Agricultural Innovation Program for Pakistan (AIP)

Semi-annual report:

April 01-September 30, 2014

Submitted to USAID on

October 31, 2014

ACRONYMS

AARI	Ayub Agriculture Research Institute
AI	Artificial Insemination
AIP	Agricultural Innovation Program
AJK	Azad Jammu and Kashmir
AR Farms	Adaptive Research Farms
ARI	Agriculture Research Institute
ARS	Agronomic Research Station
AVRDC	The World Vegetable Center
AWD	Alternate Wetting and Drying
AZRI	Arid Zone Research Institute
BLB	Bacterial Leaf Blight
CA	Conservation agriculture
CCRI	Cereal Crops Research Institute
CGS	Competitive Grants System
CIMMYT	International Maize and Wheat Improvement Center
DAP	Diammonium phosphate
DG	Director General
DSR	Dry seeding of rice
DSS	Decision support system
FAO	Food and Agriculture Organization of the United Nations
Ha	Hectares
HEC	Higher Education Commission
HRD	Human Resource Development
ICARDA	International Center for Agricultural Research in the Dry Areas
ICI	Imperial Chemical Industry
ICT	Information and Communication Technology
ILRI	International Livestock Research Institute
IPM	Integrated Pest Management
IRD	Informal Research and Development
IRRI	International Rice Research Institute
IRS	Internationally Recruited Staff
KP	Khyber Pakhtunkhwa
KSK	Kala Shah Kaku
LCC	Leaf color chart
MEW	Mega Environment for Wheat
MMRI	Maize and Millet Research Institute
MR	Moderately Resistant
MS	Moderately Susceptible
NARC	National Agriculture Research Center
NARS	National Agricultural Research Scientist
NUYT	National Uniformity Yield Trial
OPV	Open pollinated variety

PARC	Pakistan Agricultural Research Council
RRI	Rice Research Institute
SARS	Summer Agricultural Research Station
SB	Super Basmati
SDS	Sodium Dodecyl Sulfate
SOP	Sulfate of potash
SSNM	Site specific nutrient management
WRI	Wheat Research Institute
WRIS	Wheat Research Institute Sindh
ZT	Zero Tillage

CONTENTS

SUMMARY

In this reporting period (April-September), AIP is progressively moving towards achieving its goals. The activities are in line with work plan with focus on four cross-commodity key themes: new varieties and seeds, new technologies (mechanization), value chain development (durum wheat, rice, vegetables, perennial crops and livestock), human resource development and knowledge management.

The commissioned projects are being implemented successfully; the productivity of yield is enhancing through the involvement of farmers, extension workers, scientists, researchers and relevant stakeholders. The project has established and further strengthened public-private partnerships. The response of key agricultural players at the 'First National Workshop on Durum Wheat in Pakistan' was positive, which has led to linking the value chain actors for further development in the durum wheat sub-sector.

Five PhD and four alternates have been selected for PhD scholarships through the Human Resource Development (HRD) component. At the final stage two of the five finalists are women. Additionally, for the MS scholarships six of the nine finalists are women.

Discussions were held at provincial levels to create and establish Provincial Agricultural Research for Development (AR4D) Boards in Balochistan, Khyber Pakhtunkhwa (KP) and Sindh provinces patterned on the Punjab Agricultural Research Board (PARB) in Punjab province. This will enable the AIP competitive grants system (CGS) to identify and prioritize research areas.

The project has increased the participation of women in its organizational and operational activities to promote gender equity.

AIP staff refined the workplan for year III (2014-2015) of the project in close consultation with the AIP primary partners, relevant stakeholders and the USAID mission in Pakistan. The updated work plan was submitted to USAID in September 2014.

A result framework for the project was designed in line with the USAID mission framework. The draft framework was shared with USAID and further refined on the basis of comments. Indicators for each Intermediate Result and Sub-Intermediate Result were developed and agreed to by the Project Management.

Keeping in view the external factors, risks involved and lessons learned, a collaborative effort of CIMMYT and its primary partners has formulated a strategy to overcome the challenges. Some of the AIP operational activities were restricted due to administrative issues, security concerns and unfavorable weather conditions; they have now resumed as planned.

BACKGROUND

The 'Agricultural Innovation Program for Pakistan' (AIP) works to increase agricultural productivity and incomes in the agricultural sector through the promotion and dissemination of modern practices in the following sectors: cereals (wheat, maize, and rice), livestock and horticulture (fruits and vegetables). Project management is vested in a unique consortium of CGIAR Centers and the Pakistan Agricultural Research Council (PARC), led by the International Maize and Wheat Improvement Center (CIMMYT). AIP aims to foster the emergence of a dynamic, responsive and competitive system of science and innovation that is 'owned' by Pakistan and will catalyze equitable growth in agricultural production, productivity and value. AIP is rooted in the principles of Agricultural Research for Development (AR4D), with particular emphasis on building partnerships between public research and those it serves, including farmers and the private sector; increasing investments; generating, sharing and making use of agricultural knowledge for development; and demonstrating and building awareness of the development impacts and returns from agricultural innovation.

AIP operates through three Activity Windows: commissioned projects, a competitive grants system and human resource development (HRD). Work within these activity windows addresses complex agricultural systems but is divided into four 'Science Windows' – cereals and cereal systems, livestock, vegetables and perennial horticulture. The key indicator of AIP's success will be the number of smallholder farmers who adopt or benefit from productivity or value-enhancing technologies.

CIMMYT is the primary implementing partner and prime grantee; managing and taking overall responsibility for AIP and providing direct oversight of the agronomy, wheat and maize commissioned projects within the cereals and cereal systems science window. Four international partners (the International Livestock Research Institute, or ILRI; University of California, Davis; The World Vegetable Center, or AVRDC; and the International Rice Research Institute, or IRRI) lead on commissioned projects in livestock, tree fruits, vegetables and rice, respectively, while PARC serves as both the hosting partner and the lead on a province-inclusive competitive grants system. Combined, those organizations are CIMMYT's "primary partners."

TECHNICAL AND WORKPLAN UPDATE

Cereals and Cereal Systems

Wheat

Increasing Wheat Production through Rapid Diffusion of New High-Yielding, Rust-Resistant Wheat Varieties

Creating awareness for new wheat varieties and developing grounds for public-private partnerships to produce and market wheat seed

Of the Eight wheat varieties included in the demonstration during 2013-14, farmers in Khyber Pakhtunkhwa (KP), did not prefer Attahabib over the widely grown varieties, e.g. Pirsabak05 or Pirsabak08 because it gave lower yield than most widely grown variety, e.g. Pirsabak and the consumers did not like the too dark color of the *chapatti* made from this variety, hence there was no seed demand for it.

Farmers in rainfed areas of Punjab preferred Dharabi11 and Chakwal 50 while AAS11 and Punjab11 were preferred in irrigated areas of Punjab and Benazir in Sindh. In Punjab, the demand for the seeds of AAS11 was highest, followed by Punjab11 for the irrigated areas while Chakwal50 was in more demand than Dharabi11 in rainfed areas of Punjab. Coincidently, rains during harvesting period affected quality of seed in some areas of Punjab and some farmers mentioned that in spite of high preference and interest by the neighboring farmers they were unable to use and share seeds from this year harvest.

Farmers compared Benazir mostly with TD1 variety in Sindh and told the researchers that its yield was at par to TD1. Demand for seeds of Benazir was quite high while seed availability was quite low.

Analyzing opportunities and gaps to strengthen wheat value chain

A number of participatory stakeholders workshops focused on the wheat seed value chain were organized by AIP between June and September 2014, led by CIMMYT in partnership with various research institutes in Khyber Pakhtunkhwa (KP), Punjab and Sindh (Table 1). These workshops brought researchers, farmers, extension workers, seed companies and seed regulatory bodies on one platform to analyze gaps and opportunities in wheat seed value chain development in Pakistan. There was an emphasis on using innovative approaches to research, extension, seed production and marketing.

The workshops resulted in functional partnerships for producing and marketing wheat seeds.

About 12 private seed companies have shown interest in working jointly with public sector organizations for producing basic seeds.

Table 1: Summary of stakeholders participatory workshop on wheat seed value chain, 2014

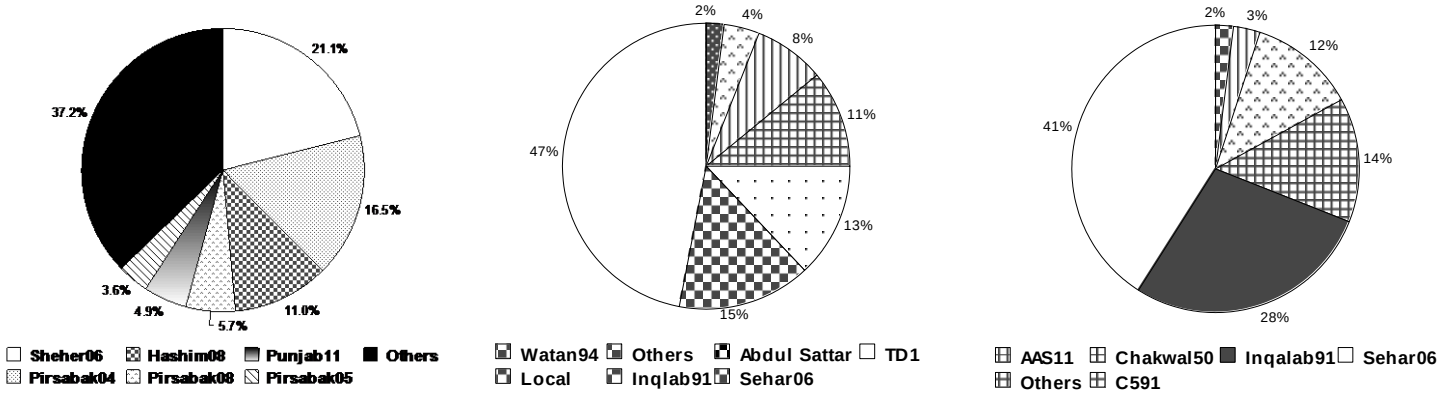
Province	Venue and date of the workshop	Number of participants	Organizers
KP	Cereal Crops Research Institute (CCRI), Nowshera, KP, June 4	49	CIMMYT, CCRI and PARC
Punjab	Barani Agricultural Research Institute (BARI), Chakwal, Punjab, September 18	65	CIMMYT, BARI and PARC
Sindh	Hotel Indus, Hyderabad, August 26	42	CIMMYT, Wheat Research Institute, Sakrand, Sindh and PARC
Total		**156**	

Deployment of new varieties in seed systems is slow due to: limited land and financial resources of research organizations; long adoption lag phase; and lack of a wheat grain pricing policy regime in all of the provinces.

Workshop findings revealed that in KP, nearly 93 percent of all wheat seeds used comes from informal sources. Supply of certified seeds every year is limited around 7 percent (3.8 percent by public sector and 2.9 percent by private seeds companies). The productivity of wheat in the province is low (1.6 t/ha^{-1}) due to the predominance of an informal seed system and because the majority of wheat is grown under rainfed conditions. The workshop participants identified weak linkages and a lack of innovative thinking among the value chain actors as major factors affecting wheat growth and sustainability. The varietal portfolio of wheat varieties released in KP as well as in Punjab consists primarily of several old varieties (Figure 1a and 1c). Progressive farmers from KP and *Pothwar* region of Punjab suggested that the timely availability of suitable varieties (that can be adapted to specific conditions) of quality wheat seeds at an affordable price with a priority for wheat varieties suitable for rainfed condition will result in improving wheat productivity in the province.

The participants identified the gaps that are causing the slow popularization of new varieties, include a lack of coordinated efforts, weak linkages among the value chain actors and access to new wheat varieties.

Workshop findings indicated that in Sindh, private seed companies supply more than 90 percent of certified wheat seeds which are common wheat varieties with high market demand (Figure 1b). The lack of a regulatory framework allowing private seed companies to produce pre-basic and basic seeds is also a factor limiting the supply of adequate seeds. Private seed companies recognized lack of varietal choice, including short duration varieties, is due to limited technical capability, financial resources, land and capital to develop research and development capacities. Farmers, in the *Pothwar* region of Punjab still grow varieties like C591 (released in 1934) and Inqilab91 (released in 1989) (Figure 1c); therefore they harvest low wheat yields.



1a: Khyber Pakhtunkhwa **1.b:** Sindh **1.c:** Pothwar region of Punjab

Figure 1: Wheat varietal diversity, 2013 (source: Khan et al., 2013)

Inadequate efforts to popularize new wheat varieties and educate farmers about their suitability are also causing low yields. Workshop participants recommended that bags of new wheat seed varieties should come with full information; specific adaptation to irrigated or *Barani* (rainfed) lands, other farmer-relevant traits and associated technological information. They also recommended that demonstration plots and other adaptive research and combining agronomic packages will help to popularize new varieties. Among other constraints, a lack of storage facilities and appropriate storage techniques were also highlighted.

The workshops created a renewed interest in further strengthening wheat seed systems. A number of action points were identified by the participants for the upcoming wheat season (October-November 2014), which include:

- Participatory varietal selection with focus on smallholder farmers, women headed households, tenants and vulnerable households.
- Participatory on-farm demonstrations of new varieties and appropriate agronomic practices involving all the major actors of the wheat seed value chain.
- Initiation of pre-basic and basic seed production by private seed companies under the direct supervision of breeders and with support from research, extension and seed regulatory bodies.
- Deployment of new wheat varieties using the Informal Research and Development (IRD) approach with smallholder, landless and flood-affected farmers of targeted areas with low wheat productivity, low varietal diversity and high poverty.

Strengthening wheat seed systems

27% wheat seed replacement rate for Pakistan (as per the official statistics) is one of the best for developing countries. Conversely, the weak sector of wheat seed systems in the country is that smallholders and rural/remote areas are not well served compared to high potential production systems and large farmers. It appears therefore that majority of wheat growers that do not replace wheat every year are majority of smallholders that comprise >70% and it closely matches with 77% figure of wheat farmers not replacing wheat seeds regularly in Pakistan.

A 2014 bulletin by the World Food Program shows that more than 27 million people in Pakistan are highly-to-severely food insecure. Most smallholders and vulnerable people live in districts that will need special attention to improve food security. To address the needs of smallholders and vulnerable people, a number of non-conventional approaches will be needed to strengthen wheat seed systems in rural/remote areas and smallholders. Following are the possible approaches for strengthening wheat seed systems; those will be piloted and validated across provinces.

- Production of basic seeds by private seed companies under the direct supervision of public sector wheat breeders. Public sector breeders will provide pre-basic seeds (new initiative by AIP) and train private sector seed technicians on the techniques for producing quality basic seeds.

- Community-based seed production linking with private companies or other market outlets and supported by proper equipment and training in quality seed production. Linking seed producers with small seed companies in the nearest markets.

- Making maximum use of Community Service Organizations (CSOs) associated with National Rural Support Programme and such other organizations. Such networks can be used to develop community-based seed production (CBSP) and marketing.

Collaborate with Agha Khan Rural Support Program (AKRSP) for Gilgit-Baltistan to deploy new, high yielding and rust resistant wheat varieties areas as market-oriented seed production is unlikely to work in those areas as highly subsidized wheat grains are supplied by government to each household in Gilgit-Baltistan.

- Working with Agricultural Extension Departments for the popularization of new wheat varieties and also seed production and marketing where these departments are still engaged in such tasks, e.g. KP and Baluchistan.

Effective Fungicides Introduced, Evaluated and Registered for Controlling Wheat Rusts

The project is assessing wheat yield loss due to rust using the most effective fungicides. This is being undertaken to identify and register the most efficacious fungicides for their use on wheat rust.

The first set of experiment was conducted to evaluate two fungicides for seed dressing and three as spray chemicals to reduce the incidence of rust at the Summer Agricultural Research Station (SARS) Kaghan in KP, from June to October 2014.

Pirsbak-2004 and Saleem-2000 were compared in the trial while Morocco, a universal rust susceptible variety was grown in the spreader rows to serve as a source of fungus inoculum. The incidence of yellow rust in the trial even on Morocco was not much (5 MR MS). Conversely, Morocco was severely infected with leaf rust (80-90 S) (modified Cobb's scale). Pirsbak-2004 is immune to this disease while some traces of it were observed on Saleem-2000. Due to a lack of disease occurrence, the basic questions of quantifying the extent of crop damage due to rust

and the extent of yield loss that could have been averted using effective fungicides remained unanswered. The study in deed has a limitation in that entire experimentation needs to be done under the natural inoculum pressure of rust fungus, as it is not ethical to release rust spores artificially for creating disease incidence in any wheat producing areas.

Contrary to the widely held belief that only yellow rust occurs during summer in the high altitude areas, findings from the study revealed that leaf rust does occur in high altitude areas on wheat crop grown during summer season. Apart from rust, powdery mildew was also prevalent in the trial.

Development of a Durum Wheat Value Chain

The existing initiatives of durum wheat variety identification, possible release of new varieties, seed production and scaling up in most suitable areas in Pakistan for growing an economical crop were explored. Some of the key activities undertaken during June-September were:

- Value chain study involving seven actors of a possible durum wheat value chain: farmers, millers, processing industry, restaurants, seed companies, dealers and consumers.
- Compilation and analysis of data from the last three to four years from various durum wheat nurseries and trials to identify the most promising durum wheat lines for inclusion in national uniformity yield trials (NUYT). Preliminary analysis revealed that there is a vast difference between durum wheat lines for grain yield potential. At least 13 of those varieties produced more than 5 t/ha^{-1} of grain yield. There seems to be little year-to-year variation for grain yield, which is a good indicator of yield stability (Figure 2).

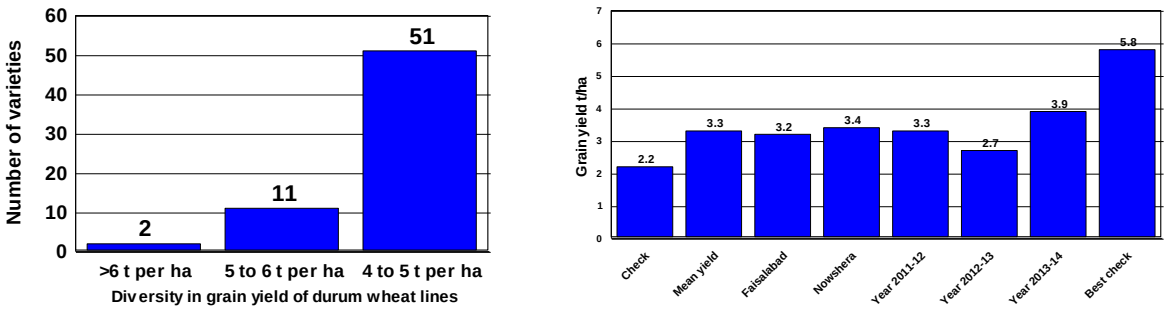
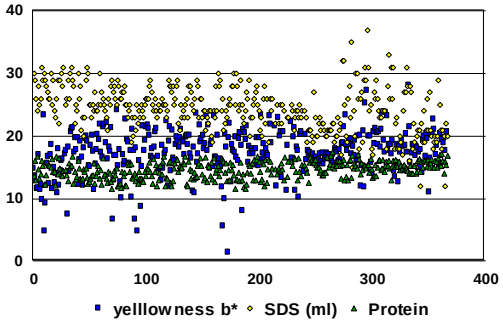


Figure 2. Variation in durum wheat lines for grain yield; overall yield performance (left) and annual mean grain yield performance at Wheat Research Institute Faisalabad and Cereal Crops Research Institute (CCRI) for last three years in comparison to check varieties (right), September 2014.

- A grain quality analysis was conducted to identify the most appropriate lines that are acceptable for use as pasta food products, focusing on protein percentage, yellowness and sedimentation values. The genetic diversity of the most promising nearly 300 durum wheat lines was analyzed for higher-value application in nutrition, processing and end-

use quality using the most efficient laboratory screening techniques. The findings revealed that there was a vast genetic diversity for protein, yellowness and sedimentation quality attributes in durum wheat lines. The average protein value was nearly 15 percent, with a substantial number of entries lying outside two standard deviations for protein percentage. Diversity for yellowness and sedimentation was also quite considerable, suggesting these lines meet the minimum quality standard for pasta food products (Figure 3).



Statistics	Protein	Yellowness b*	SDS (ml)
Range	11.5-17.5	11.5-28.1	12-37
Average	14.61	17.43	24.41
Standard deviation	1.34	3.57	3.68

Figure 3: Scatter plot of protein percentage, yellowness and sedimentation values of durum wheat lines (left) and their statistics (right) analyzed in AARI Wheat Research Institute laboratory Faisalabad, September 2014.

Regional variation for quality attributes for durum wheat lines was also assessed and it was revealed that lines from Nowshersa and Quetta showed a good combination of all three quality traits. Bhawalpur and Sakrand lines also had a good combination of protein and sedimentation, but were low in yellowness values (Figure 4). Lines from Faisalabad were low in protein and yellowness. Interestingly all the lines were high in sedimentation value. Around 40 lines have been found with the right combination of high yields, protein, yellowness and sedimentation values that will form the basis for composing the NUYT on durum wheat for October-November planting.

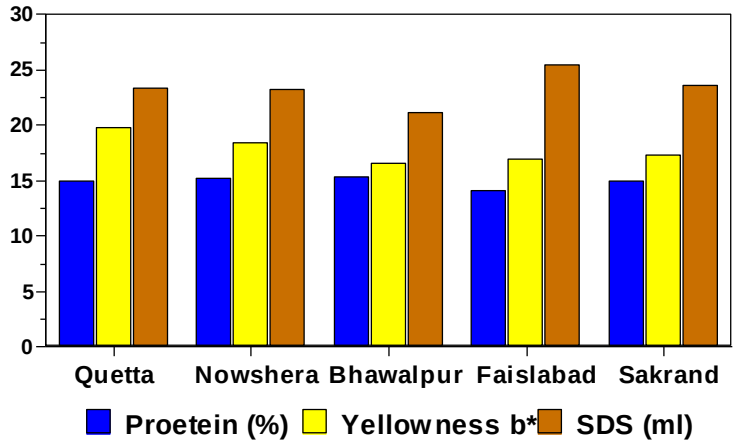


Figure 4: Regional variation in durum wheat lines for protein, yellowness and sedimentation values, September 2014.

- The first national durum wheat workshop in Pakistan was organized on September 22-23 to explore emerging opportunities and associated challenges of durum wheat in the country.The workshop brought together farmers, millers, processing industries, dealers, seed companies, extension professionals, researchers and policy makers at a common forum to exchange knowledge, share experiences and identify new avenues of development in this sector. About 100 participants from the four provinces of Pakistan (Baluchistan, KP, Punjab and Sindh), participated in the workshop. The findings of various activities discussed above were shared. It was agreed that durum wheat varieties with the best combination of all the traits will be identified and included in the NUYT starting in October-November 2014.

The project will make use of existing agronomic and yield data as a part of varietal release requirement. Producing an adequate quantity of seeds in parallel to varietal release and their popularization in the most appropriate regions will fast-track the cultivation of durum wheat in the shortest period possible. At least two durum wheat products (pasta and noodles), will be validated and promoted in local markets/industries within the life of the project.

Currently no new recommended varieties of durum wheat are available to farmers for on farm demonstration or popularization. One of the major tasks in completing durum wheat value chain is to identify and release couple of most promising durum wheat varieties during life of AIP project and develop a road map to fast track their seeds increase, and deployment in various parts of Pakistan. To achieve these objectives the following action points have been identified by the workshop for implementing by AIP commencing October-November 2014:

- A coordinated NUYT will be composed by pooling the best available entries from all the partner organizations: Cereal Crops Research Institute, Quetta, CCRI, Nowshera, WRI Faisalabad, AARI Bahawalpur and WRI Sakrand. Durum wheat lines that have the best combinations of all the traits – better adaptation, high yield and acceptable grain quality and disease resistance will be included in the trial.
- Pre-release seed multiplication of most promising lines.
- Giving continuity to the dialogue with business communities for converting bread wheat milling technology into dual purpose or for durum wheat milling.
- Providing technical support to convert bread wheat mills into durum wheat milling.
- Around 50 people will be trained on durum wheat science, grain quality analysis and utilization.

Maize

Updates of Activities under Commissioned Projects

Commissioned projects conducted under AIP concentrate on four strategic areas:

- Develop/introduce climate resilient maize
- Develop/introduce biofortified maize
- Develop/introduce maize tolerant to biotic stress
- Enhance the maize seed sector

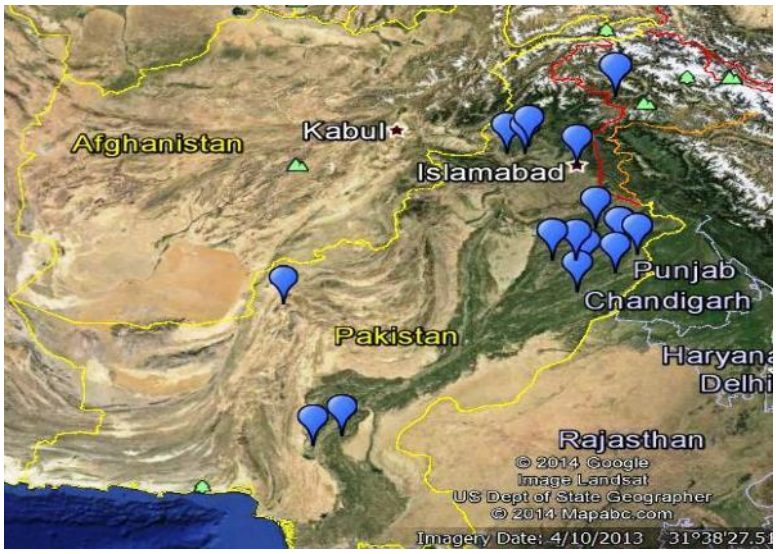
Following are the updates of major activities in relation to commissioned projects during April-September 2014.

Development/Introduction of Climate-Resilient Maize:

CIMMYT, under the AIP-Maize component, introduced various types of maize germplasm (listed under Appendix-IX) bred to adapt to stress environments. These varieties are being evaluated in partnership with national institutions (Appendix-X) at various locations across Pakistan (Map 1). The achievements of this commissioned project during April-September 2014 are as follows:

- Introduction and evaluation of 332 white maize climate-resilient hybrids sourced from CIMMYT's Latin America and Southern Africa regional offices (Mexico and Zimbabwe).
- Introduction and evaluation of 30 white maize climate-resilient open-pollinated varieties (OPVs) sourced from CIMMYT's Southern Africa regional office (Zimbabwe).
- Introduction and evaluation of 28 yellow maize climate-resilient hybrids sourced from CIMMYT's Latin America regional offices (Mexico and Colombia).
- Establishment of a maize variety evaluation network in Pakistan with the participation of nine public and nine private institutions.
- Data from the multi-location variety trials collected and being analyzed to be utilized for validation process in the subsequent seasons.
- Introduction and seed increase of 137 elite parental inbreds introduced from CIMMYT regional offices (Mexico, Colombia and Zimbabwe).

In addition, most of the trials from the spring season were harvested during the reporting period (Appendix-XI). The data from these trials were compiled and a technical variety evaluation report will be shared with the partners in the first quarter of 2014-15 budget year. Based on the evaluation data, partners will select the best performing entries for variety registration according to variety release guidelines.



Map 1: AIP-Maize varieties evaluation sites in Pakistan

Figure 5: AIP maize varieties evaluation at CCRI, Nowshera-KP, June 2014

Figure 6: AIP maize evaluation at Gilgit Baltistan, September 2014

Figure 7: AIP maize evaluation at University of Agriculture Faisalabad, May 2014

Development/Introduction of Biofortified Maize:

CIMMYT germplasm that have a proven protein quality and enriched with provitamin A (beta-carotene) are being evaluated in Pakistan for use as food and feed. During this reporting period the following achievements were made:

- Introduction and evaluation of:
    - 50 advanced white quality protein maize (QPM) hybrids from CIMMYT's Southern Africa regional office (Zimbabwe).
    - 10 yellow QPM hybrids from CIMMYT–Colombia.

    - 24 provitamin A hybrids introduced from CIMMYT–Mexico.
    - 75 provitamin A inbred lines for performance evaluation from CIMMYT-Mexico.
- Establishment of a biofortified maize variety evaluation network in Pakistan with the participation of public and private institutions.
- Collection of data from the multi-environment trials which will be useful for validation process in subsequent seasons.

The partners will analyze the introduced biofortified maize varieties (Appendix-XII) and identify the best performing entries for variety registration.

Developing/ Introducing Maize Resistant to Biotic Stresses

Under the AIP project a pest and disease screening network will be established. During the reporting period the experiences of CIMMYT projects in Kenya were assessed. The inputs from these projects will help to design the necessary training to partners as well as to fulfill the required facilities at NARC. The possibilities of introducing metal silos, which help to reduce post-harvest loss in maize, were also assessed during the visit to Kenya. Other activities undertaken during the reporting period include:

- A preliminary assessment of facilities, including an insectary and a greenhouse at NARC was made and required laboratory facilities were discussed.
- Working manuals and lab protocols acquired for the isolation and mass rearing of maize stem borer and grain weevils for use by NARS in Pakistan.
- NARC identified to be the center of insect resistance maize screening network.

Figure 7: Stem borer mass rearing facility (left) and pupa of maize stem borer (right) at Kiboko, Kenya, April 2014

Enhancing the Maize Seed Sector

Access to and the availability of quality seed are the most important factors to enhance agricultural productivity. In this regard, the Pakistani maize seed industry is not robust enough to meet the high demand for maize seeds. More than 85 percent of hybrid maize seed is imported annually (FSC&RD, 2013), which makes the price simply unaffordable for most smallholder farmers. As a result, farmers are forced either to recycle seed or to use substandard seeds available in the market. Resolving the issues related to price and quality

through the participation of public and private institutions will help to unlock the potential of maize productivity in Pakistan.

AIP-Maize established and further strengthened public-private partnerships in variety evaluation and seed dissemination among nine public and nine private institutions that are engaged in maize research and dissemination activities at various levels.

Maize breeding and quality seed production training was conducted for public and private institutions; 40 representatives from public and private institutes attended the training (Appendix VIII). AIP-Maize is working in partnership with a number of public and private institutes to enhance the maize seed sector by producing and marketing the seed of released maize varieties.

Figure 8: AIP-Maize variety evaluation at Jullundur Seed Company, June 2014

Rice

The following commissioned project activities of the AIP-Rice component were conducted from April to September with the collaboration of provincial partners. Under each commissioned project, sub-components were incorporated.

- Breeding program for improved indica and basmati rice,
- Improved crop management.
- Improved post-harvest and quality control.
- Capacity building for rice researchers and extension officers.

Breeding Program for Improved Indica and Basmati Rice

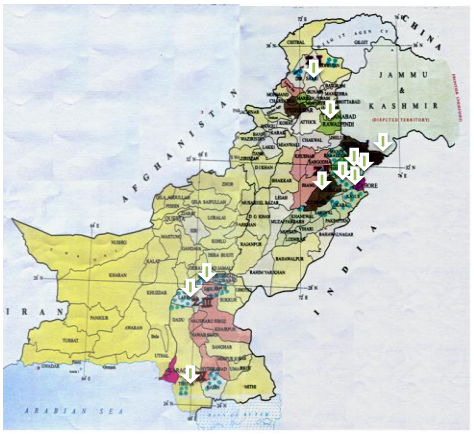
New Generation of High-Yielding, Stress-Tolerant, High-Quality Indicia and Basmati Varieties and Hybrids

In Pakistan, rice crops suffer from biotic and abiotic stresses that cause substantial quantitative and qualitative losses each year. Under this sub-activity, AIP-Rice planned to incorporate additional Bacterial Leaf Blight (BLB) genes (Xa23, Xa27) into local germplasm (advance lines/cultivars) that are resistant to some of the local virulent, along with submergence and drought tolerance through marker-assisted breeding. During this reporting period, the following were accomplished.

- Identified and selected the three best BLB resistance lines: PAK B-20, PAK B-24 and PAK B-25 from Super Basmati (SB) parent. Several SB populations with resistance genes for bacterial blight were further developed. Phenotyping of SB/IRBB57 advanced lines against 10 races of Xoo were done and a total of 94 BC2-derived lines from SB/IRBB66 populations were phenotyped, permitting selection and further line advancement. Additional generation advancement and line development activities were performed for two other populations: SB/IRBB27 and SB/IRBB23, but fixed lines are not yet available.
- New IR6-Sub1 lines were developed using a combination of phenotyping and marker-assisted selection for Sub1 (submergence). A backcross-pedigree method was used to select for plant type in segregating populations. Promotion of 142 lines for evaluation in an observational yield trial (OYT) in the 2014 dry season at IRRI HQ. Of these lines, 60 lines were selected based on performance, to be re-tested in the OYT during the 2014 wet season at IRRI. An additional 17 advanced IR6-Sub1 entries were also tested in the wet season. The submergence phenotype for all entries (77) will be confirmed by phenotyping and marker genotyping in the wet season.
- Selected more than 900 advanced breeding lines having different traits including yield potential, grain quality, biotic (BLB) and/or abiotic (submergence, drought, salinity and heat) tolerance. This material included 225 high-yielding irrigated lines, 77 submergence tolerant, 27 BLB-resistant, 23 drought-tolerant lines, 10 heat-tolerant and 9 salinity-tolerant lines. A total of 933 IRRI lines totaling 45 kg were shipped to Pakistan, but due to the late arrival of this material, it was not possible to plant for testing at the proposed localities in Pakistan. Therefore, these breeding lines will be evaluated during the crop year 2015.
- Three BLB resistant rice varieties PAK B-20, PAK B-24 and PAK B-25 from Super Basmati (SB) ready for National Uniform Yield Trial (NUYT). Seed of these varieties would be available to farmers by the end of 2015.
- Two rice varieties, EF-39 and EF-52, developed by NIAB, Faisalabad are being evaluated for cold tolerance and yield at Agriculture Research Institute (ARI), Mingora, Swat in KP. The crop is still in the field and showing excellent stand establishment. The data on yield, yield components and adaptability will be collected at the time of harvest.

Figure 9: Rice varieties EF-39 and EF-52 in field at ARI, Mingora Swat

- Five rice hybrids (MH114, MH115, MH116, MH 117 and MH118), developed locally, are being evaluated for heat tolerance in comparison with the established rice variety IR-6 at Rice Research Institute (RRI) Dokri in Sindh. The crop is in the field and data on yield and parameters will be recorded at the time of harvest.



Target area/region for intervention

Activity	Locations
Varietal development/ evaluation	IRRI Hq, NARC, RRI, Kala Shah Kaku, NIBGE, NIAB, RRI Dokri, ARI Mingora, ARI Tandojam Sindh , Emkay seeds Farooqabad, Engro Eximp, AR, Jafarabad
Up-scaling of Bas 515, NIAB IR-9	Basmati growing areas of Punjab, Balochistan
Extension of DSR and AWD	Rice growing areas of Punjab, Sindh and Balochistan
Intensification of r-w system	Punjab and Sindh
CropCheck development/ evaluation	IRRI Hq, Rice areas of Punjab, Sindh and Balochistan
Post -harvest management	Rice areas of Punjab and Sindh

Up-scaling of High-Yielding Basmati 515 Variety in Punjab and NIAB IR-9 in Balochistan

- There is a very narrow gene pool of basmati varieties in Punjab and rice farmers have a very limited choice to grow basmati varieties. SB is the sole variety grown on 65 percent (Agriculture Crop Reporting Department, Gov. Punjab) of the basmati area in Punjab since 1996. This variety has lost its yield potential and also is prone to damage by insects and diseases. Farmers are gradually shifting to banned, non-basmati varieties which are short duration but highly susceptible to diseases. Basmati 515, is high-yielding, has better grain quality and a comparatively short duration. It is an option to supplement SB. Under this activity, arrangements were made for the procurement of 600 kg of certified seed of Basmati 515 and it was distributed among 30 farmers (20 kg each) for planting on 120 acres in Sheikhupura, Gujranwala, Hafizabad and Sialkot districts of

Punjab. Certified seed was produced by one of AIP partners, Engro Eximp, Sheikhupura.

- The majority of the farmers planted the Basmati 515 variety by using their own random transplanting practices; however, they were provided with information about maintaining optimum plant population (OPPM). These farmers established a 1-acre demonstration on OPPM by random transplanting to compare with their own practices. The average plant population in these plots was recorded as 19 plants per square meter, which is close to the recommended 80,000 plants per acre. The crop is still in the field; the data on yield and comparative benefits will be available during the next quarter.
- In Balochistan, farmers mainly grow rice variety IR-6. The quality of seed is poor because most of the farmers use their own seed. At the request of the Directorate of Agriculture Research, Jafarabad (Balochistan) 100 kg of NIAB IR-9 (a certified high-yielding, salt-tolerant seed with low phytate rice variety) was provisioned for production and distribution among farmers through the Director of Agriculture Research. Two acres were planted at the Seed Farm in Usta Muhammad in Balochistan for seed production and the remaining was distributed to the following farmers in the area (Appendix-XII).

Figure 10: Crop stand of NIAB IR-9 and visit of Director General Research at Usta Muhammad, September 14, 2014

Improved Crop Management

Extension of Direct Seeding and AWD Technology in Different Rice Ecosystems

Rice is traditionally grown through manual transplanting of 30-35 day-old seedlings in a well-puddled and flooded field. Rice consumes over 30 percent of the available water resources in the country. The present rice cultivation system is not very productive, is resource-inefficient and unsustainable. Dry sown rice is grown like wheat or maize crops and addresses these issues and saves water, labor and time and improves stand establishment of the following *Rabi* crops. However, modification and refinement of dry direct seeding and AWD technologies is needed. These technologies were demonstrated in rice growing areas of districts Sheikhupura, Gujranwala and Sialkot (Punjab), Larkana and Thatta (Sindh) and Jafarabad (Balochistan) in collaboration with the public and private sectors: NARC, RRI, Kala Shah Kaku (Punjab); ARI, Tandojam (Sindh); RRI, Dokri (Sindh); Extension Department and Engro Eximp.

Seed Drill

The major achievement was the modification of the flute roller of the *Rabi* machine. A *Rabi* seed drill was refined/modified in collaboration with the private sector and tested for dry seeded rice (DSR). IRRI, in association with RRI, Kala Shah Kaku and Engro Eximp tested the modified Greenland Engineering seed drill for seed breakage at Mureedke. High levels of seed breakage had been encountered when using the existing old *Rabi* drill having 8-fluted roller metering device. Spraw kits with a space to accommodate wet/ soaked seed was created to avoid grain breakage with new machine. The new machine (with a 6-fluted roller) reduced seed breakage from 5.1 percent to 1.7 percent and increased germination from 88 to 93 percent, respectively with the new roller (Appendix-XIV). The drill was tested over a range of planting rates. Minor adjustments are being done further to improve the machine, like i) installation of better metering device to calibrate seed rate and ii) improved tines and seed throwing system with inclined tine base to avoid choking and missing. During year 2014, 8 new machines were purchased by Engro Eximp to demonstrate DSR technology with line sowing in rice growing areas of Punjab.

Field results have shown a good establishment rate in the field at planting rates of 35 kg/ha giving between 80,000-120,000 seedlings per hectare. Engro Eximp has now purchased eight units and planted many demonstration plots during the current rice season (2014). IRRI and RPL also have used the drill, comparing three different seeding rates (30, 60, 90kg/ha) with traditional transplanting on leveled and unleveled fields in Muridke. These fields will be harvested in November 2014. Results to-date suggests a planting rate of 40-50kg/ha may be sufficient to give the desired plant stand. Yield increments of DSR plots with new machine were 12-20 % higher vs. conventional plots sown through transplanting. Achieved average benefit of Rs. 3000-6000 per acre, in addition of water saving of Rs. 3500-5000 per care and cost saving of Rs. 4000 on land preparation, puddling, transplanting. Benefits of time saving and environment friendliness are in addition. The yield advantage was attributed to more number of plants/ sq meter (80-115) in DSR vs. 16-22 plants per square meter in transplanted plots.

Figure 11: New fluted roller

Demonstration of Dry Seeding of Rice (DSR)

The demonstration of DSR exceeded the proposed targets set for 2013-14, which was 100 acres and 50 farmers. DSR technology was demonstrated on 243 acres of 59 farmers in different rice ecologies. These plots were established with the support of AIP partners from the public sector (NARC, RRI Kala Shah Kaku, RRI Dokri, ARI Tandojam, Agri Reserach, Jafarabad and Extension Department) and in the private sector (Engro Eximp, Emkay Seeds).

Rice varieties were sown according to the ecologies. In Punjab, Basmati 515 was used primarily for DSR, followed by Super Basmati and short duration variety PK-386. Basmati 515 is suitable for DSR due to its low tilling capacity. In Sindh, IR-6 and rice hybrid Guard 53 were sown. NIAB IR-9 was planted in Balochistan. In most of the cases the fields were laser leveled before dry sowing. The data (Appendix-XV) reveals that the highest number of the DSR acreage was in Punjab (226.5 acres in Gujranwala, Sheikhupura, Sialkot and Hafizabad), 16 in Thatta and Dokri, Sindh and 1 in Balochistan. The higher acreage under DSR in Punjab may be due to the higher awareness of farmers gained through two pilot projects already implemented. Farmers acknowledge DSR benefits (good crop stand, saving in cost/ time/labor/fuel/water, conservation and environment).

Agronomic Observations

Data on different parameters were recorded from DSR plots in comparison with farmers' practices. Field results have shown that the germination rate was highest in DSR with broadcast of soaked seed followed by DRS with drill. The lowest number of plants was found in farmers' field (Appendix-XVI). The results also revealed that planting rates of 35 kg/ha with drill generated between 284,000-368,000 seedlings per hectare (Appendix-XVI). Since the number of plants per unit area was higher with the use of DSR, the number of tillers was lower in either drilled or broadcast fields (Appendix-XVI). Data on yield increment and economic benefits will be obtained after crop harvest.

Figure 12: Plant population count by farmer

Demonstration of Alternate Wetting and Drying

Pakistan is facing water scarcity at times, but also floods in some areas; both impact the drive for sustainable rice production. To address the problem of water scarcity, IRRI has developed alternate wetting and drying (AWD) technology to decrease the amount of water consumed by the rice crop. AWD technology is based on the knowledge that rice tolerates up to 30 percent reduced water supply during the main growing period compared to conventional irrigation. To determine the timing of irrigation, the water level in the soil is measured by a perforated plastic tube, which is inserted into the rice field. AWD requires irrigation when the water level drops 15cm below the soil surface.

To popularize AWD's water-saving technology, perforated water measuring tubes were manufactured locally and are being used in contract farmers' fields of AIP-Rice national partner Engro to monitor water levels and irrigation strategies being used by the farmers. The original

plan was to demonstrate this technology at 10 locations in different rice growing areas of Punjab and monitor water levels during the growing season. Keeping in view the interest of farmers in the technology, AWD was demonstrated on more than 50 locations (including Basmati 515 growers) in the Sheikhupura, Hafizabad, Gujranwala and Sialkot districts of Punjab. Similar demonstration plots were also established with the help of Agriculture Extension at the Adaptive Research Farm, Gujranwala and Sheikhupura districts of Punjab for the promotion of resource-saving technologies for the benefit of visiting extension workers and farmers at these farms. Under AIP project, 50 AWD water measuring pipes were distributed to 50 farmers. In addition, Engro Eximp distributed these pipes among 8000 farmers in rice growing areas of Sheikhupura, Gujranwala, Sialkot, Hafizabad and Mandi Bahuddin districts. More than 10,000 farmers witnessed AWD promotions.The results showed that there was a substantial reduction in water use with AWD as compared to farmers' old-style practice. Water saving varies between locations and a maximum 36 percent water saving was measured with AWD. However, on average, 19 percent water reduction was recorded in AWD plots.

Figure 13: Water measuring tube (AWD)

Demonstration of biofertilizer in rice

In Pakistan, farmers normally do not apply balanced fertilizers to all crops, including rice. One of the reasons is the high cost of inorganic fertilizers. The use of organic fertilizers and microbial materials (bio-fertilizers) is an option to reduce the production cost as well as promote a healthy environment. NARC has developed a biozote technology for cereals including rice and wheat. This bio-fertilizer is a nitrogen fixer which solubilizes phosphate (P) and potassium (K) as well and makes it readily available to plants. There is potential to use 25 percent less chemical fertilizers with at least a 15 percent increase in yield. To determine its effectiveness, it was planned to demonstrate bio-fertilizer at farmers' fields in collaboration with IRRI, NARC and Adaptive Research Farm, Gujranwala.

Ten plots of one acre each were established on farmers' fields in Basmati-growing areas of Punjab using bio-fertilizer in direct dry seeded as well as transplanted crop. The following observations were recorded:

- Better root and shoot growth in bio-fertilizer plots than traditional fertilizer application.
- Rice plants were having better, consistent and uniform green color during vegetative stage.

- Obtained higher 120-200kg per acre with bio-fertilizer, which is 5-8% higher than conventional plots.
- Farmers were convinced and willing to adopt this technology in future.

Development of Crop Management Tools for Extension Officers and Farmers

- AIP-Rice has developed a local crop check system working with local partners. Benchmarks and crop checks have been developed for all of the critical stages of crop production and harvesting. A local crop check system is now being used by 320 farmers with Rice Partners Ltd. in Muridke, Punjab. All recommendations and actual inputs are being recorded. Quality control (QC) officer's visit selected farmers to check on compliance and crop management on a weekly basis. Farmers acknowledged this practice. A field book has been developed for diagnostic purposes relating to crop nutrition, diseases and insects.
- A presentation was also given to Engro field technicians on the use of the IRRI-developed Crop Check System.

Intensification of Rice-Based Cropping System in Different Ecosystems

The activity could not be undertaken due to the late transfer of operational funds from IRRI HQ to IRRI Pakistan Office. By that time the fallow period between wheat and rice was over.

Improved Post-Harvest and Quality Control

Establish Level of Losses and Contamination in Post-Harvest Processes

Sun-drying of the rice crop, as practiced by most of farmers, does not reduce the moisture level desired for adequate storage of rice grains. As a result, rice grains with moisture levels that are too high are stored, which provides quite favorable conditions for the growth of aflatoxin. A rice crop may be infested with this fungus in two phases. First, the contamination may take place in the crop as it grows in the field, or secondly in the mature rice grains after harvesting in field as well as in storage conditions, where even dried rice grains are susceptible to the growth of the fungi.

A system for determining aflatoxin contamination has been being proposed by AIP-Rice in partnership with PARC, the Rice Research Institute Kala Shah Kaku and Engro Eximp, Muridke in Punjab. During the rice harvest season, in November 2014, it is proposed that grain samples be collected for analysis from different sources: the crop prior to harvest; the combine harvester during harvest; the transport trucks; drying facilities (both ground and machine); and the storage facilities to determine the source of contamination.

Evaluation of Small Combine Harvesters and Seed Dryer

Discussions were also held on evaluating different types of combine harvesters during the harvest season. The crop is still in the field. The proposed activities will be carried out by using both the modified and specialized rice harvesters at the time of harvest and post-harvest processing.

Capacity Building for Rice Researchers and Extension Officers

Develop a Cadre of Young and Well-Trained Scientists and Extension Officers

On June 24, a one-day training on developing and validating a local Rice Crop Check System was organized by AIP-Rice at Engro Rice Plant, Muridke, and Sheikhupura districts of Punjab. Seven field staff of Engro Eximp attended the training.

AIP-Rice organized four-day training on evaluating the local Crop Check system with their farmers; seven QC officers of RPL attended the training held at Muridke, Shiekhupura districts of Punjab from July 22-25.

Engro Eximp (AIP partner) a team of 50 Agri Graduates and Agri Diploma holders on DSR, AWD, quality seed and seed treatment and promotion of Basmati 515 and its improved production technology.

Agronomy

Agronomy component has following four commissioned projects/major activities:

- Dissemination of conservation agriculture technologies.
- Pilot testing and refinement of new CA-based implements and technologies.
- Evaluation of CA-based crop management technologies/methods in different cropping systems.
- Nutrient management.

Dissemination of Conservation Agriculture Technologies

A partnership has been developed with seven national institutes for dissemination and demonstration of technologies through AIP. These partner institutes established a total of 55 demonstrations that included 20 on relay crop, zero tillage (ZT) and bed planting of wheat during wheat season 2013-14 and 35 on direct seeding of rice and hybrid maize Babar with improved production technology during autumn season 2014. For dissemination of CA technologies, three farmer field days were held in Bahawalpur district of Punjab, Sakrand district of Sindh and Mardan district of KP that attracted more than 260 farmers

AIP Platform Developed for Dissemination of Technologies

To disseminate CA technologies, a partnership has been developed with seven national partners' institutes/farms from agriculture research and extension in Punjab, Sindh and KP (Appendix- XIX). These institutes/farms have been designated as AIP platform.

Demonstration of CA Technologies

During wheat season 2013-14, a total of 20 demonstrations were established that included relay cropping of wheat, ZT and bed planting of wheat. The wheat crop was harvested in May 2014. In addition, 35 demonstrations were established in autumn 2014 and these included direct seeding of rice and improved production technology of the maize hybrid Babar. Details of these sites and results are summarized below:

- Relay cropping of wheat in standing cotton in comparison with the farmer practice was demonstrated on three sites in Punjab province on 8 hectares. This technology helped

farmers to plant wheat 40 days earlier than farmer practice and obtain 0.5 t/ha more wheat grain yield. In addition, it also helped the farmers to get additional picking of cotton and saving of PKR 7500/ha in land preparation cost.

- ZT planting of wheat after rice crop was demonstrated on 15 farms in Samundari, Faisalabad district of Punjab on 35 hectares. These farmers were able to plant wheat 10 to 15 days earlier with a ZT drill in comparison with the farmer practice (land preparation and broadcasting of wheat seed). The benefits of the ZT technology at these sites included saving in land preparation cost of PKR 7000/ha and yield increase of 0.5 t/ha. Average wheat grain yield with ZT was 5.5 t/ha in comparison with 5.0 t/ha with farmer practice.
- Bed and furrow planting of wheat was demonstrated at two farms in the province of the Punjab. This technique helped save 35 to 45 percent in irrigation water and better yield.
- DSR can help farmers generate 25 to 32 percent water saving and 16 to 25 percent yield increment over farmers' practice. During autumn 2014, DSR was demonstrated at 15 sites in Punjab on 25 ha. The DSR was demonstrated at five sites in Faisalabad, six sites in Jhang, two sites in Sheikhupura and two sites in Gujranwala.
- In KP, hybrid maize is on less area and more area is under open pollinated varieties (OPVs). In this area, resource-poor farmers tend to apply less fertilizer and are not able to get higher yields. Our partner institute, CCRI, developed the maize hybrid Babar that generates better yield and seed and is also cheaper than multinational hybrids. To create awareness among farmers, demonstration of hybrid maize Babar with improved production technology was carried out in partnership with CCRI, Pirsabak. Hybrid maize was planted on 20 farmer fields on 12 hectares in districts of Peshawar, Charsada, Nowshera, Swabi and Mardan in mid-July under irrigated conditions with row to row distance of 0.75 m and plant to plant of 0.2 m. Fertilizer application included two bags of diammonium phosphate (DAP) and one bag of sulfate of potash (SOP) at planting and one bag of urea after 20 to 25 and 35 to 45 days after crop emergence.

Dissemination of CA Technologies through Field Days

To create awareness among stakeholders, three farmer field days were organized at Bahawalpur in Punjab, Sakrand in Sindh and Nowshera in KP. These events attracted more than 260 farmers, agriculture experts and agriculture extension and private seed companies. Farmers liked the idea of mechanized bed planting of maize and cotton and balanced fertilizer application to maize hybrid. Some farmers asked to try bed planting for the next wheat crop in Sakrand and Bahawalpur districts.

- In Bahawalpur, Agronomic Research Station (ARS) and Rice Research Institute (RARI) held a farmer day on June 26 in their field area. In this event, 100 farmers and agriculture experts visited cotton fields planted on wide and narrow beds with use of multi-crop ZT planters. Participants also witnessed a demonstration of mungbean planting with a bed planter.
- A field day was organized by Wheat Research Institute Sindh (WRIS) in partnership with CIMMYT and PARC on August 27 at Sakrand in Sindh. In this event, 85 participants from the farming community, agriculture extension, agriculture research and private seed companies (Tassco Seed Company and Lakyari Seed) had the opportunity to observe

bed-planted cotton, a demonstration of bed planting operation and participate in discussion on its use and performance.

- A farmer day was organized by CCRI in partnership with CIMMYT at Fazalabad, Takht Bhai in Mardan district of KP on September 18. In this event, 75 farmers and agriculture experts participated and observed the performance of maize hybrid Babar with improved production technology in farmers' fields. Information regarding maize crop management and seed storage was also provided to the participants. Farmers appreciated the performance of hybrid maize with balanced nutrient management in comparison with farmer practice and some were willing to adopt the technology in the next season.

Pilot Testing and Refinement of New CA-Based Implements and Technologies

During the reporting period, 10 national partners (Appendix-XX) were provided nine multi- crop planters, three ZT drills and three ZT happy seeders for pilot testing and demonstration. National partners used bed planters and ZT planters to plant field trials, and farmer field demonstrations on 47 sites located in 10 districts; Shaheed Benazir Abad in Sindh, Nowshera in KP, Vehari, Sahiwal, Okara, Pakpattan, Bahawalpur, Faisalabad and Chakwal in Punjab and Islamabad for different crops on an area of more than 20 hectares. In addition, in partnership with PARC, CIMMYT arranged training for 24 participants on the operation and maintenance of multi-crop bed planters at NARC Islamabad on July 3-4.

Create a Partnership to Pilot Test New Seeders

Pilot testing of multi-crop raised bed planters was initiated for cotton and maize planting during the autumn season. These new bed planters can be used to make beds and planting of various crops like cotton, maize, mungbean and soybean, whereas local planters can only plant one crop. These planters also have the ability to plant in previous crop residue under ZT conditions. A total of nine multi-crop bed planters have been provided to the national partners (Appendix-XX) from agriculture research, extension and private sector in three provinces (Punjab, Sindh and KP) for pilot testing and demonstration at farmer fields during May-July. ZT planters have also been provided to three partners.

Three national partners from agriculture extension, research (RRI – Kala Shah Kaku, Adaptive Research Farms Sheikhupura and Gujranwala districts of Punjab) have been provided happy seeders for wheat planting that would be tested in wheat season 2014-15.

Training of Stakeholders on Multi-Crop CA Bed Planters

CIMMYT and PARC, supported by USAID organized a two-day training on a conservation agriculture planter at NARC Islamabad on July 3-4. The training was comprised of classroom lectures, workshop and on field experience for the use of multi-crop bed planters. It provided hands-on experience to the trainees on the operation of bed planters, calibration of seed and fertilizers and planter maintenance. A total of 24 trainees from diverse agricultural backgrounds which included agronomists, agriculture engineers, farm mangers and machine operators from Punjab, KP and Sindh provinces attended the training; one woman agriculture engineer also attended the training. The participants were also provided a manual prepared in partnership

with PARC for the future use in field operation and maintenance of bed planters (Appendix–IX).

Dissemination of Planters through Pilot Testing and Demonstration in Targeted Areas

National partners (AppendixXXI) used bed planters to plant field trials, and farmer field demonstrations on 40 sites located in 10 districts, (Shaheed Benazir Abad in Sindh, Nowshera in KP, Vehari, Sahiwal, Okara, Pakpattan, Bahawalpur, Faisalabad and Chakwal in Punjab) and Islamabad, for different crops on more than 20 hectares. Multi-crop planters that can plant under ZT conditions were also demonstrated in partnership with CCRI– Pirsabak for maize planting on seven sites in Nowshera district in KP.

National partners – ARS-Bahawalpur and WRI-Sakrand – initiated pilot testing and demonstrations on four sites for cotton planting in Bahawalpur district of Punjab and Shaheed Benazir Abad district of Sindh. Pilot tests showed that partners acknowledged its unique feature of planting various crops (cotton, maize, mung and mash) with a single machine on wide and narrow beds. The partners were satisfied with mungbean stand; however, there was issue of low germination in bed-planted cotton and the following points were noted.

- In all sites, germination of cotton was more than 90 percent in hand-planted plots, whereas germination was 70 percent in bed-planted plots. Missing or doubling of seed issues were noted and that resulted in low plant population in some plots.
- Plant-to-plant distance was not accurate in bed-planted plots.
- The shovels used to make furrows should be adjustable so that wider furrows could be made in cotton planting.
- Separate cover of seed and fertilizer boxes for convenience of lifting.

Figure 14: Cotton planted on wide beds

Figure 15: Cotton planted on narrow beds

Pilot testing of multi-crop bed planters for maize was initiated in mid-July in partnership with seven partners that included agriculture extension, research and a private seed company. The national partners CCRI, Maize-NARC, WRI-Faisalabad, Jullundur Seeds, AR Farms- Vehari and BARI-Chakwal were instrumental in planting maize with bed planters on 34 sites at Islamabad, Nowshera district of KP, Rawalpindi, Vehari, Sahiwal, Okara, Pakpatan and Faisalabad district of Punjab. In addition, bed planters were also used for mungbean planting on two sites. In the Islamabad and KP, farmers are growing maize varieties that cost less and they were satisfied with the bed planting of maize and its crop stand. In an irrigated area of Punjab, farmers are planting hybrid maize by hand on already made wider beds or narrow ridges that results in excellent crop stand. These farmers and partner institutes have following observations/ comments on the performance of bed planters:

- Lower plant population in comparison with manual sowing.
- Doubling and missing of seeds during planting.
- Trouble with plant spacing and depth adjustments.
- Shape of bed is not compact and during sowing deformation of bed edges occurs.
- Two wide beds with two rows in a single pass cannot be made, which is the common practice and saves fuel, time and reduce the number of rounds of tractor. There could be wider frame needed to make wider beds.
- Low beds in fields that are not precisely leveled create overtopping of water and affect germination. Due to this fact, farmers like high beds and deep furrows that needed to be incorporated in refined bed planter.
- Dumping of soil in front that blocks the drive wheel and results in seed being missed.
- Less seed covering issue at some sites was observed. It was suggested that the tines of the planter may be shifted on the front of the bed shaper so that seed dropped first and bed made later that would result in better seed covering and compact bed. (This modification was tested at farmer sites in 12/11 L, district Sahiwal by Adaptive Research Punjab and it resulted in better germination, appropriate bed height and more plant population and comparable with the ridge sowing.)

Figure 16: Maize planted with multi-crop bed planter

Figure 17: Conventional method

- Operational issues (missing / doubling of seed and plant spacing) in new planters will be addressed through more comprehensive hand on training of stakeholders and that will be organized before the sowing of the next crop. In addition, to address some of technical issues regarding seed soil contact and bed size, proper shovels and openers with press wheel will be arranged and tested in the next kharfie season.

Evaluation of Conservation Agriculture-Based Crop Management Technologies/ Methods in Different Cropping Systems

Under this activity, a baseline survey of 950 farmers was completed. The findings will be available in separate survey report in FY-2015 that will help AIP staff to better understand productivity constraints and adoption status of CA technologies like ZT, bed planting and DSR in wheat-based cropping systems. With the help of national partners, five long-term trials and seven medium-term trials/production-scale plots on planting methods and residue management techniques have been established in rice-wheat, cotton-wheat, maize-wheat and rain-fed wheat. These trials should help to determine suitable planting methods and residue management techniques and assess the performance of the cropping systems.

Identification of Productivity Constraints and CA Adoption in Wheat-Based Cropping System (survey and report)

The activity is being carried out in partnership with the CIMMYT Socioeconomics Program (SEP). A baseline survey was completed, in which 950 farmers were interviewed throughout the country in different wheat-based cropping systems of Pakistan. The survey findings will help to answer questions related to productivity constraints in the wheat- based cropping systems of Pakistan. It will also help AIP staff to know the current adoption status of CA technologies like ZT, bed planting and DSR in the target area.

Long-Term Evaluation of Planting Techniques and Residue Management Techniques under Different Cropping Systems in the Country

Trials have been initiated in partnership with national partners (ARS-Bahawalpur, BARI–Chakwal, RRI-Kala Shah Kaku, CCRI-Pirsabak and WRI-Faisalabad) on five sites in rice-wheat,

maize-wheat, cotton-wheat and rainfed wheat cropping systems in the country. Initial or preliminary results will be available after 2 years (2016), however more pronounced effects can be observed after 3-5 years of establishment. These trials would be platforms for multi-disciplinary research and provide information concerning sustainability including soil health issues. In addition, these can be helpful in capacity development of researchers and students for research and national partners could be able to make them part of their future research activities.

- Evaluation of different planting methods/techniques in cotton-wheat system (ARS-Bahawalpur). In this trial, different planting techniques for cotton (hand-planting of cotton on ridges, line sowing of cotton, bed planting with and without residue) in combination with conventional wheat planting and relay crop of wheat have been established.
- Long-term effect of planting techniques on the productivity of different rain-fed cropping systems (BARI-Chakwal). In this trial, ZT, permanent beds and conventional tillage are being evaluated with different cropping systems (fallow-wheat, mung-wheat and soybean-wheat).
- Evaluation of different residue management and planting techniques under heavy residue environment of rice-wheat cropping system in the Punjab (RRI-KSK): In this trial, five different combinations of planting systems and residue levels (burning of residue, partial retention and full retention) are being evaluated.
- Effect of planting techniques (ZT, bed planting and farmers' practice) on the productivity of irrigated maize-wheat cropping system of KP (CCRI-KP). In this study, four planting techniques (ZT, fresh bed, permanent bed and farmers' practice) in combination with two levels of residue (no residue and 20 cm residue) are being evaluated.
- Evaluation of double no-till (DSR and ZT wheat) in a low residue environment of rice-wheat system (WRI-Faisalabad). In this study, a combination of rice planting methods (transplanting, direct seeding with tillage and direct seeding with ZT) with wheat planting methods (farmers' practice and ZT) are being evaluated in hand-harvested fields.

Medium-Term Cropping Systems Production-Scale Plots with Residue Management Techniques to Collect High-Quality Data on Key Indicators of Systems Performance

Seven trials/production-scale plots have been established in partnership with national partners; initial / preliminary results from these plots / platform trial will be available in year 2015 that can be validated in second and third year (2016-17); details of trials as follows:

- Diversification through legumes and oilseed crops in rice-wheat system (RRI-KSK): In this trial, the impact of the inclusion of canola, berseem and mungbean in traditional rice-wheat system will be documented.
- Effective control of weeds such as Leptochloa chinesis (Kallar grass) and Dactyloctenium aegyptium (Madhana grass) in DSR through cultural practice and fungicides. In this trial, five different weed control strategies are being evaluated to control weeds in direct-seeded Basmati rice.

- Residue management trial in cotton-wheat cropping system (ARS-Bahawalpur): In this trial, bed planting of cotton in standing, incorporated and no residue conditions are being evaluated.
- Mechanization for convenient adaptation of relay cropping of Bt cotton in standing wheat crop at ARS-Bahawalpur: The study is designed to adjust the Bt cotton crop in standing wheat as a relay crop. In this study we are exploring the option of mechanization of relay cropping of wheat in to the cotton crop. The study showed that planting of wheat in 6-row strips in between 150 cm ridges and planting of cotton on 150 cm ridges can result in better yield of both crops.
- Bed planting of maize and wheat under different residue management (AR Farm Vehari): In this production-scale plot, bed planting with and without residue will be compared in maize-wheat and maize-maize cropping systems. Autumn maize has been planted with a bed planter in these plots.
- Residue management in rice-wheat cropping system (AR Farm Sheikhupura and Gujranwala): In these production-scale plots, a rice crop has been planted with transplanting and direct seeding techniques. After harvesting of the rice crop, wheat planting will be done with a ZT happy seeder in full- and half-standing rice residue.
- ZT and permanent bed planting in maize-wheat cropping system (CCRI-Pirsabak, KP): In these production-scale plots, a maize crop has been planted with ZT and bed planting techniques. After harvesting of the maize crop, wheat planting will be done in one-third maize residue.

NUTRIENT MANAGEMENT

In this activity, a survey of 950 farmers was completed on the use of fertilizer and farmers' access to related services. Validation of Nutrient Expert™ (NE) for hybrid maize was initiated at 11 sites in four hybrid maize growing districts of Punjab. For the dissemination of leaf color chart (LCC) techniques in rice, 25 demonstrations in the Gujranwala, Sialkot, Faisalabad and Sheikhupura districts of Punjab were established in districts of Punjab. In addition, 24 stakeholders, including farmers and extension workers, were trained on the use of LCC in rice crop.

Extent of Fertilizer (Nutrient) Use and Related Services (Extension, Soil Fertility Laboratory) Use and Their Impact on Productivity of the Different Cropping Systems of Pakistan

A baseline survey has been completed in partnership with the CIMMYT SEP. In this survey, 950 farmers were interviewed to learn the extent of fertilizer use (chemical fertilizers and farm yard manure, macronutrient and micronutrient) and related services in the cereal systems. Farmers' access to nutrient recommendation services (soil laboratory and extension services) in these systems with an emphasis on the use of available facilities by the farmers was also part of the information collected. A report on the survey is in progress and it will be available in the second quarter of year III of the project.

Evaluation of Decision Support Systems/Site-Specific Nutrient Management Techniques

Nutrient Expert™, a new, nutrient decision support system (DSS) based on the principles of site-specific nutrient management (SSNM), offers solutions for providing field-specific fertilizer recommendations to improve the yield and economics of maize growing famers in the region. While generating recommendations, NE considers yield response and targeted agronomic efficiency in addition to quantifying the contribution of nutrients from indigenous sources. The NE tool for maize and wheat has been validated in South Asian countries and it could be helpful for crop advisors/extension agents in the country to provide farmers with fertilizer guidelines that are suited to their farming conditions. CIMMYT has initiated work on validation of NE for hybrid maize in major maize growing area of the Punjab at 11 farmers' fields. Under this activity, farmers' field trials have been initiated at 11 locations in hybrid maize growing districts (Sahiwal, Pakpattan, Vehari and Faisalabad) of Punjab during the autumn. In these trials, three fertilizer management practices – farmers' practice, Agriculture Extension Punjab and NE recommendation – are being compared. Trials were established and fertilizers were applied according to recommendations. Data during the season revealed that plant population was uniform in the trials. After harvesting, yield data will be collected and results will be shared in the next reporting period.

Dissemination of Site-Specific Nutrient Management Techniques at the Farm Level

A leaf color chart is a SSNM technique that can help farmers to save nitrogen fertilizer and improve rice yield. Demonstration of LCC managed nitrogen has been initiated at 25 farmers' fields in districts (Sheikhupura, Gujranwala and Faisalabad) of Punjab.

CIMMYT and PARC organized trainings on the use of an LCC for rice crops at the Adaptive Research Farms at Sheikhupura on July 16 and at Gujranwala on July17. During these trainings, 24 trainees including researchers, agriculture extension workers and farmers were trained in the use of LCC for rice through interactive lectures, demonstrations and hands-on experience in the field related to leaf color measurement, data recording and making decisions on fertilizer application.

Socio-Economics

A baseline survey for wheat and conservation agriculture was successfully completed; 950 farmers were interviewed from Punjab, Sindh, KP and Balochistan. The salient findings of the study are as under;

The mean age of the farmers was 43 years. The mean education was 7 years of schooling, mean experience was 22 years. About 93 percent of the respondents were male and approximately 81 percent of the surveyed farmers were owner of the land. The mean wheat yield was about 35 mounds per acre and the mean. The per annum income of the surveyed household from all the sources was rupees 324170. As the data was collected from all four main provinces of Pakistan so there were different cropping patterns and wheat being the main crop during the Rabi season (Province wise detailed comprehensive reports have been compiled and available for sharing).

A separate baseline was proposed for maize and a comprehensive questionnaire was drafted. For the maize baseline survey, 625 farmers (200 from the Punjab, 150 from KP, 100 from Sindh and 75 from Balochistan while 50 from AJK and 50 from Gilgit-Baltistan) are being interviewed from all the provinces, including AJK and Gilgit-Baltistan.

The durum wheat value chain study was successfully completed. After a series of discussions and a literature review, seven initial value chain stakeholders were identified (farmers, dealers, seed companies, millers, restaurants, food processors and consumers). After negotiations the restaurants were dropped from the value chain due to insignificant contributions. For each stakeholder a separate questionnaire was designed. The survey was carried out in all four provinces (Punjab, Sindh, KP and Balochistan). During the survey, 295 stakeholders were interviewed, which includes 100 farmers, 41 seed companies, 30 dealers, 19 millers, 81 consumers, 19 restaurants and 5 food processors. Findings of the study have important policy implications; the majority of the stakeholders in all the various categories were interested to be part of the durum wheat value chain. Seven farmers have also planted durum wheat on a limited area and according to them the production was up to 5.7 tons per hectare (higher than bread wheat). However, the challenging factors for durum wheat are its susceptibility to stem rust and its stover was hard to be used as animal feed. The farmers' cooperatives/associations can play an important role in popularizing the durum wheat varieties among the farming community. From the consumers' perspective, the consumption of pasta products is increasing in Pakistan. Currently all the pasta products are made from bread wheat, so durum wheat pasta products will increase the quality of pasta products for the domestic consumer market; a potential export market for durum wheat pasta products also exists. The only stakeholder group where new investment is needed is the milling industry for semolina production. Existing milling units need modification and the installation of new milling units. Few food processors own milling units for bread wheat; nor are they prepared for new investments in durum wheat milling units. All the stakeholders were interested to be part of the durum wheat value chain; stakeholders' willingness is the key to success of the durum wheat value chain in Pakistan.

CIMMYT organized the 'first national workshop on durum wheat in Pakistan' held at WRI in Faisalabad on September 22-23. In the workshop, a large number of durum wheat value chain stakeholders participated, including researchers, business owners, farmers, dealers, seed companies, millers, food processors and consumers. It was challenging to bring all the stakeholders to one platform. Bullord, a well-regarded company, agreed to the installation of new milling units or the modification of existing units. The key action points from the business perspective of the durum wheat value chain workshop were that the existing milling units need to be modified so that they are suitable for semolina production.

In addition, CIMMYT prepared the brochure 'Durum wheat in Pakistan: Emerging Opportunities and Associated challenges' (Appendix-XXIII).

Livestock

Dairy Value Chain

During the period, a set of rapid assessment survey tools was developed to collect information from stakeholders involved in the dairy value chain. Using the tools developed, discussions with

members of farmer groups and other stakeholders were held to document the constraints faced by various actors in the dairy value chain. These discussions took place at the dairy project sites in Bahawalnagar, Jhang districts of Punjab and Hyderabad and Matyari districts of Sindh; extensive discussions were also held with 17 members of the Dairy Farmers Association in Mardan (KP). The major constraints faced by farmers included feeds and feeding strategies, feed conservation technologies, management and housing with smallholders, animal health and diseases, reproduction and breeding (especially with buffaloes) and milk marketing. In order to provide feedback to the farmers, the project is organizing a training on innovative technologies, including a panel discussion at which the farmers can directly interact with experts and obtain appropriate solutions to their problems.

DVC Rapid Assessment – Training of Trainers

In May, a group of 25 stakeholders involved in dairy production from each of Pakistan's provinces were trained by ILRI scientists (Drs. Nadhem Mtimet and Abedullah) on the seven rapid assessment (RA) tools developed/modified by AIP-Livestock. A manual with an Urdu glossary has been prepared for wider circulation in Pakistan.

Rapid assessment helped to identify the gaps at different nodes of dairy value chain; (starting from input supply to the final delivery of output to consumers. In a brain storming session with livestock experts these gaps were discussed to identify the possible solutions (interventions). In the light of experts' suggestion line of action is decided as mentioned above.

Farmer Group Discussions in Punjab Sites

In June, 14 focus group discussions (FGDs) were conducted in Bahawalnagar and Jhang districts, capturing information from 304 smallholder dairy farmers (176 men and 128 women).

Constraints revealed by farmers on all aspects of dairy production (feeding, breeding, health, milk collection/marketing, input supply) are being compiled as a report, and the draft report will be ready for distribution in early November. The findings will be discussed at an expert group consultative meeting scheduled for October, where the 'best bets' for intervention and the needs for focused research will be formulated.

The main constraints identified by the farmers were related to:

- Feeds and feeding.
- Need for salt-tolerant food and feed crops.
- Insufficient irrigation facilities for food and fodder crops.
- Unavailability of high quality and timely input supply in the villages (AI and animal health services, milk marketing, feed supply, extension services).
- Knowledge on nutritive value of feeds and balanced rations for dairy animals.

Focus Group Discussions in Sindh Sites

In August, discussions were held with the provincial secretaries of agriculture, livestock and other provincial livestock line ministry staff in Karachi and Hyderabad, Sindh, as well as the director of research and other academic staff of the University of Agriculture Tandojam, Sindh.

In Sindh province, the AIP team conducted FGD with farmers in two villages in Hyderabad district and in one village in Matyari district. In each of these FGDs, 15 farmers participated.

The constraints identified by farmers in the three villages were:

- Shortage of roughage; those available are of poor quality (mostly matured natural grasses).
- Farmers rely heavily on cotton seed cake as concentrate feed, which is of low quality and moldy. Other types of concentrate feeds are not available.
- Lack of awareness regarding balance ration/concentrates.
- Lack of knowledge on hygienic milk production to provide quality milk to consumers.
- Most common diseases are Foot-and-mouth disease (FMD), haemorrhagic septicaemia (HS), mastitis, liver fluke infestation contagious bovine pleuropneumonia, etc.
- Animals have reproductive problems like repeat breeding, abortions and prolapse of uterus.
- Lack of animal housing facilities; most animals are tethered to trees and fed.

Way forward after Focus Group Discussions

The possible areas of intervention in dairy value chain (DVC) identified through rapid assessment (RA) are grouped into eight categories; improvements in dairy shed (floor, roofing) and amenities (watering and feeding facilities), training of farmers on improved dairy husbandry practices, marketing, nutrition and feeding, improvement in fodder availability and conservation techniques, health, reproduction and breeding. Cross cutting issue to these areas is training on relevant livestock technologies to different stake holders including farmers to be initiated simultaneously.

Interaction with farming community in the project villages on the needs and modalities of implementing innovations was initiated. Initially 3 to 5 volunteer farmer training model farm in each of the selected project villages will be established. These training model farms will be used for practical demonstration to other farmers in the community. Establishment of training model farm on a cost sharing basis will be completed by the end of July 2015. Farmers who are financially poor and rear animals with high production potential will receive financial assistance along with technical assistance to adopt the innovation.

Intervention with a Progressive Dairy Farmer in Mardan, KP

In May 2013, the AIP-Livestock project manager visited a progressive buffalo farmer in Mardan who owned 80 milking buffaloes and 2 bulls. His replacement milking animals were purchased from Punjab at premium prices. Technical advice was provided to him on feed preparation and balanced feeding to maximize milk production, and also to rear his own replacement heifers.

In September 2014, an AIP-Livestock team visited the same farmer. He is now achieving 28 kg of milk per day per animal, compared to 21 kg milk per day before at the peak lactation. He attributed the increase in milk production to balanced feeding, and more importantly he had started rearing his own replacement stock.

Figure 21: Farmer rearing replacement heifers in Mardan,

Dairy Farmer Association in Mardan (KP)

In September 2014, the AIP team held a discussion with the members of the Mardan Dairy Farmers Association. The farmers as a group identified the following constraints:

- Lack of proper and reliable milk collection system.
- Low production/fodder acreage due to soil salinity and adoption of traditional agricultural practices.
- Lack of awareness regarding good quality hybrid seeds and balanced diet for animals.
- Unavailability of quality medicines; and deaths due to the use of expired vaccines.
- Unavailability of good quality semen.
- Lack of quality concentrate feed in the area.
- Financial constraints for the farmers who have two to three animals.

Figure 22: Farmer Association meeting in Mardan, KP

The association also requested technical assistance to overcome these constraints. The AIP team will arrange a one-day training in October. The constraints identified and listed above will be addressed by a training session and practical demonstrations of innovative technologies such as 50 kg poly-wrap silage preparation, introducing new feed and fodder varieties, feed milling technologies, animal health issues and marketing options.

Small Ruminant Value Chains Small Ruminant Value Chain Rapid Assessment

The first step in value chain development is a rapid (qualitative) value chain assessment (VCA). The assessment results and insights will be used to develop coordinated intervention plans through multi-stakeholder workshops.

Figure 23: RA tools training, KP

A specialized three-day training on the assessment of the small ruminant value chain (SRVC) was provided to research partners on June 3-5.

The training was attended by 25 participants from different provinces of Pakistan with a majority from Chakwal and Bahawalpur districts of Punjab. The training reinforced the principles of the value chain concept and trained research partners on how to conduct a value chain assessment. At this training, working groups of local partners were formed to revise the SRVC rapid assessment survey tools targeting different value chain actors.

The modified checklists from the workshop were then pre-tested at two action sites in Chakwal. With this information the toolkit was completed with a sampling strategy and a detailed outline for the VCA reports.

The training was followed by a pre-testing of the SRVC Rapid Assessment (RA) tools at AIP-Livestock project site in Chakwal. Four separate FGDs to pre-test the tools were held in the project villages in Chakwal and Bahawalpur.

The ICARDA team also visited the Bahawalpur site villages and had discussions with staff of the Livestock Department, Islamia University and the ARID Zone Research Institute.

Figure 24: SRVC RA training and pre-testing of tools in Chakwal

The Social Sciences Research Institute (SSRI), NARC and the ICARDA team developed a detailed work plan and budget for the implementation of the rapid VCA in the selected villages.

A collaborative research agreement (CRA) was signed between SSRI and ILRI that covers VCA implementation and reporting.

The improved health, breeding, feeding and husbandry management will enhance overall 20-30% productivity in terms of weight gain, wool/hairs, milk, early maturity, survival of sheep and goats. Indirect benefits from the need based capacity building regarding the proper/technical inputs will also leads to the enhancement of the farm productivity.

The introduction of integrated management practices involving crops-range-livestock production will improve the outputs round the year. The linkages of farmers with different stakeholders will strengthen their technical knowledge, quality and timely plan for their farms production. These practices will increase the farmer's income as well as their socio-economic status.

Artificial Insemination in Goats

Every year, millions of genetically superior indigenous male goats (bucks) with higher growth rate potential are castrated before breeding age and are not available for breeding purposes. This is a routine practice by farmers involved in rearing goats for 'Eid' sacrificial purpose. This practice has resulted in scarcity of quality breeding bucks, hence use of low grade bucks for breeding. AIP-ILRI took initiative to remove this constraint by introducing AI in goats with the objective of maintaining the purity of valuable, high productivity goat breeds such as beetal, machacheeni.

A training manual on artificial insemination of goats was developed. Furthermore, on March 3-8 a training of trainers program was conducted at the University of Agriculture Faisalabad for 24 NARS scientists, academia and members of breeder associations from Punjab, Sindh, KP, Baluchistan and AJK. Participants obtained 'hands-on' training on artificial insemination of indigenous goats from a Kenyan trainer. As a follow-up to the training, the trainers from KP under the auspices of the Livestock and Dairy Department, KP and AIP-Livestock conducted a similar training for 20 field veterinarians, livestock assistants and farm managers at the Livestock Experimental Station, Jaba, KP in April.

Beetal goat semen was produced for the first time in Pakistan with technical assistance from AIP at the semen production unit (SPU) at Harichand and a private SPU in KP. Both these SPUs are producing about 500 straws per month. Both SPUs are conducting training on artificial insemination in goats following the protocols of the training manual.

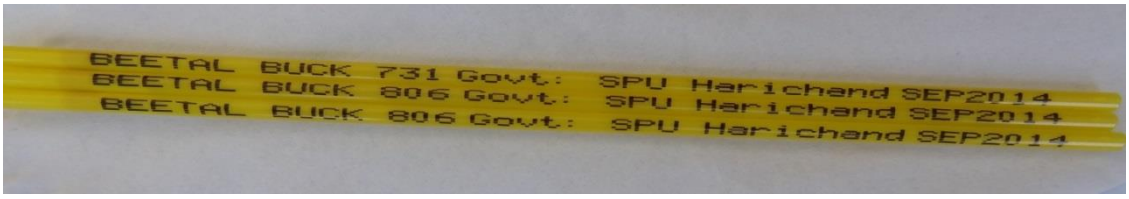


Figure 18: Beetal semen was produced in straws for commercial use for the first time in Pakistan

Goat and Sheep Mela

The Goat Breeders Association for Pakistan (GBAP) was established by the University of Agriculture Faisalabad, Small Ruminant Directorate of the Department of Livestock, Punjab and AIP-Livestock. The objectives of the association are to create awareness on indigenous breeds and promote conservation through the utilization of indigenous goat breeds of Pakistan. GBAP organized a 'goat and sheep mela' on June 20 at DG Khan, Punjab. A Nuqri goat and Mundri sheep competition was held, co-sponsored by AIP-Livestock. Sixty-five farmers participated in the competition, and another 135 witnessed this event. Animals were judged under the categories (adults, growing, and young) in Nuqri goats and Mundri sheep. AIP Livestock provided the trophies and cash rewards to the prize winners, and GBAP organized certificates for the prize winners. Farmers highly appreciated the initiatives taken by AIP in organizing this special event for endangered goat and sheep breeds.

Figure 19: Special Nuqri goat and Mundri sheep competition held at the Goat and Sheep Mela in DG Khan

Foundation Laid for Commercial Production of PPR Thermo-stable Vaccine in Pakistan

Peste des Petits Ruminants (PPR) is a deadly disease in goats and sheep which claim millions of animals every year. The PPR vaccine currently produced by two laboratories in Pakistan (VRI in Lahore and Centre for Advanced Studies Vaccinology and Biotechnology [CASVAB] in Quetta) are thermo-stable at 35ºC; the ILRI preparation is thermo-stable at 45ºC.

Invited by AIP-Livestock and FAO Pakistan, Dr. Jeff Mariner (a former ILRI employee) visited Pakistan in June and carried out a technical audit of the PPR production process in the two laboratories. A comprehensive technical audit report has been produced by the consultant, and an action plan is to be implemented in the two laboratories before the training and production of the first batch of vaccine.

After implementing the recommendations, a training session was conducted at VRI Lahore from August 13 to 21; 14 scientists from VRI, CASVAB, Animal Health Laboratory of NARC, UVAS and a private vaccine-producing laboratory were trained on the protocols for production of the PPR thermo-stable vaccine. Also, a training manual was developed for future use.

Figure 20: PRR activities

The goals of the training were to:

- Provide an overview of the production process for thermo-stable PPR vaccine.
- Advanced the work plan for enhancing PPR virus production in Pakistan.
- Provide hands-on experience on implementing the lyophilisation procedure for thermo-stable vaccine.

Feed, Fodder and Rangeland (FFR)

Identification and Promotion of Improved Forage Varieties with High-Yield Potential under Dry Conditions with Appropriate Agronomic Practices

The relatively low fodder yields and decreasing fodder production areas have led to fodder scarcity periods in winter (December and January) and in summer (June and July). The two main reasons for low fodder yields are non-availability of improved seed and the limited access of farmers to improved production technologies. Fodder preservation and storage practices are also lacking due to poor dissemination of new technologies. The AIP project plans to introduce improved production technologies and high-yielding fodder crop varieties to fodder growers in the medium to low rainfall areas of the Pothwar region in the Chakwal District (Appendix-XXIV and Figure 20).

Figure 20: Plantations of maize and Mott grass at research sites

Selection and Promotion of Improved Cereal Crop Varieties with Increased Nutritional Value of Residues

Green fodder is not available in sufficient quantities, especially in extreme hot (June-July) and cold (December-January) seasons. The majority of ruminant animals remain under-fed during these seasons, and crop residues which are of low nutritive value form the bulk of the feed for ruminants. AIP plans to provide high grain and straw-yielding varieties for farmers in order to improve their livelihoods and sustain their livestock during feed scarcity periods.

Links have been established with CIMMYT, and the most promising maize varieties from its maize evaluation trails will be tested for nutritional quality for ruminants and disseminated to livestock farmers, particularly in the medium to dry rainfall areas. In August, stover samples from 42 maize varieties (in particular the 'stay green' varieties) were collected from the zonal maize evaluation trial at NARC in order to screen them for stover quality (crude protein, digestibly, etc.).

In Punjab at the Chakwal project site, 12 farmers from Begal village and 15 farmers from Dhulli village have been selected to receive improved varieties of wheat (Chakwal 50), barley (Sanober 96 and Rakhshan 2010) and oats (NARC 2011), which will be planted in November.

Introduced Balanced Grazing Management

Rangeland Interventions

In mid-August, two sites (Begal and Dhulli) of the AIP project site in the Chakwal District of Punjab were visited by a team of range scientists. Ten farmers from Begal and 15 from Dhuli were selected for conservation and rangeland activities on an area of 25 ha from communal lands. It was observed that the farmers are taking a keen interest in rangeland rehabilitation activities and they will be further motivated to introduce rotational grazing.

An inventory of the important range plant species of the area was conducted using the line transects method. The plant species were identified and listed.

The grass species include: Cenchrus ciliaris, Bothriochloa pertusa, Cymbopogon jwarancusa, Saccharum spontaneum, Aristida depressa, Desmostachya bipinnata, Poa annua, Saccharum munja, Heteropogon contortus, Saccharum munja, Dichanthium annulatum, Heteropogon contortus, Cymbopogon jwarancusa and Panicum antidotale.

Tree/shrub species include: Acacia modesta, Acacia nilotica, Tamarix aphylla, Grewia oppositifolia, Acacia farnesiana, Zizyphus mauritiana, Tecomella undulate, Calligonum polygonoides, Carrissa opaca, Gymnosporia royleana, Prosopis cineraria, Periploca aphylla and Zizyphus nummularia.

The above-ground biomass was collected at Begal, Chakwal district of Punjab by clipping whole aerial parts of herbaceous plants, shrubs and grasses from 1x5 m^2 alternative quadrates established on a 35m transact line. The plant samples were weighed, dried in an oven at 60^{o}C until constant weight was reached and dry matter (DM) was determined (AppendixXXV).

Silvo-Pastoral Intervention

Due to intensive dry land agriculture in Chakwal, in August 2014, 50 ha of marginal land was planted with fodders for rotational grazing and subsequently will be extended up to 200 ha. Benefits of rotational grazing on animal productivity is a medium to long term process, however the impact of rotational grazing will yield results after monsoon rain in 2015; particularly in relation to low kid mortality, and weight gains. In 2015, extensive coverage (600-800 ha) will be brought under rotational grazing in Southern Punjab, Balochistan and Sindh provinces.

Ipil Ipil, a small, fast-growing tree native which can grow in a wide range of rainfall (600 -1700 mm) has been successfully planted in low rainfall areas of Punjab. After discussion with local community in Chakwal, farmers have planted Ipil-Ipil in blocks and would serve as a source of protein bank. Dry matter yield of 25-30 t/ha/year can be obtained by planting at 1 m spacing. Leaves and pods are very nutritious. Once the plants are established, farmers will be trained on the value of Ipil-Ipil leaves as source of protein supplement for small and large ruminants.

In August, this intervention was initiated through a pilot experiment on communal lands at Begal and Dhuli, in the Chakwal district of Punjab. Contours were laid out with a mold-board plow and saplings of Leucaena leucocephala (iple iple) were planted with one meter spacing. More than 3,000 saplings per hectare have been planted on both sites. Forage grasses (Panicum maximum, Chloris gayana, Panicum antidotale) are being grown in the alleys to provide a balanced feed regime.

Figure 21: Rehabilitated land for shrub plantations

Plantation of Spineless Cactus

Cactus (Opuntia ficus indica) is amultipurpose crop and for first time we have disseminated spineless cactus in Chakwal area with the expectation that Opuntia species will gain an important place in the agricultural systems as fruit, forage and fodder with minimal agronomic inputs. Initially farmers were not willing to plant cactus on their lands, but AIP team with the collaboration of NARS convince the community by arranging farmer day at NARC and by showing them the importance of cactus in other parts of the world. After this meeting farmers were convinced about the importance of cactus and with their consent, we planted cactus on approx. 4 ha at Chakwal with this expectation that its planation will be further extended on marginal areas of Chakwal as an animal feed, fruit, and for carbon sequestration.

Under AIP-Livestock, a total of 3,000 pads were planted at a spacing of 1 x 2 m along the slopes on marginal lands of 20 farmers at both sites (Begal village and Dhulli village). The cactus pads were supplied by RRI, NARC. Eye-brows (semi-circular micro-catchment) and furrows were made against the catchment to harvest rain water. Survival was almost 100 percent and most of the pads have sprouted.

Figure 22: Plantation of cactus at farmer's field

On May 15, an introductory farmer day to familiarize farmers with the benefits of cactus was organized by AIP in partnership the Rangeland Research Institute (NARC), ICARDA and ILRI at NARC. Forty farmers from Chakwal participated. An information flyer on cactus was also provided to the participants.

Figure 23: Participation of farmers in the cactus introductory workshop at NARC Islamabad

Under the CGIAR Research Program (CRP) Dryland Systems, new cactus accessions from Brazil have been added to the germplasm collections at NARC. These accessions will be multiplied and eventually the most promising accessions will be introduced to the AIP project sites.

Capacity Development on Feed, Fodder and Rangeland (FFR)

In collaboration with AIP-Livestock and Oregon State University (OSU), ICARDA organized a specialized group training course on "Agro-Ecological Monitoring" in Jordan on April 6-12. Six training participants were drawn from Pakistan's major national institutions engaged in the

rangeland sector: the Rangeland Research Institute, NARC, the provincial governments of Baluchistan and Pakhtunkhwa, and two universities from Punjab. The AIP project covered the cost (airfares, accommodation and per diem) of the six participants.

The objective of the training was to enhance the knowledge and capacity of NARS through training of trainers on agro-ecological monitoring. The training focused on vegetation mapping using state-of-the-art technology, such as digital cameras with built-in GPS and customized software (VegMeasure) to monitor and assess rangeland vegetation and natural resources in the Dryland Systems. In addition, the course addressed the principles of agro-forestry practices (alley cropping using shrubs/trees).

Figure 24: Pakistani Participants during the agro-ecological monitoring training in Jordan

Vegetables

The following commissioned projects of the AIP-Vegetable component were finalized with provincial partners in Islamabad in August 2013 following the inauguration of the project:

- Protected Cultivation of Vegetables
- Improved mungbean Production
- Vegetable Value Chains

Due to their importance, three additional foci were also included: increasing national vegetable seed production capacity (because more than 90 percent of vegetable seed is imported); introducing more heat- and cold-tolerant varieties of vegetables to extend open field production seasons; and to develop better farmer access to virus-free seedlings.

Project priorities for all three sub-projects have been discussed with representatives of NARS from across the country. This revealed a wide variety of priorities from different provinces, and local interest in different crops. These were incorporated into each of the sub-components.

Protected Cultivation of Vegetables

- Identify and promote the best varieties of crops commonly grown under protected cultivation.

- Improve insect and disease management to reduce pesticide use in protected cultivation.
- Identify and promote new crops for protected cultivation with higher economic returns.
- Identify and promote improved protected cultivation systems.

A complete list of institutions responsible to carry out these activities is given in Appendix-XXXXIV. These activities have been solely commissioned by the AIP-Vegetable component. Detailed information on project activities conducted by provincial partner institutions is discussed below, and their locations are shown in Map 2.

Map 2: Location of partners' vegetable

Identify and Promote the Best Varieties of Crops Commonly Grown under Protected Cultivation

Most vegetable varieties developed by the government agriculture research institutes performed well in on-station trials. However, these varieties/hybrids did not perform satisfactorily in farmers' fields under different agro-climatic conditions. This is mainly due to lack of systematic communication among researchers, extension workers and farmers. In Pakistan, there is a shortage of diverse genetic materials for crop improvement through breeding, including new germplasm of tomatoes, cucumbers, chilies and sweet peppers. As a result, only a few varieties have been cultivated for a long time. An increasing number of imported hybrids are now being cultivated in the country. However, their local adaptation is usually not evaluated before commercialization. The screening of vegetable cultivars for higher yield needs to be continued to introduce more genetic materials into the system to minimize the vulnerability of varieties to diseases and to increase yields. Therefore, 18 trials were conducted both on-station and on-farm, under protected cultivation, during the natural off-season (often at high altitude) and during the main growing season. This has helped to test a wide range of new materials under different growing conditions and shown that for tomatoes, cucumbers and sweet peppers yields can be improved by using new genotypes and by growing the vegetables under special

conditions rather than normal conditions. This is the first year of trials, so additional trials will be needed next season to validate the results. Farmers were provided with necessary technical help and information to grow best available seed and best management practices to get fresh vegetable yield. Farmers are able to fetch good price due to early production of vegetables under cover or natural off-season. Basic seed is being multiplied with the help of research institute, farmers and seed companies.

On Station Validation Trials

Protected Cultivation

Tomatoes

The current yield potential of open pollinated (OP) varieties of tomato is low and there is a need for the introduction of high-yielding varieties, either OPVs or hybrids. Eight varieties of tomato have been released by government institutions in Pakistan. Only one commercially popular indeterminate tomato hybrid is commonly used for protected cultivation and other varieties and hybrids need to be screened. Four public sector research institutes – Agricultural Research Institute-Quetta, Barani Agricultural Research Institute-Chakwal, National Tea and High Value Research Institute-Mansehra and Agriculture Research-Muzaffarabad – evaluated 31 tomato hybrids from both the public and private sectors under protected cultivation.

The average national yields of tomatoes under open field conditions range from 8.5 t/ha to 10.5 t/ha (Fruit, Vegetables and Condiments Statistics of Pakistan, 2012-13).Commonly available OPVs cannot compete with the yield of hybrids, so the use of hybrids is growing. Commercially available hybrids were tested to determine the best one for each of four agro-climatic zones. LITH-623 is a new hybrid from the Ayub Agriculture Research Institute (AARI) Faisalabad and performed well in the Pothwar region of Chakwal with the highest yield of 73.2 t/ha (Appendix-XXXI). This variety needs further testing following the first year of trials but looks like a promising hybrid for use under protected cultivation. Tomato hybrids adapted well in regions with a relatively dry, cool climate.

Chilies

Protected cultivation of chilies has recently become popular in Punjab. Commercially available chili cultivars and hybrids need to be screened for cultivation under cover. In this first year of trials 17 green chili varieties were screened on station at high altitude in Mingora-Swat. The yield of Swat Chili-9 (29.5 t/ha) and Swat Chili-1 (27.0 t/ha) was comparable with the yield of hybrid Colt F_1 which gave the highest mean overall yield of 31.4 t/ha. Three green chili varieties – Red Revil, Temble and PBC-1356 – were also evaluated in the arid temperate highland region of Quetta-Balochistan. Red Revil generated the highest yield of 10.0 t/ha, followed by Temble (5.3 t/ha), while PBC-1356 generated the lowest yield of 3.4 t/ha.

Sweet Peppers

A summer season trial of three sweet pepper hybrids (Capistrano, Excel and Royal Wonder) was carried out in Islamabad. Previous research found that these were the best recommended hybrids for the Pothwar region. All three hybrids were not significantly different and gave yields in the range of 8.4 to 9.9 t /ha. Further testing during next season will be essential to narrow down this selection.

Brinjal

Five varieties of brinjal were tested at the Agricultural Research Institute, Quetta-Balochistan. The variety Dil nasheen gave the highest yield of 37.5 t/ha, followed by Purple Long (33.8 t/ha), while the lowest yield of 30.0 t/ha was recorded for the local check. All three are high- yielding varieties when compared with the yield of brinjal planted under normal field conditions in Pakistan which is 10.1 t/ha (Fruit, Vegetables and Condiments Statistics of Pakistan, 2012-13). It indicates that it is possible to significantly increase the yield of brinjal through good management of existing varieties under protected cultivation but further investigation is needed to finalize the best varieties next season.

Natural Off-Season

There are vegetable-producing pockets that are frost-free in the different part of the country. The growing season is same for under cover (plasticulture) and natural off-season.

Chili

The narrow choice of cultivars and the use of low-yielding cultivars limit yields. The average national yield of chilies is 2.3 t/ha (Fruit, Vegetables and Condiments Statistics of Pakistan, 2012-13). Six chili genotypes were evaluated at the temperate natural off-season of Quetta. The Variety PBC-1356 gave the highest yield of 6.4 t/ha, followed by Talhari (5.8 t/ha). A great deal of research work needs to be done on varietal improvement and new germplasm lines must be evaluated for the selection of desirable genotypes.

Cucumbers

The current yield potential of cucumber OPVs is low and there is a need to introduce higher yielding varieties and hybrids. Four cucumber hybrids were tested in the arid highland region of Quetta. Cus-080 gave the top yield of 45.0 t/ha, followed by Gharib Nawaz and the local check (26.3 t/ha). The hybrid Diamond was also tested at another site at Mansehra in KP and yielded 22.8 t/ha. Early results indicate a good performance of the hybrid Cus-080 but further investigations are needed to validate these results.

Brinjal

Four brinjal varieties were evaluated under natural off-season conditions at in the arid temperate highland region of Quetta. The variety Purple Long generated the highest yield of 14.0 t/ha, followed by Dilnasheen (13.6 t/ha), while Sarwan had the lowest yield of 9.0 t/ha. Four varieties of Brinjal were also tested under natural off-season, high altitude conditions at Mansehra. The Pusa Long variety generated the highest yield of 37.0 t/ha, followed by Black Beauty (33.5 t/ha), while the lowest yield of 29.2 t/ha was recorded for Long Black. The national average yield of brinjal in Pakistan is 10.5 t/ha. It is encouraging to witness the yield increase of brinjal through the use of improved varieties and hybrids. Further testing is needed to validate these results.

Normal Growing Season

The normal growing season in Pakistan for summer crops is February to July and for winter crops is October to March.

Tomatoes

A nursery was established under cover for tomatoes to be grown in the normal season. The seeds were sown in January and transplanted in the first week of March for a spring tomato crop. Fruit picking started from April and continued up to the end of July in the Pothwar region of Punjab. Eighteen genotypes were compared in spring 2014 (Figure 25). The hybrid Lerica gave the highest yield (54.2 t/ha); Peto-86 followed with 53.5 t/ha. These may be considered suitable for cultivation in Pothwar region. The performance of these genotypes will be further tested to make recommendations for large-scale cultivation.

Figure 25: AVRDC advance lines tested at NARC, Islamabad

Chilies

Eight chili hybrids (High Fly-2, NARC-4, Magma, Big Daddy, PH-274, Osaka, P-6 and Fengle Seed China) were evaluated under the normal growing season at Islamabad. High Fly-2 gave the highest yield of 19.1 t/ha, followed by Big Daddy (18.1 t/ha), while Osaka was the lowest yielder (8.6 t/ha) among the three hybrids. High Fly-2 and Big Daddy will be tested next season to assess their yield potential (Figure 26).

Figure 26: Establishment of chili trials

Cucumbers

Eight cucumber hybrids and varieties were evaluated in Pothwar region. The hybrids 163-A and Sulman gave almost similar top yields (17.1 and 16.9 t/ha, respectively).Although these yields are above the national average (14.2 t/ha), more genotypes will be tested for high yield next season.

Onions

Onions are grown throughout Pakistan with different harvesting periods. However, the supply of onions falls short of need from December-January and prices rise compared to the normal season. The traditional method of producing an autumn season crop is to start seedling production in the first week of July (for onion sets only). Not all varieties of onion are suitable for an autumn crop. During 1999-2005, work on off-season/autumn crops of onion through the use of sets was conducted in the Pothwar area. A short-day variety Phulkara was found to be the most suitable for autumn cultivation in this area.

Because of this work, the trials conducted focused on improving the main season varieties. Eighteen OPVs of onion were evaluated in the normal growing season at Chakwal (Pothwar) (Figure 27). Cyleon gave the highest yield of 36.0 t/ha, followed by Red Couch (30.0 t/ha), while the lowest yield of 8.0 t/ha was recorded for Perma and Vrio-01. The yield of Cyleon was twice as high as the average yield of onion in Pakistan which is 14.3 t/ha (Fruit, Vegetables and Condiments Statistics of Pakistan, 2012-13).The results will be confirmed next season.

Figure 27: Establishment of onion trial at BARI, Chakwal

On Farm Adaptability Trials

Protected Cultivation

Chilies

An adaptability trial of six hybrids (King Pepper, CGT, DG, Temble, PBC-1356 and Red Revil) was carried out in a farmer's field under protected cultivation in the arid temperate highlands of Quetta, Balochistan. Red Revil generated the highest yield of 10.0 t/ha, followed by PBC-1356 (3.4 t/ha), while the lowest yield of 2.3 t/ha was recorded for hybrid DG. A wider range of genotypes may be needed to obtain higher yields.

Natural Off-Season

Tomatoes

Off-season tomato crops can increase farmers' household incomes, but there has been little work on off-season cultivation of tomatoes and there have been few yield improvements over time. Twenty-one hybridswere tested in five agro-climatic regions. Rio-grande performed well in high altitude environments and generated high yields at two locations (Appendix-XXXII). Commercial hybrids were also evaluated and Lerica showed promising results at Mansehra. Hybrid Dollar performed equally well in the arid temperate highlands of Quetta, Balochistan. The results will be confirmed next growing season.

Cucumbers

Cucumber hybrids were evaluated under natural off-season conditions in thearid temperate highland region of Quetta. Four hybrids were tested. Cus-080 gave the highest yield of 7.0 t/ha, followed by Gharib Nawaz, Badshah and Beithalfa which all yielded close to 5.5 t/ha. A larger number of genotypes may need to be evaluated next season.

Brinjal

Brinjal evaluation trials were established under the natural off-season in the arid temperate highland region of Quettain a farmer's field. Four varieties were tested. Dilnasheen generated the highest yield of 13.0 t/ha, followed by Purple Long (12.0 t/ha), while the lowest yield (9.0 t/ha) was recorded for Sarwan. The yield performance of these varieties was not much higher than the national average of 10.1 t/ha. A wider range of varieties should be tested next season.

Okra

Three OP varieties – Sabzpari, Rama Krishna and Irka – were tested. Sabzpari generated the highest yieldat Mansehra (15.8 t/ha), followed by Rama Krishna (13.4 t/ha) and Irka 11.4 t/ha). The performance of these varieties was higher than the national average of 7.6 t/ha. Seed of these varieties may be provided for scaling-up of okra production at other locations.

Cauliflower

Off-season vegetables fetch good prices but farmers risk low production or even crop failure. A narrow choice of cultivars is one of the basic reasons for the low yield of early season cauliflower. The production of different cauliflower genotypes was assessed under high summer temperaturesin the Soon Valley (Khushab). Three hybrids – Adventa, White Rich and Local – were tested. White Rich (Figure 28) gave the highest yield of 44.1 t/ha, followed by Adventa (31.6 t/ha) and the local check. Thenational average yield of cauliflower is 17.1 t/ha (Fruit, Vegetables and Condiments Statistics of Pakistan, 2012-13).The good performance of White Rich needs to be confirmed next season.

Figure 28: Flower of Cauliflower Hybrid White Rich

Radishes

Three varieties were evaluated at the high altitude conditions of Mansehra. The OPV Green Neck gave the highest yield of 30.25 t/ha, followed by Minoearly (24.56 t/ha), while the lowest yield (21.92 t/ha) was recorded for Minowase. Though the yields of these varieties were above the national average (16.4 t/ha), the yield performance may also need to be tested at other locations next season.

On-Farm Demonstrations

A total of 11 demonstration plots consisting of an area of 0.4 ha and eight vegetable varieties or hybrids were planted at three locations in KP (Appendix-XXXIII).

Improve Insect and Disease Management to Reduce Pesticide Use in Protected Cultivation

According to integrated pest management (IPM) principles, healthy seedling production is the first step in growing a healthy vegetable crop.For vegetable crops, farmers use pesticidesto control insect pests irrespective of their residual impact on human health (Figures37 & 38). There is little consideration of withholding periods, and farmers spray vegetable crops one day and send it to the market the next day without thinking of the human health implications. To address this problem, 10 training courses on “Healthy Vegetable Seedling Production” and “Off-Season Vegetable Production” were organized by AIP-Vegetable through its provincial partners. Practical training was imparted to the farmers on site selection, raised bed preparation, seed sowing and the use of farm yard manure in nursery beds. The construction and installation of low plastic tunnels to cover nursery beds was demonstrated. A group of 10-20 participants was selected for each training course (as shown in Appendix-XXXIV). Trainings are an integral part of these activities to help farmers in production & post-harvest management, packing and marketing of fresh vegetables. Moreover, trials on farmer's field and demo plots were also established in each cluster for farmer's awareness.

Figure 29: Powdery mildew attack was a serious threat tocucumber crop in AJK

Figure 30: Downy mildew attack was a serious problem in Punjab

Evaluate and Identify Summer Crops for Protected Cultivation with Higher Economic Returns

During winter, plastic tunnels are used to raise tomatoes, sweet peppers, chilies and cucumbers. Growing off-season vegetables during the winter is a profitable business, and the tunnels are utilized from October to the end of April. Additional income from the investment incurred in tunnel construction can be generated by utilizing the land from May to August.

Seeds of two cultivars of spinach, two cultivars of coriander and one cultivar of Swiss chard were sown on May 31 under shade net. Seedlings of the following vegetable crops were transplanted for demonstration in the field area of the NARC Vegetable Crops Research Program:

- Cabbage
- Chinese cabbage
- Lettuce
- Bunching onion

The crops listed above were destroyed due to heavy insect and disease infestation. Spinach, coriander and Swiss chard were also planted for demonstration. The germination of coriander and Swiss chard were very low. Spinach was found to be a more promising crop in term of higher return (PKR 70,000/ha of additional income at Islamabad) due to its use during the month of Ramadan.

Experiments were conducted on coriander, spinach and Swiss chard at NARC, Islamabad, and the Vegetable Research Institute, AARI, Faisalabad to identify new crops for growing under protected cultivation in summer. Coriander and spinach were successfully germinated and the crops gave two cuttings at Bahawalpur (South Punjab), the second site of AARI. Coriander gave a yield of 16.0 t/ha while spinach yielded 6.0 t/ha in Faisalabad. Spinach was a more promising crop in Islamabad and in Bahawalpur, and an economic evaluation of growing spinach under protected cultivation was estimated to provide PKR 70,000/ha additional income for the farmer (Appendix-XXXV).

Five lettuce varieties (Iceberg, Green Rapid, Green Lake, Green Cos and Silver Beat) were tested at ARI, Mingora, Swat in KP to study their seed production performance. Of these varieties Iceberg, Green Rapid and Green Lake performed well and seed was harvested in June. The process of drying, threshing and cleaning of seeds is underway.

Identify and Promote Improved Protected Cultivation Systems

Drip irrigation, fertigation and plant geometry are among the techniques explored to improve crop yields in nurseries. Experiments were conducted on the use of nets and vertical structures for cucurbits in farmers' fields at D. I.Khan. Vertical structures were good for bitter gourd, bottle gourd and sponge gourd crops. Use of netting and reduced row spacing enhanced bottle gourd yields by 35percent, and significantly improved the quality of fruit, enhancing prices received in the market (Figures39 and 40).

Figure 31: Use of netting for Cucurbits

Figure 32: Significant fruit quality difference after using netting

Drip Irrigation System for Tunnel Farming

The Punjab Irrigated-Agricultural Productivity Improvement Project was launched in 2012-13 in Pakistan's Punjab Province. Drip irrigation is one of the components of the project, and orchards are the major focus. The AVRDC drip irrigation system built for this project will be validated and the technology for the protected cultivation of vegetables will be transferred.

A demonstration drip irrigation system was installed in a tunnel 10 *Marlas* (245m^2) in size at Islamabad. The fertigation system consists of a fertilizer tank in which fertilizer will be liquefied and applied to the vegetables as per requirements. Several advantages, including water savings, uniform distribution of water and fertilizer and reduced weed infestation, have been observed from the demonstration. Water savings of up to 65 percent can be made, and effective control of weed infestation is another important feature of the system. The system is cost-effective (a total cost of PKR 66,000) and user-friendly. The conventional drip irrigation system has been re-designed to decrease the cost while maintaining the same level of efficiency. As the head unit cost is constant in the drip irrigation system for this area, the remaining component of the system is cost–effective, since the irrigated area can be increased with additional laterals, while using the same head unit. Installation of a replica of the system on a farm in Haripur will be completed by the end of September (Figure 33).

Figure 33: First demonstration on drip irrigation system in tunnel by AIP-Vegetable team

Improved Mungbean Production

The main objective of this sub-project is to improve mungbean yields and to expand the area of the crop in existing mungbean growing areas as well as in new areas through various interventions. This would involve introducing mungbean into various cropping systems, as well as intercropping in sugarcane. Initially, eight national institutes were selected to participate in various project activities at different geographic locations. A complete list of participating institutes is given in Appendix-XIX. For double-cropping, NARC, Islamabad and BARI, Chakwal were selected in the Pothwar region of Punjab. For the rice-wheat cropping system in Punjab and Sindh, one partner institute was selected in each of these provinces. These were AARI (Faisalabad) in Punjab and QAARI (Larkana) in Sindh. The responsibility of testing mungbean intercropping with sugarcane was assigned to AARI (Faisalabad) in Punjab and NSTHRI (Thatta) in Sindh province. AZRI (Bhakkar) was selected for trial work in Punjab province, which accounts for more than 90percentof Pakistan's mungbean production. The summary of major activities under each priority is given below.

Map 3: Location of partners' mungbean project activities

Identify Opportunities to Improve Mungbean Production as Part of the Traditional and Rice-Wheat Cropping System and through Inter-Cropping (Irrigated); and Double Cropping in Wheat-Fallow Areas of the Pothwar Region (Rainfed)

This is the most important activity of this sub-project of mungbean and the interventions were made in four different cropping systems:

Mungbean Production in the Traditional Area

This sub-activity was carried out by AZRI, Bhakkar in the traditional mungbean area where it is a major crop. Demonstration plots of high-yielding varieties NM-11 and AZRI-6 were planted in six clusters involving 48 farmer beneficiaries. The long-term average yield of the area is 600 to 700 kg/ha. The use of improved production practices including line sowing, use of *Rhizobium* + PSB-Phosphorus Solubilizing Bacteria, post-emergence chemical weed control and IPM to control insects led to a significant increase in yields and farmer incomes. The mean yields achieved ranged from 1155 to 1858 kg/ha. This resulted in PKR 72,500/- to 142,800/- net profit and produced higher quality seed which fetches a relatively higher price than normal grains for human consumption (Appendix-XXXVI and Figure 34).

Figure 34: Mungbean farmer's field in traditional area of Bhakkar district with improved agronomic practices (left) and a field with traditional farmers' practices (right) where broadcast sowing method results in a poor and patchy plant stand (Bhakkar, June 25, 2014)

Mungbean Production in Rice-Wheat Cropping System

This sub-activity was carried out by AARI, Faisalabad in Punjab and QAARI, Larkana in Sindh province. This was the first experience of the farmers in growing the crop. There was a lack of seed of high-yielding varieties in the country at the time of sowing. Although the variety AZRI-06 generates high yields in the traditional mungbean area, it failed to perform well in the rice-wheat system due to GxE interaction. On the other hand, NM-11 performed superbly due to its high yield potential and adaptability to that particular environment. The yield ranged between 400 to 1500 kg/ha. The high yields from NM-11 and good farmer returns confirm it can be used as a catch crop in the rice-wheat cropping system to maximize overall income. An additional net profit of PKR 5,000/- to PKR 87,500/- per hectare was achieved, reflecting the success of the innovation (Appendix-XXXVII and Figure 35).

Figure 35: The mungbean variety AZRI-06 was planted in the last week of May 2014 in the rice-wheat cropping system in Sheikhupura district. The top left corner showsfallow field (left) and the same field with a bumper crop on August 8, 2014 where matured pods have already been picked (right). Rice transplanting is underway on the fallow field which continued until August 25, 2014.

Mungbean Production through Intercropping with Sugarcane

Two institutes, NSTHRI, Thatta in Sindh and AARI, Faisalabad in Punjab were involved in this activity. This activity was adversely affected due to a late start in Sindh province as the sugarcane crop is planted there earlier than in Punjab. The shading affected the yield of mungbean to some extent. However, the success of the innovation was evident. It was an additional crop for the farmers without affecting the long-duration sugarcane crop of sugarcane. The farmers were satisfied with this additional income. The mean yield was in the range of 293 to 437 kg/ha and a net profit/ha of PKR 26,782/- to 37,734/- was achieved (Appendix-XXXVIIand Figure 36).

Figure 36: Mungbean intercropping with sugarcane in T.T. Singh district.

Figure 37: A bumper crop of mungbean (variety AZRI-06) in district Chakwal. As it was their first experience with the crop the farmers were initially reluctant to plant mungbean and left half of their fields fallow but later realized the benefits of new legume crop.

Mungbean Production through Double Cropping in Pothwar Region

This sub-activity was shared by NARC and BARI. The crop is still in the field and data were not available at the time of reporting. However, a bumper crop is currently visible in the field, clearly indicating the success of the innovation. The crop is expected to be harvested before the end of September 2014. It will provide sufficient time for moisture conservation for wheat planting under rainfed conditions (Figure 37). First of all, the plots in different cropping systems are planted on the road sides where the farmers of the area and other passing by see the crop and questions about the innovation to the beneficiary farmer because they never saw mungbean growing in these cropping systems before. They are convinced immediately after realizing the potential of the crop which is not taking anything from them but giving a lot in the form of an extra crop with soil improving abilities. It is win-win situation for them.

Field days were conducted and around 150-200 direct and indirect beneficiaries were invited to each gathering where scientists demonstrate them a complete crop production technology. Even during very first experience, a farmer was so much convinced that he planted 78 acres instead of one acre and got a very bumper crop in rice-wheat cropping system where they always had fallow land after wheat.

Evaluate the Efficiency and Effectiveness of the National Seed Supply System and Assess the Opportunity to Develop "Seed Villages" for Production of High-Quality Seed of Improved Varieties

This was the responsibility of AZRI (Bhakkar) which is situated in the heart of the traditional mungbean growing region. The total seed produced through this activity by AZRI was around 23.68 tons which is more than double to the 10-ton target. The seed has the net value of PKR 2.4 million and is sufficient to plant 775 ha area during the 2014-15 cropping season. During this time period, a similar quantity of additional quality seed from the demonstration activities of our partner institutes is expected to enter into the system to complement our efforts to develop seed villages and partnerships with private seed companies. The seed production is fulfilling the requirement of the farmers of the area as well as maximizing their net profit (Appendix-XXXVIII).

District	Cluster No.	Cluster Name	Farmer Beneficiaries	Area Planted (ha)	Seed produced (t)	Mean Yield kg / ha	Total income/ha @ PKR 100/- per kg
Bhakkar	5	Thal -I	12	4.86	5.74	1205	120500
	6	Nashaib	5	2.02	2.46	1338	133,800
	7	Tibba Hamid Shah	5	2.02	2.89	1858	185,800
	8	Luck Kallan	9	4.45	5.51	1398	139,800
Layyah	9	Thal-II	8	3.04	3.08	1155	115,500
	10	Chowk Azam	9	3.64	4.00	1218	121,800

Evaluate Methods Including Resistance Breeding for Improving Post-Harvest Storage to Reduce Bruchid Damage

This activity has two sub-activities with short- and long-term goals:

- Training of the beneficiaries to minimize post-harvest storage losses (short-term).
- Development of bruchid-resistant lines through a strong breeding program at the institute level (long-term).

Training of Beneficiaries to Minimize Post-Harvest Storage Losses

Each of the six partner institutes were involved in the first sub-activity except BARI, Chakwal. Field days and training activities were held by AARI, Faisalabad and AZRI, Bhakkar on how to reduce post-harvest losses through the sun-drying of seeds, using clean or pest-free bags and the use of chemicals (fumigation with phostoxin) in the stores (Figure46). The target was 100 direct beneficiaries; however, 276 direct and indirect beneficiaries were provided with this training and the sub-project target was achieved. These trainees will serve as master trainers. It was the first year in real terms. The number will continuously to increase each year. These beneficiaries are from community members working on post-harvest management practices in each cluster.

Figure 38: Hands on training for fumigation process at one of the farmer's sites in Thatta district

Figure 39: Germplasm under evaluation process *in-vitro* for bruchid resistance at NARC

For the second sub-activity, NARC, Islamabad took on this task of breeding work due to their strength in this area. Bruchids can be controlled by chemicals, but a resistant cultivar is preferable due to reduced risk to health and environment and a reduction in the cost of insecticides.

Evaluation of Mungbean Genotypes and Breeding for Bruchid Resistance

Evaluation

Eighteen mungbean genotypes including 14 improved lines from AVRDC and four improved varieties from Pakistan were used to identify bruchid-resistant genotypes. Since these genotypes were not known for resistance against C. maculatus the prevalent species in Pakistan, these were evaluated under controlled conditions in collaboration with NARC's Integrated Pest Management Program (Figure 40). The experiment was replicated three times. Data on the number of adults emerged andthe percent of damaged grains were recorded. The genotype V 1001802 B-G showed the minimum percentage of grain damage (0.7percent) followed by the genotypes V 1001709 B-G and AVMU 8901 with 1.3percent and 11.5 percent grain damage, respectively (Appendix-XXXIX). These three genotypes were found to be resistant against *C. maculatus*.

Hybridization

The three confirmed bruchid-resistant genotypes (AVMU 8901, VI001709 B-G, VI001802B-G) and four unconfirmed types (VI06322 A-G, AVMU8902, AVMU0401 & AVMU40002) were used as resistant parents in the hybridization program during the 2014 spring season. The unconfirmed genotypes for bruchid resistance will be tested in due course. The crosses were made between seven bruchid-resistant genotypesand four susceptible but high-yielding cultivars (NM-11, NM-06, AZRI-06 and NCM-2013).Twenty-four cross combinations were attemptedandonly 15 were successful. The F1 generation of these 15 cross combinations were planted during summer 2014. During summer season the crossing block was also planted for hybridization among bruchid resistant and susceptible varieties (details in Appendix-XXXX)

Bruchid Resistance Breeding in Taiwan and in Hyderabad

The AVRDC breeding work on bruchid resistance is being conducted at two locations – AVRDC headquarters in Taiwan and at its South Asian regional headquarters in Hyderabad, India using two bruchidresistant accessions (V 2802 and V 2709). The screening for resistance to bruchid species, *Callosobruchus chinensis* is being carried out in Taiwan. There were 24mungbean lines at the F_5 generation identified with excellent levels of resistance to *C.chinensis* (Figure. 40.a) Screening for resistance to *C.maculatus* is being undertaken in Hyderabad, India. Promising mungbean lines with resistance to *C.maculatus* have been identified at the F_3 generation (Figure. 40.b), which will be tested in the field for agronomic performance.

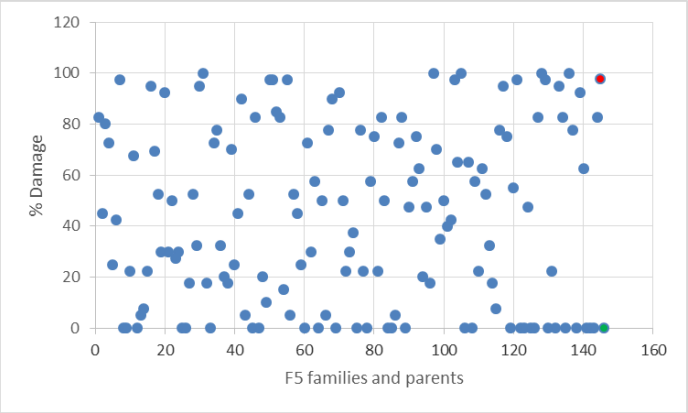


Figure 40.a: Screening of mungbean lines for resistance to *C. maculatus*. (The point highlighted in green is the resistant parent V2802 and the one in red is NM 94).

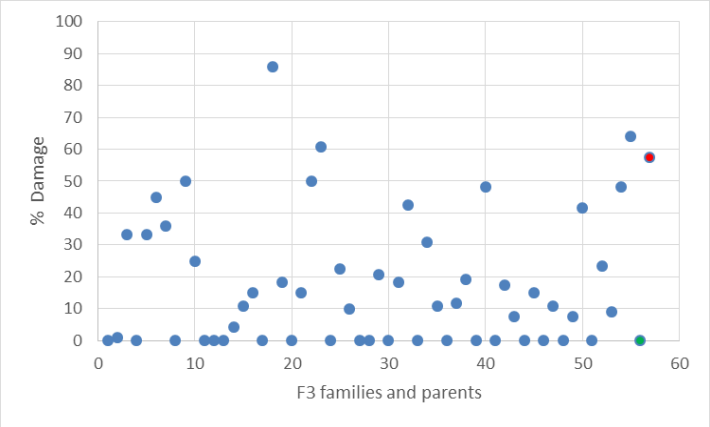


Figure 40.b: Screening of mungbean lines for resistance to *C. maculatus*. (The point highlighted in green is the resistant parent V2802 and the one in red is NM 94).

Identify Opportunities for Adoption of IPM Practices in Mungbean Cultivation

Almost all institutes except BARI and Chakwal were involved in this activity. The target was 200 direct beneficiaries but this was exceeded by the partner institutes. There are 276 direct and indirect beneficiaries aware of the use of IPM practices and the potential for yield increases of over 20percent. Practices involved pest scouting and the monitoring of parasites, parasitoids and predators. Farmers were involved in the identification of insect pests and controlling the sucking pest complex of trips, white flies and jassids using imidacloprid 15ml/15 liter of water, applying detergent with water and spraying Chlorfenapyr (Squadrin) @ 500ml/ha. Armyworms were controlled with Match (Lufenuron) 25ml, field crickets with Lorsban (Chloropyrophos) 4 ml/liter of water and mixing in 5kg wheat flour for application. Lambda cyhalothrin (Silk) @ 620ml/ha was sprayed for the control of Helicoverpa and pod borer (Figure 41). Post-emergence herbicides were also used and farmers were provided with a complete training program.

Figure 41: Some of the common insect pests of mungbean in Thatta and Sajawal districts

Assess the Opportunities for Mechanical Harvesting of Mungbean

With the help of an AVRDC agriculture engineer, NARC made the old Heigy harvester functional and it will be tried for combine harvesting sometime in late September or early October.This old combine harvester was discarded, and has been sitting in the NARC junkyard

since 2012. It was handed over to the Pulses Program, NARC in May/June with the collaborative efforts of AVRDC-AIP Pakistan. The joint team of gricultural & Biological Engineering Institute (ABEI), and the AVRDC agricultural engineer made extensive efforts to get the machine operating. The harvester is now fully operational, and has successfully harvested demonstration plots of chickpea and lentil. It will also be tried with mungbean and necessary modifications will be made to ensure it works successfully (Figure 42).


Figure 42: Small combine harvester Heigy acquired and made functional for further trials on mungbean

Vegetable Value Chains

Increased National Vegetable Seed Production to Improve Supplies and Reduce Prices to Farmers

Suitability Trials for Improved Varieties of at Least TwoMajor Vegetables

Tomatoes and onions are major focus crops for AVRDC and they are both economically important crops in Pakistan and are grown on alarge land area. AVRDC onion and tomato breeders provided 12 lines of onions and 15 lines of tomatoes (F_7 and F_8) for adaptability trials in Pakistan. The onion, chili and tomato lines from AVRDC will be evaluated in at least two locations in collaboration with these partner institutions:

- Agriculture Research Institute (North), Mingora, KP
- Vegetable Program, National Agricultural Research Centre (NARC), Islamabad
- Vegetable Research Institute, AARI, Faisalabad, Punjab

Presently, the following seed companies/associations have consented to be a part of the vegetable value chain activities:

- Shuga Seed Growers Association, Buner, KP
- ARCO Seeds, Gujranwala, Punjab
- Kashtkar Traders, Kamoke, Punjab
- Chili Growers Association, Kunri, Sindh

Activities will include evaluation of seed production, fresh produce yields and post-harvest impacts on shelf life.

Vegetable Basic Seed Production

Vegetable seed production is highly technical; requiring skills and experience from sowing through to packing and marketing. Basic seed is the first step and partner institutes were able to produce a good quantity of basic seed during 2013-14 which can be used for bulking up next season. The details of seed produced by partner research institutes is provided in Appendix-XXXXI. Seed of open pollinated varieties of onion, tomato and peas are being multiplied under the supervision of Vegetable Seed Specialist on and off farm by researcher, farmer and seed companies.

These quantities of seed are a primary source for improving the vegetable value chain, and will be used for further bulking up of seed supplies to private sector dealers. As better varieties are identified through the project they will be substituted into the basic seed production system. The aim of this activity is to speed up production of basic seed of varieties that are currently used by farmers, and for which there is a ready market. The seed dealers have been directly linked up with seed producers so that they have a ready market for the seed they produce. About five private seed companies have been identified and three of them have been connected to seed producers.

Figure 43: Onion seed production at Vegetable Seed Farm, ARI, Quetta, and Balochistan.

Figure 44: Onion seed plot at Shuga, Gokand Valley, District Bunir, KP

The suitability of a vegetable crop for an area depends upon its climatic and geographical situation, and the available human resources at a particular research institute where seed production is to be initiated (Figures 43 and 45). The crops and area targets have been assigned according to these principles. Seed production areas for five commercially important vegetable crops were selected – onions (3 ha), peas (2 ha), tomatoes (0.5 ha), okra (2.5 ha) and chilies (2ha). A total of 10 hectares of vegetables for seed production will be sown with seven clusters of farmers across the country, and the following public research institutes were selected as partners:

- Agriculture Research Institute (North), Mingora, KP
- Vegetable Program, National Agriculture Research Centre (NARC), Islamabad
- Vegetable Research Institute, AARI, Faisalabad, Punjab
- Vegetable Seed Production, ARI, Sariab, Quetta, Balochistan

Figure 45: The symptoms of a deadly disease, purple blotch, are shown to farmers on an onion seed crop at Shuga, Gokand Valley, District Buner, KP. In 2013-14, the seed crop was wiped out in the valley by this disease. The disease occurred and spread due to torrential rains in the spring season.

Crops	Swat- KP	Pothwar Punjab	Central Punjab	Sindh	Balochistan	Private Sector	Total (ha)
Onion	0.5	0.5	0.0	0.5	1.0	0.5	3.0
Peas	0.5	0.0	0.5	0.0	0.0	1.0	2.0
Tomato	0.0	0.0	0.5	0.0	0.0	0.0	0.5
Okra	0.3	0.5	0.5	0.0	0.2	1.0	2.5
Chili	0.0	0.0	0.0	1.0	0.0	1.0	2.0
Total Rabi	**1.3**	**1.0**	**1.5**	**1.5**	**1.2**	**3.5**	**10.0**

The partner institutes provided the target crops, and area to be planted for seed production. The areas for winter vegetable seed production by partner institutes in the public and private sectors are given below:

The partner institutes had divided their work in two categories of vegetable seed production. They have planned production on each institute's land according to its capacity and the rest of the land has been obtained through contract farmers with the involvement of seed dealers. In some institutes, the field work has been started, while in some places, sites and farmer selection is still in progress (Appendix-XXXXII).

Evaluate Value Chains for Major Vegetable Crops

The AVRDC socio-economists started these studies in June.A formal survey and FGDs have been carried out to assess the state of value chains for key vegetable crops (Figures54 and 55). It was conducted in four provinces, and vegetable producers, commission agents and seed dealers were interviewed. A check list was prepared before conducting the FGDs. After pre-testing the formal questionnaire, 271 respondents across the country were interviewed on various aspects of vegetable value chains (details discussed below along with the other baseline studies).

Mr. Mazullah Khan, a vegetable seed specialist participated in a post-harvest workshop held at Bangkok, Thailand from June 1-3 and conducted by a USAID post-harvest project working

across Bangladesh, Nepal and Cambodia. The workshop provided an opportunity to focus the crops for post-harvest studies and to coordinate these studies with other vegetable value chain studies underway in the region. The number of vegetables for seed production were reduced from 10 to five, and the number of vegetables for value chain studies from 10 to three. The five vegetables for seed production are onions, peas, tomatoes, okra, and chilies, while onions, tomatoes and chilies are the focus for fresh vegetable value chain studies.

Figure 46: Old-style tomato wooden crates in wholesale fruit and vegetable market, Hazar Ganji, Quetta, Balochistan

Figure 47: This crate is being prepared for packing tomato inthe wholesale fruit and vegetable market, Hazar Ganji, Quetta

Packing vegetables in plastic boxes improves prices for the producers. A finding of this study is that this important value chain activity has a great potential, since 83 percent of vegetable producers in Pakistan do not use plastic boxes.

Assess and Promote Improved Post-Harvest and Value-Adding Technologies

Capacity building is important to initiate improvements in post-harvest handling. For this purpose, a two-day training workshop was arranged on "Post-Harvest Strategies for Vegetable Value Chain Improvement in Pakistan" on September 17-18 at the AVRDC-Pakistan office. It was aimed at partner institutes to build their capacity as master trainers with the aim of utilizing their expertise in the future on post-harvest production technologies. The basic purpose of this training was to develop a pool of trained scientists in the public sector to shoulder the responsibilities of reducing post-harvest losses (Figures 56 and 57) which is poorly studied in Pakistan. In the workshop, 20 scientists participated, representing various regions and walks of life – researchers, extension experts, agriculture universities and representatives from the private sector from all over the country. Dr. Jun Acedo, AVRDC post-harvest specialist from the South Asia Region office, conducted the training.

Figure 48: After threshing, onion seed is being cleaned manually in Mingora, Swat, Khyber Pakhtunkhwa with the help sew

Figure 49: Onion seed is being cleaned manually in Mingora, Swat, Khyber Pakhtunkhwa with the help of electric fan

Baseline Surveys for the AIP-Vegetable Component

A short-term socio-economist consultant, Dr. Mohammad Nasir, was engaged to conduct the baseline studies of three sub-projects of the AIP-Vegetable Component in collaboration with AVRDC socio-economist Mazhar Bukhari starting in June. Three questionnaires were formulated and translated into Urdu, the national language. These were pre-tested in the field, and amended accordingly. Approximately 30 enumerators were trained to collect the information for these three components throughout the country. The data collection was completed in the second week of July. The data was edited, cleaned and entered in Excel sheets for basic analysis, which is still in process. The work of technical report writing has started, and will be completed in November.

The baseline survey for sub-project-I: Protected Cultivation of Vegetables was conducted in 23 districts throughout the country, comprising 39 clusters. The main information in the survey included cropping system, tenancy status, landholding, winter and summer vegetables, village profile, farm assets, source of seed, vegetable varieties, weeds and pesticide problems and related vegetable production technologies. Other important information collected was on gender participation and decision–making, including women's participation in farm activities. A total of 649 vegetable growers were interviewed, and 741 variables have been investigated in this sub-project (Figures 50 and 51).

Figure 50: Enumerators collecting data at farmers' field during baseline survey in Noorpur, Punjab

Figure 51: Enumerators being trained for data collection in Gilgit- Baltistan

The survey for sub project-II: Improved Mungbean Production was conducted in 14 districts throughout the country, comprising 20 clusters. The main information in the survey included the cropping system, tenancy status, landholding, farm assets, varieties, weeds and pesticide problems and crop production technologies. Gender participation was also probed. A total of 96 growers were interviewed, and 586 variables have been investigated in this sub-project.

The Survey of Vegetable Value Chains

A vegetable value chains survey was conducted in all four provinces, including 10 wholesale vegetable markets. A total of 271 vegetable/seed producers, commission agents and seed dealers were interviewed in these markets (Appendix-XXXXIII). This sub-project comprised eight clusters. The important information included marketing channels, vegetable prices, open and hybrid vegetable varieties used and sources of seed. The other vital information consisted of pre-harvesting, harvesting and post-harvesting information on activities. The vital value chain activities have been determined in this sub-project. These include vegetable harvesting/picking, grading, packing, transporting, commissioning/bidding, mode of payment and financial assistance from various sources. The provisional results indicate that 86 percent of farmers were grading their vegetables. Almost the same percent of farmers received a higher price due to this activity. Studies on vegetable value chains has been completed and in the process of compilation.

Perennial Horticulture

During this reporting period, the team defined priority crops, assessed the major problems, defined projects that would have impact and solicited commissioned research and extension projects. The most important crops, in order, are mangoes and citrus followed by grapes, olives and pistachios. Generally, the most important problems related to these crops are in two broad categories: first, orchard establishment and management, including nursery tree production; and second, post-harvest practices including development of value-added products to decrease losses. The progress in both topics is summarized below. After 2014, the emphasis of the Perennial Horticulture program will shift from mangoes and citrus to grapes, olives and pistachios. A larger impact can be made with the latter crops, as there is less extension information developed and disseminated in comparison to mangoes and citrus, for which considerable information and extension programs exist.

Perennial Horticulture Production Systems

Mangoes

Among the major problems in mango production is the simultaneous harvest of the current cultivars, flooding the market and depressing prices. To address this problem, research proposals will be funded to conduct a long-term field test of 10 newly identified native accessions with different harvest dates and fruit quality characteristics. On September 10, a Mango Field Day was held at the University of Faisalabad (UAF) in Punjab, which was attended by 126 growers. At this meeting the new cultivars were introduced and distributed to registered growers. Their information combined with that of the mother block at UAF will produce the reliable field production data needed to determine if a new cultivar has value. Depending on this data, the adoption of varieties with varied maturity dates will be by the end of 2016.

Citrus

In citrus production, nursery production of good quality, true-to-type disease-free trees, including new cultivars, for orchard establishment is very essential. Much of this information has been developed in other countries, particularly Australia and the United States (California). Australia has had a long-term project, Australian Sector Linkages Project (ASLP), which has developed much of this information for Pakistan, including cultivar introduction. However, what is needed is implementation. AIP will build on these results by funding two demonstration research projects, each one year long, to develop a model citrus nursery and demonstrate the benefits of lighter potting media at CRI-Sargodha. In addition to these two nursery projects, AIP funded a citrus extension demonstration block for year-round farmer field schools on timely topics and an IPM extension project to demonstrate pest management practices throughout the year. As mentioned above, much of this information has been developed elsewhere or through the ASLP program but lacks an effective extension program. The first of these farmer days will be held in the first two weeks of December.

Grapes

The major problem with Pakistan's grape industry is a lack of information about how to develop vineyards. To address this issue, AIP funded a vineyard trellising demonstration block at the UAF research station and with their cooperator in Quetta, Balochistan. Figure 52 below is a

photograph of the newly established vineyard. The trellis will be installed in the winter of 2014.

Figure 52: Newly planted vineyard at UAF field research station. The trellis will be installed in winter 2014.

Olives and Pistachios

Very small, fragmented table and oil olive and traditional pistachio industries have been started in Pakistan. Both suffer from lack of knowledge of about how to produce trees, establish orchards and produce good quality fruit. Initial contacts have been made with the primary olive researchers, led by Dr. Abdul Samad at the ARI at Tarnab, Peshawar KP and with Drs. Muhammad Azhar Iqbal and Muhammad Aqueel from the Barani research stations and Dr. Javeed Tereen, the primary pistachio research scientist in Quetta. With olives, the primary

problems appear to be selecting the best cultivars with reliable flowering and increasing fruit set and selecting the best cultivars for oil and table olive processing. For both pistachios and olives, nursery production needs to be developed. Furthermore, small, unsplit pistachios, perhaps new cultivars, better rootstocks and production practices need to be developed (Figure 53). Discussions are ongoing about developing these long-term projects.

Figure 53: Pistachios from Quetta province demonstrating a high percentage of unsplit shells.

Perennial Horticulture Post-Harvest Systems

As with the production horticulture projects discussed above for 2014, the post-harvest activities focus on mangoes and citrus to build upon existing projects. Post-harvest horticulture falls into two broad categories: improving fresh fruit quality through pre-harvest, harvest and post-harvest practices; and developing alternative uses for the product which is not marketable fresh and would otherwise be wasted.

In this reporting period, AIP funded fresh fruit post-harvest activities, including two fresh citrus demonstration research activities and one mango research project in cooperation with the commercial mango industry.

For the two citrus research demonstration projects, AIP has developed harvest, transport and post-harvest practices into an annual extension program of farmer field schools and field days for growers. The program will be held within the first two weeks of December, during harvest. The team is also developing a similar program, based on existing resources, for citrus packinghouse operators.

For fresh mangoes, UAF and the commercial packinghouses are collaborating in evaluating an acoustic sensor that when incorporated into packinghouse lines will enable the shipment of evenly ripening mangoes. A prototype of an acoustic sensor to determine future full maturity is being demonstrated at UAF, which should be available for commercial operations within two years.

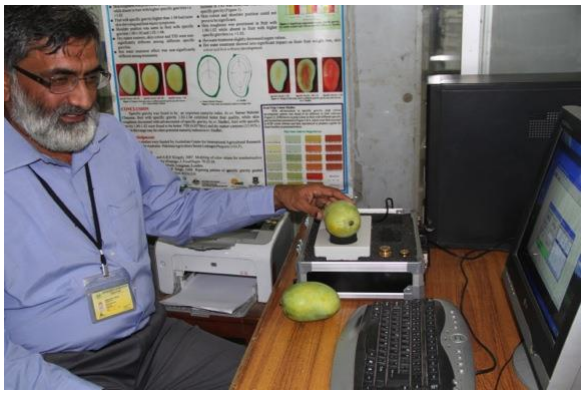


Figure 54: Dr. Malik of UAF Post-harvest Fruit Technology Department demonstrating how the acoustic sensor can be used to determine future full maturity.

The value-added post-harvest projects funded in this reporting period have a dual focus – first, developing a value-added product and second, developing the production methods at both a smallholder farmer scale, to be taught at Farmer Field Schools and production methods at the commercial level. All are projects that will be completed within a year. For mangoes, the development of mango pulp as a 'natural candy' fruit leather (Figure 54) and the extraction of mango seed kernel waste for processing into a substitute for cacao butter are funded projects. Finally, funding will also support the establishment of two small-scale facilities for the extension demonstration teaching of stone fruit dehydration and small scale processing techniques for both citrus, mangoes and other fruits at UAF and CRI-Sargodha.

Figure 55: Dr. Moazzam Rafiq Khan of the UAF Department of Food Science and Technology preparing a mango fruit leather as a "natural candy" from mangos that would otherwise be lost to postharvest spoilage.

Human Resource Development (HRD)

Graduate Studies

In this reporting period, the committee selected 22 Ph.D. and 30 M.S. semi-finalists. The final selection of the students is detailed below.

Final selection of PhD students

The announcement for these positions was posted country-wide by the Pakistan Higher Education Commission. Three hundred PhD applications were initiated through the UC Davis online process. Candidates were screened to eliminate applications that were late or incomplete. The AIP-HRD committee (Appendix- XXXXV) examined all candidates online to limit the candidate pool to a small number; 20 semi-finalists were interviewed in-person at HEC Islamabad, Pakistan. Unfortunately, two female candidates withdrew just prior to their interview time citing family issues. The semi-finalists were interviewed in-person on May 5 and 6. Semifinalists were informed in advance to prepare a five-minute presentation about their interest in the scholarship, research topic and their intentions in Pakistan after completion of the PhD. This was followed by questions by the committee. A point scale system was developed by the committee to evaluate the applicants on the basis of their poise, preparation, ability to express themselves and answers to committee questions. The committee then requested reference letters, GRE and TOEFL/IELTS scores and selected five finalists and two alternates. Successful candidates were matched with appropriate professors in the United States and they then applied to one or more land-grant universities. Five PhD and four alternates have been selected for PhD scholarships. At the final stage two of the five finalists are women.

As of this report, the following scholars have been admitted for PhD study:

- Mr. Yayha Rauf – University of Minnesota – wheat rust
- Mr. Muhammad Ahsan Khan – Washington State University – wheat drought
- Mr. Naqeebullah – Mississippi State University – salinity rice

The two remaining PhD scholars are applying to other land-grant universities for admission in spring term 2015.

Final selection of M.S. students

In this reporting period, nine M.S. scholars and four alternates have been selected. The announcement for the positions was posted country-wide by the Pakistan Higher Education Commission. Three hundred forty-eight applicants initiated an application through the UC Davis online process. Candidates were screened to eliminate applications that were late or incomplete. The AIP-HRD committee examined all the candidates online to limit the candidate pool to 30 semi-finalists. Semi-finalists were not interviewed in-person. A point scale system was used by the committee to evaluate the applicants. Nine finalists and four alternates were selected for the scholarships. In the final selection, six of the nine finalists are women. The committee has requested the selected candidates to provide reference letters, GRE and TOEFL/IELTS scores. Successful candidates were matched with an appropriate major professor at land-grant universities in the United States; five candidates have been admitted for MS study:

- Ms. Salma Bibi Noshad – Texas A&M University – rice genetics
- Mr. Ismail Khan – Mississippi State University – metabolic engineering in crops
- Ms. Maria Amir Solangi – University of Massachusetts – animal diseases
- Mr. Bazgha Zia – University of Arkansas – fruit chilling stress, horticulture
- Mr. Habibullah – University of Missouri – plant nutrition, soil fertility

Ms. Maria Amir Solangi has already arrived in the U.S. and begun her studies. The remaining four MS scholars are applying to other land-grant universities for spring term 2015 admission.

Vocational Training

In June, the vocational training workgroup was officially established with membership from each of the primary partners. The committee consists of: Mark Bell – UC Davis (chair); Muhammad Imtiaz – CIMMYT; Mohamed Ibrahim – ILRI; Abdul Rehman – IRRI; Mansab Ali – AVRDC; and Dr. Shahid Masood or Dr. Muhammad Ashfaque – PARC .

Priorities were confirmed (proposal writing and statistics being the top ranked topics). In addition, the group agreed upon the following general priorities:

Communication

- Writing, including: proposal writing, Basic writing skills and Scientific writing
- Extension and delivery
- Use of modern tools in communication
- Presentation skills
- Adult learning principles and constructing a workshop

Experimentation

- Statistics – using “R” (Experimental design, Data collection, Data analysis)
- Setting research priorities CGIAR

Cross-Institute Technical Themes

- Pesticide use and safety
- Seed health

The first workshop with 41 participants was held at NARC, Islamabad, on September 9-10.The proposal writing workshop evaluation report contains further details about the workshop. An online refresher statistics course is being offered to the partners in November-December. Future trainings and the targeted audience for those trainings are discussed and agreed upon by the Vocational Training Workgroup, which includes representation from all AIP partners.

Figure 56: Proposal writing workshop participants engage in discussion.

e-Pak Ag

e-Pak Ag is an agricultural information online portal that promotes the use of information and communication technologies (ICT) to better support the transfer of knowledge to agricultural professionals. ICT activities and initiatives are being conducted in-country and a study is being finalized to summarize the findings below.

Two workshops on the application of ICT in agriculture were held in June; one in Rawalpindi (with 84 participants, including 22 women) and one in Faisalabad (with 211 participants, including 55 women). Both workshops had representatives of the local directorates of information. The workshop in Faisalabad had extensive private sector involvement. Some of the highlights from these workshops include:

- Consensus that a huge databank of agricultural information exists on the internet and print media in Pakistan. However, the trustworthiness and reliability of the available information needs validation.
- Farmers' trust in the information provider is critical to its usefulness and application.
- Information should be relevant (e.g. according to ecological zones), and presented in an attractive and interesting manner (pictorial, graphics and video-based).
- A system of liaison and coordination between information providers should be established, including an effective monitoring and evaluation of the information.
- Promotion of the use of affordable ICT tools (mobile phone, Internet) within the local socio-economic and cultural context.
- Continuous and dedicated work of extension staff is important and they need to be equipped with appropriate ICT tools. Also, subject specialist extension workers at the local level have an important role to play.
- Establishment of village-level community centers and call centers may be useful.
- Promotion of ICT in village festivals and fairs.

These two workshops form part of a series of workshops being held across the country to bring together ICT practitioners to identify and share best practices. The workshop in Rawalpindi was also associated with a student fair at which the students demonstrated their research findings. A draft set of findings has been developed and these will be further refined based on the ongoing

series of workshops. One interesting observation to date is the suggestion that there is a need for a simple interface to direct people to the myriad of nationally created information presently available on the Internet.

Given the pluralistic nature of extension, the full range of players involved is being engaged to provide input as to how information can best be communicated with farmers. PARC, the provincial Directorates of information, key universities and select private sector players have been consulted and engaged in this activity. As such, they are best positioned to communicate with their constituencies about the new e Pak Ag site. The first M.Sc. student at UAF has finished his studies looking at information channels at the village level and the potential role of ICT in meeting those information needs. By improving the understanding of how farmers are currently accessing information, AIP will be better able to meet their needs through e-Pak Ag.

The pages of the e-Pak Ag portal have been developed. The pages dealing with tree crops were extensively built out in collaboration with Dr. Louise Ferguson. The current focus is citrus and mango in order to build on the highly successful ASLP (i.e., don't reinvent the wheel, but build off it). It is expected that pages on grapes, pistachios and olives will be added in the future as the tree research expands to these other crops. Priority crops and priority needs and opportunities continually updated and revised in consultation with stakeholders for wheat, rice, maize, vegetables, livestock and tree crops. UC Davis will work with partners to refine and add topics, as partners implement further activities in the field. While the project document outlines the primary starting points, e-Pak Ag will be a dynamic activity that adjusts in line with the core partners as they recognize and identify evolving needs and opportunities.

For example, discussions were held with AVRDC regional representative Warwick Easdown, on ways to support the activities of AVRDC in making its extension and training materials more widely accessible. Similar discussions will be held with the other major partners. Through consultation with key AIP partners, the intent of e-Pak Ag will continue to be further refined as needed.

Competitive grants system (CGS)

Opening of Revolving Fund USAID Grant in respect of AIP

- The Finance Division of the Government of Pakistan (GoP) has devised revised accounting procedures for revolving fund accounts (Foreign Aid Assignment Account). The revised procedures were issued vide Finance Division (Budget Wing Office memo No. F-2(1) BR-II/2007-949 dated August 8.
- According to the Finance Division's notification, a separate assignment account for the maintenance of a revolving fund for the foreign-funded programs will be maintained by the host project authority and clearance of assignment account, allotment of ID Number as well as budget approval to reflect the program budget in the federation budget as per mechanism approved by the GoP/Finance Division. The grant will be subsequently reflected in Pak Rupees cover in the GoP budget.

Progress on Opening of Assignment Account for AIP in the Reported Period

- The process of opening of an Assignment Account for AIP was initiated in September 2013. Formal administrative approval by the Federal Secretary, Ministry of National Food Security and Research (MNFS&R) to AIP was granted on October 20, 2013. After Administrative Approval by MNFS&R, the ministry was requested to get "Approval of Token/Technical Supplementary Grant as well as Opening of Assignment Account Revolving Fund and Allocation of I.D Number/Budget Approval and Issuance of NOC from Finance Division, GOP for cheque signatories of the USAID's funded project Agriculture Innovation Program (AIP) for Pakistan" on December 13, 2013. Ministry of Finance, Budget Wing allotted ID No. 5626 to AIP vide Finance Division' U.O. No. 1(14) DFA (NFSR)/2013, dated March 04, 2014.
- Ministry of Finance, Budget Wing issued a no objection office memorandum for opening of Lapsable Assignment Account in USD in respect of AIP vide Finance Division (Budget Wing) O.M. No.F-2(3) BR-II/2009-233/14 dated March 3, 2014 to the MNFS&R to approach the State Bank of Pakistan (SBP), and the Accountant General of Pakistan Revenue (AGPR). The Ministry requested the AGPR and SBP on March 17, 2013. The AGPR requested some additional information about AIP like PC-I (proposal/Concept Note) for its records and the same were submitted to AGPR. The AGPR also sought NOC from the controller General of Accounts (CGA).
- The SBP issued NOC to NBP on March 24, 2014; the CGA on May 22, 2014 and the AGPR on June 2, 2014 to NBP for opening of AIP Assignment.
- AIP Assignment Account in favor of USAID-funded Agricultural Innovation Program was opened at the National Bank of Pakistan (NBP), Civic Center, Islamabad.
- The Chairman of PARC signed the Sub-grant agreement on July 9 and the agreement was forwarded to CIMMYT-Mexico for the counter-signature of the CIMMYT representative. The signed copy of the agreement reached PARC on July 23.
- On August 5, CIMMYT transferred US $ 818,611 in AIP Assignment Account but on the same day the NBP returned the funds to Mexico with the request to transfer funds through State Bank of Pakistan (SBP) as per revised accounting procedure of the Finance Division, GoP. On August 28, CIMMYT transferred the funds to SBP, which has been credited on the same date with a sum of PKR 83,765,844.07 equivalent of US$ 818,611.00 at exchange rate of 102.3268 PKR per USD. Codal formalities in the form of Technical Supplementary Grant (TSG) are being met and followed in the Finance Division, Ministry of Finance & Revenue, GoP to transfer the funds from the Government Account to USAID-AIP Account maintained at NBP, Civic Center, Islamabad.

Activities of Competitive Grants System under AIP

PARC is responsible for the creation and implementation of a transparent and province-endorsed competitive grants system (CGS) in a deliberate manner and creation and establishment of Provincial Agricultural Research for Development (AR4D) Boards in Balochistan, KP and Sindh.

- During a meeting with Provincial DGs (Research and Extension) held at PARC headquarters on June 16, all DGs were requested to identify and share priority research areas for CGS under AIP. So far, KP and Sindh provinces have shared priority research areas.
- A mechanism for CGS management to establish the Fund's program and priorities and its financial and managerial policies has been developed. A national advisory committee (NAC) is the governing body and responsible for the program and its financial and managerial policies. NAC composition and terms of reference (ToR) were developed and submitted for approval of Competent Authority. Similarly, composition and ToRs of the technical advisory committee (TAC) as the advisory body of the NAC were also developed and submitted for approval by the competent authority.
- A project proposal template has been developed in consultation with and technical support from CIMMYT-Pakistan, UC Davis and PARC's Planning & Development Division. A template will be used to seek proposals for granting of competitive grants under AIP.

Creation and Establishment of Provincial AR4D Boards

PARC is also entrusted with the responsibility to create and establish Provincial AR4D Boards in Balochistan, KP and Sindh provinces. The boards are patterned after the Punjab Agricultural Research Board (PARB) in Punjab province.

- This activity involves the creation of boards and then channeling funds through them to provinces. The rationale behind this activity is to bring more integration and help provinces to establish sustainable research funding bodies.
- PARC is responsible to coordinate and support the relevant departments in Balochistan, KP and Sindh for necessary legislation to be carried out to create and establish provincial boards in these provinces.

Details of the correspondence made and meetings held with the provincial stakeholders since March are given below:

- A meeting of all provincial DGs (Research and Extension) was convened on June 16 at PARC headquarters in Islamabad to discuss and devise strategies for the Establishment of Provincial Agricultural Research Boards & Finalization of Priority Research Areas for Competitive Grants System. Request for meeting along with agenda and Record note of the meeting are attached at.
- DG Research Balochistan informed meeting attendees that the Balochistan Agricultural Research Board Act (BARB Act-1998 was passed in the provincial assembly in 1998 but the board is not functional as yet.
- In view of the vast experience of Dr. Mubarak Ali (Consultant, PSSP-IFPRI and Ex-CEO, PARB), the Chairman PARC requested that USAID utilize his services to review the existing PARB Rules & Regulations and come forward to help AIP create the Provincial AR4D Boards in Balochistan, KP and Sindh..
- On September 1, DG Research Sindh was requested to help PARC in organizing a meeting with Additional Chief Secretary (P&DD), Government of Sindh and Secretary of

Agriculture Sindh. The meeting did not occur due to engagements of Additional Chief Secretary (P&DD), Government of Sindh and Secretary of Agriculture Sindh. However, Member, PSD and CIMMYT's Country Representative held a meeting with DG Research Sindh and DG Extension Sindh in the office of DG, Plant Protection Department in Malir Cantt. Karachi on August 25.

- The DGs of Research and Extension Sindh appreciated the efforts of PARC and CIMMYT and proposed that since the SARB Act will take time to be drafted and enacted by the provincial assembly, a proposal for an interim board arrangement will be prepared and submitted to P&D Department, Sindh through the Secretary of Agriculture for approval.

AIP-CGS budget funds although received in State Bank of Pakistan, Karachi on August 28 from CIMMYT Headquarters are yet to be transferred to the AIP Assignment Account in National Bank of Pakistan, Civic Center, Islamabad.

PARC gratefully acknowledged the cooperation of CIMMYT-Pakistan for providing financial support to the activities under AIP-CGS either in Islamabad or at provincial headquarters.

PERSONAL/ MANAGEMENT UPDATE

Dr M. Imtiaz who was acting as AIP senior project leader has been appointed as AIP Senior program leader in April 2014. In July, CIMMYT hired a finance manager and a communications specialist and three administration assistants to carry out event and logistics coordination, procurement and office management for AIP; however, the finance manager resigned in September. An M&E specialist joined the AIP team in August. The AIP Project Manager was also hired, who joined CIMMYT in Islamabad in September.

In cereal and cereal systems, two wheat research associates were recruited in CIMMYT; one based at the Cereal Crops Research Institute (CCRI), Pirsabak Nowshera KP and the other is posted at the Wheat Research Institute, Sakrand, Sindh. CIMMYT appointed two maize research associates in June; they are posted at Islamabad and Yousafwala, Punjab. An office boy/security personnel joined AIP-Rice on June 1.

Agronomy

Research Associate - Agronomy for CCRI Nowshera in KP joined in May.

Hiring of Research Associate for Agronomic Research Station, Bahawalpur (Punjab) could not be completed as no suitable candidate could be identified.

Socio Economics

A research associate for the socioeconomic program joined the CIMMYT-Pakistan office in May.

Livestock

Dr. Abedullah (IRS/Livestock Economist) assumed his duties on April 27. NRS staff (economist, dairy scientist, project administration and accountant), appointed through CIMMYT, joined in May. The NRS small ruminant production scientist was appointed through ICARDA (collaborator with ILRI for the small ruminant value chain component) in August.

The renovation of the ILRI-Pakistan office located in the ASI/NARC was completed in March.

Vegetables

In April, administrative and account staff of AIP-Vegetables joined, which includes an account associate, administrative associate, office junior and driver. A socio-economist and an agricultural engineer joined the technical team.

A legume agronomist was hired for the Improved Mungbean Production commissioned project at field office Sargodha in Punjab and a vegetable seed specialist was hired for the vegetable value chains commissioned project at Field Office Mingora in Khyber Pakhtunkhwa.

Mazullah Khan, a vegetable seed specialist with AVRDC-Pakistan participated in a planning workshop at Bangkok, Thailand on June 1-3. One of the important components of the workshop was to discuss vegetable value chain approaches for the implementation of field activities, and also to link them with the research partners. A general focus was also on the project targets, and how to monitor them. The activity provided a valuable experience in regard to vegetable value chains development through experience-sharing with international experts.

Dr. Mansab Ali, AVRDC-Pakistan Team Leader, visited the USAID Horticulture Project team to share practices/experience in Bangladesh on August 23-28. This was followed by a field visit to the Jessore project area which provided valuable information about summer production of tomatoes that are protected from rain with UV-resistant plastic. This practice may be useful in some parts of Pakistan, particularly in the monsoon season.

Perennial Horticulture, HRD and e-Pak Ag

Hiring of UC Davis-AIP project consultant based in Islamabad, Pakistan, has been processed. Ayesha Arif has been selected for the position and will join in October. Her primary responsibilities will be project monitoring, networking, identifying project needs, facilitating events, representing the project, public relations, reporting and commissioned project monitoring and evaluation.

Competitive grants system (CGS)

PARC established an AIP Secretariat for competitive grants system at its headquarters in Islamabad, which is headed by Member Plant Sciences. One Senior Scientific Officer has been placed in the Secretariat for assistance.

LESSONS LEARNED

Cereals and Cereal Systems

Wheat

Some of the planned activities (which included wheat seed value chain analysis workshops planned for: (i) Sindh, June 12; (ii) Pothwar region of Punjab, June 18; and (iii) planning meeting for KP, June 24) during June-July were postponed due to security concerns. All the postponed events were completed in August and September but with a substantial toll on arrangements for trials, demonstrations and seed distribution in October and November.

- Following a number of wheat seed value chain analysis workshops held in KP, Punjab and Sindh, it was revealed that wheat seed systems in Pakistan vary demographically and require separate strategies.
    - Overall use of certified seed is very low in KP due to the lack of well-developed private sector seed companies, absence of any seed corporation such as Punjab Seed Corporation (PSC) or Sindh Seed Corporation and also due to the predominance of smallholders in the province.
    - In Sindh, varietal turnover rate for wheat is less than one and there are more than five varieties released in the last five years or less. Contrary to this situation, the wheat seed supply system is dominated by old and obsolete varieties. Contribution of private seed companies is increasing and is very important. Agricultural extension in Sindh does not have any specific activities for popularizing new wheat varieties, and as a result – in spite of a number of new varieties in the portfolio – none of those are yet in the seed production chain.
    - Rainfed wheat comprises more than 1 million ha of wheat area in Punjab that is still poorly served in terms of providing farmers choices of new wheat varieties and quality seeds. The presence of private seed companies is very thin in the region; as a result smallholders living in these areas have limited access to new seed varieties.
- Wheat varietal choice in Baluchistan is limited. Although two new wheat varieties have been added there is still not an adequate quantity of pre-basic and basic seeds.
- Participatory wheat seed value chain analysis workshops were instrumental in identifying a number of practical and outcome-oriented action points related to wheat seed systems. Some of these action points – for example, development of public-private partnerships for fast-tracking new high-yielding, rust-resistant wheat varieties across the various production systems of Pakistan – have been initiated.
- In all the provinces coordination and linkages are missing between durum wheat value chain actors. Several rounds of meetings and dialogues resulted in developing collaborative and participatory on-farm demonstrations of wheat. Efforts are undertaken to strengthen coordination and linkages through the development of functional public-private partnerships.

Maize

The following are the major lesson learned during the reporting period:

- Most of the introduced CIMMYT germplasm showed good selection potential through initial evaluation; therefore it necessitates the importance of a clear seed road map by partners for the deployment process.
- The need for continued capacity building on the techniques of maize variety development and validation to NARS – particularly in Sindh, Gilgit Baltistan and Baluchistan provinces.
- The importance of support to local seed companies to take the lead under AIP-Maize.
- Capacity building through technical training for actors of maize value chain actors to enhance the production of maize.
- Floods and heavy rain caused delays in planting AIP-Maize trials.

- Slow response in finalizing sub-grant agreements.
- The need for collaboration of all stakeholders to enhance the empowerment of women in the sector.
- The importance of maize seed support for the Internally Displaced People (IDP) from North Waziristan Agency.
- The importance of policy framework and law enforcement in the maize seed sector, particularly in controlling sub-standard seeds and marketing of unregistered varieties.

Rice

- In Punjab, most of the farmers are recipients of improved crop management practices like DSR and AWD. However, some farmers are reluctant to establish their rice crops through DSR due to the issue of weeds. Post–emergent herbicides are available in the market, but cannot control all weeds like Crowfoot grass (Madana grass). Timely application of herbicides is very important for effective weed management. There also is a need for laser land leveling before DSR for uniform irrigation and germination of rice seed.
- Training of researchers/extension staff and farmers in areas of Sindh and Balochistan on DSR and AWD is needed.
- More modified DSR drills are required, especially in Sindh and Balochistan.
- Difficulty in acquiring basmati varieties (e.g. Basmati 515, IR6 and other important varieties) from or for IRRI for use in developing a new generation of stress-tolerant varieties for future release and adoption by farmers in stress-prone environments in Pakistan.

Agronomy

Involvement of the private sector could be more helpful in pilot testing and refinement of new planters. The private sector is more flexible in its working environment and free from administrative procedures. Efforts are underway to include two partners from the private sector in this activity and we hope that these private sector partners will be more involved in pilot testing of ZT happy seeder and planter and refinement during wheat season 2014-15.

Socio Economics

During the baseline survey the involvement of women respondents was a real challenge due to social and cultural environments. This challenge was addressed by engaging women enumerators in Punjab, Sindh and KP provinces.

Livestock

Considering the cultural constraints, when conducting FGDs in rural villages it is advisable to engage women facilitators to conduct FGDs with women's groups and men for the men's groups.

Vegetables

- Timely application of herbicides is very important for effective weed control and maximum production in the protected cultivation of vegetables and improved Mungbean production.

- A proper sowing drill may need to be designed to obtain the optimum plant population under improved Mungbean production.
- Combine harvesting is essential to avoid any loss to quality and quantity of Mungbean seed.
- Improvement is needed in vertical structures used under protected cultivation to support a maximum weight of produce.
- The development of market linkages will be helpful for marketing of vegetable seed in value chains.
- Adoption of proper post-harvest storage techniques is important for avoiding losses in value chains.
- The slow adoption of protected cultivation among vegetable growers needs to be seriously addressed by mass awareness activities.

Perennial Horticulture

The major lesson learned this reporting period is that frequent initial evaluation trips were necessary to determine the areas in which the project could produce the best impacts with our resources. With multiple NGOs working in the major perennial crops and producing quite good information, it is important to ensure synergy and eliminate duplication. AIP's most valuable role would be to help develop the extension applications of their information rather than repeating their efforts. In addition, focusing on the less-developed crops (e.g. olives and pistachios) will have a greater impact because fewer NGOs are working in these crops.

Human Resource Development (HRD)

The PhD semifinalist interview process was very successful; however, the team could not anticipate that two of the women candidates would withdraw just prior to being interviewed. In the future the team will make an extra effort to assist women candidates in securing family support, if desired, and in better understanding the obstacles these applicants may face.

The processes, costs and timing for applications in the land-grant universities in the United States needs to be considered while planning.

Vocational Training

The workshop held in September was successful; however, the venue for the proposal writing workshop was inadequate. A person is needed in-country to determine where workshops are conducted and to make sure the venue and other accommodations are appropriate and adequate for the types of workshops being planned. The recent hiring of a new staff member to assist the UC Davis team will mitigate these types of issues in the future.

Despite requesting early career individuals (predominantly women), the proposal writing workshop participants were mainly senior individuals with no women participating. To ensure gender balance in the workshops, the team will need to work more closely with in-country counterparts and be more explicit and intentional prior to the training, including reviewing the list of participants ahead of time, and seeking alternates as needed.

A series of lessons learned were developed after the first vocational workshop. While the workshop was evaluated as very successful (based on participant evaluation), points to note for

the future include: 1) interactive training (although well-documented as beneficial for the adult learner) is somewhat new for some participants and so workshops need to advise participants why such an approach is being used; 2) ensure the venue meets the requirements of the workshop; 3) remind partners of the desired participant profile; and 4) clarify lodging and per diem assignments in advance. While the content of the workshop can be outstanding, it is important that the logistical elements support (rather than distract) from the workshop. Establishing working relationships with the NARC training staff and the CIMMYT events coordinator in Pakistan will enrich future workshops.

e-Pak Ag

There are a plethora of existing activities involving ICT in agriculture being undertaken throughout the country. The initial lesson learned is that the structure of this information portal lacks interactivity for the user. As a result, a recommendation from the Faisalabad workshop was to look in to the development of a national portal that guides people to the various sources of information that could be relevant to them.

EXTERNAL FACTORS

Cereals and Cereal Systems

Wheat

There are no fungicides registered to reduce yield loss of wheat due to rusts in Pakistan.

Five fungicides for crop protection, approved by U.S. Federal law, were evaluated during summer season at the high altitude site of Kaghan in KP. This trial will be further evaluated for leaf, stem and yellow rust in the hotspots of the three rust diseases.

This is a joint study for evaluation, registration and popularization of registered fungicides to control wheat rusts, between CIMMYT, provincial research institutes (NARC, Islamabad and CCRI, Nowshera for yellow rust, WRI, Faisalabad and AARI, Bhawalpur for leaf rust and WRI, Sakrand and CDRI, Karachi for stem rust) and PARC. It will also bring on board two multi-national private companies Bayer Crop Sciences and Syngenta for this research. Bayer Crop Sciences and Syngenta have formally agreed to collaborate in the research and provide free samples of all the fungicides to be evaluated. This two-year study has initiated joint evaluation of the fungicides and subsequently registration and popularization of registered fungicides will be undertaken to control wheat rusts in the fourth and fifth year of the project.

Maize

Absence of a plant variety protection law is one of the major factors for the production of hybrid maize outside Pakistan. This also contributed to the high price of maize seed. The presence of the law will motivate multinational seed companies and others to produce the seed locally, which will help in the provision of quality seed at affordable prices.

Due to security concerns planned field days, meetings, visits of high profile dignitaries, seed import, variety evaluation and a traveling workshop were cancelled.

Rice

Field visits were affected due to security concerns, particularly in Punjab, Sindh and Balochistan.

Agronomy

During this period, we initiated sub-grant agreement with six partner institutes. We were successful in signing only two agreements with CCRI-KP and Maize–NARC. In Punjab, CIMMYT initiated the process during the last week of May; a formal agreement has not been signed to-date due to lengthy administrative procedures in Punjab. If these agreements are not signed in the near future, it may significantly affect progress of activities such as pilot testing of happy seeder and bed planter and long-term research trials. To address this issue, private sector players are engaged for the pilot testing of ZT happy seeders in rice-wheat areas of Punjab.

Socio Economics

Due to security concerns, it was difficult to conduct baseline studies in Balochistan and Gilgit-Baltistan. For this the local Social Sciences Research Institute has been involved.

Vegetables

A new MoU with PARC has been signed to provide a stronger basis for technical cooperation between AVRDC and PARC. Due to legal concerns raised by AVRDC Human Resources, some project staff are to be officially appointed under CIMMYT. This is still in-process and will be completed with support of AVRDC headquarters and the help of the CIMMYT South Asia Regional and Pakistan offices.

The marketing issues related to Mungbean should be addressed on a priority basis to encourage farmers to grow the crop on larger areas. The essential steps to be taken are for surplus Mungbean production to be exported.

There is a need of better regulatory framework in regard to marketing of vegetable seed.

There are several reasons for the slow adoption of protected cultivation among vegetable growers. This includes the high cost of hybrid seed and expenditures on staking. The attack of fungal diseases under cover is more severe due to an increase in humidity rather than rains.

Heavy rains also affected the production of improved Mungbean seed due to delays in pod filling and damage to mature pods.

Perennial Horticulture, HRD and e-Pak Ag

The relationships and cooperation among the respective in-country extension research institutes, organizations, programs and agencies can influence the success of the project.

Security concerns have influenced the willingness of some foreign instructors to come to Pakistan. This has particularly affected AIP-HRD getting key statistics instructors to the country. We will continue looking for people who are willing to travel to Pakistan and deliver the courses (given a certain amount of unrest and uncertainty).

RISKS

Cereals and Cereal Systems

Wheat

There may be security concerns while implementing various research and dissemination activities on wheat, particularly in Baluchistan, Northern Waziristan, KP and some parts of Sindh. Collaborating with organizations that have a presence in the areas could help in achieving project targets.

Maize

- Further delay in the variety evaluation and validation process is expected due to restricted mobility/security concerns.
- Variety evaluation at new sites, particularly in Sindh, Baluchistan and Gilgit Baltistan may cause poor performance of varieties.

To lessen the effect of these anticipated risks, AIP-Maize categorized locations based on proximity and load of activities. The sites will be managed independently with the help of NRS posted at provinces.

Rice

- Operational funds from IRRI HQ were transferred to IRRI Country Office during the third week of May, which caused a delay in our field activities. Timely release of funds is vital; otherwise it may delay carrying out activities as planned.
- The arrangements for the acquisition of rice germplasm started in February; the shipment process of rice germplasm from IRRI HQ is very long. Due to the late arrival of the seed, planting of advanced breeding material will be carried out in the next crop season 2014.
- The first batch of rice germplasm containing 767 lines from IRRI HQ arrived on July 28 – after the sowing season and could not be evaluated. The seed has been placed under cold condition for next season in consultation with Dr. Surapong and local rice breeders. The second batch of seed containing 415 lines arrived on September 5.
- Delay in obtaining seeds of important recipient varieties to develop a new generation of basmati varieties for target stress-prone regions in Pakistan. This will result in further delay in developing desired crosses with combined biotic stress resistance and abiotic stress tolerance traits for Pakistan.
- Heavy rains and floods in Punjab damaged a few rice demonstrations, which made it difficult to estimate water use in the AWD plots.

Agronomy

We have plans to disseminate conservation agriculture technologies in Balochistan and KP. However, there are security concerns to reach out to farmers in these areas. To execute and generate better results in the coming season, we have built partnerships with relevant local research and extension departments.

Socio Economics

For carrying out socio economic activities, security is major concern.

Vegetables

- Precipitation is the main risk at sowing, transplanting and vegetable maturity and can have an adverse effect on yield under cover as well as in improved Mungbean production.
- A weak drainage system is also a risk factor that leads to lower production of vegetables under cover and to improved Mungbean production.
- Smallholder farmers have little or no capital to purchase a seed thresher and cleaning machinery, so medium-sized farmers are more likely to be the early adopters of improved mungbean production.

Perennial Horticulture, HRD and e-Pak Ag

The biggest risk is repeating work already done and developing extension methods that are not effective with the local clientele. Being well-versed in what other actors are working on in the country and maintaining good communication with them will ensure that there is no duplication. Communication with the intended users of the extension materials will ensure the appropriateness of the methods.

The civil unrest mentioned above has offered some challenges to movement around the country.

Establishment of Research Boards:

Three provinces namely KP, Balochistan and Sindh still require time to rethink about the structure of these boards. The concern is that establishment of another organization like board with dedicated staff would require legislation from the respective assembly. Also would need resources when the project finishes.

CONTRIBUTION TO USAID GENDER OBJECTIVES

Cereals and Cereal Systems

Wheat

None during the reporting period.

Maize

Under AIP-Maize, CIMMYT is evaluating quality protein maize (QPM) germplasm and Provitamin-A varieties, which are a good source of weaning food for nursing mothers and will help to reduce the mortality rate of children under five years of age once they are popularized in Pakistan. The production and promotion of QPM in Pakistan will serve as a cheap source of lysine for poultry feed, which will in turn help to reduce the cost of other sources of protein for resource-marginalized communities.

Rice

One of the DSR and AWD demonstration sites belongs to a woman farmer in the Sheikhupura district of Punjab. With the extension of DSR technology on a larger scale, the amount of female labor in rice cultivation will be reduced, which will save women from drudgery and pain during transplanting. In the traditional method of transplanting rice, women are the primary source of labor in the country.

Agronomy

We are sensitizing our partners to increase the participation of women staff/students in dissemination activities like field days and training; this is part of the new sub- grant agreements. One woman engineer also attended the conservation agriculture planter training held at NARC, Islamabad.

Socio Economics

For fulfilling the gender inclusion objectives, about 50 women were interviewed from Punjab, and 25 each will be interviewed from Sindh and KP.

Vegetables

During the training of master trainers for “Raising healthy vegetable seedlings,” five women interns were trained along with farmers. More than 50 percent of laborers in the Soon Valley research work are women, while 70 percent of those growing vegetables under protected cultivation in Gilgit-Baltistan are women.

Perennial Horticulture, HRD and e-Pak Ag

All aspects of the project will be mindful of the gender dynamics in the Pakistan context and make concerted efforts to ensure women’s participation in appropriate and meaningful ways. For example, in the perennial horticulture trainings that will be developed, content, timing and venues will be tailored for women as well as men.

HRD is contributing to higher education opportunities/scholarships for academically talented women and men. In the selection of M.S. and Ph.D. scholarship candidates, the committee aimed for gender and regional equality. In the initial screening extra points were added for women candidates and candidates from marginalized communities. In the Ph.D. interview process, no extra points were allocated for women candidates and the selections were made solely on merit. The final results show that well-qualified women candidates excelled:

Program	Men	Women	Total
PhD semifinalists	12	10	22
PhD finalists	5	2	3
M.S. finalists	3	6	9

The workshops on ICT in agriculture held in Rawalpindi and in Faisalabad were both of interest to women participants. In Faisalabad, there were 47 women at the presentations skills workshop (of 201 participants) and 55 at the ICT in Ag workshop (out of 211 participants). In Rawalpindi, 22 of the 84 participants in the ICT in Ag workshop were women.

MONITORING AND EVALUATION

Two meetings were carried out with USAID's AOR for the Project to discuss the monitoring and evaluation- (M&E) related matters including development of activity M&E plan, results framework and data requirements for USAIDInfo (USAID's web-based reporting system) in August.

As M&E preliminary activities, a results framework for the project was designed in line with the USAID mission framework. The draft framework was shared with USAID and refined on the basis of comments (attached as Appendix-XXXXVIII). Indicators for each Intermediate Result and Sub- Intermediate Result were developed and agreed to by the project management. Moreover, the Performance Management Plan for the project is in development, which will help informed management decisions, improve operations, identify performance gaps, reassess performance targets and set goals for improvement.

In order to track beneficiary data for reporting (both narrative and USAIDInfo), a tracking sheet has been designed. The tracking sheet is under review and will be shared with partners once it is finalized. The tracking sheet will cover basic information of beneficiaries and type of assistance provided under AIP.

In order to collect consistent data on the USAID mission's strategic framework indicators, reporting templates are being designed keeping in view all required segregations. The templates will help M&E in acquiring data with all required segregations for posting on USAIDInfo.

During September, M&E collaborated with all partners to seek their inputs for consolidation and to help refine the AIP work plan for the third year. The work plan was refined in terms of narrations as desired by the donor and submitted to senior management for sharing with CIMMYT HQ and USAID.

For the purpose of this report, all primary partners were asked to compile data on beneficiaries of the project so far (See Appendix- XXXXVII for details).

ENVIRONMENTAL COMPLIANCES

Cereals and Cereal Systems

Wheat

All the wheat varieties under AIP are thoroughly evaluated and released in Pakistan; a few of the varieties are also being developed in Pakistan. Some of these varieties are drought-tolerant and require less water. The AIP-wheat component will be popularizing only newly released, rust- resistant and high-yielding varieties, which will minimize the use of pesticides.

AIP-Wheat also plans to work with the agronomy component to popularize CA technologies and precision agriculture for positive environmental impacts. There will no adverse environmental impact of growing these wheat varieties in Pakistan.

Maize

Most of CIMMYT's maize germplasm are climate-smart varieties which can perform under stress environments. CIMMYT's germplasm that are tolerant to heat and water stress will benefit farmers in water-scarce environments. In addition, CIMMYT materials, which are under evaluation in Pakistan, are developed through conventional breeding techniques; therefore they do not need additional inputs or extra environmental/biosafety care as compared to germplasm developed through non-conventional methods.

Rice

- Heavy rains and floods in Punjab damaged some of the rice demonstrations.
- DSR and AWD are resource conservation technologies and environmentally friendly as omission of methane gas is lower compared to transplanted crops.

Agronomy

The technologies that are being evaluated or disseminated are resource-conserving and have a positive impact on the environment. Use of ZT and happy seeder in rice-wheat areas would help to reduce burning the crop residue and be better for the environment.

Vegetables

Many vegetable growing activities were restricted due to frequent rains in March in the Islamabad Capital Territory (ICT)**.**The timely planting of off-season vegetables was delayed due to severe cold weather in April and May in Gilgit Baltistan. Mungbean production is environmentally safe since the selected chemicals used have a low environmental impact.

COMMUNICATIONS

Cereals and Cereal Systems

Wheat

- The first national durum wheat workshop in Pakistan, held on September 22-23 in Faisalabad and organized by AIP-Wheat received media coverage – information appeared in 10 national and 13 local newspapers and on one national news channel.
- AIP-Wheat contributed to CIMMYT Informa (CIMMYT's weekly newsletter, which is distributed to internal and external stakeholders):
    - Predominance of Informal Seed Systems in Khyber Pakhtunkhwa (KP) Pakistan: a Wake-up Call for Improvement by Krishna Dev Joshi, Muhammad Imtiaz and Akhlaq Hussain; Informa No. 1893, June 13-20
    - Wheat Value Chain Workshop Aims to Bolster Food Security in Sindh, Pakistan by Krishna Dev Joshi; Informa No. 1906, September 15-19

Maize

Under AIP–maize, emphasis has been given to communicate the project activities to local and international stakeholders following the communications guidelines of USAID. The following media were utilized to communicate AIP-Maize activities:

- AIP-newsletter.

- CIMMYT Informa (nos. 1890 and 1891).
- Share photos on Flickr.
- Participation in workshops, conferences and meetings.
- Giveaways – T-shirts (100) and field caps (100) – were distributed among the participants of the workshop and field day.

Rice

Contributed to AIP newsletter.

Agronomy

Two trainings and two field days were organized and these events received coverage in CIMMYT Informa and two events were posted on the CIMMYT blog.

http://blog.cimmyt.org/aip-stakeholders-share-experiences-with-multi-crop-bed-planter-in-pakistan/press

http://blog.cimmyt.org/aip-stakeholders-share-experiences-with-multi-crop-bed-planter-in-pakistan/

In addition, conservation planter training was covered by Pakistani national press.

http://pakobserver.net/detailnews.asp?id=246252

Vegetables

The Minister and Secretary of Agriculture were briefed about field activities of AIP-Vegetable in Balochistan. AVRDC and PARC signed a MoU for more scientific cooperation.

Four radio talks from Radio Pakistan Mirpurkhas, DI Khan, Mansehra and Gilgit-Biltistan were broadcast. Various local and national newspapers published field activities of AIP-Vegetable. Nine stories about the AIP work were distributed to an international audience through the AVRDC newsletter FRESH.

FRESH, News from AVRDC - The World Vegetable Center			
Date Published (2014)	**Volume #**	**Page #**	**News Title**
April 15	004	12	A look at protected production
		12	Stronger seedling
May 2	005	9 & 14	Healthy vegetable seedling
May 30	006	5	AVRDC and PARC signed a Memorandum of Understanding
		5 & cover page	New Pakistan Office
June 27	007	7	Going under cover in Pakistan
July 31	008	2-3	Sweet future for mungbean in Pakistan
September 10	009	10	Mungbean catch crop in Pakistan's rice-wheat cropping system
		15	Baseline data collection begins

The Chairman of Pakistan Agricultural Research Council Dr. Iftikhar Ahmad and AVRDC Official Dr. Mansab Ali signing MoU for scientific cooperation on vegetable crops at PARC Headquarters, Islamabad

Opening ceremony of AVRDC-The World Vegetable Centre Pakistan Office at NARC Campus, Islamabad

Perennial Horticulture, HRD and e-Pak Ag

Print media – national/local	AIP's perennial horticulture meeting on September 10 on mango accessions	Appeared in 12 national newspapers	September 11
Online	E-Pak Ag highlighted the importance of ICT in Pakistan http://www.agricorner.com/speakers-for-strengthening-agriculture-extension-system-through-ict/		

OTHER

Cereals and Cereal Systems

Rice

- Mr. Joe Rickman, an IRRI Scientist, visited Pakistan from June 22-25. Along with Dr. A. Rehman, IRRI Pakistan Office, he held discussions on evaluating different types of combine harvesters during the coming season with Director RRI, Kala Shah Kaku and Officials of Engro Eximp. It is planned that in addition to the Kabuta rice harvester, the existing wheat harvesters can be modified by placing concave kit in the Holander Harvester and be operated at reasonable ground speed significantly reduce the grain losses.

- Dr. A. Rehman, IRRI Pakistan Office, participated in a planning meeting of Vocational Training under AIP project on June 18 with Dr. Mark Bell and Dr. Louise Ferguson from UC Davis along with other AIP primary partners at CIMMYT Pakistan office.
- Mr. Joe Rickman (IRRI Agronomist/post-harvest Specialist) conducted a one-day training on developing and validating a local Rice Crop Check System on June 24 at Engro Eximp, Muridke, Sheikhupura district of Punjab.
- Dr. Abdul Rehman, IRRI Pakistan Office, participated in the training/workshop on data collection of rice varietal releases and adoption estimates (IRRI-SIAC 2.1 project) from September 17-19 at Vientiane, Laos. Data on rice varietal release and adoption that will be collected in 11 countries in Asia as part of this project will be used to assess IRRI's contribution to varietal improvement and contribute to the development of breeding product profiles.
- Pictorial glimpse of various field activities:

Laser leveling the field before DSR

Rice sowing with modified drill

DSR with modified drill (Sheikhupura, Punjab)

DSR with broadcast (Sheikhupura, Punjab)

DSR of Basmati by *Rabi* drill Sialkot district of Punjab

Farmer with DSR drill plot

Farmers training on AWD Water measuring tube installation training (AWD) Sheikhupura

Installation of water measuring tube (AWD)

Measurement of water in tube (AWD)

Agronomy

Eight meetings were held with national partners in Punjab, KP, Sindh and Baluchistan for discussion on AIP work plan, sub- grant agreements and execution of activities. In addition, two sub-grant agreements with national partners (CCRI –Pirsabak and Maize Program – NARC) were signed. Due to procedural hiccups, four agreements with partners in Punjab are pending.

APPENDICES

Cereals and Cereal Systems

Wheat

Appendix-I Events held during April- September

S. No.	Meeting Name	Date	Purpose	Focal Person	Venue	Partners	Brief Outcome
1	Boarlug100	April 23, 2014		Ifitkhar Ahmed/Muhammad Imtiaz	Marriott hotel, Islamabad	CIMMYT, Ministry of Food Security and Research, PARC	Commemoration of 100th birth anniversary of Noble Laureate Dr Norman Borlaug and his contribution of food security in Pakistan
2	Borlaug100	April 25, 2014		Adib Mehmood, Makdhoom Hussain	Ayub Agricultural Research Institute (AARI), Wheat Research Institute (WRI), Faisalabad	CIMMYT, AARI, WRI Faisalabad	Commemoration of 100th birth anniversary of Noble Laureate Dr Norman Borlaug and his contribution of food security in Pakistan
3	Planning meeting for first national durum wheat workshop	June 27, 2014	To plan for (i) grain quality analysis; (ii) identify workshop venue and associated activities; (iii)	Krishna Dev Joshi	CIMMYT International – Pakistan office	CIMMYT, AARI, WRI Faisalabad	– Agreement on durum wheat grain quality analysis at AARI, WRI Faisalabad – Agreement to

			compilation of last 3-4 years agronomic and disease data for durum wheat lines evaluated in Pakistan.				hold first national durum wheat workshop at AARI, WRI Faisalabad – Agreement to compile and analyze available agronomic data on durum wheat in Pakistan
4	Stakeholders' participatory workshop of wheat seed value chain in Khyberpakhtun Khawa (PK)	June 4, 2014	To identify (i) opportunities and gaps in wheat seed systems; (ii) practical action points for strengthening wheat seed systems.	Krishna Dev Joshi	Cereal Crops Research Institute (CCRI), Pirsabak, Nowshera, KP	CIMMYT International, CCRI and PARC	Identification of (i) major gaps and opportunity of wheat seed systems in KP; (ii) interested partners to work jointly on strengthening wheat seed value chain; (iii) action points for strengthening wheat seed systems for implementing by AIP wheat.
5	Stakeholders' participatory workshop of wheat seed	August 26, 2014	To identify; (i) opportunities and gaps in wheat seed	Krishna Dev Joshi	Hotel Indus, Hyderabad, Sindh	CIMMYT International, Wheat Research	Identification of (i) major gaps and opportunity of wheat seed

	value chain in Sindh		systems; (ii) practical action points for strengthening wheat seed systems.			Institute (WRI) and PARC	systems in Sindh; (ii) interested partners to work jointly on strengthening wheat seed value chain; (iii) action points for strengthening wheat seed systems for implementing by AIP wheat.
6	Planning meeting for AIP wheat agronomy, variety and seed for Baluchistan	September 10, 2014	Plan for activities of commissioned projects in AIP	Krishna Dev Joshi, Imtiaz Hussain	CIMMYT International – Pakistan office	CIMMYT, ARI Quetta, Extension Department	Plan of action for wheat agronomy, seed and varieties in AIP for Balochistan
7	Planning meeting for AIP wheat agronomy, variety and seed for KP	September 16, 2014	Plan for activities of commissioned projects in AIP	Krishna Dev Joshi	CCRI, Nowshera, KP		Plan of action for wheat agronomy, seed and varieties in AIP for KP

8	Stakeholders' participatory workshop of wheat seed value chain in rainfed areas of Punjab	September 18, 2014	To identify; (i) opportunities and gaps in wheat seed systems; (ii) practical action points for strengthening wheat seed systems.	Krishna Dev Joshi, Imtiaz Hussain	Barani Agricultural Research Institute (BARI), Chakwal, Punjab	CIMMYT International, BARI and PARC	Identification of (i) major gaps and opportunity of wheat seed systems in KP; (ii) interested partners to work jointly on strengthening wheat seed value chain; (iii) action points for strengthening wheat seed systems for implementing by AIP wheat.
9	First national durum wheat workshop	September 22-23, 2014	To identify; (i) opportunities and gaps in durum wheat value chain; (ii) practical action points for strengthening durum wheat value chain.	Krishna Dev Joshi	AARI, WRI, Faisalabad	CIMMYT International, AARI, WRI and PARC	To Share state-of the-art of durum wheat science, practice, trade & commerce in Pakistan by capitalizing on existing initiatives & innovations on durum wheat by national & international partners
10	Developing Partnership for implementing	September 29, 2014	To discuss about the possibility of	Krishna Dev Joshi	CIMMYT International – Pakistan	CIMMYT NRSP	- Agreed to work together for implementing

	AIP activities with NRSP		developing partnership with National Rural Support Program (NRSP) for implementing AIP activities		office		AIP – Subgrant agreement to be signed soon
11	Developing Partnership for wheat seed production and marketing in Pothwar region of Punjab	September 29, 2014	To discuss about the possibility of developing public-private partnership for the production and marketing of wheat seeds in Pothwar region of Punjab	Krishna Dev Joshi	CIMMYT International – Pakistan office		– Agreed to work together for implementing AIP – Subgrant agreement to be signed soon

Appendix-II Field days, exhibitions and conferences attended

S. No.	Name	Date	Place	Purpose	Brief Outcome
1	Exposure visits of 500 smallholder and other farmers' to show on farm demonstrations, participatory varietal trials and variety by agronomic interventions	March to May	various parts of Balochistan, KP, Punjab and Sindh	To popularize best bet wheat technologies; varieties, agronomic practices including use of machines and strengthen wheat seed systems through public-private partnership	Improved knowledge and demand for new seed varieties and agronomic practices

Appendix–III List of sub-grants under competitive or commissioned grant programs

S. No.	Project Title	Amount Allocated	Duration	Expected Outcome
1	Yield loss assessment of wheat due to rust using fungicides at Kaghan	$3,600	Two years	Determining the extent of yield loss due to wheat rust that can be minimized with the use of fungicides to
2	Participatory varietal Selection (PVS) Mother Trials and Baby Trial on wheat	$1,600	One year	To identify best adapated wheat varieties for Gilgit and surrounding areas

Maize

Appendix-IV Events Calendar for Meeting Held

S#	Meeting Name	Date	Purpose	Focal Person	Venue	Partners	Brief Outcome
1	NARC meeting on maize stem borer	April 2	Discussion on how to set up stem borer mass rearing facility and field screening	Maize improvement and Seed System specialist	CIMMYT Pakistan office	NARC (maize entomologist and maize coordinator)	Needs and areas of collaborations identified and prioritized
2	Insect Resistant Maize for Africa meeting	April 14	Experience sharing and creating collaboration	Dr. Steven Mugo (IRMA project leader, CIM-Kenya)	CIMMYT Nairobi office	CIMMYT entomologist and project local staffs	Lessons and experience from IRMA shared, lab protocols identified and way forward indicated
3	CIMMYT management meeting	April 21	To discuss and update AIP activities	Dr. Hans Braun and and Scott Mall	CIMMYT Pakistan office	CIMMYT IRS and AIP primary partners	AIP-Maize activities discussed
4	Norman	April 22	Discussions	PARC and	NARC	PARC, USAID,ILRI,	Future actions

	Borlaug 100th years celebrations		on the works of N. Borlaug	CIMMYT	Islamabad	IRRI,AVDRC,USDA	discussed to continue the legacy of N. Borlaug
5	Norman Borlaug 100th years celebrations	April 23	To honor and remember the works of N.Borlaug	US Embassy, CIMMYT, PARC and Government of Pakistan	Marriot Hotel Islamabad	Jeanie Borlaug and other local and international dignitaries	Awards and honors conferred by the President of the Islamic Republic of Pakistan
6	International maize conference	May 3	Experiences Sharing	University of Agriculture Faisalabad	UAF	Seed companies, research institutes, post graduate students and academia	AIP-Maize activities shared and areas of collaborations discussed
7	AIP maize partners meeting	May 8	Discuss on project progress	Maize improvement and Seed System specialist	CIMMYT Pakistan office	NARC maize team	Discussion on the promotion of prerelease NARC white maize hybrid
8	AIP maize partners meeting	May 14-16	Field evaluation of AIP-Maize	"	At various fields and offices of AIP-Maize partners mainly in Punjab	UAF, Ali Akbar Seeds,4B group, MMRI,JPL,ICI,Tara	Evaluation of trials and way forward
9	CIMMYT-Pakistan IRS meeting	May 19	To create good working atmosphere at CIMMYT-Pakistan	Dr. Md. Imtiaz	CIMMYT-Pakistan	CIMMYT IRS	Problems and solutions discussed
10	PARC and AIP primary partners meeting	May 22	To brief on the ongoing activities	Chairman PARC	PARC office/Islamabad	AIP primary partners and USAID	Valuable inputs were shared and commitment made to support the AIP activities

11	ILRI meeting on AIP-Maize germplasms as fodder	May 23	To discuss on the fodder quality and testing of AIP-Maize materials	Maize improvement and seed systems specialist and ILRI Pakistan office Representative	ILRI office/Islamabad	NARC livestock and feed specialists	Discussion held how to test the stover quality of the AIP-Maize matrials sown at NARC after harvest particularly those with stay green character
12	AIP-HTMA Maize training	May 29-31	Experience and knowledge sharing	AIP-Maize and HTMA project leaders	Usmania Hotel Sahiwal	Public and private partners of the two projects	New tools and techniques discussed in maize breeding and seed production
13	Wheat seed value chain meeting	June 4	To get experiences on the seed value chain in KP	CIMMYT Pakistan and CCRI	CCRI/Nowshera	Public and private institutions	Wheat Seed Value chain discussed and lessons for maize identified
14	Meeting with newly appointed maize NRS staff	June 10	To wel come and give orientations	Maize improvement and Seed System specialist	CIMMYT office Islamabad	Two maize research associates	Briefing on AIP-Maize , delineation of activities and working guidelines
15	Meeting on ICT tools and training needs	June 19	To discuss on ICT tools and training needs with UCDAVIS team	Mark Bell (UCDAVIS)	CIMMYT office Islamabad	CIMMYT IRS	ICT tools discussed and statistical data analysis training for AIP-Maize partners shared
16	Durum wheat conference	September 22-23	Experience sharing and networking	AIP-Wheat and AIP-Socio economics	AARI, Faisalabad	Various local stakeholders	AIP-Maize activities shared and important points discussed
17	Meeting with PARC maize team	September 30	To update AIP-Maize to PARC and to the newly	AIP-Maize lead and PARC maize team	PARC office/Islamabad	Former coordinator and NARC maize team	CIMMYT's activities on maize briefed and future work plan discussed

			appointed cereals coordinator				

Appendix-V Meetings Planned for Next month, Semi-Annual Period

S. No	Meeting Name	Date	Purpose	Focal person	Venue	Partners	Expected Outcome
1	International colloquium on maize	October 14-15	Capacity building	UAF	Faisalabad	Public and private institutions and academia	Experience sharing
2	12th Asia Maize Conference	October 30 - November 1	Experience sharing	Various stakeholders	Bangkok Thailand	AIP maize partners will attend the conference	Activities update, posters and publications
3	QPM breeding and seed production training	November 2014	Capacity building	AIP-Maize	Islamabad	AIP maize partners	Capacity of NARS will be developed in relation to maize breeding and seed production
4	Training on data analysis	November/ December 2014	Capacity building	AIP-Maize	Islamabad	AIP maize partners	Capacity of NARS will be developed in relation to maize trials management
5	Maize training on biotic stress tolerant	January 2015	Capacity building	AIP-Maize	Islamabad	AIP maize partners	Capacity of NARS will be enhanced
6	Maize working group meeting	January/ February 2015	Experience sharing	AIP-Maize	Islamabad	AIP maize partners	Experience sharing and lessons learnt from previous activities
7	Quality seed production and quality control	March 2015	Capacity building	AIP-Maize	Islamabad	AIP maize partners	Capacity of NARS will be developed in relation qulity seed production

Appendix-VI International Travel

S. No.	Name	Date	Place/destination	Purpose	Brief Outcome
1	Abdurahman Beshir, maize specialist	April 14-16	Nairobi-Kenya	Experience sharing and discussion on way forward on insect resistance maize under AIP	Way forward discussed, Lab protocols and, manuals identified

Appendix-VII Field days, exhibitions and fairs attended

S#	Name	Date	Location	Purpose	Brief Outcome
1	Insect resistant maize field and lab screening visit	April 15-16	Kiboko and Katumani, Kenya	Experience sharing	Experience sharing and priority setting for AIP-Maize
2	AIP-Maize field visit at NARC	April 24	NARC	To discuss and visit AIP-Maize trials by DG CIMMYT and senior management staff	Maize trials visited and various opportunities and challenges discussed
3	Norman Borlaug 100 years celebrations	April 25	Ayub Agr. Research Inistitute, Faislabad	To honor the works of N. Borlaug	Field and facilities visits at the research station and networking with participants

Appendix-VIII Number of participants and institutions attended in the maize workshop

S#	Institutions	Ownership	No. of participants	Remarks
1	Agricultural Research Institute-Sindh	Public	1	
2	Ali Akbar seeds	Private	2	
3	Ayub Agricultural Research Institute	Public	2	01 woman participant
4	Cereal Crops Research Institute	Public	3	
5	Department of Agriculture Gilgit Baltistan	Public	1	
6	Four Brothers Group	Private	1	
7	ICI Pakistan	Private	1	
8	Maize and Millet Research Institute	Public	13	Host institution
9	National Agricultural Research Center	Public	3	
10	Pakistan Agricultural Research Council	Public	1	
11	Pioneer Pakistan Ltd	multinational co.	1	
12	Rafhan maize products	Private	1	
13	Syngenta Pakistan Ltd	multinational co.	2	
14	Tara Crop Sciences	Private	1	
15	University of Agriculture Faisalabad	Public	2	01 woman participant
16	CIMMYT India	International org	3	Resource persons
17	CIMMYT Pakistan	International org	2	Resource persons

Appendix-IX AIP maize trials introduced for planting during summer 2014

S#	Trial Name/code	Trial description	No. of entries	No. of reps	No. of sets	Remark/Seed source
1	PAKTCINT	Intermediate maturity, three way cross between tropical and temperate parents	72	2	5	Advanced new trials from CIMMYT Zimbabwe
2	PAKTCLATE	Late maturity, three way cross between tropical and temperate parents	100	2	5	Advanced new trials from CIMMYT Zimbabwe
3	PK14A/13ASA18HY	Yellow kernel normal maize single cross hybrids	16	3	6	New trails from CIMMYT Colombia
4	14TTWCWL	Tropical white materials for lowland ecologies (adapted to 0-1000m a.s.l)	15	3	5	CIMMYT Mexico
5	14TTWCYL	Tropical yellow materials for lowland ecologies (adapted to 0-1000m a.s.l)	12	3	5	CIMMYT Mexico
6	IHYB14	Intermediate maturing, white kernel hybrids	60	3	2	CIMMYT Zimbabwe
7	LHYB14	Late maturing, white kernel hybrids	40	3	4	CIMMYT Zimbabwe
8	EPOP14	Early/extra early maturing white kernel OPVs	30	3	7	CIMMYT Zimbabwe
9	EHYB14	Early/extra early maturing white kernel hybrids	45	3	5	CIMMYT Zimbabwe

Appendix-X List of AIP-Maize trials distributions and collaborators involved during summer 2014

Appendix-XI Status of spring season (2014) trials evaluation at different centers

S#	Partner institution/center	Institution	No. of trials	Status
1	Maize and Millet Research Institute (MMRI)	MMRI	4	Completed
2	Cereal Crops Research Institute (CCRI)	CCRI	5	Completed
3	National Agricultural Research Institute (NARC)	NARC	7	Completed
4	Jullundur Private Ltd	JPL	3	Completed
5	Four brothers seed company	4B	3	Completed
6	Ali Akbar Group	AA group	2	Completed
7	ICI Pakistan Ltd	ICI	2	Completed
8	Petal Seed Company	PSC	1	Completed
9	Agricultural Research Institute - Baluchistan/ Quetta	ARI-Quetta	1	Ready for harvest
10	Agricultural Research Institute (ARI) - Sindh	ARI-Sindh	1	Ready for harvest
11	Agricultural Research Institute - Gilgit Baltistan	ARI- Gilgit	1	Ready for harvest
12	University of Agriculture Faisalabad	UAF	1	Completed
13	University of Agriculture Peshawar	UAP	1	Completed

Appendix-XII List of biofortified maize trials introduced to Pakistan, Kharif, 2014

S#	Trial Name/code	Trial description	No. of entries	No. of reps	No. of sets	Remark/Seed source
1	14CHTPROA	ProA (entries enriched with VitA) of subtropical materials	24	2	2	New trials from CIMMYT-Mexico
2	14HPLET	ProA lines per se evaluation of subtropical materials	75	2	1	New trials from CIMMYT-Mexico
3	ADVQPM	Advanced white kernel Quality Protein	50	2	6	New trials from CIMMYT-Zimbabwe
4	PK14A/ 13BEARHQPMY	Yellow kernel QPM hybrids	10	3	6	CIMMYT-Colombia

Rice

Appendix-XIII NIAB IR-9 seed distributed among farmers in Balochistan

S#	Farmer's Name	Village
1	Qurban Mastoi	Khanpur Jamali
2	Zaheer Abbas	Dhok Baloch Khan
3	Muhammad Siddiq	Goth Haji Hote Khan
4	Gulab Khan	Goth Jafarabad

Appendix-XIV Results of seed metering devise for two types of fluted roller

Plant rate (kg/ha)	Damaged seeds		Germination (percent)	
	8 flutes	6 flutes	8 flutes	6 flutes
8	5.1	3.0	88.8	93.0
17.5	5.5	1.3	85.9	91.8
35	5.5	1.2	88.1	92.2
50	7.8	2.8	87.8	93.3
Control	0.9	0.4	94.7	93.8
Mean	6.0	2.1	87.7	92.6
Change	**5.1**	**1.7**	**7.0**	**1.2**

Appendix-XV Number of DSR farmers (direct beneficiaries)

Province/District	Acres	Farmers
Punjab		
Sheikhupura	122.5	39
Hafizabad	26	4
Gujranwala	16	8
Sialkot	62	2
Sindh		
Thatta	15	4
Dokri (Larkana)	1	1
Balochistan		
Usta Mugammad (Jafarabad)	1	1
Total	**243.5**	**59**

Appendix-XVI Germination count in various plots in Sheikhupura, Gujranwala and Sialkot districts of Punjab

S#	Planting technique	Lowest plants/m^2	plants/m^2Highest	Average
1	Direct seeding of rice (Drill)	64	73	68.5
2	Direct seeding of rice (Broadcast)	77	102	89.5
3	Farmers practice	13	16	14.5

Appendix-XVII Comparison of number of plants in different planting techniques

S#	Planting technique	Plants/m^2	Lowest plants/ha	Highest plants/ha	Average
1	Farmers practice (Random transplanting	13 - 15	52000	60000	56000
2	Transplanting in lines by farmers	21- 23	84000	92000	88000
3	Intensive transplanting without ropes and lines	17.5 -20.5	70000	82000	76000
4	Direct seeding of rice (drill)	71 - 92	284000	368000	326000
5	Direct seeding of rice (broadcast)	83 - 107	332000	428000	380000
Result of 35 plots each in Gujranwala, Sheikhupura and Sialkot (Daska) of Punjab					

Appendix-XVIII Number of tillers in different planting techniques

S#	Planting technique	Number of tillers/plant Super Basmati			Number of tillers/plant Basmati - 515		
		Lowest	Highest	Average	Lowest	Highest	Average
1	Farmers practice (random transplanting)	17	22	19.5	11	14	12.5
2	Transplanting in lines by farmers	16	24	20.0	11	15	13
3	Intensive transplantation without ropes and lines	16	21	18.5	10	14	12
4	Direct seeding of rice (drill)	4	5	4.5	3	4	3.5
5	Direct seeding of rice (broadcast)	4	6	5	3	5	4
Data of 35 plots (Average of 10 plants)							

Agronomy

Appendix-XIX National partners' institutes for dissemination of technologies

S#	Institute	Location
1.	Cereal Crops Research Institute (CCRI)	Pirsabak, KP
2.	Wheat Research Institute (WRI)	Sakrand, Sindh
3.	Barani Agricultural Research Institute (*BARI*)	Chakwal, Punjab
4.	Wheat Research Institute (WRI)	Faisalabad, Punjab
5.	Rheat Research Institute (RRI)	Kala Shah Kaku, Punjab
6.	Adaptive Research Farms	Vehari, Gujranwala and Sheikhupura districts of Punjab

Appendix-XX Details of new CA seeders provided to national partners in the country

Name of Institute	Zero Till Multi Crop Planter	Zero Till Happy Seeder	Multi Crop Raised Bed Planter
BARI – Chakwal	1	-	1
CCRI – Nowshera, KP	1	-	1
Adaptive Research Farms Punjab		2	1
Wheat research Institute, Sakrand	-	-	1
Agronomic research Station – Bahawalpur	-	-	1
Maize and Wheat – NARC	1		1
Rice Research Institute, Kala Shah Kaku		1	
Jullundur Seeds (Pvt) – Arifwala			1
Maize & Millet Research Institute			1
Wheat Research Institute, Faisalabad			1

Appendix-XXI Pilot testing and demonstration of multi-crop bed planter and ZT planter

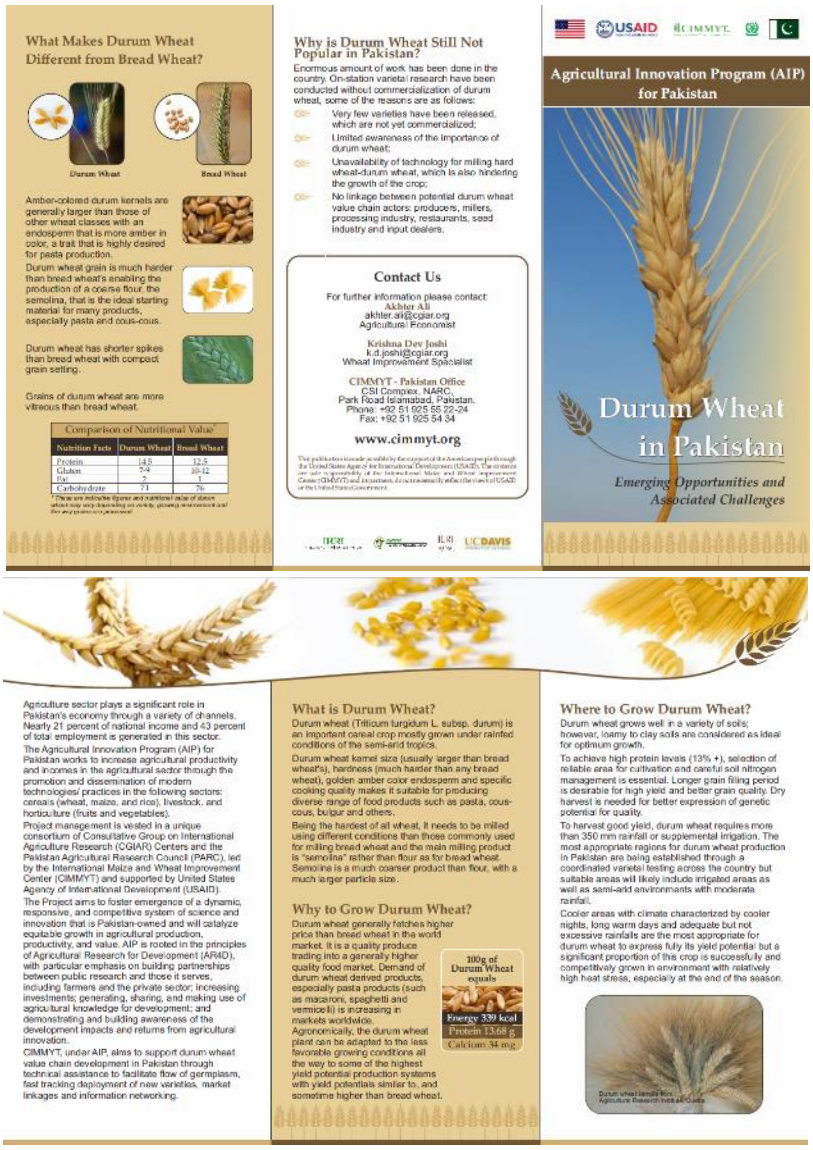
Partners	Bed planted Maize	Bed planted Cotton	Bed planted Mung	Zero Tillage Maize
CCRI – Pirsabak	08			07
WRI – Faisalabad CIMMYT office	05			
AR Farm Vehari	11			
Jullundur Seeds	01			
BARI-Chakwal	01		01	

NARC-Islamabad	08			
WRI – Sakrand		01		
ARS-Bahawalpur		03	01	
Total	34	04	02	07

Appendix-XXII Title page of manual on bed planter

Socio Economics

Appendix-XXIII Durum Wheat Brochure



Livestock

Appendix-XXIV Forage production at two target sites in Chakwal District

S. No.	Crop	Begal		Dhulli	
		No. of Farmers	Area (Acre)	No. of Farmers	Area (Acre)
1	Maize	2	0.5	9	3
2	Millet	-	-	8	6
3	Guar	-	-	2	1.5
4	Mott Grass	2	1	2	1

Appendix-XXV Current biomass production at Begal, Chakwal district of Punjab

Site	Fresh Matter Yield (kg ha-1)	Dry Matter Yield (kg ha^{-1})
Hill top	350	210
Southern slope	660	480
Northern slope	310	160
Flat area	880	530

Note: These measurements will be repeated during upcoming seasons (winter, spring, summer and autumn) after range improvement practices (grazed and protected area) is implemented to compare with the current status.

Appendix-XXVI Events and meetings held during April to September, 2014.

S. No.	Meeting Name	Date	Purpose	Person Responsible	Venue	Partners	Brief Outcome
1	Agro-ecological Monitoring of rangeland Vegetation	April 5-12 , 2014	Train a Core group of Forestry/ Rangeland academia & scientists from Punjab, KP, Balochistan provinces on recent techniques available to assess vegetation	Dr. Mounir Louhaichi (ICARDA), Dr. Douglas E. Johnson, Oregon State University, USA Ibrahim (AIP-LIVESTOCK)	Amman, Jordan	ICARDA, Oregon State University, OR - USA	Expertise to assess forest & rangeland vegetation developed in Pakistan. 6 Pakistani Rangeland scientists were trained .

2	Field Training on AI in goats	April 14-16, 2014	To Train field Veterinarians, and Farm Managers in Mansehra district, KP	Dr. Waheed Ullah, Director/LES Jaba, Dr. Muqarrab Ali Khan/Director, Breed improvements, KP and Dr. Ibrahim (AIP-LIVESTOCK)	Livestock Experimental Station Jaba, KP	Livestock and Dairy Department, KP and AIP-LIVESTOCK	AI training in goats popularized at district/village level in KP. 23 livestock practitioners obtained hands-on training.
3	Training on Dairy Value Chain Rapid assessment and bench marking surveys	May 13-22, 2014	Train scientist from NARS on tools to do Rapid DVC and Dairy bench marking surveys	Dr. Nadhem Mtimet (ILRI), Drs. Abedullah and Ibrahim (AIP-LIVESTOCK)	Islamabad Hotel	AIP ILRI and ILRI scientists	Expertise and VC tools developed to assess/analyse DVC in different production systems. Training manual Prepared for future trainings.
4	Farmer field day on spineless cactus – Importance and uses of planting cactus on rangeland	May 15, 2014	Training farmers on importance and suitability of cactus for conservation of rangeland	Dr. Imtiaz Qamar (RRI/NARC), Dr. Islam (ICARDA), Dr. Ibrahim (AIP-LIVESTOCK)	NARC	RRI, NARC, ICARDA, AIP-LIVESTOCK	40 farmers participated in the field day which had few talks on the importance of cactus as animal feed, and field tour of the cactus plantation at NARC.

5	Training on Small Ruminant Value Chain Rapid assessment and bench marking surveys	June 3-5, 2014	Train scientist from NARS on tools to do Rapid SRVC surveys	Dr. Barbara Rischkowsky (ICARDA), Dr. Girma Tesfahun Kassie, (ICARDA), and Dr. M. Islam (ICARDA – AIP) Dr. Ibrahim (AIP-LIVESTOCK)	Islamabad Hotel	ICARDA scientists and AIP-LIVESTOCK scientists	Expertise and VC tools developed to assess/analyse SRVC in different production systems
6	Training on audit and evaluation of PPR vaccine production laboratories	June 8 – 13, 2014	Auditing and evaluation of the PPR vaccine production process in the 2 laboratories in Pakistan	Dr. M. Afzal (FAO), Dr. Jeff Mariner (Tufts University), and Dr. Ibrahim (AIP-LIVESTOCK)	Veterinary Research Institute, Lahore	FAO PPR program, AIP-LIVESTOCK, Tufts University/ USA	PPR vaccine production in laboratories at Lahore (VRI) and Quetta (CASVAB) audited and evaluated for trouble shooting during production process. Comprehensive report on the status of PPR Pakistan prepared.
7	Training on production of pilot batch of PPR	August 5-15, 2014	Train scientists and laboratory staff on thermo-	Dr. M. Afzal (FAO), Dr. Jeff Mariner (Tufts University),	Veterinary Research Institute, Lahore	FAO PPR program, ILRI, Tufts University/ USA	The comparatively higher thermo-stable PPR vaccine

	vaccine based on ILRI recipe		stable PPR vaccine production	and Dr. Ibrahim (AIP-LIVESTOCK)			developed at ILRI, Nairobi introduced to Pakistan. 12 scientists were trained on the production process.
8	Consultation meeting with Mardan Dairy Farmer Association members	September 6, 2014	Discussion on problems faced by members of the association	Dr. Muqarrab Ali Khan/Director, Breed improvements, KP and Dr. Ibrahim (AIP-LIVESTOCK)	Mardan	L&DD, KP and AIP-LIVESTOCK	Documentation of problems faced by dairy farmers

Pakistani Participants during the agro-ecological monitoring training in Jordan

Hands-on training on artificial insemination in goats at Jaba farm, KP

Participation of farmers in the Cactus introductory workshop at NARC Islamabad

Small ruminant rapid value chain assessment training

Appendix-XXVII: Upcoming meetings to be held within the next reporting period.

S. No	Meeting Name	Date	Purpose	Person Responsible	Venue	Partners	Expected Outcome
1	Panel Discussion with Dairy Farmer Association members from Mardan and Nowshera, KP	23 October 2014	Expose the dairy farmers on feeding and feed processing technologies	Dr. Muqarrab Ali Khan, (L&DD,KP), Dr. Fatah Ullah (Director/ASI, NARC), Ibrahim, (AIP-LIVESTOCK)	NARC	L&DD, KP; NARC and AIP Scientists	Dairy farmers will have a better understanding on balanced feeding, rearing of replacement stock, and feed conservation techniques.
2	Stakeholder consultation meeting on Dairy Value Chain Rapid Assessment study in Bahawalnagar	27 October 2014	To discuss with various dairy value chain actors the findings of DVC RA study and agree on best bets for interventions	Dr. Abedullah (AIP-LIVESTOCK), and Ibrahim (AIP-LIVESTOCK)	Sahiwal	Islamia University Bahawalnagar	Best bets for interventions on feeding, breeding, reproduction, animal health, input services and capacity building in Bahawalnagar
3	Stakeholder consultation meeting on Dairy Value Chain Rapid Assessment study in Jhang	28 October 2014	To discuss with various dairy value chain actors the findings of DVC RA study and agree on best bets for	Dr. Abedullah (AIP-LIVESTOCK), and Ibrahim (AIP-LIVESTOCK)	Sahiwal	Depat. Of Livestock and Research Centre for conservation for Sahiwal Cattle	Best bets for interventions on feeding, breeding, reproduction, animal health, input services and capacity building in Bahawalnagar

			interventions				
4	Training of Facilitators on Feed Assessment tools (FEAST)	6-9 June 2014	Train scientist from NARS on tools to do Rapid DVC and Dairy bench marking surveys	Dr. Nadhem Mtimet (ILRI), Drs. Abedullah and Ibrahim (AIP-LIVESTOCK)	NARC, Islamabad	AIP ILRI and ILRI scientists	Expertise and VC tools developed to assess/analyse DVC in different production systems

Appendix-XXVIII: International travel undertaken during April-September, 2014.

S #	Name	Date	Location	Purpose	Brief Outcome
1	M.N.M. Ibrahim	June 2014	Nairobi, Kenya	Discussion with DDG/Bio-Sciences and Director/Vaccine on challenge testing of PPR vaccine in Pakistan	As the same strain is used in Nairobi and in Pakistan there is no need to do the test in Pakistan, because it will be done in Nairobi. However, there will be a need to do test the thermo-stability of the product produced in Pakistan.
2	M.N.M. Ibrahim	September 2014	DakLak, Vietnam	As a resource person for the Feed Assessment Tools Summit	Based on the discussions held with the organizes, a resource person from ILRI/ICARDA will visit Pakistan to conduct the FEAST training for Pakistan scientist

Appendix-XXIX: Field days, exhibitions and fairs attended

S#	Name	Date	Location	Purpose	Brief Outcome
1	Goat and Sheep Mela (Nuqri and Mundru Show)	20 June 2014	Rajanpur (DG Khan)	Create awareness on the importance and genetic merits of lesser known indigenous breeds	65 farmers were proud in parading their lesser known animals in front of an audience of 135 and 6 judges. Farmers greatly appreciated and acknowledged the efforts of USAID and AIP-LIVESTOCK in organizing such an event in their home track.

Appendix-XXX: List of sub-grants (Amount, Recipient, Purpose) (not ones to ILRI, AVRDC, but ones under competitive or commissioned grant programs)

S#	Project Title	Amount Allocated	Duration	Expected Outcome
1	Evaluation and Promotion of improved forage varieties	PKR 680,000	4 months	10 Model farms with improved forages set-up in project villages low and medium rainfall sites in Chakwal
2	Establishment and evaluation of fodder and cactus varieties in rangeland areas of Chakwal	PKR 1,200,000	5 months	Fodder and cactus planted in rangeland belonging to 30 households in 4 villages in Chakwal

Vegetables

Appendix-XXXI Tomato hybrids yield under protected cultivation at different locations

Location	Highest (t/ha)	Followed (t/ha)	Lowest (t/ha)
ARI, Quetta	APCL-007 (70.0)	Dollar (33.8)	Pooja (18.8)
Ag Research, AJK	Lerica (13.0)	Yaki (13.0)	T-1757 (10.0)
BARI, Chakwal	Lith-623 (73.2)	Sahil (62.4)	Samrudhi (49.2)
NTHRI, Mansehra	Sahil (32.7)	Rio grande (23.0)	Lerica (17.5)

Appendix-XXXII Tomato hybrids yield under natural off- season cultivation at different locations

Location	Highest (t/ha)	Followed (t/ha)	Lowest (t/ha)
Ag Res, Gilgit-Baltistan	Rio-grande(29.3)	Roma(28.0)	Local(23.7)
ARI, Quetta	Dollar(32.0)	Rio-grande(30.0)	Pooja(18)
Ag Res, Azad Jammu and Kashmir	Lerica(13.2)	Yaki(13.0)	T-1757(11.2)
SHRI, Mirpurkhas, Sindh	1359(9.7)	2565(7.3)	Roma(6.6)
ARS, Mansehra, KP	Lerica(44.4)	Yaki(33.8)	Pooja(18.8)

Appendix-XXXIII Vegetable demonstration plots (0.40 ha) planted in Khyber Pakhtunkhwa from April to September 2014

Crops	Variety/Hybrid	Mansehra(t/ha)	Swat (t/ha)	DI Khan (t/ha)
Bitter gourd	Durga	-	-	4.5
Bottle gourd	Super Star Neutech	- -	- -	55.0 56.0
Sponge gourd	Naga	-	-	3.5
Cabbage	Saint	-	21.0	-
Broccoli	Raesa	-	6.0	-
Turnip	Purple Top	-	17.5	-
Bean	Paulista	5.0	-	-
	Moth Red	3.5	-	-
Peas	Climax	16.9	-	-
	Dollar	11.8	-	-

Appendix-XXXIV List of training conducted across Pakistan

Subject	Date	Place	Purpose	No of attendees	Type of participant
Healthy Vegetable Seedling Production	April 16	Mingora, Swat	To raise healthy seedlings	20	Farmers
Capsicum nursery raising/management	April 25	Gonar-Diamer	To raise healthy seedlings	10	Farmers
Healthy Vegetable Seedling Production	April 29	D.I. Khan	To raise healthy seedlings	21	Farmers
Healthy Vegetable Seedling Production	May 2	Bancer, Chattar Plain, Mansehra	To raise healthy seedlings	51	Farmers
Healthy Vegetable Seedling Production	June 13	Kalam, Swat	To raise healthy seedlings	26	Farmers
Healthy Vegetable Seedling Production	June 14	Utror,Swat	To raise healthy seedlings	24	Farmers
Off season Vegetable Production Technology at Soon Valley	June 17	Naushera, Khushab	Off-season vegetables production techniques	24	Farmers

Protected Vegetable Production-Quetta	August 21	Vegetable Seed Farm, Quetta	Off-season vegetables production techniques	22	Farmers
Protected Vegetable Production-Pishin	August 26	Rozi Khan Farm, Pishin	Off-season vegetables production techniques	33	Farmers
Protected Vegetable Production-Kachhi at Dhaddar	September 10	Rindali, Dhaddar	Off season vegetables production techniques	28	Farmers

Appendix-XXXV Vegetable Program, NARC, Islamabad

Existing Practice	**Improved Practice**	**Farmers/ Demo**	**Yield Kg / ha**	**Additional net income PKR/ha**	**Lesson Learned i.e. farmer/ market**
Leave tunnel vacant for 6 months till August	Introduction of coriander/spinach Bunching onion/ English vegetables	01 NARC	Spinach 6000	PKR 70,000	Spinach was found more promising crop in term of higher return.

Appendix-XXXVI Net revenue gains from mungbean variety AZRI-06 for seed production in the traditional mungbean growing area of Layyah and Bhakkar districts of Punjab.

District	**Cluster #**	**Cluster Name**	**Farmer Benef.**	**Area planted (ha)**	**Seed produced (t)**	**Mean Yield kg / ha**	**Total income/ha @ Rs. 100/- per kg**	**Cost of production per hectare(PKR)**	**Net Revenue Gain/ha (PKR)**
Bhakkar	5	Thal -I	12	4.86	5.74	1205	120500	43,000	77,500
	6	Nashaib	5	2.02	2.46	1338	133800	43,000	90,800
	7	Tibba Hamid Shah	5	2.02	2.89	1858	185800	43,000	142,800
	8	Luck Kallan	9	4.45	5.51	1398	139800	43,000	96,800
Layyah	9	Thal-II	8	3.04	3.08	1155	115500	43,000	72,500
	10	ChowkAzam	9	3.64	4.00	1218	121800	43,000	78,800

Note: The value of by-products and cost of irrigation were almost equal, therefore are not considered in the calculation.

Appendix-XXXVII Net revenue gained from mungbean production as a catch crop in the rice-wheat cropping system of Punjab and Sindh provinces.

Province	District	Cluster No.	Cluster Name	Farmer Benef.	Variety used	Area Planted (ha)	Total grain productio	Mean Yield	Total income/ha @ Rs. 75/-	Cost of productio n per ha (PKR)	Net Revenue Gain/ha
Punjab	Sheikhupura	3	Farooqabad	19	AZRI-06	3.8	1.94	510	38250	25,000	13,250
	Nankana Sahib	4	Chandikot	1	NM-11	31.2	46.8	1500	112500	25,000	87,500
Sindh	Larkana	18	Ratodero/ Larkana	5	AEM-96, NM-92, Local	1.6	0.64	400	30000	25,000	5,000

Note: The value of by-products (nitrogen and straw) and cost of irrigation were almost equal, and therefore are not considered in the calculation.

Appendix-XXXVII Net revenue gained from mungbean production intercropped with sugarcane in Sindh and Punjab provinces

Province	District	Cluster No.	Cluster Name	Variety	Farmer Benef.	Area planted (ha)	Mean Seed Yield (kg/ha)	Value of seed @ 75/- PKR	Value of byproducts ha per	Total income per ha (PKR	Cost of production ha per	Net Revenue Gain/ha
Sindh	Thatta	19	Makli	NM-06	7	3.64	293	21,975	7,807	29,782	3,000	26,782
	Sajawal	20	Saeedpur	AZRI-06	2	0.81	340	25,500	7,857	33,357	3,000	30,357
Punjab	T.T.Singh	1	Mumdana Kallan	AZRI-06	10	2.2	437	32,775	7,959	4,734	3,000	37,734
	Kasur	2	Pattoki	AZRI-06	1	4.0	395	29,625	7,915	37,540	3,000	34,540

Appendix-XXXVIII Net revenue gained from mungbean variety AZRI-06 for seed production in the traditional mungbean growing area of Layyah and Bhakkar districts of Punjab

District	Cluster No.	Cluster Name	Farmer Beneficiaries	Area Planted (ha)	Seed produced (t)	Mean Yield kg / ha	Total income/ha @ PKR 100/- per kg
Bhakkar	5	Thal -I	12	4.86	5.74	1205	120500
	6	Nashaib	5	2.02	2.46	1338	133,800
	7	Tibba Hamid Shah	5	2.02	2.89	1858	185,800
	8	Luck Kallan	9	4.45	5.51	1398	139,800
Layyah	9	Thal-II	8	3.04	3.08	1155	115,500
	10	Chowk Azam	9	3.64	4.00	1218	121,800

Appendix-XXXIX Preliminary Screening of 18 mungbean genotypes for bruchid resistance under controlled conditions

S#	Genotypes	Adults emerged	percent grain damage
1	AVMU8501	34.0	53.8
2	AVMU8601	50.7	54.0
3	AVMU 8901	10.0	11.5
4	AVMU9701	42.3	43.2
5	AVMU0001	32.7	44.7
6	AVMU0101	64.3	67.4
7	AVMU0201	47.3	61.6
8	AVMU0801	19.7	33.6
9	AVMU1003	43.0	66.2
10	VI059227	38.0	46.6
11	VI059228	43.3	39.8
12	VI062212	31.7	60.1
13	VI001709 B-G	2.3	1.3
14	VI001802 B-G	1.0	0.7
15	AZRI Mung-06	57.3	38.1
16	NCM-2013	50.7	50.6
17	NM-06	45.0	45.9
18	NM-11	52.1	55.2

Appendix-XXXX Details of F1 crosses of mungbeancurrently in the field during the 2014 cropping season

S. No.	**Cross Name**
1	AVMU40002 xNM-06
2	VI001709 xAZRI-06
3	VI06322A xAZRI-06
4	VI001709 xNM-11
5	AVMU10401 xNCM 2013
6	AVMU4002 xNCM 2013
7	AVMU40002 xNCM 2013
8	AVMU8902 xNCM 2013
9	AVMU8904 xNCM 2013
10	VI06322 xNM-06
11	AVMU10401 xNM-06
12	VI001709 xNM-11
13	AVMU8902 xNCM 2013
14	VI0001709 x NCM 2013
15	AVMU10401 xNM-11

Appendix-XXXXI Seed produced by various partner research institutes in Pakistan

S#	**Crops**	**Varieties**	**Total (kg)**
1	Onion	Swat-1, Phulkara, Chiltan Red, TA377, TG502	668
2	Spinach	Aman, Faisalabad, Bolan, Desi	1038
3	Peas	Climax, Meteor, Green Feast, Ambassador	1406

4	Turnip	Purple Top	2414
5	Carrot	T-29, Black Local	3889
6	Radish	Harboi white, Green Neck	2861
7	Tomato	Dollar, Rio Grande, Shalkot	under processing
8	Okra	SabzPari, Swat Green,	842.5
9	Cucumber	-	20
10	Chilies	NARC, DG, Talhari, CDT	under processing
	Total		**13139**

Appendix-XXXXII Area of vegetable seed production in winter (Rabi season) during 2014-15

Crops	Swat- KP	Pothwar Punjab	Central Punjab	Sindh	Balochistan	Private Sector	Total (ha)
Onion	0.5	0.5	0.0	0.5	1.0	0.5	3.0
Peas	0.5	0.0	0.5	0.0	0.0	1.0	2.0
Tomato	0.0	0.0	0.5	0.0	0.0	0.0	0.5
Okra	0.3	0.5	0.5	0.0	0.2	1.0	2.5
Chili	0.0	0.0	0.0	1.0	0.0	1.0	2.0
Total Rabi	**1.3**	**1.0**	**1.5**	**1.5**	**1.2**	**3.5**	**10.0**

Appendix-XXXXIII Provincial distribution of vegetable value chains respondents (in numbers)

Provinces	Vegetable Value Chains Players			Total
	Vegetable/ Seed Producer	Commission Agents	Seed Dealers	
Balochistan	5	5	5	15
KP	21	21	21	63
Punjab	44	42	43	129
Sindh	10	13	11	34
Pakistan	90	91	90	271

Appendix-XXXXIV List of Provincial Partner Institutions

a) Institutions for Protected Cultivation (April to September, 2014)

1. Agricultural Research, Gilgit-Biltistan
2. Agricultural Research , Muzaffarabad, AJK
3. Agricultural Research Institute (N) Mingora Swat
4. Agricultural Research Station, Baffa, Mansehra
5. National Tea and High Value Crops Research
6. Vegetable Program, HRI, NARC, Islamabad
7. Barani Agricultural Research Institute (BARI), Chakwal
8. Vegetable Research Institute, AARI, Faisalabad
9. Agricultural Research Institute (S), DIKhan
10. Sindh Horticultural research Institute(SHRI), Mirpurkhas

11. Directorate of Vegetable Seed Production, ARI, Sariab,Quetta

---

NIAB, Faisalabad was not able to participate due to administrative and management issues.

b) Institutions for Mungbean Production (April to September, 2014)

1. Pulses Program, CSI, NARC, Islamabad
2. Barani Agricultural Research Institute (BARI), Chakwal
3. Pulses Research Institute (PRI), AARI, Faisalabad
4. Arid Zone Research Institute (AZRI), Bhakkar
5. Quaid-e-Awam Agriculture Research Institute (QAARI) Larkana
6. National Sugar & Tropical Horticulture Research Institute (NSTHRI), Thatta

---

PRS-RRI, Dokri was unable to perform due to management issues.

c) Institutions for Vegetable Value Chains (April to September, 2014)

1. Agricultural Research Institute (N) Mingora- Swat
2. Vegetable Program, HRI, NARC, Islamabad
3. Vegetable Research Institute, AARI, Faisalabad
4. Directorate of Vegetable Seed Production, ARI, Sariab, Quetta

d) Private Companies & Progressive Growers

1. Shuga Seed Growers Association, Gokand Valley, Bunier, KP
2. Zamindar Seeds, Mingora, KP
3. Arco Seed, Gujranwala, Punjab
4. Chili Growers Association, Kunri, Sindh

Perennial Horticulture, HRD and e-Pak Ag

Appendix-XXXXV Selection Committee members

Voting members of the HRD committee		
No.	Name	Affiliation
1.	Thomas Rost	UC Davis (Committee Chairman)
2.	Muhammad Imtiaz	CIMMYT
3.	Nadeem Amjad	PARC
4.	Sarwat Mirza	PMAS, AAU
5.	Fida Mohammad	AUP
6.	Asif Ali Khan	UAF
7.	Altaf Ali Siyal	SAUT
Non-voting ex-officio members		
1.	Ahmad Yahya Khan	HEC
2.	James Hill	UC Davis
3.	Sarfraz Rizwan	UAF
4.	Laura Lovgren	UC Davis

Appendix-XXXXVI Events and meetings held during April 01, 2014 – September 30, 2014

#	Meeting Name	Date	Purpose	Person Responsible	Venue	Partners	Brief Outcome
Perennial Horticulture							
1.	Characterization of native and potential mango varieties in relation to Ceratocystis manginecans and other economic traits	September 10, 2014	To release initial information about 10 selected accessions screened from 471 wild mangos collected; to release these 10 accessions to the 126 growers for individual evaluation in their orchards	Dr. ASIF Khan UAF Office of Research Commercialization	UAF Faisalabad	UAF	126 attendees received registered mango varieties
Human Resource Development							
1.	HRD PhD interviews	May 5-6, 2014	Interview 22 PhD semifinalists	Thomas L. Rost	HEC HQ, Islamabad	Committee members	Selected 5 PhD finalists and 2 alternates
Vocational Training							
1.	Vocational Training workgroup	June 17, 2014	Establish TORs, priorities and Committee membership	Mark Bell	NARC	CIMMYT, IRRRI, PARC, AVRDC, ILRI	Committee, priorities, and next steps established
2.	Proposal writing workshop	September 9- 10, 2014	Prepare participants for the AIP competitive call through increasing their skills	Thomas L. Rost; Samuel Rodriguez	NARC / PIASA, Islamabad	PIASA, CIMMYT	Evaluations indicated very good satisfaction with the course from the

							42 participants
E- Pak Ag							
1.	ICT in Ag workshop	June 19, 2014	Share developments and identify lessons learned in the use of ICT in Ag	Mark Bell; Badar Naseem	AAUR, Rawalpindi	AAUR, Agri Punjab	Networking and initial identification of issues and needs
2.	ICT in Ag workshop	June 23, 2014	Share developments and identify lessons learned in the use of ICT in Ag	Mark Bell; Babar Shabaz	UAF, Faisalabad	UAF, Agri Punjab, Private sector representatives	Networking and initial identification of issues and needs

MONITORING AND EVALUATION

Appendix- XXXXVII Summary of beneficiaries by commodities/themes and partner organization

Activity name	**Livestock**	**Vegetables**	**Maize**	**Wheat**	**Agronomy**	**Rice**	**Perineal Horticulture**	**e-Pak Ag**	**HRD**
Trainings	80	279	80		48	7			41
Farmers' fields planted with new varieties/technologies	30								
Awareness on IPM practices		276							
Workshop participants				256				295	
Exposure visit to varietal trials				500					
Distribution of seed (Hybrid/Basic/Pre-basic)			90			34			
Farmer field days					260		126		
Demonstration of new technologies						129			
Total	110	555	170	756	308	170	126	295	41

Appendix- XXXXVIII Result Framework-Agricultural Innovation Program for Pakistan