbuds was almost similar (1,80 and 1,76%, respectively) as compared to the control (1.15 %).

Research results suggest that planting the bottom and slopes of gullied ravines with bushes enriched the soil with organic carbon through root systems of the grassy semi savanna plants and also provided surface cover to reduce impact of rains on soil erosion. Under the canopy of tree species, we obseverved that cereal-legume plants grow intensively, to enrich the soil with humus and also arrest the erosion processes. In order to determine the influence of different brushes and grass cover on the changes in the physico-chemical properties of the soil, samples have been collected for all four ravines. The NDVI measurements for measuring surface coverage were not taken because of drought. Dry biomass was not removed/ weighed from the sites to avoid soil erosion. Phytomelioration measures thus seem to improve the ravines ecology.

Activity 5. Calibration and use of Optical crop canopy sensors (GreenSeekers) for measuring crop development over time and space, comparing crop management practices for SLM and efficient nitrogen management

The GS experiment was not conducted in winter 2007 or the spring 2008. Is hoped that the trial will be conducted in Winter 2008. Two scientists from Soil Science Research Institute were trained twice to help them conduct the trial.

Activity 6. Promote community nursery-raising for plantation in sloping lands.

In 2008, more than eight thousand saplings of Spanish greenweed, bogryannik (redbud), wild cherry, apricot and walnut were grown in plastic tubes (10 cm dia.and 15cm long) for transplanting on the sloping ravine lands. A major goal of this work was also to develop methodology of raising the tree saplings (fruit trees, shrubs and other crops) from the seed during the winter-spring time in the green houses. A portion of these saplings when 70-80cm in height, will be given to farmers for transplanting them in spring 2009. Because of the drought, about 30% of seedlings were lost. All remaining seedlings will be planted in the fields on sloppy lands and rehabilitate ravines.

Activity 7. Dissemination of results and developing mechanisms for up scaling and scaling out the SLMR options

On April 6, 2008, Chairman of Faizabad Hukumat and his deputies organized a seminar in Karsangsk base station of the Institute of Soil Science with the participation of leaders of Faizabad rayon. More than 30 farmers and representatives of the Hukmat participated in the travelling seminar. The travelling seminar was led by the deputy director on Science, Kurbonov R. K. and his staff and students.

Activity 8. Crop production in irrigated saline soils , Vakhs.

Crop production in more than 80 percent of the irrigated lands in Tajikistan suffer due to presence of excessive amounts of soluble salts. The main reason of soil salinity in Vaksh valley is shallow and saline underground water. Under the condition when underground waters are deposited at the significant depth (below 3 meters) salinity accumulation does not significantly progress. Meanwhile, when level of underground waters reaches the soil layer above 3 meters which is accompanied by increase in underground water salinity soil becomes saline despite of applied leashing. Soils are saline with highly soluble chloride and sulfate salts of sodium, calcium and magnesium. Subsequent increase in the level or salinity of the underground waters leads to more intensive salinity accumulation.

Productivity of the agricultural crops on mildly saline lands is noticeably low. Land reclamation requires salt leaching. Methods of dissolving include:

1. Winter and spring leaching with a small rates of water application on furrows
2. Appropriate regimes of vegetative irrigation.

Measures for preventing accumulation of soil salinity and water logging are important for further increase of yields, gross production of cotton and other agricultural crops.

Non-implementation of the soil ameliorative measures on irrigated lands with insufficient drainage of underground water leads to rise in water table and accumulation of salinity in root zone. Therefore, it is natural that part of lands with non-saline lands becomes saline while on other lands salinity can reach the level that makes these lands unusable for agricultural purposes.

Therefore on all farming holdings and districts where the soil condition can deteriorate due to the natural resources it is important to conduct measures on preventing and arresting salinity and water logging problems.

Major goal of preventive measures includes:

a) Efficient use of irrigation water to prevent rise of water table;
b) Maintain favorable salt and water balance, retain residues to reduce upward fluxes;
c) Provide drainage and grow less water requiring, salt tolerant crops.
d) Conjunctive use of multi-quality water.

Therefore, studies management of saline environments were initiated for improving crop productivity and arrest degradation processes in farming holdings of Vakhs, Tajikistan.

Activity 8.1 Evaluation of the best winter wheat, barley, rape seed **and shabdar varieties under the conditions of surface underground water tables.**

An experiment was conducted in 2007-2008 to evaluate the performance of wheat (3 cultivars-Navruz , Atay-85, Jager); barley (2 cultivars- Marokko 9/75, Chenad-345); rape seed and Shabdar. Cultivars of each crop were grown in large saline plot size (170 m^2) without replications. All the tested wheat and barley cultivars, have similar yield potential, when grown in non-saline good soils. Crops were planted on November 26, 2007 with the seed rate for wheat (220 kg/ha), barley (160 kg/ha), shabdar (14 kg/ha) and rape seed (14 kg/ha). Fertilizer was applied in autumn (carbamide – 150 kg/ha) and spring (ammonium nitrate – 150 kg/ha). Yield are given in table (14).

Table 14. Grain yield data on cereal and gramineous crops

#	**Variety**	**Quintals/ha**
1	Wheat variety “Navruz”	23.4
2	Wheat variety “Atay-85”	21.9
3	Wheat variety “Jager”	22.7
4	Barley variety “Marokko 9/75”	25.5
5	Barley variety “Chenad-345”	27.8
6	Rape seed	2.6
7	Shabdar.	3.4

Results indicate that wheat variety “Navruz” and barley variety “Chenad-345” were better suited for saline soils.

Activity 8.2. Influence of two variations of cotton cultivation on yields on fine fiber cotton of the variety 9326-B

Cotton crop was planted on 2nd April 2008. into two large size plots. One of these plot was leached before cotton planting following the recommended irrigation norms (3000-4000m^3/ha). The other field was not leached. To facilitate germination, soil moisture was improved before sowing. As compared to leached field plot, salinity reduced germination and hence plant population in the plot- not leached. Salinity (un-leached plots) delayed the development and growth of the cotton. Salinity delayed bud formation delayed flowering.

Table 15 Growth and development of cotton

#	Treatment	Plant density, (000,\ha	Bud formation , date	Flowering date	Yields, kg/ha
1	Without leaching	68.7	17June	22 July	awaited
2	After leaching	77.0	3 June	8 July	awaited

Efficient use of irrigation water and salinity avoidance for cotton growing

Irrigation water has dissolved salts. One meter depth of even snow melt water (0.2dS/m) applied annually can contribute nearly 1.28 tons of salts/ ha. If these salts are not leached and drained out they continue to accumulate in the root-zone, builds up soil salinity such to adversely affect plant growth and yield. It may be mentioned here that the salinity of the irrigation water generally increase during summer season ranging upto 3.0 dS/m. In order to reduce to salt load, it is only imprudent to reduce water use. This can be achieved by precision land leveling (saves ~20%water), alternate furrow irrigation and better the irrigation schedules. Cotton crop watered by irrigating each furrow would need more water than skipping every alternate furrow. Skip furrow irrigation practice has the potential to save water by another 10-15% such as to reduce the salt load of the soils. In order to save on irrigation water, farmers generally practice skip furrow irrigation system as shown in the photo 3. In this scheme of water is applied to furrow # 1,3,5, 7 ….. etc in 1st irrigation cycle and then to furrows 2,4,6, 8 etc in 2nd cycle. This scheme promotes a uniform distribution of soil moisture and salts. But when salt accumulates in excess amounts, the issue is how to leach them without dismantling the raised bed systems. It is hypothesized that it is better to continuously irrigate the same furrows numbers, rather than alternating the water application to even furrows under saline environments. Such a scheme will facilitate salt accumulation in the dry subsoil layers immediate below the un-irrigated furrows (e.i. even number furrows) to facilitate salt leaching even with less irrigation volumes. Care should however be taken to ensure that odd number furrows are first filled with water to prevent salts moving back from salinized dry soil zones.

Improving survival and plant population in saline environments.

Generally, farmers don't get sufficient water at the right time to practice salt leaching before cotton planting. Late planted cotton crop vacates the field late and often result in reduced yields. Cotton planted in saline environment, timely, without proper leaching reduces plant population due to seedling mortality. It is well known that threshold salt tolerance of young cotton seedlings is low and increase with plant development (ontogeny). It has also been observed that most corps including cotton is sensitive to salts in early growth stages (germination, emergence and braching) and become more tolerant as crop growth proceeds. Therefore, patchy germination and reduced crop growth is commonly observed in cotton fields in slick spots. Reseeding of cotton many times proves futile under saline environment. In order to avoid delayed planting and to take advantage of crop ontogeny (enhanced salt tolerance), cotton seedlings were raised in small polythene tubes and were transplanted after 45-50 days into the main field. The practice has great potential in improving crop productivity through improved plant population, avoiding late planting, and providing time for proper leaching of salts.

Photo3:Skip furrow irrigation system

Photo 4: Transplanted cotton

Also some farmers who are not able to plant cotton timely have to either keep their fields fallow or divert the area to some other crops. In order to accomplish timely planting, improve seedling survival and stagger the demand for irrigation water for seasonal leaching over time, it is suggested that cotton seedlings should be raised in small diameter polyethylene tubes for transplanting late in the season/ and to ensure establishment of a good crop stand. This technology allows to catch up late planting, as well as allows young seedlings escape early salt injuries such as to facilitate establishment of good crop stands. The above photo 4 shows a transplanted crop of cotton in a relatively saline field in Vakhsh, Tajikistan.

Note: Results of crop yields are awaited

Work Plans for Turkmenistan: July –Dec.2008

SLMR Activities : Turkmenistan	Qr 3	Qr 4	Expected Results	Outcomes
1. Assessment of yield losses due to late planting in cotton-wheat cropping system	X	X	• Optimal planting dates for cotton • Assessment of yield losses in cotton due to late planting	• Farmers practice timely planting to reduce crop losses
2. Assessment of yield losses due to salinity. Determine the salt tolerance of cotton and wheat under prevailing climatic conditions.	X	X	• Assessment of cotton yields under the saline condition. • Salt tolerance of cotton. • Validate optimal planting time of wheat - seeding	• Farmers demand seed of the salt tolerant cotton cultivars to reduce crop losses
3.Farmer participatory trials for validation , fine tuning and development of new RCTs	X	X	• Comparative evaluation of traditional and zerotill planted winter wheat in standing cotton (with and without plant residues)	• Main streaming process for manufacturing of new prototypes is initiated by local entrepreneurs to make available them for farmers use
4. Develop permanent raised bed planting system in cotton –wheat sequence.	X	X	• Comparative evaluation of performance of winter wheat planted on the raised beds 3/4 quarters of the year 2008. •Analysis of the cost of cultivation	• Farmers grow winter wheat at reduced costs and save on water
5. Maintaining favorable salt balance in raised-bed furrow system in cotton-wheat	X	X	• Evaluate the different leaching practices for salinity management under different planting methods • Effect of leaching on cotton productivity , irrigational water saving and tillage costs	• Farmers become aware of the benefits of good leaching practices
6. Impact of pigeon-pea and tree species in development of surface covers to control soil erosion in sloping lands.	X	X	• Growth and development of pigeon pea (PP) •Role of PP in prevent soil erosion on sloping lands. • Data on growth and development of planted forest lines and the condition of one year seedlings in nursery. • Survival and growth of tree saplings planted as wind breaks	• PP and wind break shelter belt practices are adopted by the programs and farmers alike to provide for speedy coverage of the bare sloping lands for reduced erosion.
7. Calibration and use of Optical crop canopy sensors (Green Seekers) for measuring crop development, and efficient N anagement.	X	X	• Develop a N calculator for assessing N requirement of wheat crop • Develop INSEY vs NDVI relationship • Precision land leveling technology assessed for savings in water use and yield gains on farmers fields.	• Farmers are able to optimize N fertilizer applications
8. Evaluate the impact of laser-assisted precision land leveling on water savings, salinity and crop yields in irrigated conditions	X	X		• water user associations provide custom service on laser leveling to the members.
9.Dissemination of results and developing mechanisms for up scaling and scaling out the SLMR options	X	X	• Participation on exhibition, distribution of the selected SLM-R technologies by organizing one traveling seminar. These methods will also be disseminated amongst farmers by organizing farmers days. Two appointments with discussions via national television and radio have been planned.	• Farmers and public at large have a better understanding of the causes of land degradation and various technical options available to them to arrest it.

Turkmenistan
SLM-R Project Report during July –December, 2008

Activity 1. Assessment of yield losses due to late planting in cotton-wheat cropping system

In accordance with the research methodology, 80 field plots were selected wherein cotton crop was planted on different dates to assess yield losses due to late planting. Cotton plant attributes (phonological and biometrical characteristics of cotton) were studied and yields were monitored. The National coordinator has remarked that graph indicating cotton yield dependency on dates of planting will be presented in the next report after 2008. Optimal dates of cotton planting will be determined that will allow sustainable yields in the agro-climatic region.

It is a major challenge for the ICARDA's SLMR team to enthuse the national coordinator and his research team to analyze the collected data. The training needs are found much larger than perceived because the Turkmen team takes long time in analysis the research data properly and reach right conclusions for which the trial was designed. The challenge increases several folds for ICARDA-CAC's SLMR project team particularly when it takes almost 8 months to receive any Turkmen authorization for the team to travel the research sites.

Winter wheat planting work was organized in September and growth attributes are being monitored.

Activity 2. Assessment of yield losses due to salinity. Determine the salt tolerance of cotton and wheat under prevailing climatic conditions.

Medium staple cotton cultivar -Iolatan-7 was planted on April 10, 2008. Emergence of seedlings was observed on April 20, 2008. Plant density was about 5-6 plants per 1 m length. Depending on the growth and development of cotton crop three fields: (i) with good growth (field 1), (ii) moderately good plant growth (field 2), and (iii) poor growth of cotton plants (field 3) were identified .
The total area of the experimental area was 40 ha. These fields have provision of irrigation and drainage facilities. Slopes of the field plots are in the South to Northernly direction, which is typical of piedmont area of Kopetdag. Drainage system has been provided in the western and southern parts of the investigated plots. Drainage network was provided in 2006. Three sites were identified to monitor the depth of water table and its salinity as well as its effect on the buildup on soil salinity in the surface-30 cm layer under cotton crop. The nature of salinity was mainly the neutral soluble chloride-sulphate salts of sodium..

The experimental field 1 was slightly saline and the yield of cotton was 29.8 quintals/ha. On field 2 which was moderately saline , cotton yield was 21.3 quintals/ha. On highly saline plot , cotton yield was 12.9 quintals/ha. Crop-cutting trials were carried out from the marked spots in each fields which varied in salinity and plant growth. In order to develop continuous yield-salinity relationship all the data points from the 3 plots will be plotted to work out cotton yield losses per unit increase in soil salinity. Yield- salinity relationship will be presented in the next report.

It may however be mentioned here that surface-water-table depth fluctuated between 98cm - and 140 cm duringthe cotton gorwing season. The dynamics of the water table fluctuations seemed to correspond with the irrigation cycles (data not presented). The salinity of the water

table varied between 10-29 g/l (16 to 34 dS/m). This suggested that shallow (1-2 m) and saline water table is a major source of secondary salinization of the rhyzoshere during cotton growing season.

Activity 3. Farmer participatory trials for validation , fine tuning and development of new RCTs

The results of experiments conducted during winter wheat planting in standing cotton with plant residues and without plowing have been presented in the First SLMR Annual Report, 2008. Also experiments have been conducted on farmer fields on establishment methods for cotton planting.

Field trials were conducted on two sites (i) on a non-saline lands, and (ii) on the Parakhat mildly-saline soils.
The report presented by the national coordinator was totally qualitative without support of soil salinity data. Hence the National coordinator has already been requested to focus his efforts in a manner that help us reach definite conclusions for development of appropriate technologies. The detailed report will be presented in next issue.

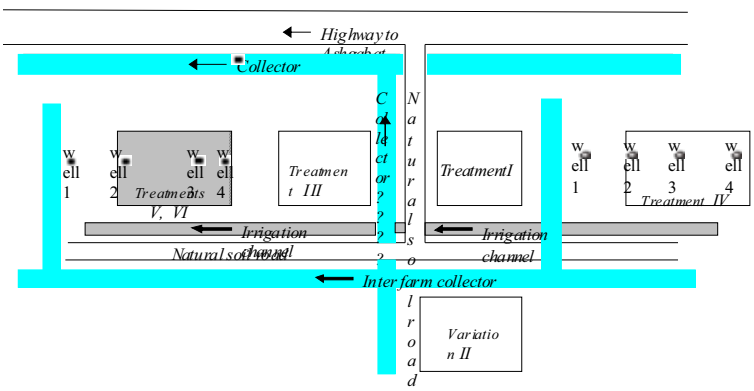
Activity 4 & 5. Develop permanent raised bed planting (RB) system in cotton –wheat sequence and maintaining favorable salt balance in RB system.

A winter wheat trial was conducted in raised-bed planting system in Ahalsk Research-Experimental Station, RI of Agriculture to study cost of cultivation of winter wheat. Before wheat planting the field was plowed and leveled traditionally and by using precision laser assisted land leveling. Crop was planted, but the seeds were picked up by a huge flocks of black crowns and also damaged the germinating winter wheat crop. Therefore reseeding was done on 9th November, 08.. In this experiment, Dr. Sopyev Yazberdi, Director of the experimental station is also testing the performance of two planters received from ICARDA. Results will be included in the next report at the end of wheat season.

Activity 5. in cotton-wheat

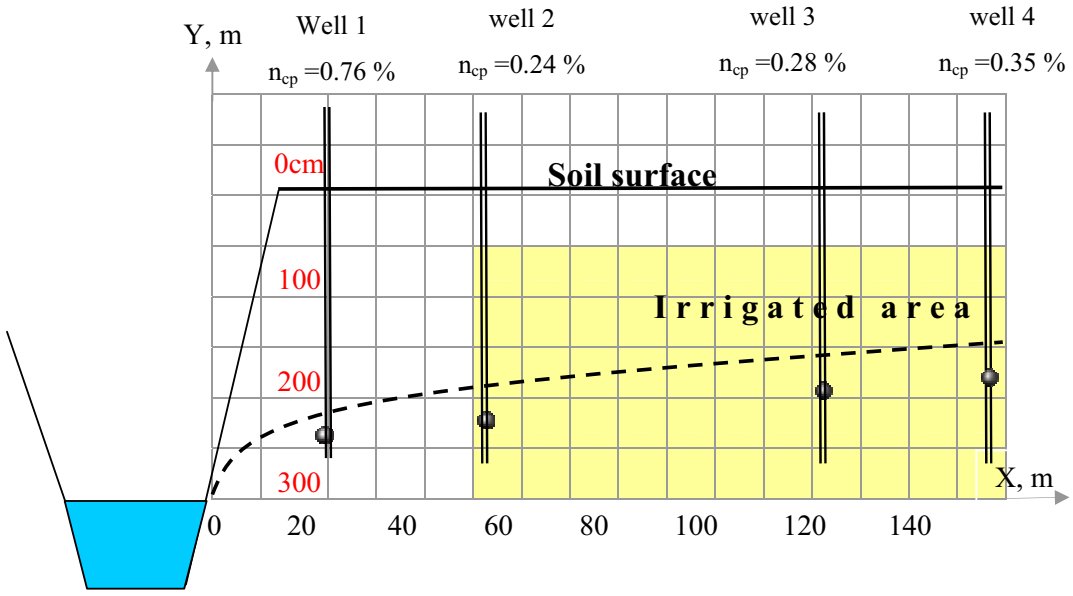
An experiment was initiated with four treatments, namely

- Farmer practice – 40cm /ha water before winter and summer planting and sowing.
- Determine the soil salinity in the saturation paste (ECe, dS/m). Leach excess salts above salt tolerance of the crop at germination stage. (A normally thumb rule- To leach 80% salts from 1 cm layer it requires 1cm of water. Calculate and leach).
- For *Pelewa* use 10-12 cm-ha of irrigation water and seed immediately. No pre-planting leaching. Pre-sowing irrigation required to build antecedent soil moisture content is sufficient.(save water 28-30cm water). If salinity is very high use a little more water.
- Direct dry seeding on the



flat or raised beds followed by irrigation. (It may be mentioned here that dry seeding followed by post- sowing irrigation offers a huge advantage in term of seeds escaping the damage from the birds).

The lay out shown below indicate that four different fields were chosen to plant the cotton crop. No results have been presented except that pre-planting irrigation resulted in saving of 1600 m^3/ha of irrigation. It has been indicated that 2600 m^3/ha of water was saved in the experiment.
The number of observation wells were installed in the fields 4, 5 and 6 for measurement of the surface to ground water table depth and its salinity. The results of the trial will be discussed in next report because the national coordinator could not provide a focused report on the queries sought from him to reach appropriate conclusions. Surface to ground water table fluctuated between 150cm (at distal end of the drain) to close to 200cm close to the open drain. The salinity of the ground water was monitored. Detailed results will be provided in the next report.



Picture 2. Graph of the underground water change as one goes away from the collector, variation IV.

Activity 6. Effect of pigeon-pea and tree species in development of surface covers in control of soil erosion in sloping lands and creation of the field protective strips on the irrigated lands.

A. Plot 1. Control of soil erosion in sloping lands.

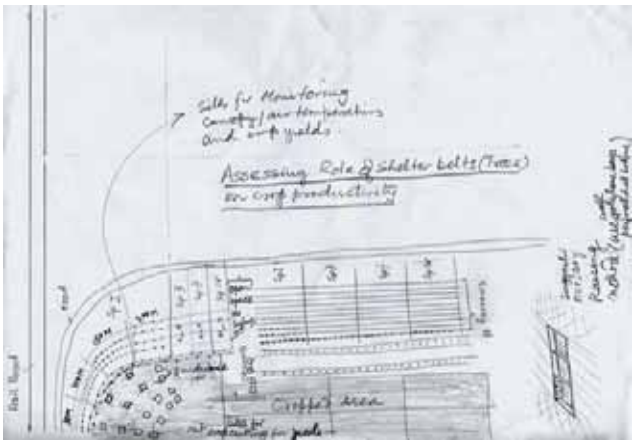
Pigeon-pea seeds were planted in early Mayto provide surface cover, reduce soil erosion and to improve efficiency of the tree saplings planted to act as shelter belt. Plant growth and development is being monitored continually. After one month, on 28 June the plant height was 56-60 cm, after another month on 28 July, height of pigeon pea plants was 100 cm. Flowering was observed in late July. The plant height was 150 cm in late August. In early September (10-13 September) fructification was started, seeds were established. In summer season (June-August) tree saplings and pigeon pea were watered using a drip irrigation

system installed at the site by the forest department. .In October, the plants were harvested for seed collection and biomass. Details are yet to be provided on surface cover and erosion losses.

Commentary: On this sloping hill side, Government is trying to establish a green belt for control of advancing desert and reduce sediment load of the air, tree saplings have been planted with provision of drip irrigation system to water the saplings. In order to provide surface cover speedily, to reduce soil erosion, create wind breaks, and improve soil fertility at the site for accelerated growth of the tree saplings, a fast growing cultivar (ICPL 131086) of pigeon pea (5-6 seed) were planted around each tree sapling, watered through the drip irrigation system.. .

B. Site 2. Creation of the field protective strips on the irrigated lands to enhance crop yields by reducing desiccation effect.

Saplings of tree species were planted as per lay out (. The growth and survival of the saplings is given in the table below. Results show the average trees survival rate was observed at 70% on 30th September,08.



In order to study the effect of trees on crop growth and yields, several species of tree saplings were planted around the the irrigated crop lands (to control sand drift). Detailed results will be presented in the next report as the work of establishment of new field protective strips (length 1400 m and > 10m in depth) is expected to be completed by end of middle of December, 2008.

Table 16. Phenological observations of tree plantations in the field protective strips

Tree species	Planting dates	Tree sapling height (cm)				Survival, %
		June	July	August	September	
1. Poplar (Populus)	December 2007	100	125	160	200	80
2. Mulberry-tree (Morus)	December 2007	60	85	105	150	75
3. Ash-tree (Fraksinus)	April 2008	100	120	130	150	65
4. Pine-tree (Pinus)	April 2008	120	130	140	150	75

Activity 7. Calibration and use of Optical crop canopy sensors (GreenSeekers) for measuring crop development, comparing crop management practices for sustainable land management and efficient nitrogen management.

According to the developed methodology the experimental site was selected for calibration of GreenSeekers instrument. This year the experimental site has been organized in irrigated territory of Akhalskyi scientific experimental base of scientific research institute of Agriculture. It is planned to plant the crops with different doses of Nitrogen fertilizers in early November, 08. Results will be analyzed following the common methodology after the crop season,

Activity 8. Evaluate the impact of laser-assisted precision land leveling on water savings, salinity and crop yields in irrigated agro-ecologies.

This experiment has initiated in two regions named as Dashoguz and Akhalskyi and in Bugdaily site. In July, in Dashaguz province the laser land leveling training program was organized under support of experts from Khoresm. These activities have been conducted in irrigated territory of Dashaguz scientific - production test center of scientific research institute of Grain crops. The experimental site has an area around 2.5 hectares. The site is divided approximately on two parts where on the first part the laser land leveling has been done, and on the second part the farming practices, accepted traditionally by farmers, were applied. In late September the pre-sowing irrigation was applied at the experimental site. Thus, irrigation norm on leveled field with the laser leveler made 800 m^3/hectares, while that in other field associated with traditional farming practices was in the range of 950-1000 m^3/hectares. Winter wheat crop was planted at the rate of 180 kg/hectares on 10^{th} of October. The second site under winter wheat crop having an area of 2 hectares have been leveled in irrigated territory of Akhalskyi scientific-experimental base of scientific research institute of Agriculture for sowing crops on permanent beds and for field with 1 ha area, where experiments were organized on calibration of GreenSeekers instrument. Also the laser leveler will be used for leveling of the irrigated fields after harvesting of cotton for the organization of field experiments on optimization of irrigation norms of cotton.

Activity 9. Dissemination of results and developing mechanisms for up scaling and scaling out the SLMR options.

Workshop on laser land leveling was organized in Dashaguz province on 7-9^{th} July 2008. Twenty (20) people participated in the event including Governor of Gubadagskyi province, Chairman of "Turkmengrain" association, Deputy of "Turkmen cotton" provincial association, farmers and experts from two districts of the province, tenants and experts of Dashaguz scientific production Test Center of scientific research institute of Grain crops.

The participants of the seminar have been trained on the use of the laser equipment (preparation and installation of the laser equipment and carrying out of the land leveling for calculation of an average mark, installation of separate gauges and devices on a scraper and supervision over work of the leveler). The project staff also participated in the International exhibition and conference "Turkmen agro 2008" which took place on 7-9^{th} August 2008 in Ashgabat.Dr. M. Nepesov, the national coordinator of the project, once appeared on national TV (the program "Altyn Asyr" on August, 8th, 2008).

Work Plans Uzbekistan: July- December 2008

SLMR Activities in Uzbekistan	Qr3, 2008	Qr4, 2008	Expected results	Outcomes
1. Assessment of soil leaching requirements in irrigated plains to enhance water productivity and reduce drainage volumes (Lysimeter and Field Experiment)	**x**	**x**	• Leaching trials for salinity management in winter wheat using saline water	• Technology in mainstreamed by the NARS partners
2. Maintaining favourable soil salinity balance in permanent raised-bed planted cotton-wheat irrigated systems	**X**	**X**	• Results of the Cotton+ Mungbean and Maize+ Mungbean trials become available in 2 raised bed planting systems	• NARS allow the intensification and diversification of the Cotton /Maize based systems
3) Assessment of both native and non-native tree and grass species for their biomass productivity, salt tolerance and bio-drainage ability to rehabilitate the degraded rangelands in arid agro-ecologies	**X**	**X**	• Promising fruit tree saplings planted (300) • Halophyes are planted for fodder and wind erosion control in saline desertic soils	• Seed of fodder grasses become available for the farmers to practice
4. Evaluation of diversified, salinity-resistant crops for enhancing biomass production for livestock in degraded rangelands	**X**	**X**	• Productivity of Sudan grass + horse beans, atriplex + Sudan grass, climacoptera + Sudan grass, maize + horse beans evaluated • Productivity of 12 different varieties of millet, varieties of alfalfa and sorghum, halophytes, maize &Sudan grass evaluated	• New intercropping systems become popular for enhanced fodder availability and increased livestock productivity
5. Calibration and use of Optical canopy sensors (Green Seekers) for measuring crop development, comparing crop management practices for SLM and efficient nitrogen management.	**X**	**X**	• N calibration curve is developed for winter wheat In Kibray district of Tashkent	• Optical sensor technology for N management become available for farm advisory .
6. Study the impact of precision laser-assisted land leveling on water saving, salt leaching, and crop performance in irrigated agro-ecologies using EM probe and Optical sensors	**X**	**X**	• Laser land leveling technology demonstrated on farmers fields in “Esanboy Ota” , “Khodja Kabud”, “Umid Shodligi”, “Sherzod Samandor Birligi” farms in Jizakh region	• New laser leveled technology become popular for precise land leveling and increased crop productivity
7. Dissemination of results and developing mechanisms for up scaling and scaling out the SLMR options	**X**	**X**	• organize farmer field day in Pakhtakor and Kyzylkum sites • TV /Radio interviews organized	• Civil society become aware of the new advances in SLMR technologies

Uzbekistan : Research Results (July –Dec. 2008)

Activity 1. Assessment of soil leaching requirements in irrigated plains to enhance water productivity and reduce drainage volumes (Lysimeter and Field Experiment)

Meteorological data collected from station "Ok Oltyn" situated in Syrdaria region has been plotted in Figure 1.which indicate that water deficit generally prevails during the period March-October. It is therefore, pre-plant irrigation is required to meet soil moisture deficits for good crop establishment.

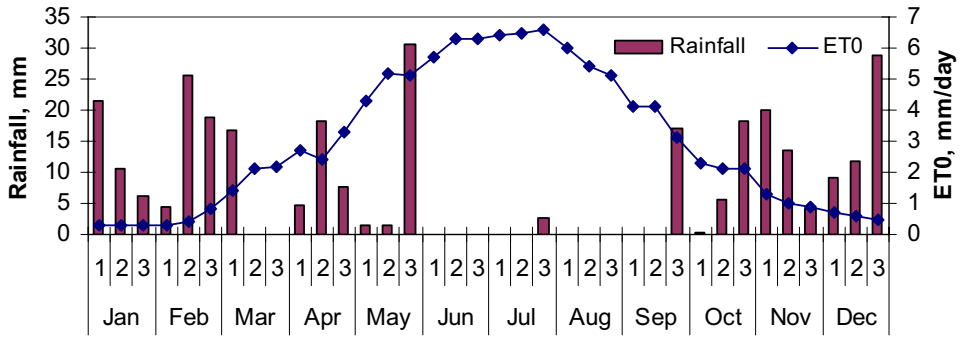


Figure 1. Rainfall and Reference Evapotranspiration for Akaltyn station (2008).

In 2008, cotton crop was planted on April 23 2008 in Lysimeter # $1_{(x)}$, $2_{(x)}$, and $3_{(x)}$. Filled-in lysimeters were leached following the designed treatments. Lysimeter $1_{(x)}$ was leached @ 4000 m^3/ha, lysimeter $2_{(x)}$ @ 2000 m^3/ha, and lysimeter $3_{(x)}$ – 1000 m^3/ha. At planting time mineral fertilizers were applied, namely: ammonium nitrate @ 50 kg/ha and Superphosphate @ 98 kg/ha. Germination of cotton was satisfactory but the experiment was destroyed by stray cattle in "Sherzod Samandar Birligi" holding. On June 11, cotton was replanted but again destroyed. On July 23, maize crop was seeded in the lysimetric plots and plots were fenced.

Data on crop yield of maize, soil salinity, groundwater salinity, total applied water and groundwater contribution are presented in Table 17.

Table 17. Effect of salinity, (soil and groundwater), on growth and development of maize

Treatments	Yield of the green mass, Tons/ha	Soil salinity, ECe, dS/m (29.09.2008)	Ground water salinity, ECgw, dS/m (29.09.2008)	Total irrigation water, m^3/ha	Groundwater contribution to ET, m^3/ha	Total ET, m^3/ha	WUE, kg/mm/ha
1000 m^3/ha	12.57	6.38	1.97	420	3172	4768(66.5)[x]	26.37
2000 m^3/ha	13.48	5.20	1.36	420	3096	5699 (54.3)	23.65
4000 m^3/ha	13.14	6.90	1.16	420	3207	7816(41.0)	16.81

[x] Figures in parentheses indicate percentages of groundwater contribution to total ET

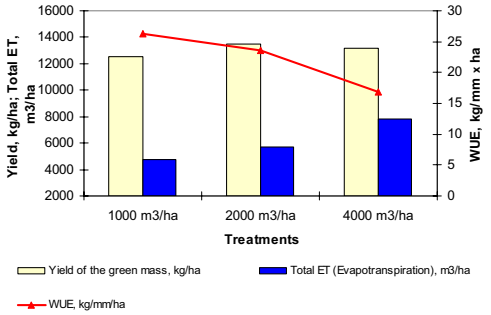


Figure 2. Yields, total evapotranspiration, and Water Use efficiency of maize

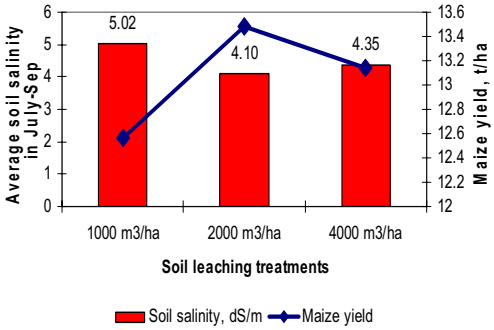


Figure 3. Effect of soil leaching soil salinity on soil salinity and yield of maize

Results presented in fig(2&3) show that grain yield in treatment 2 (2000 m^3/ha) was similar to the traditional wheat agronomic practices followed by the farmer leaching with 4000 m^3/ha, before maize planting. As could be seen from the above figure maize yields did not show any significant differences among treatments 2 and 3 (13.3±0.2 t/ha) whereas ET_{actual} had an increasing trend and ranged from 4768 to 7816 m^3/ha. The maximum ET was observed in plots leached with 4000 m^3/ha water and minimum with the minimal leaching (1000 m^3/ha). A heavier pre-sowing irrigation practice (2000 m^3/ha) to meet soil moisture deficit and to effect some salt leaching from the seed zone seems to be sufficient in achieving our twin goals of water saving and reducing the problem associated with disposal of excessive drainage volumes. The irrigation water productivity of maize was ~ 1.5 times higher with the new salinity management strategy. Water use efficiency calculated on the base of actual ET and crop yields decreased with increasing volumes of leaching water.(from 26.37 to 16.81 kg/mm/ha). Results above indicate that contribution of groundwater to total ET of maize ranged from 3100 m^3/ha to 3200 m^3/ha when water table was within 100cm from surface. Thus 41-66% of maize water requirement was met from the ground water having salinity in the range up to 2 dS/m. Groundwater contribution to ET was calculated using Harchenko equation (Harchenko, 1975):

$$ETgw = ETo / e^{mh}$$

Where: Etgw=Groundwater contribution to ET,mm
ET_o= Evaporation from water surface, mm
m=parameter reflecting the soil characteristics and crop growth stage
h=groundwater level, m

Estimates of groundwater contribution to ET were found to be 2212 m^3/ha i.e. by 40-45% lower than those actually determined in lysimetric plots. From this we conclude that the empirical coefficient (m) needs adjustment in above equation for estimating groundwater contribution to ET for local soil-crop conditions.

In September, 2008 winter wheat was planted in the lysimeters after leaching schedules as shown under in Table 18

Table 18 –Soil salinity, groundwater salinity at initial stage of winter wheat development in fall 2008

Leaching treatments (m^3/ha)	Groundwater salinity, before leaching ECgw, dS/m 20.09.2008)	Groundwater salinity, after leaching,ECgw, dS/m,(14.10.2008)	Total irrigation water, m^3/ha	Soil salinity, pre-leaching ECe, dS/m (20.09.2008)	Soil salinity, postleaching ECe, dS/m (14.10.2008)
Pre-plant , 1000	4.20	1.84	1000	6.83	2.84
Pre-plant, 2000	4.60	1.30	2000	5.77	2.31
Pre-plant, 4000	4.36	1.64	4000	8.50	1.89
Post-sowing, 1000	4.64	1.88	1000	5.64	2.11

The experiment is still in progress.

Field experiment A2.

Experiments laid out in 2008 were carried out in accordance with the work plan. Despite fact that results of field experiments were very encouraging in winter 2007 but the problem stray cattle and poultry continues to pose threats. Average soil salinity measurements taken on 01 August 2008 and 13 September 2008 before leaching is provided in the below Figure 4. The treatments included the following:

(a) Saline ploughed field leach with fresh water @ 4000m^3 /ha; all residues removed .
(b) Saline irrigation (7cm) to improve soil moisture and then immediately leach with @ 1500m^3 /ha, all residues removed.
(c) Saline irrigation (7cm) to improve the antecedent soil moisture and then immediately leach with fresh water @ 1500m^3 /ha. All residues retained.
(d) Shallow planting followed by post planting leaching with @ 1500m^3 /ha.
(e) Shallow planting and soil immediately leached with @ 1500 m^3 /ha. 50% N and all other nutrients applied before pre-sowing irrigation to compare with Treatment (d).

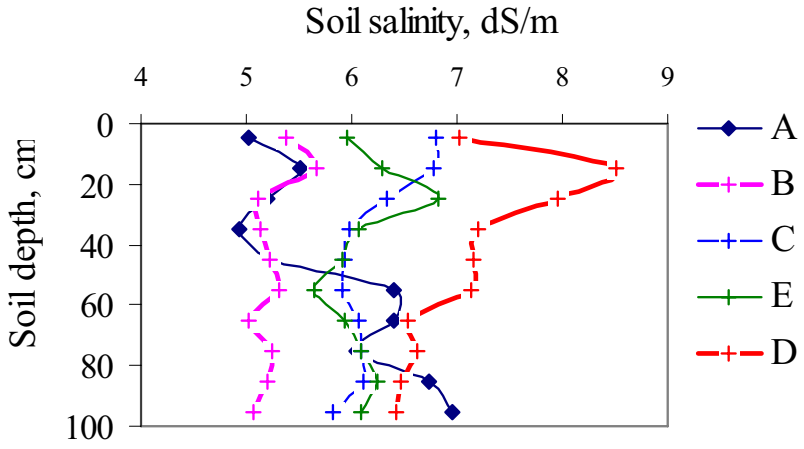


Figure 4. Effect of different treatments on salinity profile in 2008

Results presented in (fig.4) indicated that salinity was more near the surface in plots where post-sowing leaching was practiced. However it may be mentioned that it did not affect wheat yields (reported earlier, Annual report July 07-July 08)). It is because salts accumulated mainly towards the end of wheat season when salt tolerance of the crop is maximum. Spatial distribution of salts was monitored using the salinity probe in the field plots, receiving different leaching treatments. Results were plotted using the Sigma Plot

software as shown in Figure 5 High soil salinity spots (0-150cm depth) reflect to inherent salinity variations in soil profile in Plot D and E rather than developed through irrigation. It suggests that special localized leaching will be required in plot D &E to desalinize these plots.

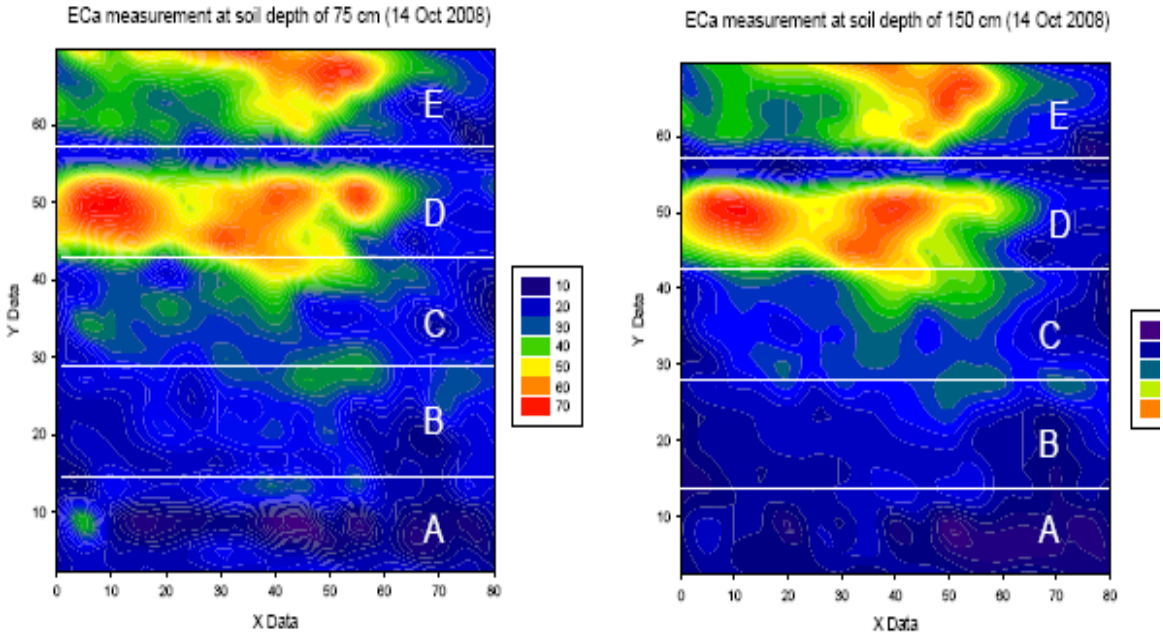


Fig. 5. Soil salinity measurements after leaching of treatments A, B, C (14 October 2008)

Wheat yields obtained in different plots have been plotted against soil salinity. Results suggest that the potential wheat productivity in Syrdaraya is ~ 6.0 tons/ha in normal soils.

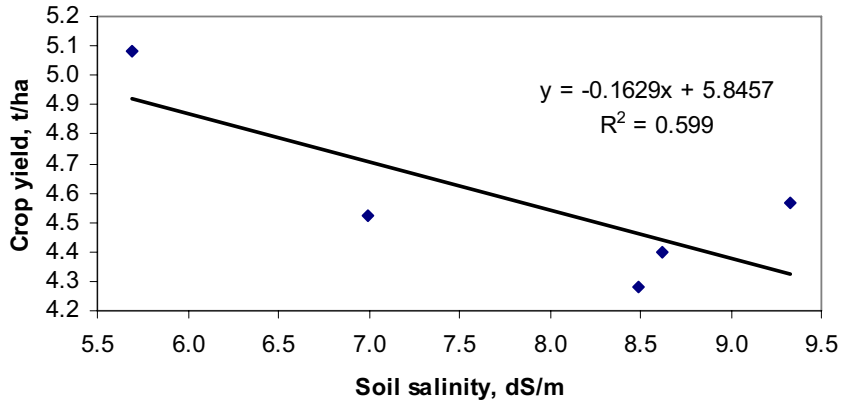


Figure 6 Crop yield as function of soil salinity at different treatments launched in 2007

Activity 2a. Maintaining favorable soil salinity balance in permanent raised-bed planted cotton-wheat irrigated systems (experiment with the winter wheat) – Jizak province.

Longer term rainfall and open pan evaporation data for the Pakhtakor site as collected from the meteorological observatory, Jizak station in Jizak province are presented in Figure 7.

Results indicated that crop production in early spring and summer season will require canal irrigation to meet soil moisture deficits in the region.
The winter wheat crop was planted in 90cm raised bed-furrow system. Beds were 15 cm in height. Wheat was planted in four rows at 15 cm spacing on the raised beds with an Indian planter. The planting treatment included (i) traditional practice, (ii) planting on raised beds, and (iii) bed planting in presence of residues. After winter wheat, maize crop was planted.

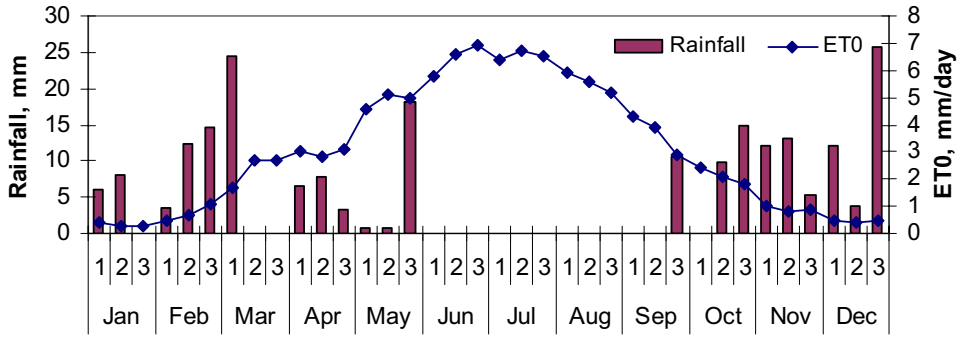


Figure 7 Rainfall and Reference Evapotranspiration for Jizakh station (2008).

Salinity data after harvesting the winter wheat has been plotted (Figure 8). It was observed that surface mulching reduced soil salinity by (17%). These results suggest that saline irrigation r without suitable salinity management intervention could buld up root zone.salinity and sodicity in irrigated soils.

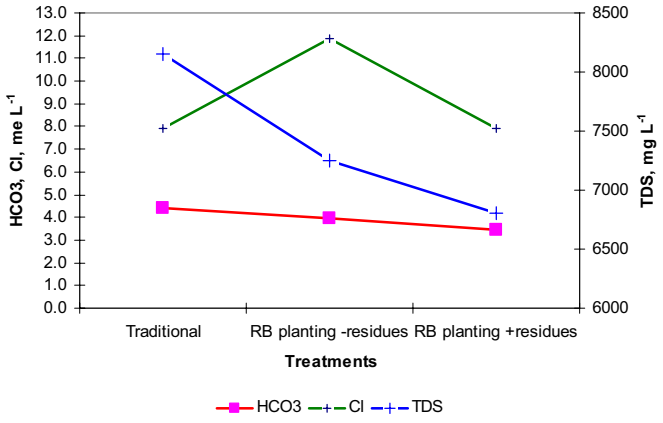


Figure 8. Total dissolved solids, HCO_3^- and Cl^- concentrations (me L^{-1})after harvest of winter wheat at 30-50 cm soil depth

Maize crop establishment trial

Each treatment received an area of 0.14 ha. The total experimental was 0.43 ha. Maize crop was planted after wheat harvest using an Indian planter. The following treatments were established: (1) Maize planted in middle of raised bed, control, 90 cm; (2) Maize planted in two rows on 90cm beds; (3) Maize + mungbean planted in paired rows, 90cm beds..

Photo: Mungbean inter-cropped with maize planted on mulched raised beds

It was observed that increasing the plant population in treatments 2 and 3 on 90cm raised bed-furrow system enhanced the grain yield by more than 0.4-1.2 ton/ha (table 19) . It may be mentioned that maize yields can be substantially improved by timely application of nitrogenous fertilizers. There are ample opportunities for pushing the maize yield plateau further inter cropping of mash (mungbean) with maize significantly improved the total system productivity. Mungbean yield was above 1.3 ton/ha.

Table 19. Effect of planting methods and intercrop (mungbean) on yields of maize

Treatment (crop establishment geometry)	Crop, yield, t/ha	
	Maize	Mungbean
Maize planted in middle of raised bed, control,90 cm	3.45	-
Maize planted in two rows on 90cm beds	4.63	-
Maize + mungbean planted in pair rows, 90cm beds	3.86	1.33

Compared with sole crop of maize (2-rows planted on 90cm raised bed system), substitution of one row of maize with mungbean significantly improved the net profit of the farmers by 770 thousand Uzbek sums (USD 550/ha). The cost benefit analysis is given in Table (20).

Table 20.Techno-economic parameters of different planting methods of maize and mungbeen in Esanboy ota farm in Pakhtakor district of Jizakh province

№	Indicators	Planting methods		
		Planting of maize in 90 cm wide raised bed in 1 rows in the center	Zero till planting of maize in 90 cm wide raised beds in 2 rows	Zero till planting of maize and mungbeen in 90 cm raised beds in 2 rows
1	Yields, t/ha	maize - 3.45 t/ha	maize - 4.63 t/ha	maize - 3.86 t/ha mungbeen -1.32t/ha
2	Gross profit, UZS/ha	1207500	1620500	2407000
3	Total expenses, UZS/ha	169880	172560	188760
4	Net profit, UZS/ha	1037620	1447940	2218240

Activity 2b. Indicators of growing cotton with mungbean using raised bed planter

Cotton crop was planted with an Indian raised bed-furrow system planter at 60cm and 90cm spacing. The planting configuration is shown in Figure (9).

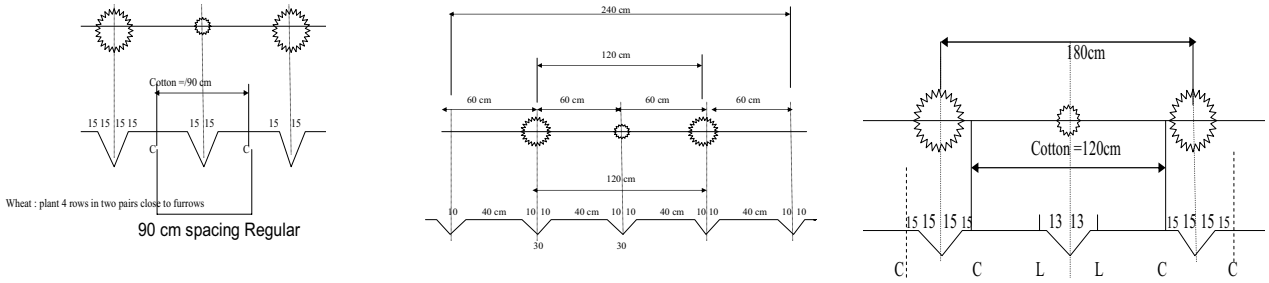


Fig. 9. Planting geometry of mungbean and cotton on 60 and 90 cm wide raised furrow irrigated systems.

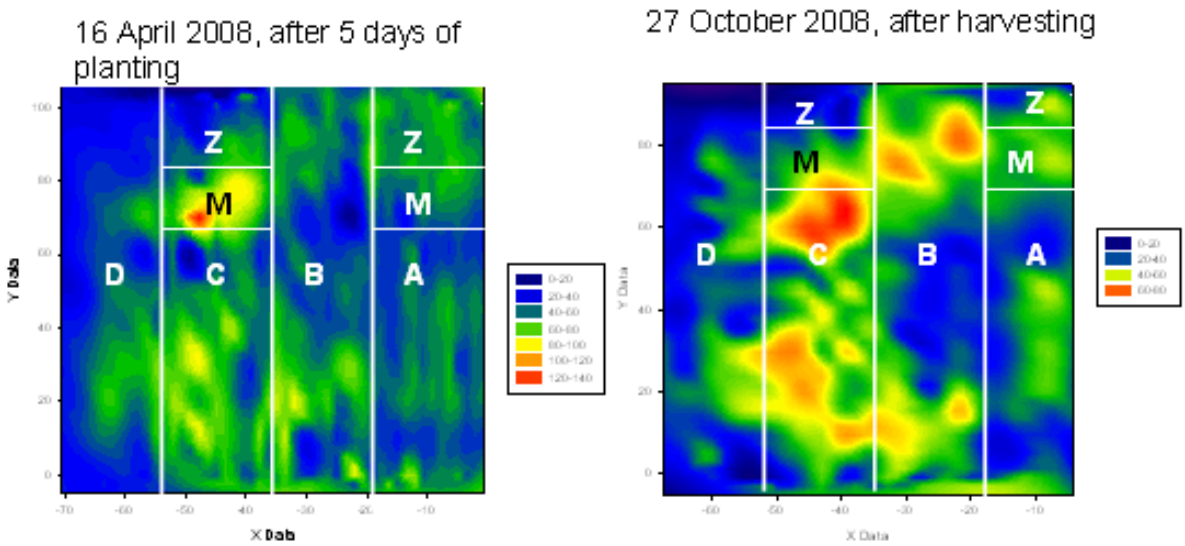
Cotton was planted in the center of the 60 or 90 cm spaced raised bed systems and also on the sides to open up the space for Mash planting as shown above. The experimental area was 0.72 ha for the 4 treatments (i) 60 cm beds with one row of cotton, (ii) 60 cm beds with one cotton row + one of mungbean (iii) 90 cm beds with one row of cotton in the centre , and (iv) 90-cm bed with one row of cotton and mungbean on sides of furrows (paired rows of cotton and mungbean). Each treatment was planted in 0.18 ha (length of beds 100 m x width of a plot 18 m). For cotton planting Buhara-102 variety was used with the seed rate of 30 kg/ha. Mungbean local cultivar was planted at the seed rate of 4 kg/ha. Crop yields for cotton and mungbean are given in Table 21

Table 21. Crops yields of cottonand Mungbean crops in different planting geometry

Treatment (crop establishment geometry)	Crop yield, t/ha	
	Cotton	Mungbean
Cotton, 90 cm	5.41	
Cotton + mungbean, 90cm	4.82	1.44
Cotton, 60 cm	4.46	
Cotton + mungbean, 60cm	3.84	1.32
Mungbeen “Zilola” variety	-	1.52
Mungbeen “Marjon” variety	-	1.78

Yield data presented in Table (21) indicated that cotton yield was maximum when planted in a single row on the raised beds with 90cm spacing. Cultivation of mungbean along with cotton reduced cotton yields but the total productivity of the system increased. . Cotton

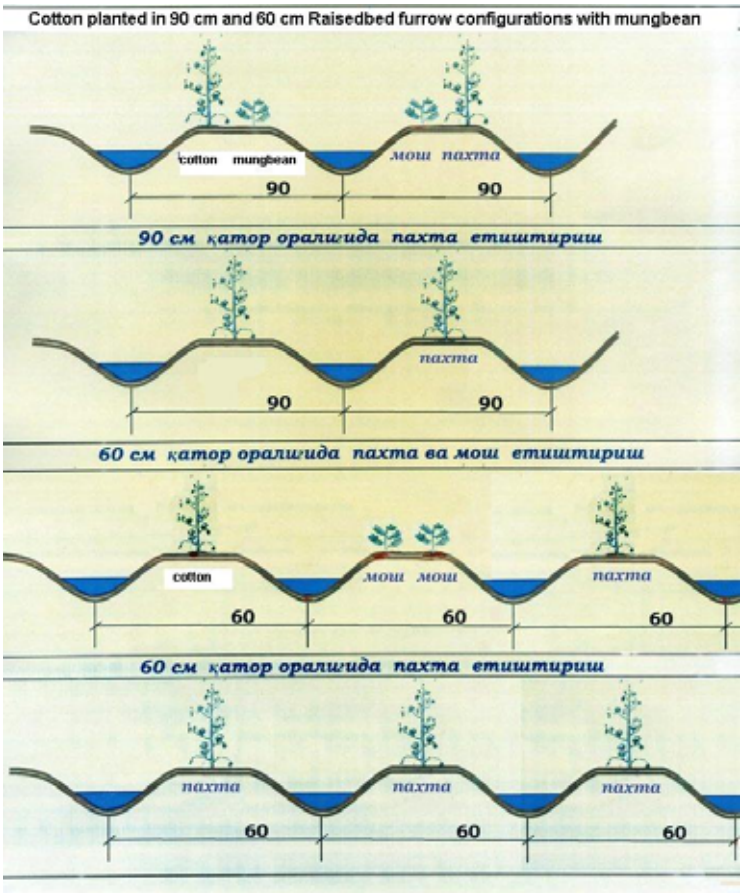
productivity in 60cm raised bed configuration was lower than the yield obtained 90cm bed configuration. It was mainly because the crop geometry as proposed in the picture was not followed. Planting a row of Mungbean along with cotton on a 60cm wide bed led to acute competition between the two crops. It may also be mentioned here that inherent higher soil salinity in 60cm bed plots also contributed to reduction in cotton yield. Leaching of this plot was not effective due to short canal water supplies (Figure 10). It is also worth mentioning that mungbean cultivar "Marjon" proved best and gave the highest grain yield as compared with 'Zilola' and the local cultivar.



X data reflects distance from right bottom corner of the field to the left were measurements were started; **Y data** corresponds to the length of the furrows

Treatments: **A**-Cotton+mungbeen intercropping at 90 cm space; **B**-Cotton at 90 cm interfurrow space; **C**- Cotton+mungbeen intercropping at 60 cm space ; **D**- Cotton at 60 cm interfurrow space; **M**-Mungbeen "Marjon" variety, Z-Mungbeen "Zilola" variety

Figure 10 Apparent soil salinity (mS/m) at cotton-mungbeen trials at 75 cm soil depth



Planting Geometry of cotton and mungbean on 90 and 60cm Raised-beds

Inter-cropping of mungbean with cotton in 90 cm and 60 cm wide raised bed configuration enhanced the net profit of the farmers (Table 22) by USD 650 and 850/ ha respectively.

Table 22. Technical-economic parameters of different plantinig technologies of cotton and mungbeen in Esanboy ota farm in Pakhtakor district of Jizakh province

№	Indicators	Treatments			
		Intercropping of cotton with Mash (raised beds with 90 cm spacing)	Planting of cotton on raised beds90 cm , spaced	Cotton + mash on Raised beds in 60 cm spacing	Cotton on Raised beds 60cm,spacing
1	Yields, t/ha	cotton - 4.8 mungbeen - 1.58	cotton - 5.4	cotton - 3.8 mungbeen - 1.52	cotton - 4.4
2	Gross profit, UZS/ha	3449200	2350400	2888800	1939600
3	Total expenses,UZS/ha	1159990	1213870	1042190	1027190
4	Net profit, ZS/ha	2289210	1136530	1846610	912410

In order to upscale raised bed technology, on 21 Oct 2008 winter wheat crop was planted at another farmer's field (Farmer Mr. Khudaiberdiev Uchkun) with area of 5 ha using Indian seeder on raised bed furrows. Different treatments with sowing rates (150, 225, 200, 250 kg/ha) were applied at the farmer's field. In the control plot seed rate was 225 kg/ha. Indian seeder was also used for seeding winter wheat in cotton-mungbeen plots and barley in maize-mungbeen trials. The experiment is still in progress.

Activity 3. Assessment of both native and non-native tree and grass species for their biomass productivity, salt tolerance and bio-drainage ability to rehabilitate the degraded rangelands in arid agroecologies

It was observed that halophyte fodder plants (Atriplex nitens, Climacoptera lanata, Kochia scoparia and Gliserizzisa glabra) flowered in September and fruiting stage in October. Fodder yields are given in Table (23).

Table 23. Productivity of some fodder plant species on Kyzylkum experimental field, Kyzylkesek August 13-14, 2008

Variety	Plant density, Thousand plants/ha	Plant height, cm	Green mass yield
Atriplex nitens	54±3,7	176±4,9	17,01±2,4
Climacoptera lanata	70,4±2,4	79±3,1	4,7±2,6
Kochia scoparia	763,4±2,4	179±4,9	25,9±4,7
Gliserizzisa glabra	163±5,90	19±4,6	5,0±3,1

Activity 4. Evaluation of diversified, salinity-resistant crops for enhancing biomass production for livestock in degraded rangelands

In August, fodder productivity of the millet cultivars was also determined. Fodder yield data is given in Table (24) Amongst of the pearl millet varieties the highest fodder productivity was observed in Aip – 19586, Aip 22269 and Aip 13150. Details of the experiment have already been presented in the Annual report 2007-08.

Table 24. Fodder crops yields at Kyzylkum site on 13-14 August 2008.

Cultivars	**Plant density, Thousands plants/ha**	**Plant height, cm**	**Green biomass, t/ha**
Pearl millet- Panicum miliaceum			
Raj 171	166.6±2.8	205.8±8.4	29.5±2.8
BK-75	116.0±3.7	131.0±8.7	42.9±3.1
HHVBC	116.6±4.8	225.7±9.3	53.1±4.6
JCMC	106.3±3.2	277.5±8.1	54.6±4.7
Aip 19588	83.0±2.1	277.5±8.0	61.3±5.1
Aip 13150	70.0±3.2	245.0±8.4	60.4±4.9
Aip 22269	63.0±4.8	200.0±6.4	64.5±4.6
Legumes Aicph-88039	80.0±4.6	140.0±4.2	6.1±1.9

Note: the table is included due to small changes in yields reported in the earlier report.

In the desert holding of a farmer, an experiment was initiated with different kinds of melons and pumpkin in a 0.25 ha plot. Pumpkin, water melon, melon and tomato were grown. Water melon, melon and handalyak-melon were planted on May 10-11 and pumpkin – on May 20. The length of growth period for pumpkin, water melon and melon is about 150-155 days, for handalyak-melon – 75 days and for tomatos – 90 days in the deserts of Kyzylkum (Table 25).

In the desert area it was observed that marketable productivity of water melons was 32.4 t/ha, melon – 30.0 t/ha, pumpkin – 20 t/ha, tomato – 28.0 t/ha.

A local cultivar of alfalfa was observed to grow profusely in the deserts of Kyzylkum. Seed production efforts were initiated to multiply seed and distribute the same to other local famers located in the deserts of .Kyzylkum. Nearly 50kg seed was distributed to promote this local alfalfa cultivar in the desert ecology.

Table 25. Cucurbit crop yields on Kyzylkum experimental field, 2008. Kyzylkesek 14.08.2008.

#	Crop	Fruit yield, t/ha
1	Pumpkin	20,0 ± 4,1
2	Water melon	32,4 ± 4,0
3	Melon	30,0 ± 4,3
4	Handalyak melon	21,0 ± 2,4
5	Tomatoes	28,0 ± 4,3

Activity 5. . Calibration and use of Optical canopy sensors (Green Seekers) for measuring crop development, comparing crop management practices for SLM and efficient nitrogen management

On the territory of the Kibray district of Tashkent region, an experiment for Green Seeker calibration is laid out in accordance with the methodology with four 4 replicates. Winter wheat variety "Moskvichka" was planted with the seed rate of 200 kg/ha using the Indian planter for zero till. Super-phosphate was applied in the rate of 108 kg/ha and nitrogen fertilizers in accordance with the program in the rates of 0-250 kg/ha. Also experiment is laid out in one farmer holding and in accordance with the program 50% of nitrogen fertilizer was applied (125 kg/ha).

Activity 6. Study the impact of precision laser-assisted land leveling on water saving, salt leaching, and crop performance in irrigated agro-ecologies using EM probe and Optical sensors

Laser leveling was carried out in Jizakh site on the area of 5 ha. At the beginning measurements on the field topography was carried out in every 20x20 plots with the use of laser system, then several variations of leveling were developed (Picture 6.1). Initial difference in the land surface was +22 and – 31 cm. The volume of the land leveling works in accordance with the most efficient variation of leveling was 552 m^3/ha. On Syrdaria experimental site laser land leveling was done in accordance with simplified land leveling. Four geodesic sections along the field and 4 across the field were implemented in an area of 13 ha Based on these measurements slopes were determined across and along the field that were to be created (picture 6.2). On the area of 2 ha from the field border area laser leveling was conducted. On the next 2 ha of neighboring area laser land leveling also was applied leading to better evenness of the field in comparison with the initial condition of the field. However, due to the frequent breakage of the tractor, lack of POL or absence of tractor perfect evenness of the field has not been achieved. For all these works 12 days were required.

Economy of irrigation water under laser land leveling system was found to be 600 m3/ha. For winter wheat planting in the leveled field, irrigation rate was 1100 m3/ha whereas it

was 1700 m^3/ha in the traditionally leveled field. Precision laser assisted land leveling reduced excessive losses of irrigation water through the seepage and reduced the irrigation time and led to an even distribution of soil moisture over the field. Productivity gains in winter wheat crop planted in leveled fields is yet to be observed.

Activity 7. Dissemination of results and developing mechanisms for up scaling and scaling out the SLMR options

#	Dates	Activity	Participants
1.	29-7- 2008	Farmer Filed Day in Jizakh	farmers, irrigation specialists and WUA specialists (Total 65)
2.	2-9-2008	Field Day organized in Kyzylkum desert	Director, Republic center for agriculture electrification - Prof. Rabbimov, ICBA - Director, UzNIIKEP- S.Yusupov, Deputy Chairman of the Uzbekkarakul company - M.Narziev, Chairman of the Navoi Karakul - A.Ashurov, heads of the farmer holdings, farmers, dehkans, scientists of SANIIRI, UzNIIKEP – in total 38 persons, National Secretary of Kassilyu program, Hakim of the district,
		TV and News Paper reports	Field days were covered by 'Pravda Vostoka'
		• Technology flyers developed • Posters developed	-11 - 5

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