Agricultural Innovation Program for Pakistan (AIP)

Semi-Annual Report

April 1, 2017 to September 30, 2017

Disclaimer

The authors' views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

Acronyms

AAG	Ali Akber Group
AIP	Agricultural Innovation Program
AJ&K	Azad Jammu And Kashmir
AKRSP	The Agha Khan Rural Support Program
AMD	Agriculture Marketing Development
ARI	Agriculture Research Institute
ARS	Agriculture Research station
AWD	Alternate Wetting & Drying
AZRI	Arid Zone Research Institute
BARDC	Baluchistan Agricultural Research and Development Center
BARI	Barani Agricultural Research Institute
BLB	Bacterial leaf blight
BRSP	Balochistan Rural Support Program
CCRI	Cereal Crops Research Institute
CGIAR	Consultative Group for International Agricultural Research
CGS	Competitive Grants System
Chr	chromosome
CIMMYT	International Maize and Wheat Improvement Centre
COs	Community Organizations
DCP	Digestible Crude Protein
DG	Director General
DLA	Diseased leaf area
DSR	Direct Seeded Rice
DT	Drought tolerant
DVC	Dairy Value Chain
EFL	Engro Fertilizers Limited
FATA	Federally Administrative Tribal Areas
FDP	Farm Dynamic Pakistan
FSC&RD	Federal Seed Certification and Registration Department
GB	Gilgit Baltistan
GOP	Government of Pakistan
GS	Green Seeker
Ha	Hector
HTMA	Heat Stress Tolerance Maize for Asia
ICARDA	International Center for Agricultural Research in the Dry Areas
ICI	Imperial Chemical Industries
ICT	Islamabad Capital Territory
IITA	International Institute of Tropical Agriculture
ILRI	The International Livestock Research Institute
IRBB	IRRI breeding line with BLB resistance
IRD	Informal Research and Development
IRRI	International Rice Research Institute
IRS	Internationally Recruited Staff
JPL	Jullundur Private Limited

KP	Khyber Pakhtunkhwa
KSK	Kala Shah Kaku
KWC	Khawateen Welfare Council
L&DDD	Livestock & Dairy Development Department
LDRC	Livestock Development Research Centre
LSOs	Local Support Organizations
MC	Multicrop
MFSC	Model Farm Services Center
MMRI	Maize And Millet Research Institute
MNFSR	Ministry of National food & Security
MoU	Memorandum of understanding
MR	Moderately Resistant
MS	Moderately Susceptible
MSF	Mission Strategic Framework
NARC	National Agriculture Research Centre
NARS	National Agricultural Research Scientist
NE	Nutrient Expert
NGO	Non-Government Organization
NIA	Nuclear Institute of Agriculture
NIAB	Nuclear Institute for Agriculture and Biology
NIBGE	National Institute for Biotechnology and Genetic Engineering
NIFA	Nuclear Institute for Food and Agriculture
NP	Nitro-phos (Nitrogen and Phosphorus)
NRS	National Recruited Staff
NRSP	National Rural Support Program
NUYT	National Uniformity Yield Trial
ODK	Open data Kit
OPPM	Optimum Plant Population Management
OYT	Observation yield trials
PARB	Punjab Agricultural Research Board
PARC	Pakistan Agricultural Research Council
PLD	Punjab Livestock Department
PPR	Peste des Petits Ruminants
PSC	Petal Seed Company
PVA	Pro Vitamin A
PVS	Participatory Varietal Selection
PYT	Preliminary yield trials
QPM	Quality Protein Maize
QTLs	Quantitative trait loci
RA	Research Associate
RARI	Regional Agriculture Research Center
RCA	Roberts Cotton Associates Ltd.
RMP	Rafhan Maize Products
RRI	Rice Research Institute
RRI-Dokri	Rice Research Institute, Dokri
RRI-KSK	Rice Research Institute Kala Shah Kaku
RSP	Rural Support Program
SB-BLB	Super Basmati with BLB resistant gene
SDS	Sodium Dodecyl Sulfate
SEP	Socio Economics Program, CIMMYT

SME	Small and Medium Enterprises
SPSS	Statistical Package for Social Scientists
SPU	Semen Production Unit
SSR	Soil Salinity Resistance
TASP	Tropical Animal Science and Production
TCS	Tara Crop Sciences
TDN	Total Digestible Nutrients
TMK	Tando Muhammad Khan Seed Corporation
UAF	University of Agriculture, Faisalabad
UAP	University of Agriculture Peshawar
UC	Union Council
UC Davis	University of California, Davis
USAID	United States Agency for International Development
USG	United States Government
UVAS	University of Veterinary & Animal Sciences
VOs	Village Organizations
WRI	Wheat Research Institute
WRIS	Wheat Research Institute Sindh
ZT	Zero Tillage
ZTD	Zero Tillage Drill
ZTHS	Zero Tillage Happy Seeder

Table of Contents

Summary

Agricultural Innovation Program for Pakistan (AIP) accomplished the set targets for the reporting period. The project has a number of innovations and key thematic areas including, new seed varieties, new technologies (mechanization, irrigation systems), value chain development (durum wheat, rice, and livestock) and human resource development. The existing primary partners of AIP are the International Rice Research Institute (IRRI), the International Livestock Research Institute (ILRI) and CIMMYT. Pakistan Agriculture Research Council (PARC) is the hosting key partner while CIMMYT is leading the project and bringing innovation by involving all these partners. Besides international partner's involvement and PARC, AIP has actively engaged local public and private sector's key players across Pakistan to enhance farming for better yield and ultimately increase in income. Special focus was placed on women's participation in the project in all components of the project.

Under AIP Livestock, a genetically proven breeding bucks were distributed to 30 small ruminant herders of the district Bahawalpur to maintain the genetic purity of the indigenous treasures and resolve the major bottlenecks of unavailability of consistent breeding services in the 40 surrounding villages of the district. A total of 106 farmers (31% women) received water troughs and milk cans, similarly 345 water troughs and 241 milk cans were distributed to the members of KWC in the district Bahawalpur. AIP-livestock has established 21 demonstration plots (6.5 acres) of Rye grass forage in six different villages of Khawaza Khela, district Swat under peach orchards to efficiently utilize those parcels of lands to gained additional economic benefits. A total of 2121 Rhodes grass demonstration plots were also established belonging to female livestock farmers covering more than 7 acres in the district Bahawalpur of Punjab province. AIP-livestock introduced innovative and cost effective solutions through Rhodes grass intervention on 9 acres (19 demonstration plots) in three agencies of FATA in collaboration with FATA secretariat.

Under AIP Maize a total of 592.5 ha are under improved technologies and management practices. Trainings were provided to 318 farmers and researchers by involving them in maize exhibition, travelling seminars and visits to public and private partners' sites. Linkages developed among 12 seed companies and 10 public sector institutions and 5 seed companies to extend their services to farmers in GB, AJK, Balochistan and near the tribal areas of KP through varietal demonstration and seed distribution. A total of 26 tons of improved seed was produced by the partners and over 50% of the seed were distributed during spring and Kharif 2017. AIP partners also identified 88 new maize products including 20 biofortified maize (two Kernel zinc enriched, 12 PVA and six QPM) and 18 heat stress tolerant maize hybrids.

AIP-Wheat reached to more than 3000 small holder farmers through conducting on farm demonstrations- Informal Research and Development (IRD) and PVS trials to popularize new varieties and associated best practices. About 15 new rust resistant and high yielding varieties were disseminated including Zincol-16 a zinc enriched variety. A total of 32% women farmers benefited from new what varieties and production technology. These new varieties are 10-15% more yield efficient than old varieties. In seed production, 18 new wheat varieties were introduced through public private partnership and village based seed groups, which covered 174 ha area and produced about 500 tons quality seed. During wheat season, 322 famers (10% women) benefited Trainings were imparted on quality seed production, agronomy and storage for 622 participants including women, staff of public research institutes, Agric. Extension, Private seed companies and Rural Support Programs.

AIP agronomy component in collaboration with 23 national partners from agriculture research, extension and private sector helped to reach 2820 farmers through assisted application of improved techniques on 486 sites, provision of 150 planters, training to 268 stakeholders and dissemination of improved techniques through field days to 1916 farmers in the project area. The component assisted more than 150 farmers for zero tillage planting and LASER land levelling on their farms that helped in saving irrigation water, reducing cultivation cost and improving 10-15% yield. Greenland Engineering

provided 150 Multicrop DSR planters to rice farmers and service providers that were used for direct seeding of rice. National partners assisted farmers for use of push row maize planter, bed planter and DSR planter on 286 farms across the country which helped farmers in mechanizing maize and rice planting and obtain 10 – 15% better grain yield. AIP also facilitated 450 farmers on efficient nitrogen management with LCC use in rice crop through demonstrations and provision of LCC. Results from sensor based N management in wheat showed that 100 farmer saved 32 Kg N /ha without yield reduction in Balochistan, Sindh, KP and Punjab in comparison with farmer practice helping to reduce farmer's input cost.

AIP, Socioeconomic component, finalized the follow up survey reports for the Punjab and Sindh provinces. The results are epochal and indicated that the farmers adopted improved wheat varieties have higher yields (5-15%) owing to increase in household income comparatively. SEP developed android mobile data collection tool on Open Data Kit (ODK) software for the study "Feasibility of the quality protein maize (QPM) in Pakistan". Training on SPSS and STATA was imparted to 104 faculty with 12% women participation.

It was agreed by USAID that CGS will be implemented in the provinces through CIMMYT in partnership with PARC. Therefore, the process of funding competitive grants was re-initiated in April 2017. Total 292 research proposals were received in AIP Secretariat and Punjab Agriculture Research Board (PARB) from all the Provinces. The USAID Mission Director and Chairman PARC awarded 40 research grants to Pakistani Researchers and scientists to improve the productivity and livelihood of small farmers.

AIP Monitoring and Evaluation unite is committed to ensure monitoring and evaluation of the project activities. The project has outperformed and achieved above the target. Total target achieved during the reporting period were 10,000 (85% men and 15% women. AIP-M&E collected data on MSF outcome indicators on quarterly basis and reported to USAID on PakInfo.

AIP keeps highlighting the program interventions which included arranging successful events, persuasive stories and maintaining media presence. The emphasis has been given to communicate the project activities to local and international stakeholders following the branding and marking guidelines of USAID.

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 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 which 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. International partners (the International Livestock Research Institute, or ILRI and the International Rice Research Institute, or IRRI) lead on commissioned projects in livestock, 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."

1 Livestock

1.1 Dairy Value Chain

1.1.1 Maiden Azikheli Buffalo Beauty and Milk Competition: Opening New Avenue of Accomplishment and Recognition

AIP, livestock component organized the first ever Azikheli buffalo show on April 23 and 24, 2017 at Khawazakhela, district Swat, in collaboration with L&DDD. This event is the first of its nature where AIP-livestock laid the foundation of recognition and appreciation for the Azikheli buffalo farmers. These buffaloes are an integral element of food security and rural livelihoods. More than 100 Azikheli animals of five different categories [Beauty (04: cows, bulls, calves, heifers) and production (01: milk)] were part of the event. More than 2000 farmers visited/participated in the program. Various stakeholders > 200 from Government department, Universities as well as private sector companies joined hands in training of farmers on the appropriate technologies (feeds and feeding, housing and management) to enhance productivity of dwindling indigenous buffalo treasures in cold and hilly terrains of Pakistan.

Figure 1 Azikheli Buffalo show in SWAT, KP

1.1.2 Better housing through Participatory Approaches: Bench-marking Green House Gases Emissions from Livestock Housing Systems

Traditional animal housing systems in Northern Areas of Pakistan is characterized by completely closed structures which are lacking components to cope with environmental anomalies including proper ventilation facility. Therefore, various gases (ammonia and methane) are accumulating inside the animal sheds throughout the year. In winter, severe human health concerns may arise because animals are tethered day and night in their sheds. Therefore, AIP-Livestock introduced/established a total of 60 specially design mesh-walled animal housing units during September-November 2016 in Northern Areas (Gilgit-Baltistan; Azad Jammu & Kashmir and Khyber Pakhtunkhwa) of Pakistan to improve animal housing system and trained the marginalized farmers on better farm management practices round the year. All the beneficiaries having mesh-walled housing constructed the cemented floor and the drain on their own cost, AIP-livestock covered the cost of animal houses including transportation and installation of the units. A reconnaissance was conducted in June 2017 in six different villages of the district Gilgit to bench-mark the ammonia and methane gas accumulation in summer season in both types of animal housing systems i.e. traditional vs. improved. Generally, in summer farmers were tethering their animals in

Figure 2 Improved housing system

Figure 2.1 Traditional housing system

open places/fields during daylight and only in nights animals were tied in their sheds. The result shows that traditional housing systems still have noticeable level (>4 ppm) of gaseous accumulation for methane and ammonia as compared to zero level of gaseous accumulation in innovative and specially design mesh walled housing systems. These findings prove the importance of proper ventilation facilities in any type of animal housing systems as it helps to improve the performance of animals i.e. milk production and also avoids accumulation of gaseous at dangerous level for animals as well as human.

1.1.3 Impact Assessment of Alternative Feeding Regime on Milk Production in Gilgit, Baltistan

Nutrient deficiency and uninterrupted supply of required quantity and quality forages to dairy animals in Pakistan is one of the major impediments towards self-sufficiency in milk production. Changes in weather patterns and adverse climatic conditions further worsen forage production/availability to the dairy animals especially in Northern parts of Pakistan. AIP-livestock has introduced improved grass varieties such as Rye grass for cooler and hilly terrains as an alternative feeding regime for milking animals since 2015. AIP-livestock has gathered sufficient production statistics (on an average 30-40% more biomass as compared to natural grasses) for Rye grass production to evaluate its performance under various agro-ecologies with variant climate patterns. Therefore, Rye feeding trials (before and after scenario) with eight dairy farmers were conducted during June 2017 to quantify the impact of Rye grass feeding on animal's milk production in villages of Sikarkoi and Amphary (Danyore Valley) of the district Gilgit. AIP-livestock scientist maintained daily recording sheets covering feed intake, water intake and milk production. These trials bench-marked the impact of Rye grass feeding regime on milk production. The result reveals that the livestock farmers can easily get 0.31 liters/day per animal with

Figure 3 Rye grass feeding and its effect on milk production

Rye grass feeding regime. On monthly basis, incremental increase yielded US$ 60 worth milk from selected animals.

1.1.4 Exploration of Early Pregnancy Diagnosis in Bovine using Modern Diagnostic Technologies in District Faisalabad

The accuracy of pregnancy diagnosis is of prime importance for its recurrent economic losses and correct pregnancy diagnosis in early days of conception. AIP-livestock tested locally/imported available pregnancy diagnostic kits; namely BoviPreg and IDEXX in collaboration with University of Agriculture Faisalabad and Sarbuland Dairy Farm Faisalabad, and compared the results with standardize ultrasound technique on May 4, 2017. Samples of milk, blood and urine were collected from 30 selected animals and compared with ultrasound pregnancy diagnosis. The proper functioning

of these kits in native animals is an auspicious emblem for maintaining an optimum calving interval and subsequent breeding of non-pregnant animals. The ultimate objective of this experiment is to

Figure 4 Use of PD

introduce cost effective and efficient farming solutions for better production and reproduction in dairy hubs/industry across Pakistan.

1.1.5 Setting Platform for Paradigm Shift of Developing Long Term Livestock Development Agenda for Better Dairy Nutrition and Provision in Azad Jammu & Kashmir (AJ&K)

AIP-Livestock component organized an awareness program on April 7, 2017 at Livestock Development Research Center, Muzaffarabad. The objective was to discuss the complexities in the traditional model housing systems, as well as the use of modern diagnostic tools through portable ultrasound machine for early pregnancy diagnosis and to detect reproductive disorders in small ruminants under field conditions. During the event, AIP-Livestock has handed over the first portable ultrasound machine (Minitube) to the livestock and dairy development department AJ&K to persuade the technical utility of pregnancy diagnosis in small ruminants. The Additional Chief Secretary (Development) graced this occasion along with other higher officials from the Agriculture Ministry, Planning and Development Department, representatives of Islamic Relief and female livestock farmers. A total of 271 participants included 133 females and 138 male attended the event. Livestock department were also seeking help to finalize the livestock development agendas for short to long term plans as per their newly proposed livestock policy for better dairy nutrition and provision.

Figure 5 Donating Ultrasound machine to AJK

1.1.6 Community Based Consultation Meetings for Prospects of Livestock Development in AJ&K

AIP-livestock in consultation with L&DDD, AJ&K organized a consultative meetings on April 08, 2017 with key representatives of 50 livestock farmers included 20 females and 30 males in village Majhoi and Malsi, district Muzaffarabad. The program revolved around finding sustainable solutions for constraints faced by livestock farmers in diverse agro-ecologies of AJ&K. Two specially design mesh-walled animal housing units were inaugurated by Director General, L&DDD, AJ&K to introduce the better farm management practices and hygienic milk production. AIP-livestock's

Figure 6 Inauguration of mobile housing

collaborator Farm Dynamic Pakistan (FDP) Pvt. Limited provided Information on new and improve fodder varieties to ensure quality feed availability round the year.

1.1.7 Development of Innovative Tools for Balanced Rationing for Feedlot Farming Industry in Pakistan: Efficient Way for Capacity Building and Changing Mindset

AIP-Livestock developed simple innovative tool for balanced rationing for feedlots farmers with indigenous feed resources to assist them in reducing their cost of production and increase their returns from feedlots enterprise. This Microsoft Excel based programing tools were introduced and practically demonstrated on May 20, 2017 during training program of USAID funded Agriculture Marketing Development (AMD) organized in collaboration with Farm Dynamic Pakistan (FDP) Pvt. Limited at Rahim Yar Khan. The tool can provide the information on cost of feed per animal per day and cost per kg live weight gain as well. The details on how to use this tool is given in Appendix 16.1

1.1.8 Capacity Building Program for Female Livestock Farmers in Deserted Agro-ecologies: A Way to Sustain and Hygienic Milk Production in Pakistan

AIP-Livestock, organized a capacity building program for more than 600 female livestock farmers on September 12, 2017 at Mehrab Goth, district Bahawalpur in collaboration with L&DDD, Punjab and KWC, Bahawalpur. This program specially targeted the poor and widow livestock farmers to equip them with modern and innovative tools for sustained livestock production and discuss their demanding roles in livestock sector under changed scenario of climate. AIP-livestock distributed 345 specially design, innovative and food graded water troughs and 241 milk in cans to ensure hygienic milk production in Pakistan.

Figure 7 Distribution of Water troughs & Milk cans to KWC

1.1.9 Sensitizing Marginalize Livestock Farmers from Coastal Belt of Sindh on Strategic Feeding and Management

AIP livestock organized a farmer awareness and training program on September 19, 2017 in collaboration with the Livestock & Fisheries Department, Sindh province and the Sindh Agricultural Growth Project-Livestock in village Habib Soomro, Thatta. The purpose was to sensitize livestock farming communities from Coastal belt of Sindh on strategic feeding and management to sustain milk production under changed scenario of climate. More than 150 farmers participated including 65 members of the Habib Somro Milk Producer Group. Through farmer participatory research trial conducted in this village, AIP-livestock highlighted the major impediments towards sustainable dairy production without efficiently utilizing the indigenous scarce feed resources. Concentrate feed bags were distributed among owners of top three performing animals to encourage livestock community members. Practical hands on training were provided on balancing the animal's feed through feeding charts to develop the concept of balance feeding through indigenous and localize feed resources. Specialized food grade water troughs and milk-in cans were distributed among 106 farmers including 30 women farmers to ensure milk hygiene.

Figure 8 Awareness program in Thatta

1.2 Small Ruminant Value Chain

1.2.1 Baseline Survey of Deserving Small Ruminant Herders in South-Punjab, District Bahawalpur

The concept of artificial insemination in small ruminants is still in its infancy as small herders were mainly relying on natural breeding method. The availability of inferior breeding bucks and farmers preferences to sacrifice their best animal for Eid after castration of male bucks; further worsen the prevailing conditions. AIP-livestock selected potential small ruminant herders to initiate/piloting the concept of using superior breeding bucks for community based small ruminant breeding services (CB-SRBS). AIP-livestock selected 30 female small ruminant herders on well-developed criteria on May 10-12, 2017 in district Bahawalpur in collaboration with KWC. This baseline information will serve as a platform to further strengthen and mature the concept of CB-SRBS to maintain the genetic purity of indigenous small ruminant breeds across Pakistan.

Figure 9 Conducting PRA with female livestock holders

1.2.2 Maintaining the Genetic Purity of Indigenous Goat Treasures of Pakistan as Pro-Poor Growth Policy option for Deserted Agro-ecologies

Figure 10 Buck distribution ceremony

AIP-Livestock organized a breeding buck distribution ceremony on May 13, 2017 for the deserving 1000 participants with 90% female small ruminant herders (poor and widows) farmers from various villages of the district Bahawalpur in collaboration with KWC. Rearing of small ruminants has the greatest advantage over other livestock species both in relation with poorer households and female centered activity under rural livelihoods scenario especially in deserted agro-ecologies of Southern Punjab. Poor farmers have their inclinations about small ruminants (goats) performance traits because of their choices are sturdily linked to enticing additional pecuniary benefits from the local markets. AIP-Livestock purchased the selected superior bucks (Beetal – Faisalabadi and Makhi Cheeni) that were reared at University of Agriculture Faisalabad, 1 year of age weighing about 35 kg. These distributed superior bucks (scientifically fit for breeding) will paved the way to maintain the genetic purity of the indigenous treasures as well as resolve the major bottlenecks of unavailability of breeding services in more than 40 surrounding villages of district Bahawalpur.

1.3 Feed, Fodder and Rangeland

1.3.1 Performance of Rye Grass in Northern Hilly Terrain of Pakistan: Bridging Nutritional Deficiencies

Figure 11 Performance of Rye grass in SWAT,

AIP-livestock has established/maintained 21 (6.5 acres) demonstration plots of Rye grass in six different villages of Khawaza Khela, district Swat since September, 2016 under peach orchards to efficiently utilize those parcels of lands to earn additional economic benefits. Rye grass was evaluated with traditional forage varieties as well as natural occurring grasses in farmer's field for comparative evaluation. The result reveals that production of Rye grass is 30-40% more (up to 16 tons per acre/cut) with 4-6 cuts annually than Shaftal, >50 % as compared to natural grasses growing in orchids as well as >20-30% Oats per acre per cuts. The result confirms that Rye grass yielded 200% more biomass annually as compared to all other grasses (Oats, Shaftal and Natural grass).

1.3.2 Introduction and Comparative Evaluation of Rhodes Grass Cultivation in FATA of Pakistan

AIP-livestock established 19 demonstration plots covering nine acres of cultivated area in three agencies of FATA namely Bajaur, Khyber and Mohmand Agencies during March 2017 in collaboration with Livestock Department of FATA Secretariat. Livestock is the integral part of FATA and farmers have greater dependency on dairy animals in terms of food security and nutrition. Rhodes grass shows exceptionally remarkable results and up to 18 tons per acre/cut biomass production. The farmers have witnessed the 350% more biomass production with 3-6 cuts annually as compared to other grasses including Shaftal, Oats and Natural grasses.

Figure 22 Performance of Rhodes grass in FATA

1.3.3 Sowing Seeds of Hope: Utilizing Degraded Lands for Crop-Livestock Interface for Enormous Economic Returns

Pakistan's agricultural land shows degraded trend at an accelerated pace. AIP-livestock have decided to sow the seed of hope for dairy farmers to utilize degraded lands for crop-livestock interface to get valuable economic returns in terms of biomass production, reclaiming/restoring soil health and sustain milk production. As a pilot project, AIP-livestock identified the district Bahawalnagar area; an important dairy hub as well as famous pocket for Beetal goat breed in Pakistan. These identified lands were saline to saline sodic in nature. Therefore, the newly introduced saline resistant variety Tolgar (Rhodes Grass) was cultivated to gauge the performance as well as estimation of economic returns from this intervention. The preliminary results confirm that Tolgar perform well with 12-17 tons per acre/cut biomass production. These results were further providing the basis for bio-saline agriculture in Pakistan with special emphasis given to the livestock sector in Pakistan.

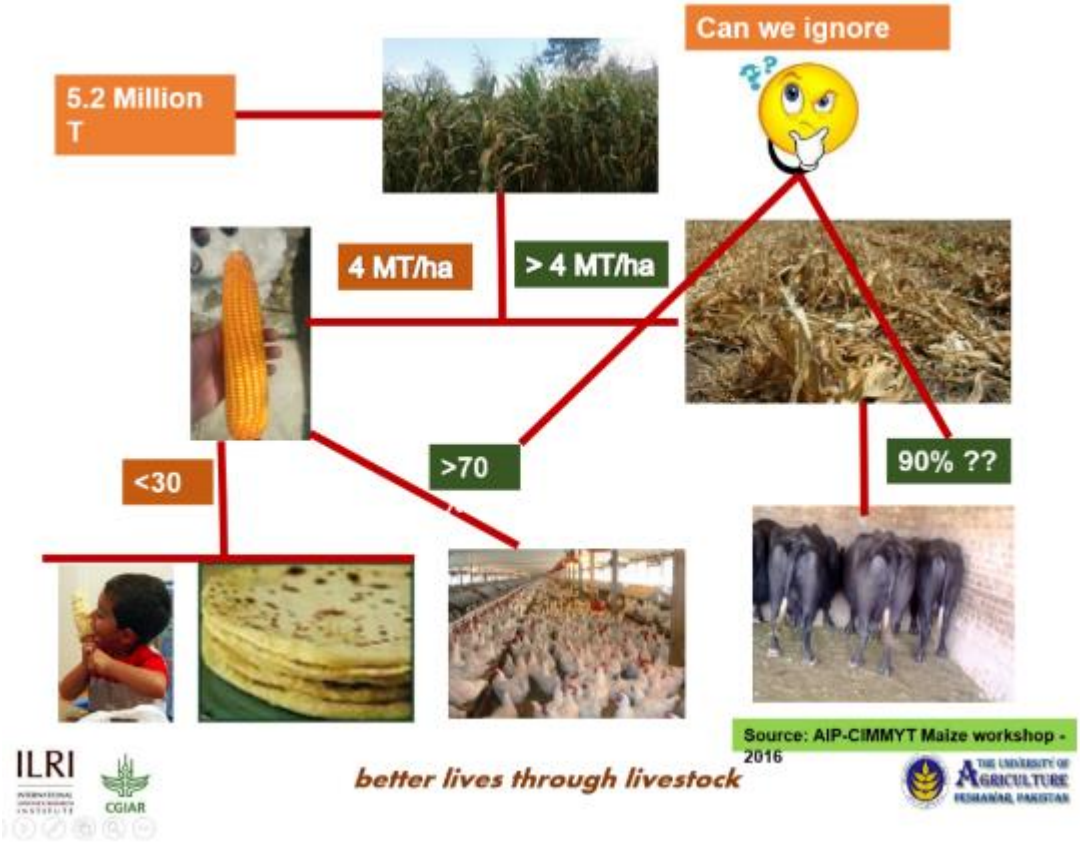
1.3.4 Distribution of Rhodes Grass Seed among Small Ruminant Herders in Deserted Agro-ecology of Pakistan, District Bahawalpur

AIP-livestock provided highly nutritious feed through Rhodes grass cultivation for small ruminants especially goats in deserted and harsh climatic regions of district Bahawalpur. There were 21 demonstration plots headed by female livestock farmers mainly widows and poor covering >7 acres of cultivated area in six union councils during July 2017. This is the nascent step for ensuring highly nutritious feeds for small ruminants to give a big push to increase their growth rate to earn substantial benefits from goat rearing in Pakistan.

Figure 33 Rhodes grass distribution in Bahawalpur

1.3.5 Prospects and Challenges of Maize in Pakistan's Livestock Industry

AIP-Livestock participated in AIP Maize conference organize by CIMMYT and PARC on April 12, 2017 at Islamabad. AIP-livestock shared some new dimensions and thoughts among various national maize stakeholders/enterprises. AIP-livestock paved the way for breakthrough for Research for Development by analyzing the amino acid of profile of maize including QPM's introduced by CIMMYT for its importance in silage production and stage of harvesting for silage production. AIP-Livestock showed a marketing way forward by exploring feed conversion ratio and its economic importance for poultry industry as well.



2 Maize

2.1 Development/ introduction of climate resilient maize

Following climate resilient maize trials were conducted and data were collected from most of the sites:

- A total of 108 yellow kernel climate resilient maize hybrids sourced from CIMMYT Mexico and Colombia
- A total of 352 white kernel climate resilient maize hybrids sourced from CIMMYT Mexico and Zimbabwe
- Heat stress tolerant hybrids consisting of 20 entries including four local checks were tested on nine sites in Pakistan. The germplasm were accessed from the USAID funded Heat Tolerant Maize for Asia (HTMA) project implemented in four South Asian countries Viz: Pakistan, Bangladesh, Nepal and India by CIMMYT. This effort targets to deploy best performing heat stress tolerant maize hybrids from the HTMA project in Pakistan and create synergies among the two USAID's funded projects (HTMA and AIP).

The list of spring 2017 trials were grouped under 70 sets (appendix 16.2.3) evaluated and harvested in the different trial sites located in all provinces and territories of Pakistan. Out of the tested entries

partners selected 24 white, 15 yellow and 10 heat stresses tolerant hybrids for product allocation and further seed scale up.

2.1.1 Evaluation of heat stress tolerant maize hybrids

Climate change poses a serious threat for future crop production. Hence, to develop maize germplasm that can withstand higher temperatures (up to 45^0 c during flowering), CIMMYT is testing heat stress tolerant maize hybrids in Asia under the HTMA project where Pakistan is among the four South Asian countries included in the project. Under the AIP program, partners are also testing heat stress tolerant maize hybrids sourced from CIMMYT, Asia maize breeding program in Hyderabad. As a result AIP partners identified ten heat stress tolerant hybrids and requested for further testing and deployment in Pakistan.

Figure 5 Seed bed preparation and maize planting spacing at MMRI

Figure 5 AIP maize field evaluation at ICI research farm Sahiwal, Kh-2017

List of heat stress tolerant maize hybrids sourced from CIMMYT Asia hybrid maize breeding program (Hyderabad, India), Spring, 2017			
No	Name	No	Name
1	CAH1521	11	ZH15381
2	ZH141592	12	ZH138088
3	ZH15445	13	VH12333
4	ZH169	14	VH12337
5	Sib	15	CAH151
6	ZH1621	16	CAH153
7	ZH15374	17	Check 1
8	ZH1622	18	Check 2
9	ZH15379	19	Check 3
10	ZH15383	20	Check 4

The following heat stress tolerant hybrids were selected by AIP partners for allocation:

List: AIP-maize trials distributed for "Kharif-2017" planting	
Hybrid code	Hybrid code

CAH153	ZH138088
CAH151	ZH1621
CAH1521	ZH 169
VH12337	VH12333
ZH15379	ZH15381

2.1.2 Development or introduction of biofortified maize Pro-vitamin A enriched hybrid maize in Pakistan

Pakistan ranks among the highest countries in the world for vitamin A and zinc deficiencies, which affect cognition and can lead to otherwise preventable blindness. To reduce this deplorable trend, AIP introduced biofortified maize products to Pakistan and partners identified well adapted hybrids for further seed scale up and distribution.

Earlier this year, AIP allocated three pro vitamin A (PVA) enriched maize hybrids to the UAF, making Pakistan the first south Asian country to receive these products. The seed increase of the parental lines as well as the hybrids is in progress currently at UAF to expedite the process of hybrids registration and large scale seed production. Apart from the higher carotenoid content, the grain yields of these hybrids are remarkably high with a record of up to 12 t ha^{-1} from the various testing stations in Pakistan.

A number of public and private partners have expressed interest in the commercialization of provitamin A and zinc enhanced maize products. The partners identified and requested the allocation of 20 biofortified maize products including two Kernel Zinc enriched, 12 PVA and six QPM hybrids. The seed production of the two QPM hybrids which were released earlier this year also continued during the reporting period.

No	Trial Name/code	Trial description	No of entries	No. of sets
1	16CHTPROA	Provitamin A enriched yellow maize hybrids	42	2
2	15AEIRHPVA	New set of ProA hybrids adapted to lowland tropics	10	1
3	ADVQPM17esp	New white kernel Quality Protein Maize hybrids	40	5
Trial Spring and Kharif, 2017				

2.2 Development or introduction of biotic stress tolerant maize

2.2.1 Status of maize stem borer mass rearing facility

Maize stem borer (*Chilo partellus*) is a destructive insect pest of maize in Pakistan. Yield losses due to

Figure 7 parental seed increase of PVA hybrids in an isolation block at UAF

Figure 6 Maize stem borer mass rearing Lab at IPMP-NARC

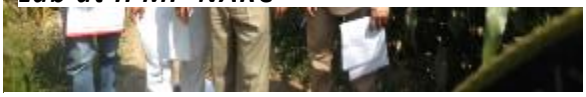


Figure 8 AIP maize evaluation at UAF, Kharif-2017

this pest are estimated to reach 10-40%. Application of insecticides is one of the practices mostly used by resource-rich farmers. However, small scale farmers have to face the yield losses unless they apply cultural practices which vary from place to place. The other alternative, perhaps the better option, is the use of tolerant varieties. Maize germplasms that have inherent resistance/tolerance to maize stem borer not only save farmer's money due to lower use of pesticides, but also help to have a greener agriculture by reducing greenhouse gas emissions. Identification of host-plant resistance in maize is part of the commissioned projects. Under AIP, stem borer resistance maize varieties sourced from the International Institute of Tropical Agriculture (IITA), Nigeria are being screened to identify varieties best adapted to Pakistan's maize growing ecology. To accelerate this screening process, it was necessary to have a stem borer mass rearing facility where larvae could be produced in mass and thereafter released in maize varieties as a form of artificial infestation. The lab is currently conducting an experiment to evaluate IITA materials for stem borer tolerance. The result from this trial will enable to identify stable and best performing entries.

2.2.2 Promotion of hermetic storage technologies (metal silo) to reduce post-harvest losses and aflatoxin contamination

Traditional storage practices in developing countries cannot guarantee protection against major storage pests of staple food crops like maize, leading to 20-30% grain losses, particularly due to post-harvest insect pests and grain pathogens. These pests in stored grain are also linked to aflatoxin contamination and poisoning. Mycotoxin contamination (especially aflatoxin and fumonisin) makes grain unsafe for food and animal feed. To address this problem, a metal silo was developed as a valid option and proven effective in protecting stored grains from attack by storage insect pests.
Metal silo is airtight; it therefore, eliminates oxygen inside the silos, killing any insect pest. It completely locks out any pest or pathogen that may invade the grains inside. CIMMYT and its partners are promoting this technology particularly in Africa and introduced to Pakistan under AIP.

In Pakistan aflatoxin contamination of maize is very common mainly due to poor drying and storage condition of maize. Farmer's awareness level on hermetic storage techniques is low. Hence, AIP is promoting the hermetic storage techniques in collaboration with NARC-Integrated pest management program (IPMP) through training of farmers on the proper use of metal silos. The prototype of different capacity of metal bins were produced and based on the ideal size and collaboration with the private sector, mass production of these storage silos will be continued.

Figure 9 display of different size metal bins prepared by NARC-IPMP for farmers distribution

Figure 10 a metal silo with 1 ton storage capacity

2.3 Enhancing the Maize Seed Sector

2.3.1 Seed micro increase for the newly introduced maize varieties

One of the major activities conducted by AIP, Maize was the start of seed micro increase of the parental lines/breeder seeds of the new maize hybrids and OPVs distributed to partners under AIP. A total of nine AIP maize partners (JPL, ICI, AAG, PSC- private ; NARC, MMRI, CCRI, ARI-GB, ARI-Quetta-public) have produced the below list of pre basic and parental seeds (Table 2.1).

Table 2.1 Breeder seed and inbred lines produced under the AIP maize during Kharif 2016

OPV/Hybrid/Parent seeds	Amount of seed produced (Kg)
TP1219	200
TP1220	113
TP1217	190
ZM 309	200
ZM401	100
CZP132011	300
CZP132001	440
TP1221	130
QPHM200	20
Various parental seeds	1318
Total seed produced	3011

These seeds will be utilized for demonstration, further seed multiplication and hybrid formation. In addition, AIP, Maize also assisted in demonstration and popularization of locally produced certified seed varieties (23 tons) to the farmers.

2.3.2 Public private partnership under AIP Maize

Currently AIP maize has 22 partners consisting of 12 private and 10 public institutions working on maize research for development in Pakistan. All these partners actively participated under the AIP's maize variety evaluation and validation network which includes sharing of performance data of different trials. In addition five private seed companies and two public research institutions extended their services to AJ&K, GB and Balochistan provinces as well as to the tribal areas through the partnership and linkages created under AIP. (See appendix 16.2.4 for details on annual activities held under AIP Maize)

2.3.3 Maize travelling seminar

AIP maize in collaboration with PARC organized a national maize traveling seminar on May 22 & 26 2017 and July 24&25, 2017. The seminar was attended by a total of 35 participants from private and public seed sector. The purpose was to enhance maize production and productivity in order to meet current demand and plan for future needs.

The traveling seminar was conducted for seven days in two phases. The participants evaluated the performance of different CIMMYT maize products at the project's partner research center, located in the Punjab province which is the hub of Pakistan's yellow maize production and the major source of poultry feed. Participants visited KP province where white maize is the dominant dietary staple. During

Figure 11 Maize travelling seminar phase I- at MMRI

Figure 12 Concluding session of maize travelling seminar

the visit stakeholders were able to better understand the dynamics of major maize producing areas and future production trends. Furthermore they also able to know the various crop management technologies, adoption and utilization patterns, production constraints and dissemination of maize-based technologies.

2.3.4 National maize workshop of Pakistan

AIP, Maize component organized annual maize workshop on April, 11&13 2017 under the theme "Innovative Maize Research for Nutritional Security and Improved Livelihoods" in Islamabad. A total of 220 participants included maize stakeholders and value chain actors attended the workshop. Maize products were displayed by 20 public and private companies.

In the opening remarks of the workshop Mr. Sikandar Hayat Khan Bosan, Federal Minister for National Food Security and Research said that "lack of affordable quality seed is one of the bottlenecks of our agricultural sector and we need to strengthen our local capacity especially in hybrid maize seed production in order to enhance availability and affordability of quality maize seeds to our farmers." During the workshop, USAID Deputy Mission Director Julie Chen appreciated the activities of AIP, particularly the sharing of CIMMYT maize products to partners. Yusuf Zafar, chairman-PARC expressed his appreciation for USAID and urged stakeholders to benefit from the intervention and innovations of AIP.

During the workshop a total of 48 speakers delivered their presentations related to maize breeding and genetics, quality seed production, maize agronomy and extension, maize utilization and policy among others. Progressive maize farmers from Punjab and KP provinces and AJ&K shared their experiences. Among the participants, 22 public and private institutions, shared their annual progress and lessons learnt under AIP. The AIP partners also shared the amount of seed produced from the CIMMYT derived maize products. Certificate of appreciation and mementos were distributed to various stakeholders.

Figure 13 Highlights of workshop inauguration

3 Wheat

3.1 Increasing Wheat Production through Rapid Diffusion of new High Yielding, Rust Resistant Wheat Varieties

3.1.1 Identification and validation of newly released wheat varieties through participatory varietal selection (PVS)

The PVS is a method, which involves on-farm testing by farmers a diverse range of new varieties and provides small farmers access to new varieties. It is an effective means of rapidly identifying high-yielding and farmer-preferred varieties, while also identifying unsuitable varieties with one or more weaknesses. A total of 58 PVS trials were conducted during 2016-17 cropping season involving 15 new high yielding, disease resistant wheat varieties across KP, Punjab, Sindh, and Baluchistan provinces to validate their performances and farmers' preference locally.

On the harvest of wheat crop, yield and other parameters that also includes farmer preference were recorded and analyzed. Results from the PVS trials indicated that newly released wheat varieties offered on average 5–17% yield advantage on-farm over the popularly grown, old check varieties. Summary of yield advantage is given below (Fig. 14):

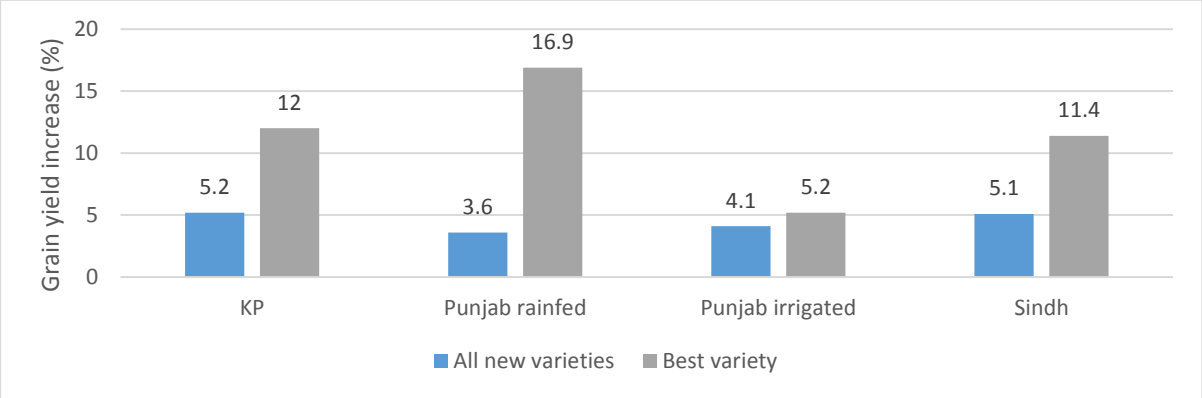


Figure 14 Province wise summary of grain yield increase (%) of new varieties included in PVS trials- average of all new varieties and the best yield (grey) among those new PVS varieties.

Pakistan-13 was preferred in the rainfed areas of Punjab, Shahkar-13 and NIFA-Lalma were preferred in KP province. Pakistan-13 was also preferred in areas with limited irrigation, as it saves the cost of irrigation due to its drought tolerance. Benazir-13, Amber, and NIA-Sarang were preferred in Sindh. Pirsabak-13 was considered the best wheat variety in irrigated areas of KP province. Grain yield of Zincole-16, a zinc-enriched variety, with 2.5 t/ha was at par with the check varieties, and more importantly, it is adapted to both rainfed and irrigated conditions. It is highly preferred for its cooking quality and taste. Ujala-16, a new wheat variety for irrigated areas, had grain yield at par with local checks. Farmers ranked Pakistan-13, Zincole-16, and Dharabi-11 as the top three varieties, considering taste, texture, and softness of roti/chapatti several hours after cooking. It is also noteworthy that wheat varieties developed through the Nuclear Institute for Food and Agriculture (NIFA), KP province and Nuclear Institute of Agriculture (NIA), Sindh province, were evaluated on-farm at this scale for the first time under AIP otherwise these institutes do not have access to large scale seed multiplication/demonstration of the varieties developed in their institues.. According to the results of these PVS trials varietal seed production plan for AIP 2017-18 has been constructed and more new varieties developed by several institutes will be evaluated on farmer's' fields.

3.1.2 Fast tracking deployment of wheat varieties for delivering genetic gains to farmers fields and buffering possible incidence of wheat rust

Farmers can benefit from improved yield potential and better disease resistance from the newer varieties because of recent advances in plant breeding methodologies, but these gains can only be realized by delivering improved varieties to farmers rapidly. A continuous flow of improved and competitive crop varieties produced by breeding programs is a prerequisite for the replacement of old and obsolete varieties to ultimately improve crop productivity and address the overall challenge of food security.

Keeping in consideration to improve competitive crop while replacing obsolete varieties a total of 2970 on farm paired plot demonstrations were conducted using Informal Research and Development (IRD) approach to fast track deployment of newly released, high yielding rust resistant wheat varieties. The program focused on 2970 smallholders including 32% women farmers. These IRD plots were conducted in 33 districts included three districts of Sindh, 16 districts of Punjab, 11 of KP and three districts in GB and Baluchistan. In Each province RSPs i.e. AKRSP, BRSP NRSP were, included as well as public and private sector partners.

Follow up surveys are already launched in collaboration with NRSP and AKRSP partners from the randomly selected beneficiaries in order to record the acceptance and uptake of these new varieties. Secondly these surveys will be also helpful to record farmer to farmer seed flow.

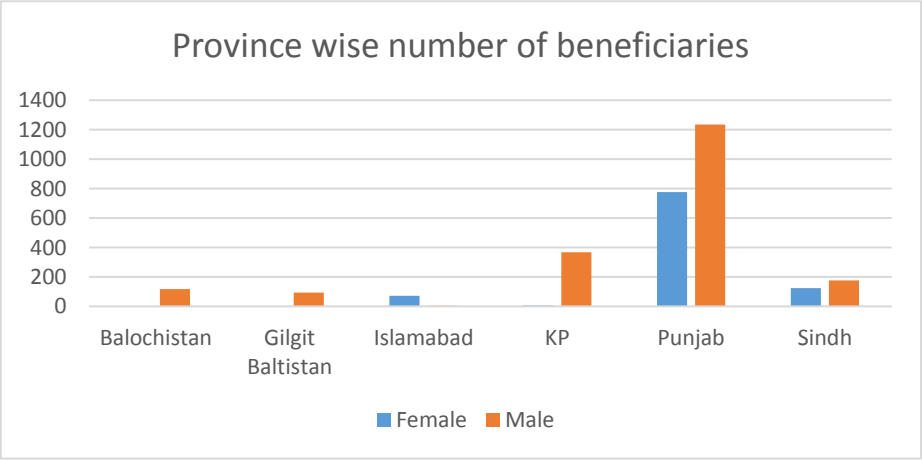


Figure 15 Summary of IRD plots beneficiaries during 2016-17

3.2 Creating knowledge on using new, quality seed and high yielding wheat varieties through Diamond Trials

A total of 50 Diamond Trials (2x2 factorial on farm trials) were conducted for demonstration purpose, to establish the importance of new high yielding and disease resistant varieties with or without certified seeds. Out of the 50 trials, 30 demonstrations plots are in Punjab province, ten in KP province and ten are in Sindh Province by involving 50 farmers. Most widely grown but rust susceptible varieties in each province were compared with new wheat variety with the objective of replacing the former by the later ones. Results of these studies revealed that the highest grain yield and highest gross profit were obtained with new varieties. Superiority of certified seed of new variety over farmer's variety was only obvious in the case of a wheat variety susceptible to rust, e.g., Sehar-06.

Table 3.1: Comparison of new and old varieties of wheat versus their CS and FSS for grain yield

Variety combinations	Mean grain yield (t/ha)						
New variety	Pakistan-13	Daharabi-11	Galaxy-13	Punjab-11	Pirsabak-13	Shahkar-13	Benazir-13
Certified Seed	2.97	3.95	4.92	4.17	3.68	2.50	3.63
Farmer Saved Seed	2.61	3.30	4.35	3.69	3.28	2.39	3.13
Farmer's popular variety	Faislabad-08	Chakwal-50	Sehar-06	Sehar-06	Pirsabak-08	Faisalbad-08	TJ-83
Certified Seed	2.56	3.63	3.85	3.87	3.14	2.36	3.28
Farm Saved Seed	2.58	3.06	3.36	3.48	3.01	2.29	2.97

The future focus should be on growing quality seeds) of new, high yielding and disease resistant wheat varieties rather than using certified seed of rust susceptible and old varieties, as demonstrated through this research. Galaxy-13, the highest yielding wheat in Pakistan is also developing susceptibility to rust, and it is important that wheat breeding research in Pakistan breeds and/or identifies wheat varieties that can out-yield Galaxy-13 with durable resistance to rust. Creating knowledge and demand for new wheat varieties on sustainable basis among farmers with an established mechanism in place to have access of farmers to new seed varieties quickly after their release will be a practical means to improve wheat productivity and enhance food security at the household level.

3.2.1 Production and provision of seeds of recently released wheat varieties through public-private partnership

During 2016-17, 322 seed growers including 10% women, multiplied seed of 18 new high yielding, rust resistant wheat varieties covering about more than 174 ha area across Pakistan. Majority of these seed growers are the part of seed groups that were established under AIP for village based seed production and marketing. Quality seed production of these new 18 varieties were achieved through public-private partnership and using the concept of village-based seed production. Majority of these activities were focused in far-flung areas and using the concept of decentralized seed production and marketing. Seed production data collected from seed producers showed that more than 500 ton quality wheat seed was produced that is available for upcoming wheat season of 2017-18. Province wise seed production is given in figure 16.

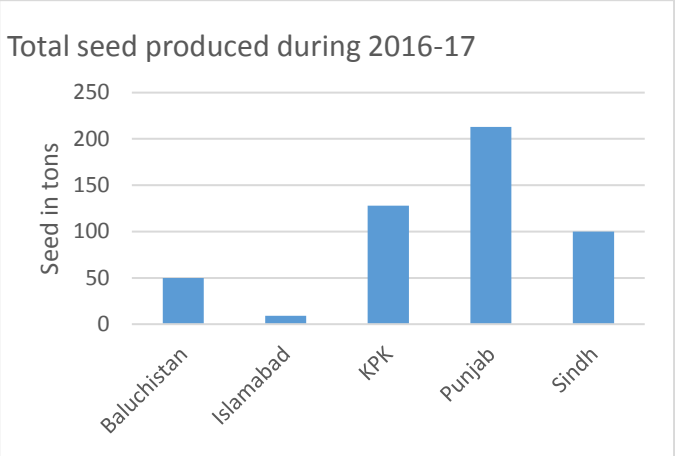


Figure 16 **Summary of province wise seed growers during 2016-17**

Seed growers were enthusiastic about the concept of decentralized seed production and marketing. The seed sale that is still pending as the wheat sale just going to be start at the end of October, 2017. This 500 ton seed will be enough to grow these new wheat varieties at more than 4000 ha in the upcoming wheat season especially in the areas where formal seed sector does not operates and thus boosting wheat productivity in those areas.

3.3 Effective Fungicides Introduced, Evaluated and Registered for Controlling Wheat Rusts

Figure 17 Seed production plots of **new wheat varieties at farmer's field of Gujjar Khan**

3.3.1 Yield loss Assessment of wheat due to rust disease using fungicides

Following two year studies by AIP during 2014-2016 cropping seasons on reducing grain yield losses in case of rust epidemics in wheat using fungicides, 31 on-farm demonstrations on two most efficacious fungicides Nativo and Tilt were conducted. In Nowshera district ten fungicide demonstration were conducted in collaboration with CCRI while one demonstration was conducted at NARC. Similarly, 20 fungicides demonstration were conducted in Faisalabad and Bahawalpur districts with the support of WRI, Faisalabad and RARI Bahawalpur. The demonstration trails were conducted as superimposed trials. Farmers grown varieties susceptible to one of the rusts namely leaf,

yellow and stem rusts were selected. One acre plot of the farmers was divided into three equal portions and two of which were sprayed with Nativo and Tilt while third plot was maintained as unsprayed control. The results of these demonstration clearly indicated that, both Nativo and Tilt are effective for the control of Yellow and leaf rust disease of wheat. Based on results it is advised to visit wheat fields frequently and spray them before rust emergence or by observing early symptoms of rusts. It was noted that pre-rust emergence spray is effective in controlling spread of the disease and is economical as well.

3.4 Development of durum wheat value chain

3.4.1 Durum Wheat National Uniform Yield Trial (DWNUYT)

AIP introduced durum wheat germplasm and tested for three years as DWNUYT which is conducted by National Wheat Coordinator, PARC in partnership with stakeholders in all four provinces. In the

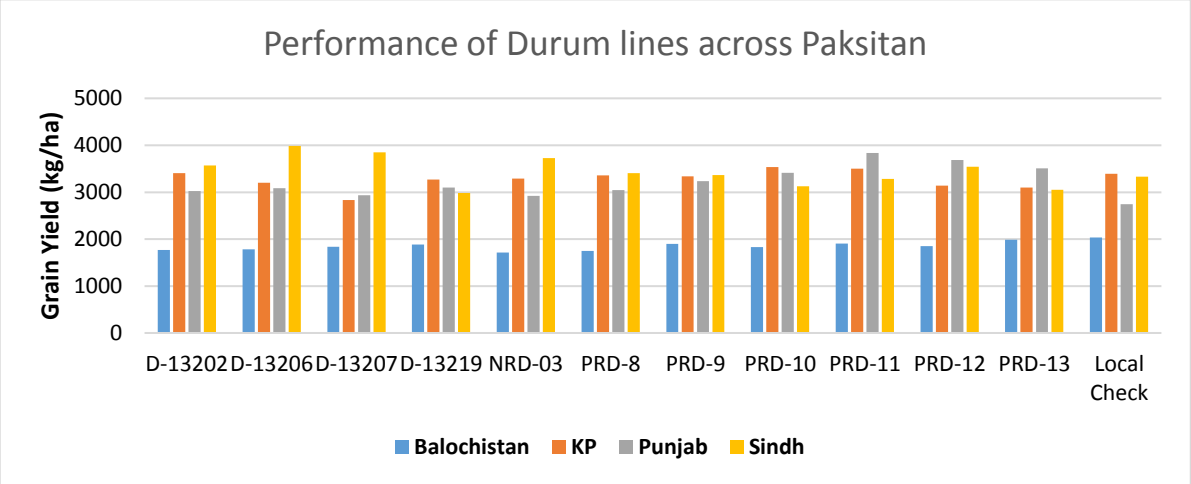


Figure 18 Province wise performance of Durum lines evaluated during 2016-17

current season this trial was conducted in 11 locations across Pakistan. A total of 11 durum wheat lines were evaluated along with 1 bread wheat check Table 3.2. Results from these trials showed that the overall mean (2789 kg/ha) of local checks is significantly lower than Durum lines (2983 Kg/ha), however the Durum lines had no significant differences among themselves for grain yield and shows a low diversity in the current germplasm. However, provinces had significant difference with Sindh having maximum mean yield 3435 kg/ha, followed by KP 3281 kg/ha. Figure 18 shows mean performance of NUDWYT lines in each province.

On the basis of results of NUDWYT it is agreed jointly with National Coordinator Wheat, PARC, and the provincial partners the best durum wheat lines evaluated in the NUDWYT will be proposed for spot examination and subsequent steps and processes to pave path for their eventual release as variety for commercial production.

Table 3.2 Detail of entries included in NUDWYT 2016-17 and locations			
S. No.	Locations of NUDWYT 2016-17	Name of entries included in NUDWYT 2016-17	Source of entries
1	NARC	D-13202	AARI, Faisalabad
2	NIA Tandojam	D-13206	AARI, Faisalabad
3	ARI, Quetta	D-13207	AARI, Faisalabad
4	NIFA Peshawar	D-13219	AARI, Faisalabad
5	WRI, FSD	NRD-03	NARC, Islamabad
6	AZRI, Bhawalpur	PRD-8	CCRI, Pirsabak
7	BARI, Chakwal	PRD-9	CCRI, Pirsabak
8	CCRI, Pirsabak	PRD-10	CCRI, Pirsabak
9	BARDC Quetta	PRD-11	CCRI, Pirsabak
10	WRI, Sakrand	PRD-12	CCRI, Pirsabak
11	RARI, Bhawalpur	PRD-13	CCRI, Pirsabak

3.4.2 Identify best wheat varieties through laboratory analysis for product based wheat and popularize those among stakeholders in Pakistan

One of the emerging concerns of the stakeholders in Pakistan is identifying wheat varieties for processing, industrial utilization for baking, making biscuits, pizza and other products. The AIP project has initially capitalized on most recently released wheat varieties for this purpose. Higher-value application in nutrition, processing and end-use quality of most recently released bread wheat varieties will be identified to meet the requirement of industries using most efficient laboratory analysis techniques and organoleptic assessment involving public and private sector.

Processing and end use quality of at least 20 recently released bread wheat varieties (released after 2010) were analyzed to find out their gluten strengthens and extensibility along with other nutritional qualities to shift the focus toward production of quality wheat.

Laboratory analysis at Grain Quality Laboratory Faisalabad and FQSRI Karachi is completed. The raw data is available and on the basis of available data, classification of varieties is under process that will be completed in the next month. Once the final results from both the laboratories would available a national workshop will be arranged to share all the findings from the research and would classify wheat varieties currently under analysis based on their suitability for different commercial products (Biscuits, Cakes, and Chapati etc.). The research protocols used will be useful for conducting wheat quality research in future in Pakistan.

3.5 Capacity building Training

A total of 622 participants representing Rural Support Program (RSP) staff (14), private seed company staff (10), seed growers (598), other farmers collaborating on various on farm research and demonstrations were trained. In the exposure visits farmer were taken to research farms of Engro Seed Company and Barani Agricultural Research Station in which they received information on different techniques and management practices that are useful for quality seed production. Furthermore, they received the information about the recently released wheat varieties. Similarly, eight field days were organized for 395 farmers to create awareness among them. Likewise, four trainings were organized for 115 farmers with the support of different partners on quality seed production. These training were helpful for the farmers who are involved in village based seed production. Farmer were equipped with the knowledge of different new techniques and methodologies that are mandatory for quality seed production.

Figure 19 A seed training organized in collaboration with NRSP on April 18, 2017 at

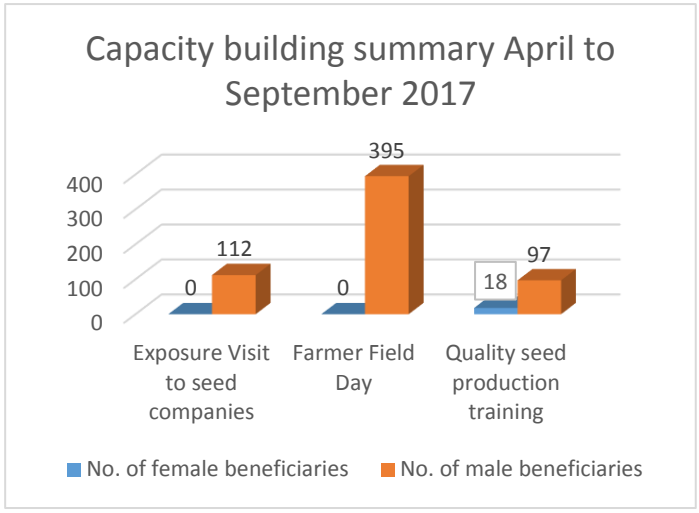


Figure 20 Summary of capacity building activities during April to September 2017

4 Agronomy

4.1 Dissemination of Conservation Agriculture Technologies

AIP agronomy has conducted demonstration of zero till planting and LASER land leveling on 150 farms. A total of 21 farmer's field days were organized for 1916 farmers in ten districts of Punjab, Balochistan and KP provinces which provided an opportunity to farmers to observe better yield. And water saving with LASER land leveling and ridge planting. It's also demonstrated the reduction in cost of cultivation in Zero tillage, saving in planting direct seeding of rice and saving in fertilizer with use of LCC in rice on their farms or fellow farmer fields.

4.1.1 Partnership for out scaling CA technologies:

AIP agronomy is collaborating with 23 national partners included 16 public sector agricultural research & extension organizations and seven private sector seed & fertilizer companies like Engro Fertilizers, Petal Seeds, machinery manufacturers like Greenland Engineers.. National partners helped in achieving the objectives of dissemination of ridge planting of wheat, ZT planting of wheat and LASER levelling, testing and local production of Multicrop DSR planter, push row planters and efficient fertilizer management techniques for wheat and rice in Pakistan.

4.1.2 Demonstration of CA technologies:

National partners helped farmers to demonstrate improved technologies on 150 farms in the target area of the project. MFSC, a collaboration of farmer committees and facilitators of the agriculture department, helped 135 farmers in the districts of DI Khan, Kohat, Tank and Nowshera on LASER land leveling of more than 225 hectares. In addition, AZRI Bhakkar, BARI Chakwal, Wheat Program NARC and CCRI Nowshera facilitated demonstration of mung planting with Zero till and conventional practice on 15 sites in the districts of Bhakkar, Nowshera, Rawalpindi and Chakwal districts of Punjab and KP provinces.

During 2016-17 wheat season, national partners facilitated 521 farmers on ZT wheat planting, ridge planting of wheat and LASER land levelling in Punjab, KP, Sindh and Balochistan provinces.

a) Farmers experienced wheat planting with zero tillage drill after the rice crop on 215 farms in the districts of Jhal Magsi and Jaffarbad in Balochistan, Thatta, Sujawal and Jacobabad in Sindh province, DI Khan in KP province and Faisalabad in Punjab province. Two Service providers in Jaffarabd district of Balochistan helped farmers in ZT planting of wheat after rice. Zero tillage wheat planting after mung / guar crop was done on 54 farms in the districts of Bhakkar, Chakwal and DI Khan. A service provider, facilitated NRSP farmers in planting wheat with ZT drill in the Bhakkar district of Punjab province. The farmers who adopted Zero till wheat have saved Rs. 7500/ha in cost of cultivation. In a rice-wheat area of Balochistan and Sindh provinces, Zero till technology helped farmers to plant wheat within 20 to 25 days which was earlier than farmer practice of broadcasting after land preparation on these poorly drained soils. As a result these farmers obtained 1.0 t/ha more grain yield. During AIP meeting held on August 2 & 3, 2017, national partners from Balochistan province mentioned that farmers purchased 300 ZT drills in this area which helped these farmers to bring 12000 acres land under zero tillage wheat after rice in 2016. Moreover, local manufacturers like Millat Engineering Shahdadkot and Amjad Brother Agri Engineering Dera Allahyar started manufacturing of ZT drill in Balochistan and Sindh provinces which will be helpful in rapid dissemination of zero till technology in rice-wheat areas of these provinces. Results shared by AZRI Bhakkar showed that farmer had 0.2 t /ha higher wheat grain yield with Zero tillage after mung bean in comparison with farmer practice in Bhakkar district. However, farmers planting wheat after guar with zero till had at par yield in comparison with farmer practice of broadcasting in Bhakkar.

Figure 21 Ridge planting of wheat in irrigated area

b) AIP, Agronomy provided seed and technical support to 224 farmers to experience ridge planting of wheat on their farms that included 16 farmers in the six districts of Sindh province, 35 farmers in the seven districts of KP province and 173 farmers in the 13 districts of Punjab province (Table 4.1). Results from farmer's field during last two years indicated that ridge planting of wheat in irrigated area of Pakistan, helped farmers to obtain 10% higher or 0.35 t / ha more grain yield, 38%, water saving and ease in irrigation management in comparison with farmer practice of broadcasting on flat surface. If this technology is adopted on one million hectare area that could help to save one million acre foot of water and it can be used to irrigate more area. Farmers adopting ridge planting of wheat got Rs. 4000/acre profit mainly from saving in irrigation cost and yield improvement.

Table 4.1. Ridge planting of wheat in various districts of Pakistan		
Province	Districts	Demonstration (No)
Sindh	Tando Allahyar, Mitiari, Shaheed Benazir Abad, Noshero Feroz, Umerkot and Thatta	16
Khyber Pakhtunkhwa	Mansehra, Kohat, Buner, Nowshera, Swabi, DI Khan and Lakki Marwat	35
Punjab	Jhelum, Sargodha, Bhakkar, Khushab, Bahawalpur, Mianwali, Bahwal Nagar, Lodhran, Vehari, Sheikhupura, Gujrat, Narrowal and Pakpattan	173

c) MFSC, provided LASER land leveler to 135 farmers in the districts of DI Khan, Kohat, Tank and Nowshera in KP province. Farmers facilitated by MFSC experienced an increase of 16% in grain yield and 29% in water saving on LASER leveled fields in comparison with not leveled fields. .

4.1.3 Dissemination and promotion of technologies through field days

National partners organized a total of 21 field days including two in Balochistan, four in Sindh, eight in the province of KP and 11 in Punjab province. The purpose of the these field days were dissemination of information of improved practices such as; LASER land leveling, ZT Happy seeder planted wheat, Zero till wheat planting after rice / mung, ridge planted wheat, Bed planted wheat and maize, planting of maize with push row planter and multicrop bed planter. Furthermore, use of green seeker for nitrogen management in wheat, LCC use in rice and direct seeding of rice through multicrop DSR planter were also highlighted in these events. These field days were attended by 1916 farmers in the districts of Jaffarabad in Balochistan province, Nowshera, Swabi and Buner in KP province, Rawalpindi, Sheikhupura, Vehari, Sahiwal, Nankana Sahib and Gujranwala in Punjab province (appendix 16.3.1) Farmers visited fields under improved practices, and adopters shared experiences with their fellow farmers and agriculture professionals that help in the process of adoption of better management techniques in wheat, maize and rice.

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

AIP, Agronomy partner, Greenland Engineering manufactures sold 150 Multicrop Zero till DSR planters to farmers in Pakistan. A total of 266 farmers used improved planters on their farms. Out of these, 35 farmers planted maize and cotton with MC bed planters, and 46 farmers planted direct seeded rice with MC Planter in Punjab, Sindh and KP provinces. In addition, 185 smallholder farmers used push row planter for maize planting in the KP province. A total of 100 farmers and agriculture staff were trained on use of small push row planter and MC bed planter for maize planting and MC DSR planter use for DSR in Punjab and KP provinces.

4.2.1 Local manufacturing of new CA planters and evaluation

a. AIP, Agronomy component imported first multicrop zero-till planter from India in 2014. Greenland Engineers in collaboration with AIP developed locally modified version of planter "Green Multicrop DSR planter" that has got acceptance by farmer and service providers in rice growing area of the Punjab province. This DSR planter has inclined plate seeding system and can drill both seed and fertilizer simultaneously, and maintain an appropriate plant to plant distance without breaking the seeds. During 2016 rice season, Greenland Engineering sold **37 multicrop** planters to rice growers across Pakistan of Rs. 120,000 per planter. During 2017 rice planting season, Greenland Engineering sold **150 DSR planters** to farming community in the country. This DSR planter had helped rice farmers to start shift from transplanting to direct seeding of rice in Punjab province.
b. AIP national partner Sharif Engineering manufactured 13 Zero till Happy seeders (ZTHS) for the farmers in rice-wheat area of the Punjab province in 2016. This technology enabled rice-wheat

farmers to plant wheat in combine harvested rice fields through one operation without burning of rice residue.

c. Sharif Engineering has modified depth wheel in ZTHS which would be used for transportation of the ZTHS from one field to other and maintenance of planting depth during planting of wheat. AIP would be sharing the 48% cost of new ZTHS with interested farmers during wheat planting season 2017.

4.2.2 Demonstration of New CA planter at farmer fields

a. National partner facilitated 34 farmers on use of Multicrop bed planter for cotton and maize planting in Punjab, Sindh and KP provinces. ARS Bahawalpur and WRIS Sakrand helped farmers on cotton bed planting with MC bed planter on 19 sites in districts of Shaheed Benazir Abad, Noshero Feroz, Matiari, Tando Allahyar, Umer Kot, Sanghar and Ghotki in Sindh province and Bahawalpur district in Punjab province. Maize bed planting with MC bed planter was also demonstrated on 15 farm on 100 acre area in Vehari, Sahiwal, Faisalabad districts of Punjab province and Nowshera district in KP province.
b. After two years of demonstrations, direct seeding of rice with Multicrop DSR planter has gained confidence of farmers in rice growing area of Punjab province. During May and June 2017, 180 MC DSR planters were used in field by farmers and service providers for DSR in rice growing area of the Punjab province in particular and Pakistan in general.
c. A total of three agriculture service providers planted rice with MC DSR planter on more than 400 acres and provided services to other farmers in Gujranwala district of Punjab province. National partners, Engro Fertilizers, RRI, AR Farms Sheikhupura and Gujranwala, helped farmers to use Multicrop DSR planter for direct seeding of rice on 46 sites in districts of Gujranwala, Mandi Bahaudin, Gujrat, Sheikhupura, and Sialkot district in Punjab province.
d. Engro Fertilizers has facilitated the use of MC DSR planter in Tando Muhammad Khan district of Sindh province. Zubair Sehol, a farmer from village Herdo Sehol in district Sheikhupura, planted direct seeded rice through MC DSR planter on 150 acres in ten days. Transplanting of rice on 50 acres with labor would take 30 – 40 days, so he saved 20 days and used this time for rice crop management. DSR technology helped him to tackle the labor and water shortage at the time of rice planting. Zubair also mentioned that during 2017 rice season, around 1700 acres of rice out of 2500 acres is under DSR technology. DSR technology helped to save Rs. 5000 per acre in planting cost with 10-15% improvement in paddy yield.
e. Petal seeds and MFSC gathered information through their network and informed AIP, agronomy component that 185 smallholder farmers planted maize with push row planter in eight districts of KP province in 2017. A total of 55 farmers used push row planter in spring for maize planting on 150 acres in KP province. For autumn maize planting 130 Smallholder farmers used push row planter on 162 acres in districts of Charsada, Lower Dir, Chitral, Shangla, Nowshera, Swabi, Mardan, Malakand in KP province and Attock in Punjab province. Farmer can plant 25000 – 28000 seed in one acre and apply 25-50 Kg fertilizer per acre with push row planter in single operation. With the help of push row planter, maize farmers planted one acre in 3-4 hours and saved Rs. 500 per acre in the form of labor saving.
f. During 2016 wheat season, Zero till Happy Seeder technology was demonstrated on 66 farmer fields in collaboration with AR Farms Gujranwala & Sheikhupura, RRI – KSK, Engro Fertilizers and WRI – Faisalabad in the districts of Gujranwala, Sheikhupura, Nankana Sahib, Jhang, Lahore and Sialkot in rice-wheat area of the Punjab province. Farmers using Zero till Happy seeder technology for wheat planting adopter saved Rs. 12500 / ha in land cultivation and planting cost and obtained 0.22 t / ha additional wheat grain yield in comparison with farmer practice of burning residue and heavy tillage. Farmers and service providers saved 14 liter diesel per acre with ZTHS technology in comparison with farmer practice.

4.2.3 Training of Stakeholders on New Seeders

AIP, CIMMYT organized training on May 05, 2017 regarding use of Multicrop DSR planter in collaboration with AR Farms Gujranwala and was attended by 36 farmers in Sialkot. On July 18, a training on use of Multicrop bed planter and push row planter for maize planting was organized for 41 staff members and farmers of MFSC in Nowshera KP province. AIP-CIMMYT in partnership with WRI Faisalabad organized a demonstration cum training on multicrop bed planting of maize in Faisalabad, attended by 23 farmers. These trainings focused on new planter use helped operators and farmers on calibration of seed and fertilizer and their operation in field. Farmers became aware about the advantages of planters like better placement of seed and fertilizer, less seed damage and reduction in planting time.

4.3 Evaluation of Conservation Agriculture-Based Crop Management Techniques Methods in Different Cropping Systems:

4.3.1 Field trials in wheat based cropping systems in Pakistan

Field trials have completed three cropping system cycle in rice-wheat, maize-wheat, cotton-wheat and rainfed wheat cropping systems in partnership with national partners namely ARS Bahawalpur, BARI Chakwal, RRI Kala Shah Kaku, and CCRI Nowshera. These trials supported validation of new techniques, improved understanding of planting techniques effects in a particular cropping system perspective. After three years, finding from these trials are summarized as under:

1. **Evaluation of Different Planting Methods/Techniques in Cotton-Wheat System at ARS Bahawalpur, Punjab:** Cotton planted with Multicrop bed planter had grain yield of 2.8-3.0 t/ha in comparison with 3.0-3.1 t/ha with manual planting on wide beds. In wheat planted after cotton, Zero till relay planted wheat in standing cotton on beds or flat surface had grain yield of 5.7 t/ha in comparison with 4.8 t/ha with farmer practice of wheat planting on prepared land after cotton harvesting. Field trails result reported by ARS Bahawalpur showed that maximum system productivity of 8.5 t/ha can be achieved with bed planting of cotton and relay planting of wheat in standing wheat
2. **Effect of Planting Techniques on the Productivity of Different Rain-Fed Cropping Systems at BARI Chakwal, Punjab:** This planting techniques (Zero tillage and farmer practice) study was conducted under mung – wheat, soybean – wheat, green manure –wheat and fallow – wheat cropping system in Chakwal. Results from the study showed that mung bean – wheat system had higher total productivity of 3.2 & 4.0 t/ha under zero tillage and conventional tillage techniques in comparison with green manure – wheat, soybean – wheat and fallow-wheat system. Mung-bean – wheat system reduced risk of crop failure through addition of 0.9 t/ha mung bean during summer season. Wheat planted after incorporated green manure crop of guar had 2.9 t/ha of wheat grain yield that was at par with fallow-wheat cropping system.
3. **Evaluation Of Different Residue Management and Planting Techniques Under Heavy Residue Environment Of Rice-Wheat Cropping System at RRI KSK, Sheikhupura, Punjab:** Three year field study on planting techniques and residue management at Kala Shah kaku in rice-wheat cropping system showed that direct seeding of rice (DSR) after tillage followed by ZTHS planted wheat in full residue had system productivity of 7.6 t/ha in comparison 6.7 t/ha with farmer practice of transplanted rice and broadcasted wheat after residue burning and heavy tillage. Basmati paddy yields were also at par with transplanted rice in comparison with DSR. However, average wheat grain yield planted with ZTHS in residue were 3.8 t/ha in comparison with 3.0 t /ha with conventional planting after residue burning.
4. **Effect of Planting Techniques such as ZT, Bed Planting and Farmers' Practice on The Productivity of Irrigated Maize-Wheat Cropping System in Nowshera District of KP Province:** In a planting technique study, maize and wheat grain yield was highest (5.1-5.4 t/ha) with bed planting on fresh bed and permanent bed with wheat residue in comparison with zero tillage and farmer

practice planting method. There was 25% saving of irrigation water with bed planting of wheat and maize in comparison with farmer practice and ZT planting.

4.3.2. Strengthening of CA research partners through capacity building and information sharing.

AIP, CIMMYT organized a national meeting on August 2&3, 2017 for agronomy partners in collaboration with PARC. The meeting was attended by 80 participants including agriculture scientists / professional from research, universities, extension, seed and fertilizer companies, machinery manufactures and farmers. During the meeting an annual progress of 23 national stakeholders regrading AIP agronomy activities was reviewed. The progress review included evaluation of new planters and crop management techniques in wheat based cropping system and their dissemination to farmers. In the opening session of the event, on August 2, Dr Ghulam M Ali, AIP Focal point and Member PARC said, that there is a need to increase per unit area productivity in crop sector as cultivated land is decreasing because of housing and degradation. Private sector active involvement in research and dissemination would also help to increase agriculture productivity in the country.

Figure 22. Inaugural session of AIP Aaronomv National Meetina 2017

Dr Md. Imtiaz an AIP Project Leader shared that so far AIP - CIMMYT collaboration with private sector resulted in local manufacturing and provision of Zero till multicrop DSR planter, Zero tillage Happy seeders and Push row planters for 300 farmers or service providers in the project area.

Imtiaz Hussain, system Agronomist highlighted that sustainable Intensification program (SIP) under AIP has reached to more than 11000 farmers in Pakistan through 1500 on farm demonstrations on zero tillage wheat after rice or legume, ridge planting of wheat, LASER levelling ; use of new planter on 870 sites including direct seeding with multicrop planter, wheat panting with Zero till Happy seeder in rice residue and maize planting with small planters; improved fertilizer management in wheat and rice on 300 farmers; training of 1900 farmers and national partner staff and 114 farmer days for dissemination of these techniques to farmers in Pakistan. In concluding remarks on August 03, Dr Azeem Khan Director General National Agriculture Research center Islamabad appreciated the efforts of CIMMYT, USAID and national partners for upscaling of environment friendly technologies for farming community in Pakistan. Furthermore, he emphasized the need of national database of resource conserving technology and said that PARC in collaboration with CIMMYT would focus on coordination that will help all stakeholders in sharing their knowledge on agronomic interventions in Pakistan. Certificate of partnership recognition were also presented by AIP to all national partners and

AIP crop management/agronomy focal points in Pakistan.

4.4 Nutrient Management

During June – August 2017, Engro Fertilizers, RRI - KSK, AR Farm Punjab, ARI Jaffarabad and WRI Faisalabad helped 50 farmers in demonstration plot on LCC use in rice crop. National partners AR Farm Sheikhupura, WRI Faisalabad, ARI Jaffarabad and RRI-KSK also trained 90 farmers on use of LCC in rice crop and distributed 400 LCC among farmers in Gujranwala, Sialkot, Sheikhupura, Faisalabad and Jaffarabad districts in Pakistan. The technologies would help in promotion of balanced and site specific fertilizer management among farming community and improve wheat productivity.

4.4.1 Evaluation and demonstration of SSNM in collaboration with national partners

a. **LCC use for N management in rice:** During autumn 2017, 50 on farm demonstration established in Gujranwala, Sialkot, Sheikhupura, Faisalabad districts in Punjab province and Jaffarabad district in Balochistan province. During last three season 2014-16, more than 100 on farm application of LCC in rice crop were conducted in districts of Sheikhupura, Faisalabad, Nankana Sahib, Sialkot and Gujranwalla districts in Punjab province and Jafarabad district in Balochistan province. Farmers saved 38 Kg N per hectare without any yield loss that was equivalent to 82 Kg of urea per ha (33 Kg of urea per acre) in LCC managed rice plot in comparison with farmer practice of general recommendation. Useful tool to reduce farmer cost of production.
b. Green seeker use for N management in wheat: AIP Agronomy in collaboration with ARS Bahawalpur, CCRI KP, WRI Faisalabad and RRI KSK evaluated crop sensor use for N (nitrogen) management in wheat during 2014-15 & 2015-16. Results from these wheat season showed that 35 kilograms of nitrogen per hectare could be saved without any loss in grain yield. This saving would be 76 Kg of urea fertilizer per hectare and farmer can save Rs. 3000 / ha in fertilizer cost without reduction in yield. AIP, Agronomy expanded its partnership in 2016-17 wheat season and 20 partners belonging to agriculture research from Punjab, Sindh, KP and Balochistan provinces; adaptive research Punjab province and private sector including NRSP and Engro Fertilizers established demonstrations on 115 fields in Punjab, KP, Sindh and Balochistan provinces. In this technique, application of Nitrogen at planting and first irrigation remains the same. At second irrigation, crop is sensed through Green Seeker and nitrogen fertilizer dose is calculated according to crop response by using NDVI and android application. In this process, a Green Seeker handheld crop sensor quickly assesses crop vigor and provides NDVI readings that are used by the urea calculator to furnish an optimal recommendation on the amount of nitrogen fertilizer the wheat crop needs. This android application has been developed by CIMMYT-India and the Borlaug Institute for South Asia (BISA) for cell phones. Results from on farm demonstrations located in the districts of Bhakkar, Bahawalpur, Sheikhupura, Nankana Sahib, Faisalabad and Vehari in Punjab provinces, DI Khan, Nowshera and Swabi in KP provinces and Jaffarabad in Balochistan province showed that farmer saved 32 Kg N/ha with precision N management in comparison with farmer practice (Table 4.2). This translates in to saving of 70 Kg urea per hectare or 28 Kg urea per acre for wheat crop in the irrigated districts of Pakistan. Dissemination of LCC use in rice crop rice-wheat cropping system

   Leaf color chart, SSNM technique, help farmers to apply Nitrogenous fertilizer according to demand of rice crop. Results from on farm LCC managed N used demonstration conducted in 2016 showed that there were no reduction in rice yield with the saving of 26 Kg urea per acre (65 Kg urea per hectare).

   A total of three training on the use of LCC for N management in rice crop were organized by AR farm Sheikhupura, RRI, KSK and WRI Faisalabad that were attended by more than 90 farmers and support staff in districts of Sheikhupura, Faisalabad and Jaffarabad. During these trainings, farmers and staff visited going on field demonstration and hands on practice in rice fields.

Table 4.2. Sensor based N management in wheat crop in various districts of Pakistan				
District	**Total N (Kg / ha)**		**Wheat grain Yield (Kg/ha)**	
	Farmer practice	**Green Seeker**	**Farmer practice**	**Green Seeker**
Bahawalpur	148	124	5.20	5.01
Sheikhupura	110	87	3.44	3.20
Nankana Sahib	144	102	4.31	4.38
Faisalabad	149	105	4.98	4.93
DI Khan, Swabi, Nowshera	137	107	4.60	4.40
Vehari	137	117	4.80	4.90
Jaffarabad	165	126	4.80	4.90
Bhakkar	138	103	3.65	3.70
Mean	**141**	**109**	**4.47**	**4.43**

5 Rice

5.1 Strengthening Breeding Program for Improved *Indica* and Basmati Rice in Pakistan

5.1.1 New Generation of High-Yielding, Stress-Tolerant, High-Quality Basmati Varieties activities at IRRI Head Quarter, Philippines

5.1.2 Genotyped IRRI elite lines with different combinations of *Xa* genes and other resistance loci

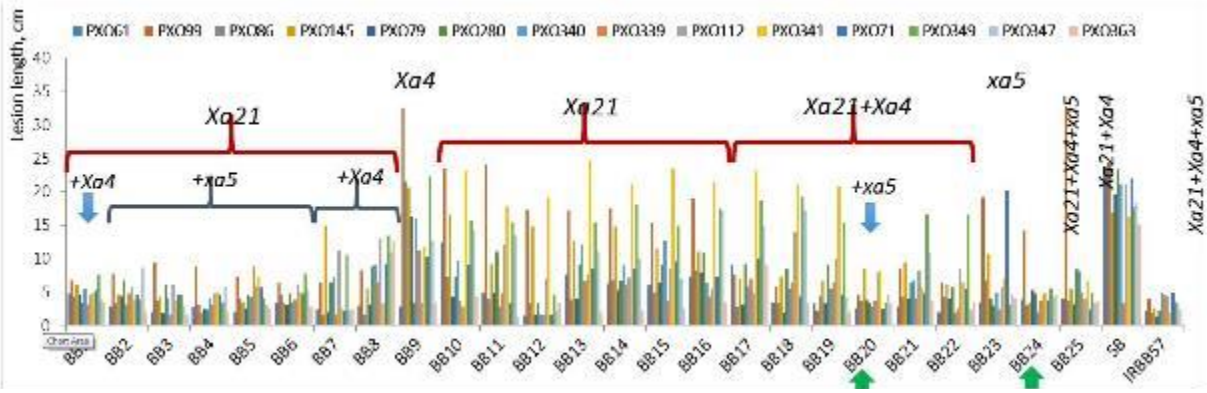
At IRRI, a set of lines for observation and preliminary yield trials (OYT and PYT) for 2015-2016 were evaluated for agronomic performance (yield, plant height, and time for 50% flowering), and the presence-absence of disease in the field. These lines were also evaluated for resistance against 14 strains of 10 diagnostic *Xoo* races based on introgression with different combinations of *Xa* genes. These advanced breeding lines were shared in 2014-2015 with partners at RRI-KSK, NIBGE, and Emkay Seeds (Pvt.) Ltd, which served as diverse donor parents for resistance to BB and other economic importance biotic and abiotic traits in Pakistan.

To determine the genotypes of these advanced lines, 104 out of the 154 elite lines were sent to two different genotyping service providers: INTERTEK and STRAIGHT BIOTECH (SB). INTERTEK genotyped traits using the following SNP markers: ten for bacterial blight (*Xa4* [3], *xa5* [1], *Xa7* [4], *xa13* [1], *Xa21* [1]); eight for blast (*Pita* [1], *Pi9* [3], *Pi54* [3], *Pi2* [1]), four for brown plant hopper (*BPH17* [1], *BPH3* [3]); and one for submergence tolerance (*Sub*). On the other hand, STRAIGHT BIOTECH genotyped traits using the following SNP markers: eight for bacterial blight (*xa5* [2], *Xa7* [2], *xa13* [2], *Xa21* [2]); one for blast (*Pita*); six for brown plant hopper (*BPH18* [3], *BPH3* [3]); and one for tungro (*RTSV).* This resource would serve as a useful genotyping platform for Basmati and *indica* rice breeding programs in Pakistan once validation of best SNP markers completed.

5.1.3 Assessment of resistance response pattern of 25 BLB resistant Basmati advanced lines against diagnostic strains of *Xanthomonas oryzae* pv. *oryzae* (*Xoo*)

At IRRI, Ms. Abha Zaka of NIBGE, Pakistan assessed the response pattern of 25 BB resistant Basmati advanced lines derived from Super Basmati and IRBB57 (*Xa4+xa5+Xa21*) against 14 diagnostic strains representing 10 *Xoo* races. Pathotyping results demonstrated that 23 out of 25 BB resistant Basmati advanced lines with different combinations of R genes *Xa4, xa5* and *Xa21* were able to restrict colonization of most of the tested *Xoo* strains causing significant reduction in lesion length. *Xoo* strain PXO99 belonging to race6 and PXO341 belonging to race10 were observed to be the most virulent

strains. However, all advanced lines were able to confer resistance against PXO61 (race 1), PXO86 (race 2), PXO145 (race 7), PXO79 (race 3B) and PXO339 (race 9a).



Resistance response pattern* of 25 BB resistant Basmati advanced lines derived from Super Basmati and IRBB57 (Xa4+xa5+Xa21) against 14 diagnostic strains representing 10 Xanthomonas oryzae pv. oryzae (Xoo) races.

5.1.4 Introgression of xa13 and natural SWEET gene mutations into Super Basmati (SB) and BB-1 for durable resistance against bacterial leaf blight

New crosses were made by Ms. Abha Zaka of NIBGE to introgress xa13 and natural SWEET gene mutations into Super Basmati and BB-1, the improved line containing Xa4 and Xa21 developed at NIBGE in partnership with IRRI to enhance the level of resistance to BLB. In the first batch, a cross was made between Super Basmati and Ejali, Khama 1183 and IRBB60 at their flowering stage. A second cross was also made between BB-1 and Ejali, Khama 1183 and IRBB60. Similarly, in the rest of the two batches, similar crosses were made at their flowering stage. F1 seeds of each cross are currently grown for further backcrosses and self-crosses for successful, stable pyramiding and introgression of Xa genes and naturally mutated SWEET genes in Basmati background.

5.1.5 New Generation of High-Yielding, Stress-Tolerant, High-Quality Basmati Varieties activities at AIP partners' Institutions in Pakistan

From IRRI breeding lines (117), NIBGE in Punjab province has selected **23** breeding lines (nine from Irrigated, three from Drought, four from Magic, three from BLB and four from SB-BLB Super Basmati) with good agronomic characters which were selected on the basis of good performance in 2015-2016 and used in breeding program for developing new varieties in 2016-17. From the 23 lines selected, six lines were with high yield and identified desirable characters and were selected for further agronomic trials in rice growing area of Punjab province. These all lines along with two control varieties (KSK133 and Super Basmati) were under testing for the year 2017.

NIBGE has developed three BLB resistant varieties BR-1, BR-18 and BR-23 by using IRRI breeding material and tested through coordinated yield trials by the PARC. The different trial locations included NARC, RRI-Dokri, Sujawal, Tandojam, Engro R & D farm, adaptive research farm Gujranwal, and NIBGE, Faisalabad. They observed an increase of 20-28% over the average yields by theses against Super Basmati during 2016 and are again under testing during the current year. NIBGE has developed 49 BLB resistant backcross inbred lines (BILs) with different combinations of three *Xa* genes for BLB resistance by using IRRI breeding material and crop. From 49 BILS developed in 2016, 36 BLB lines were selected and transplanted along with two check varieties for disease evaluation in 2017.

NIBGE is developing climate-smart crops or lines with combined bacterial leaf blight resistance, drought, and salt tolerance genes in Basmati background, through marker assisted backcross breeding approach. Eight lines are currently being evaluated for their yield performance and grain quality parameters. For salinity tolerance, Basmati quality parameters are being estimated for the F3 lines developed from the cross of FL478 salt tolerant donor line (non-Basmati) and the BLB resistant lines in Super Basmati background (developed from the cross Super Basmati x IRBB57).

Figure 23. Various AIP IRRI rice lines screening and new generation experiments at NIBGE research farm, Faisalabad.

AIP BLB lines, MAGIC lines, and Drought lines were transplanted in crossing block. Crosses were made with Super Basmati and BR-1 during the current year.

Rice Research Institute (RRI), Dokri, Sindh evaluated the IRRI breeding materials (283 lines) having submergence (submerged 15 days under water and then receded the water), drought, salinity, and heat tolerance genes or QTLs. The results of 2016 evaluation indicated that many lines carrying submergence tolerance in the background of Sabitri Sub1 (Nepal) and IR6-Sub1 showed higher yield potential of 6200-7250 kg/ha than the local check varieties; DR-83 showed yield of 5000 and 5825 kg/ha, respectively. From the IRRI breeding materials carrying heat tolerance, all lines showed higher yield potential (5000-7750 kg/ha) than the local check variety IR-6 (5250 kg/ha) except one line having the lowest yield of 4250 kg/ha. All the lines selected during 2016 from the screening on the base of yield and quality were retested in the current year (2017) and were used in the crossing with local rice varieties for developing new rice varieties having desirable characteristics.

A total of 187 lines selected out of 824 IRRI lines were evaluated at RRI, KSK against biotic bacterial leaf blight (BLB) and abiotic (flood/submergence, drought, salinity and heat) stresses tolerance, yield potential and grain quality. Of the selected lines, 101 were high yielding elite, 53 were Super Basmati bacterial leaf blight (BLB) resistant, 23 tolerant to drought and salinity, and 10 lines of IR-6 Sub1 for submergence tolerance. These lines were used to develop 42 new fresh crosses during 2016 for BLB resistance and submergence and salinity tolerance, and high yield at RRI-KSK. Pre-selected 187 IRRI lines along with new crosses made in 2016 were planted in 2017 for evaluation.

Soil Salinity Research Institute, Pindi Bhattian selected 65 lines form the lines provided by IRRI in 2016 and were planted in 2017 for screening in the salinity block having two salinity levels (6.0 Ece dS to 18.0 Ece dS-1) which were developed by adding the salt sodium chloride keeping one level normal Ece3.5 dS-1. After 15 days, mortality data was recorded. The second set of screening trial was transplanted in the field having natural salinty at Soil Salinity Research Institute, Pindi Bhattian farm. These lines were also evaluated for BLB. For Yield and BLB evaluation nursery of 30 additional IRRI lines selected during 2016 were transplanted in the field for evaluation.

Seed Research and Development Farm of Engro Fertilizer, Sheikhupura evaluated IRRI provided 164 lines having BB Resistant and Zinc Fortified lines with some other varieties/lines like Indian varieties (Sharbatti, Pussa Sogandha, Duplicate Basmati, Pussa 1509 & Pussa 1401), NIBGE (BR 1, BR 18 & BR 23), GSR 1 & GSR 2), NIAB (like Noor Basmati, & old one IR – 9), Rice Research Institute, Kala Shah Kaku (PS – 2, Basmati.515, Punjab Basmati, Chenab Basmati & Kissan Basmati, PK – 386, IR-6, KS – 282, KSK – 133, KSK – 434 with Basmati Super as a local check) varieties under natural conditions of BB hot spot at Seed & R and D Farm. Some IRRI lines and NIBGE variety BR-1 (developed by crossing basmati rice with IRRI lines by NIBGE) showed resistance against BB and having good quality cooking characteristics.

Figure 24 Screening of AIP IRRI lines at Research and Development Farm of Egro Fertilizer Pvt Ltd.

Emkay Seeds (Pvt) Ltd Sheikhupura, Punjab done the Screening of 26 IRRI developed drought tolerant lines. The irrigation was stopped to initiate the stress after 50 days of sowing. Data on stress was noted at 10.00 am, at noon (12.00) and 2.00 PM on September 20, 2017 when moisture level of soil was much reduced.. The four lines were marked as drought tolerant in our climatic condition, and were crossed with basmati varieties/ lines to develop drought tolerant Basmati varieties for Pakistan. The seeds of these lines will be multiplied for direct sowing in bigger blocks. . A total of 34 lines having Sub-1 gene developed by IRRI scientists were screened against eight and 15 days' submergence. After eight days submergence, few plants were severely damaged, and after 15 days of submergence most plants were severely damaged. There were only six plants (Sub.1-6, Sub.1-11, Sub.1-15, Sub.1-23, Sub.1-25, and Sub.1-46) which have showed tolerance to submergence.

Figure 25 Screening of IRRI-developed lines for Submergence tolerance.

5.2 Up-scaling of high yielding New Rice Varieties

5.2.1 Up-scaling of High-Yielding Basmati 515 Variety in Punjab

For the up-scaling of high-yielding basmati 515 variety in Punjab, ten metric ton (10 MT) certified seed of Basmati 515, was distributed in collaboration with Engro Fertilizer Pvt Ltd, Mojaz Foundation, and Extension department to 1000 rice farmers . Each farmer received 10 kg bag of rice. These farmers are from basmati growing areas of Punjab province.

Figure 26 Seed distribution free of cost among rice growers for the promotion of new varieties in Punjab.

5.2.2 Up-scaling of High-Yielding New Variety Sawati 14 and and Fakhre Malakand in KP, Province

Under AIP, Rice component distributed a certified seed of 250 kg among 50 rice progressive growers in KP province with the collaboration of ARI, Mingora, Swat. The objective was to introduce the cold tolerant, early maturing, disease resistant, better grain quality rice variety Swatai 2014 in high altitude rice growing areas and Fakhre Malakand in plains of Malakand division using DSR method of rice cultivation. Data on comparison of new varieties with old will be shared in final report after harvest of all plots.

Figure 27. Inputs Distribution among farmers

5.2.3 Up-scaling of High-Yielding New Variety in Sindh Province

A total of 130 farmers received 2600 coarse rice seed in upper Dokri and larkana and lower Sindh (Thatta and Baden etc) with the collaboration of RRI, Dokri, Sindh for DSR demonstration plots.

Figure 28 Seed distribution free of cost among rice growers for the promotion of new variety in Sindh.

5.3 Improved Crop Management

5.3.1 Extension of dry-seeded rice (DSR) at farmer's field

Dry-seeding of rice (DSR) technology was demonstrated on 5000 acres in different rice ecologies (2043 acres in Nankana, 1000 acres in Sheikhupura, Sialkot, Narowal, Hafizabad districts of Punjab province, 130 acres in the district Thatta, Larkana of Sindh province and 50 acres in the districts Swat, Dir, and Malakun KP province with the help of public and private sectors. Previous field results have shown good rice crop establishments planting at the rate of 30-40 kg/ha giving 50,000-200,000 fertile

seedlings per ha. In DSR, 10-20% yield increase, was obtained over conventional puddled transplanted rice (PTR) with 25-30% water saving. Crop also matured in 10-15 days earlier than conventional PTR.

5.3.2 Extension of alternate wetting and drying techniques (AWD) at farmer's field

As the application of Alternate Wetting and Drying (AWD) technology reduces water use therefore water measuring pipes will be manufactured locally and will be used in farmers' fields to irrigate the rice field by monitoring water levels inside the pipe. It is planned to place more than 300 water pipes in farmers' fields and monitor water levels and number of irrigations during the growing season of year 5.

A total of 100 demonstration plots of AWD on an area of 900 acres (700 acres in Nankana Sahib and 200 acres in Sheikhupura) were established at farmers' field in Punjab province in 2017. Data from

Figure 29 Demonstration of AWD at farmers' field.

depicted that maximum 36% water saving was recorded with AWD on average of 20-25% water reduction. AWD fields have 3-5% higher yield as compared to conventional irrigated fields and practices. For the year 2017, data on yield increment and economic benefits would be shared after harvesting the crop.

5.3.3 Extension of Drum-seeder demonstrations at farmer's field

Drum-seeder demonstrations were conducted on an area of 30 acres in Punjab and KP provinces. Data on yield increment and economic benefits would be shared after harvesting the crop.

Figure 30 Demonstrations of DSR and Drum-seeder at public institutes and at farmers' field

5.3.4 Demonstration on Optimum Plant Population Management (OPPM)

Basmati 515 was used in 200 acres of OPPM demonstration by most of basmati growers in rice core areas where seed was distributed to the farmers. Details will be shared in the final report with conventional yield comparison.

Figure 31 Demonstrations of Optimum Plant Population Management (OPPM) per unit area.

5.4 Capacity Building of Rice Researchers and Extension Officers

5.4.1 Training of Researcher from AIP partner Institutes on molecular plant pathology

5.4.2 Molecular Characterization of *Xoo* Population into Races through DNA analysis

An intensive training on "Molecular characterization of *Xanthomonas oryzae* pv. *oryzae* populations through DNA markers" was conducted for Dr. Hafiz Muhammad Imran Arshad, Senior Scientist from NIAB, Pakistan. From August 9-29, 2017, Dr. Imran was immersed into protocols, tools, and working knowledge for quick DNA sampling using FTA cards, fast identification of Xoo DNA by loop-mediated amplification, traditional DNA extraction of microbial DNA, sequencing and sequence manipulation, sequence comparison for relevant SNP identification, primer design, and PCR.

5.4.3 Molecular Characterization of BB-Resistant Basmati Rice Mutants and Breeding Lines

A training was conducted on August 9 to 29, 2017 on "Molecular characterization of BB-resistant Basmati rice mutants and breeding lines" which was hosted by Dr. Muhammad Rashid, Principal Scientist from NIAB, Pakistan. During this period, Dr. Rashid was trained for *Xa* gene marker validation, and SNP genotyping techniques and their breeding applications, population diversity analysis, population structure, and genome-wide association studies.

5.4.4 Harmonizing tools and strategies for disease resistance improvement and standardization of phenotyping protocols for bacterial leaf blight of rice

On September 5 to 14, 2017, the Host Plant Resistance to Diseases (HPRD) group hosted a training on "Harmonizing tools and strategies for disease resistance improvement and standardization of phenotyping protocols for bacterial blight of rice". Standard protocols for phenotyping rice resistance to bacterial leaf blight were shared with two participants, Ms. Halima Qudsia, Assistant Research Officer, Plant Pathology and Ms. Tahira Bibi, Assistant Research Officer, Plant Breeding and Genetics Group of RRI, KSK, Pakistan.

5.4.5 Training of Rice Researchers for Hybrid Rice Technology

A training was organized from September 12 to October 13, 2017 for rice researcher on hybrid rice technology in Pakistan. A total of 30 participants (15 from public and 15 from private institutions) across four provinces of Pakistan attended this training. They learned about how to develop the hybrid rice varieties and their seed production. The main topics included : Hybrid rice development in China, Hybrid rice genetics & breeding, Hybrid rice seed production technology (worldwide experience), Hybrid rice cultivation technology, Hybrid Rice Status and varieties for different regions, Hybrid Rice Business and future Prospectus, Hybrid Rice Seed Production (China nationwide experience). In addition to the training field visits were arranged to visit the rice research institutions, Seed companies' research farm and farmers' field across four provinces of Pakistan.

Figure 32 Nursery for Blast Screening (a), Blast Inoculum Spray (b), and BLB Hot Spot in Pila Town

5.4.6 Develop a cadre of young, well trained scientists and extension officers

AIP rice component, organized specialized training courses with the collaboration of partners for 200 researchers, extension officers, and progressive growers about resource saving (DSR, AWD, Drum-seeder) rice production technologies in Punjab and KP provinces. They learned about disease and insect management, harvest and post-harvest management issues (100 at Soil Salinity Research Institute, Pindi Bhattian and 100 at ARIMingora Swat, KP province.

Figure 33 Capacity building training at ARI, Mingora Swat and SSRI, Pindi Bhattian

5.4.7 Farmers' Trainings and Field days.

To popularize the resource saving (DSR, AWD, Drum-seeder) rice production technologies trainings / field days were arranged for 2000 rice growers about new variety adoption, resource saving (DSR, AWD, Drum-seeder) rice production technologies. Trainings were imparted to these rice growers through meetings, field visits and group discussions at each stage of rice crop. Farmers were trained on land preparation, laser leveling, variety/seed selection, sowing of DSR, OPPM, AWD, proper and appropriate fertilizer management, weeds identification and proper and appropriate use of weedicide according to the weed species, insect and disease control.

Figure 34 Seed treatment (a), spray of weedicide (b), and AWD (c) field activities by farmer-trainees.

5.4.8 Training for Women on rice transplanting labor

Among the major constraints of low rice yield in Pakistan, one is the low plant population (50,000-60,000 hills/acre) per unit area than recommended (80,000 hills/acre). Trainings were organized for 225 women laborer working in rice fields. The purpose of these trainings was to increase the young cadre of skilled women working in rice fields by enhancing their skills, that how to grow healthy rice nursery, uprooting, and transplant optimum rice plant population per unit area to get higher wages and get higher rice grain yield. They were informed how to make a contract to get wages per plant/m2 (unit area) instead of per acre or hectare bases. By adopting this contract, women laborer will get higher rate of wages for rice transplanting and farmers' by spending 1000 rupees/acre more, can get additional benefit of Rs. 5000 from the increased production per acre.

Figure 35 Trainings of the laborers especially women working in the field for rice nursery uprooting and transplanting.

6 Socioeconomics (SEP)

Under AIP, SEP seven surveys were completed to document the effect of AIP interventions in the cereals and cereal systems.

6.1 Wheat Follow up Survey

AIP, SEP completed Wheat follow up surveys in the Punjab and Sindh provinces. Stratified random sampling technique was employed to select eight districts on the basis of general food security and moderately food insecurity level, from the Punjab province. While selecting the district, certain aspects were particularly considered for understanding the status of the district which included irrigated or rainfed conditions and the presence of the baseline farmers in these districts. For more detail on the sample selection in Punjab province table 6.1 is given below. Among the 274 respondents, 74% were assisted beneficiary (IRD, mother trial and seed production) farmers, 15% were non beneficiary farmers and 11% were baseline farmers; 11% were female respondents.

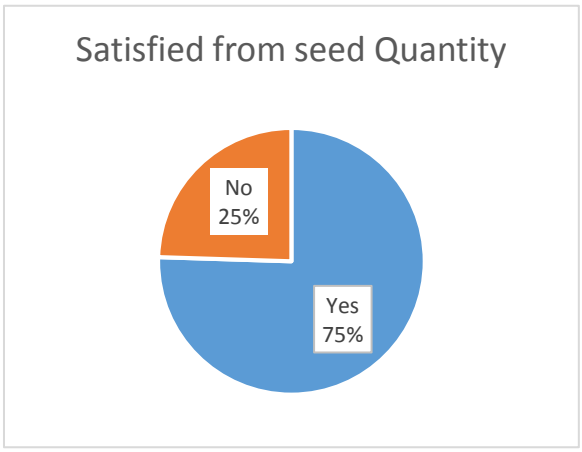
Figure 36 Follow-up survey in Sindh

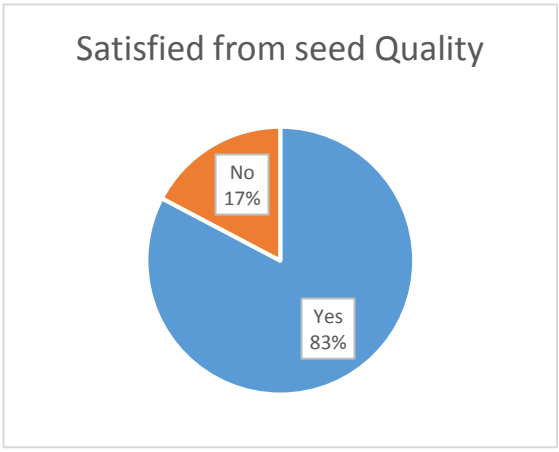
AIP, wheat component distributed seed bags to 12480 male farmers and 4650 female farmers under the IRD program. For mother and baby trails 1076 males and female farmers received seed of 100-150 Kg. Similarly for seed production 1044 males and females farmers received seed of 50-150 Kg each while for Diamond trials 10-25 Kg certified seed of old and new variety was provided to the farmers.

Table 6.1: Sampling Distribution from the Punjab Province					
District	Beneficiary	Non beneficiary		Total	Percentage
		New	Baseline		
Attock	28	5	0	33	12
Bhakkar	28	4	0	32	11.6
Chakwal	28	4	9	41	14.9
Hafizabad	21	5	5	31	11.3
MB din	21	6	0	27	9.8
Rawalpindi	26	5	3	34	12.4
RY Khan	28	6	9	43	15.6
Sargodha	24	5	5	34	12.4
Total	204	40	31	275	100

The farmer's satisfaction level was assessed by taking information on the quantity sufficiency and quality of seed they have received. Approximately 75% beneficiary farmers were satisfied with the quantity of seed while 82 percent were satisfied from the quality of the seed as shown in the below figures. The quality includes different parameters like color, taste, kneading the dough and chapatti making. As per the satisfied farmers the AIP promoted variety is good in all these quality attributes while the other variety is not good.

The results indicated that beneficiary farmers have 5-15 % higher wheat yields which can be attributed to good quality seed provided and distributed through AIP project. These higher wheat yields leads to higher food security levels, higher household incomes (rupees 3000-4000) per acre while less poverty levels. For poverty calculation head count index of poverty was used and the poverty levels were less





for the beneficiary households in the range of 2-3%. The cost benefit analysis was carried for the comparison of AIP variety with the, beneficiary farmers own variety as well as non-beneficiary farmer's variety. The cost benefit ratios was highest for the AIP variety i.e. 1.90 followed by beneficiary farmers own variety i.e. 1.7 followed by non-beneficiary farmers variety i.e. 1.67.

The changing climatic conditions especially the occurrence of the winds and hailstorm were affecting the wheat crop in the form of lodging and yield loss especially in rain fed areas. The beneficiary female farmers have more information about agricultural practices i.e. 58 % while the information level of non-beneficiary female's farmers was only 45 %. The more information of the beneficiary female farmers is also due to AIP interventions include trainings and awareness programs.

AIP, SEP completed wheat follow up survey in the Sindh province during May, 2017. A total of 150 farmers were interviewed from the Sindh province. The sample comprised of 54.6 % assisted beneficiaries and 68 45.4% non-beneficiary farmers. About 18% of the respondents were female's farmers. The data was collected from six districts of Sindh i.e. Hyderabad, Mitiari, Tando Allah Yar, Tando Muhammad Khan, Umerkot and Benazirabad. The sampling details from the Sindh province are presented in the below table 6.2

Table 6.2 : Sampling Distribution from the Sindh Province					
District	Beneficiary	Non Beneficiary		Total	Percentage
		New	Baseline		
Hyderabad	16	4	3	23	15
Tando Allah Yar	25	5	8	38	25
Tando Muhammad Khan	19	7	0	26	17
Matiari	0	7	8	15	10
Umer Kot	21	6	0	27	18
Benazirabad	1	6	14	21	14
Total	82	35	33	150	100

The yield of the AIP variety was higher in the range of 10-13%. The higher yields leads to higher food security levels (4-5%), higher household income (Rs. 3700-4800) per acre and less poverty levels (3-4 %). The AIP beneficiary farmers have the highest cost benefit ratios i.e. 2.01 followed by the baseline farmers i.e. 1.74 and new non-beneficiaries i.e. 1.67.

A total of 88% farmers were satisfied with the seed quality and 81% were satisfied with the seed quantity. It indicates that farmers were satisfied from seed appearance, germination, growth of crop as well as yield. Satisfaction from seed quantity indicates that the quantity of the seed provided by AIP project was sufficient to meet the needs. TD-1 was found the most popular variety with average yield of 37.4 mounds per acre. Only one third of the farmers reported that females have knowledge about different agricultural activities.

6.2 Economic Impact of Maize Germplasm in Pakistan

AIP maize component has distributed germplasm to the public and private partners across Pakistan over the last four years. , The SEP program has designed a questionnaire for data collection from the partners to document the economic impact. Currently the data collection is in progress from all the Public and private sector maize partners. After data collection the entry and analysis will be carried out by using the SPSS software.

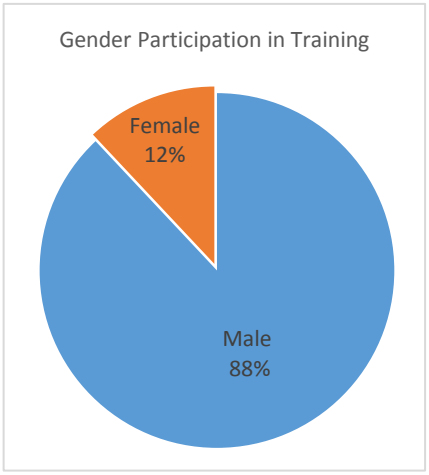
6.3 Developed Electronic Data Collection Tool

AIP, SEP developed an electronic data collection tool by using ODK (Open Data Kit) software for the study entitled “Feasibility of the quality protein maize (QPM) in Pakistan”. The electronic data collection method has a number of advantages over the conventional paper based method. It does not need paper based questionnaire. The questionnaire can be designed according to the need and number of checks can be applied for the data accuracy. The data can be entered and stored simultaneously and analysis can be done easily. The information on GPS locations and images can also be collected. The data collected can be synchronized to a local cloud server which can provide easy access to aggregated data. The future plan is to out-scaled this tool to the national partners of the country and provide associated training how to use ODK.

6.4 Capacity Building

AIP, SEP organized training on May 23 & 24, 2017 regarding “Orientation to SPSS and STATA” in collaboration with University of Swat at Kanju campus. A total of 104 participants included 12% female from the faculty attended the training as shown in the figure. The concluding session was chaired by the vice Chancellor, who appreciated the efforts of the USAID, AIP, and CIMMYT in the capacity building of the faculty members. The trained faculty members will further impart training to the

students which will help them in their research work. The SPSS and STATA software were distributed among all the participants.



7 Competitive Grants System

PARC was entrusted the responsibility to establish Provincial Boards in KP, Sindh and Balochistan provinces and manage province-inclusive Competitive Grants System (CGS). Proposals were invited for CGS through advertisement in the leading newspapers. A number of research proposals were received in March 2015 from all the provinces. Despite of significant efforts made by PARC-CIMMYT, Agriculture Research Boards in the provinces could not established due to lengthy legislative process and other technical issues including lack of interest at the provincial level. As a result PARC mandated CGS component of AIP was delayed and could not materialized well in time.

In the absence of these boards, with the consent of USAID it was agreed that CGS will be implemented in the provinces through CIMMYT in partnership with PARC and the process of funding competitive grants was re-initiated again in April 2017. This will also strengthen national coordinated system and enhance collaboration between federal and provincial institutes.

Total 292 research proposals were received in AIP Secretariat and Punjab Agriculture Research Board (PARB) from all the Provinces. These include 169 from Punjab, 80 from Khyber Pakhtunkhwa (KP), 37 from Balochistan, and 6 from Sindh. Keeping in view the priority areas, a preliminary screening was done by a technical committee comprising of PARB representative, COP AIP, Members of the Council, relevant coordinators from PARC and subject expert from AIP. Total 66 projects were shortlisted from all the provinces, of these 17 were from livestock and 49 were from the crop sector.

A CGS committee meeting headed by Chairman PARC was held on August 8&9 at PARC headquarter. It was attended by all the stakeholders from Punjab, KP, Sindh and Balochistan including

USAID representative. All the PIs presented their projects to CGS committee members. Of these 40 projects were finally selected by the CGS committee from all the four provinces including GB.

The USAID Mission Director and Chairman PARC awarded 40 research grants to Pakistani Researchers and scientists to improve the productivity and livelihood of small farmers in livestock and crops through USAID-funded AIP (Appendix 16.4). The competitive grants award ceremony was organized jointly by AIP, CIMMYT and PARC on September 13, 2017 at NARC Auditorium. The USAID mission director was the chief guest of the CGS award ceremony which was attended by the key representatives from the Agriculture Sector including public and private sector organizations, PIs of the wining proposals. While the sub-grant agreement with PIs institutes is in process, the project started from October 1, 2017 with expected duration of two years' time.

8 Monitoring and Evaluation (M&E)

AIP Monitoring and Evaluation unite is committed to ensure monitoring and evaluation of the project activities. The project has outperformed and achieved above the target. AIP-M&E collected data on MSF outcome indicators on quarterly basis and reported to USAID on PakInfo. AIP targeted a total of 10,000 beneficiaries in reporting period 85% men and 15% women. Furthermore, data on component outcome indicators were collected and reported to higher management (see M&E appendix 16.5).
Third party evaluation of AIP is in progress by MSI. Assistance was provided in access to beneficiaries, public and private partners in all provinces. A number of meetings were held with MSI managements and other staff assigned to review process to make them understand the nature, spread, and implementation models of the AIP.

9 Personnel Management

AVRDC and UC Davis closed their operations under AIP in March 2017 and all staff were compensated accordingly. Under AIP, Livestock one of the Research Associate (RA), Mr. Zahid Manzoor, appointed for Punjab province resigned as from August 2017 to take up a Dairy Manager position in Karachi, Sindh province. Livestock component completed most of the activities in AJ&K, therefore, M. Shakeel Ashraf will take over on-going activities in Southern Punjab. Furthermore, seven final year students (interns) from UAF (five DVM and two Economics) completed their three months internship program with AIP-Livestock. As from September 2017, two DVM intern students joined AIP, Livestock from University of Agriculture Peshawar.
AIP Maize, has appointed a new Research Associate (RA), Mr. Amir Maqbool, for Sahiwal field office. In addition AIP maize RA also attended an international two weeks training on ""Increasing genetic gains in maize breeding through integration of novel tools and technologies" held in June 2017 in Nairobi-Kenya. A total of five Pakistani participants attended the training. During the reporting period, AIP Wheat Improvement specialist Krishna Dev Joshi completed his assignment period and left for his home country Nepal. Under AIP, Mr. Abdullah joined as an accountant in Islamabad, he has also completed his probation period. Mr. Waheed has resigned from RA Maize position to join as seed/training consultant position in FAO. TraiNet was also successfully managed by Dr. Md. Imtiaz AIP-COP working as an R2 for USAID. Student's data studying in US under AIP-UC Davis project were uploaded by COP. During last six months all AIP sponsored master students completed their studies and returned to Pakistan.

10 External Factors

- Due to changes to USAID-CGIAR agreement, the flow of the AIP last tranche of fund was delayed and obligated in September 2017. Now the expected receipt of the fund is in November/ December 2017. This caused a slowdown in some of the AIP activities.
- CIMMYT is facilitating PARC to take leadership on the CGS in the provinces, however, being a government system administrative bottlenecks still prevails especially in reallocating the fund

transferred to PARC for CGS under the new arrangements of fund transfer through CIMMYT Pakistan.

- Favorable environment in all provinces to execute livestock activities, except FATA (only minor activities such has forage seed distribution and monitoring, distribution of water troughs and milk cans). No issues with IRS getting NOC from MOI to visit these provinces.
- Getting visa becoming lengthy process and this affecting some of the activities e.g. for Maize resource persons coming from outside of Pakistan remains as a hurdle to conduct planned trainings under various components.

11 Challenges / Risks

- The pending INGO issues and the delay in getting NOC for the Host Country Agreement between GoP and ILRI have created the hindrance in actively working with livestock farmers in FATA. However, AIP-livestock has started their activity through the collaborators and/or aligned departments to reach the small herders in the most difficult of part of Pakistan.
- Under the AIP, Rice the following major challenges faced by public and private sectors during the promotion/implementation of DSR in their respective Districts are:
    - Technical Expertise for operating the drills: operating a DSR drill effectively, in particular its calibration, is a sensitive skill that has direct impact on germination rate. Some of the tractor drivers and their helpers are not expert in the effective operations of the seeding drill machine.
    - Germination: A number of factors like un-leveled field, germination of last year dropped seed, rainfall immediately after or before sowing.
    - Weed/Pest Control: Weed is a major challenge in DSR due to non-puddling of soil. Unavailability of appropriate herbicide for controlling three noxious weeds of DSR such as Leptochloa chinensis (Ghorra Ghass), Dactylactenium aegyption (Madhana Ghass), and Eragrostis japonica (Bansci ghass) was also a challange.
    - Disease Control: Blast (Magnaporthe oryzae) and Brown Spot (BS, Bipolaris oryzae) diseases have more attack on DSR fields as compared with transplanted rice. Rice blast is generally more severe on upland or in water-limited condition than on flooded fields. Brown spot is also generally favored in water-limited condition.
- Under AIP, SEP, a challenge was to trace out and collect information from the baseline farmers as many farmers have changed their mobile numbers and some have also relocated/migrated to other areas.
- Another challenge was to develop Open Data Kit (ODK) electronic tools for the data collection but AIP, SEP team successfully developed ODK for electronic data collection. To collect data from the female farmers was a challenge and to overcome this problem, female enumerators were hired.
- In case of fungicide demonstrations if there was no rust attack the purpose of demonstration will not be accomplished as in case of Punjab Province.
- Security risks particularly in KP, Sindh and Baluchistan remains a concern for local and international scientists for free mobility and visits of each and every demo plots.

12 Contribution to USAID Gender Objectives

- AIP encourages the participation of women in all possible ways. Considering the remoteness of the villages in the hilly terrains of Muzaffarabad district, hardships faced by women to bring

the sick animals for treatment, and the access time to the Veterinary offices. AIP-Livestock was requested to assist in training of women master trainers to play an intermediate role in emergency animal health care. A tailor made two days intensive hands-on training program for 15 women farmers from eight villages was conducted. The participants were also provided 'Animal Health Kits' which contained the essentials for emergency treatment for common diseases.

- The availability of inferior breeding bucks and farmers preferences to sacrifice their best animal for Eid after castration of male bucks; further worsen the prevailing conditions. Therefore, AIP-livestock in collaboration with KWC conducted baseline survey for 30 female small ruminant herders in the district Bahawalpur.
- Under AIP, Livestock component organized female livestock farmer's capacity building program on September 12, 2017 in collaboration with LD&DD, Punjab and KWC, Bahawalpur in the district Bahawalpur. More than 600 female livestock farmers were participated this program. AIP-livestock has distributed specially design, innovative and food graded water troughs (345) and milk in cans (241) to ensure sustain as well as hygienic milk production in Pakistan.
- AIP-Livestock in collaboration with KWC organized a breeding buck distribution ceremony on May 13, 2017 for the deserving small ruminant herders (poor and widows) villages of the district Bahawalpur. More than 1000 participants with 90% females] attended the event. AIP-Livestock purchased the selected superior bucks (Beetal – Faisalabadi and Makhi Cheeni) were reared at University of Agriculture Faisalabad, and distributed the bucks to 30 deserving female farmers on the agreement that the buck will be shared with other neighbors who are rearing goats. AIP-livestock there were 21 demonstration plots headed by female livestock farmers mainly widows and poor covering >7 acres of cultivated area in six Union councils of the district Bahawalpur during July 2017.
- Under Agronomy In collaboration with national partners, 31 women experienced improved techniques in the area.
- In the training carried out in collaboration with University of Swat about 12 percent of the participants were females.
- AIP Maize, is evaluating protein and vitamin A enriched maize varieties in Pakistan. Apart from their grain yield advantage these germplasms will provide protein and other crucial micronutrients with particular importance to women and children to mitigate malnutrition and attendant diseases. Under AIP, Wheat component, ensured participation of women as Seed beneficiary for in the capacity building activities which is 23% during this reporting period compared to 12% during 2014-15 (Figure 6).

Under AIP, Rice component the female research and extension officer were encouraged to participate in the capacity building training programs of resource saving modern rice production technologies. In this regard two hundred and twenty-five (225) Women laborer were trained, for rice nursery uprooting and transplanting, to get a chance to work as a skilled laborer. Two female scientists Plant Breeding and Genetics Group of Rice Research Institute, KSK, participated in training of Harmonizing tools and strategies for disease resistance improvement and standardization of phenotyping protocols for bacterial leaf blight of rice at International Rice Research Institute (IRRI), Philippines.

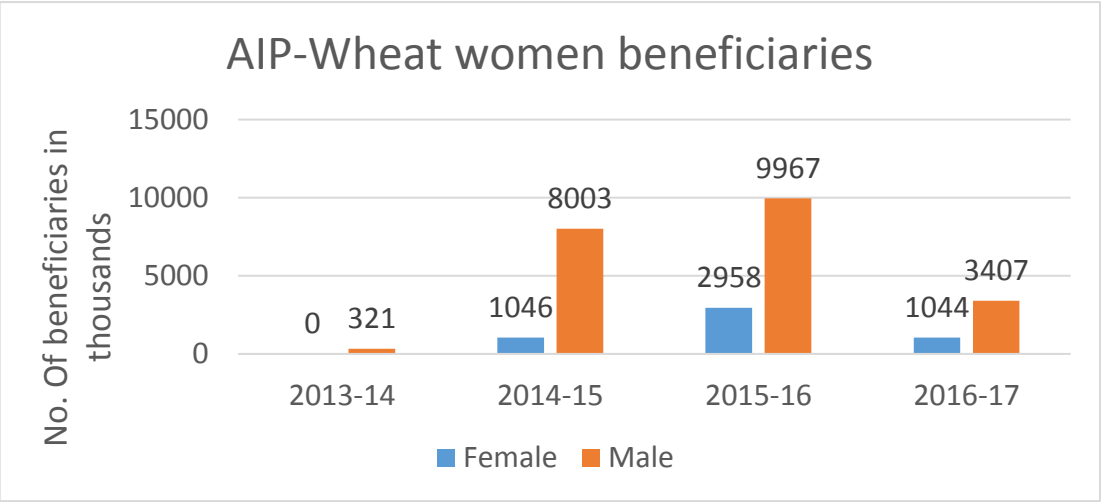


Figure 7 Fig. 6 Women participation on various activities of wheat component of AIP in 2016-17 compared to last three year

13 Environmental Compliances and Climate pro-Practices

AIP agronomy is disseminating improved techniques like Zero tillage, ridge planting of wheat, upscaling of new planters like Bed planter, Multicrop DSR planter, Zero tillage happy seeder and push row planter and precision nutrient managements. These new techniques helped farmers to reduce tillage, water and fertilizer use, avoid burning of residue and ultimately improve environment through reduced GHG emissions.

Under AIP, Maize, most of CIMMYT's maize germplasm are climate smart varieties which can best perform under stress environments. CIMMYT's germplasm which 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, hence, they don't need additional inputs or extra environmental/biosafety care as compared to germplasms developed through non-conventional ways.

In agriculture, nitrous oxide is emitted when people add nitrogen to the soil through the use of synthetic fertilizers and it is volatized into the atmosphere. The impact of one pound of nitrous oxide is 300 times as potent as one pound of carbon dioxide. AIP is evaluating nitrogen efficient maize to reduce the need for fertilizer. The target is to reduce the use of chemical nitrogen fertilizers by 75% and to get a comparable grain yield with well fertilized soils. For instance, if the current nitrogen application is 200 kg per ha, these varieties are expected to perform well with the application of only 40-50 kg per ha. These varieties will not only save farmers money, but could potentially significantly reduce greenhouse gas emissions.

Similarly, varieties included under the stem borer tolerant trials will have significant environmental impact by avoiding or reducing chemical pesticides. Based on field evaluation partners identified best adapted low nitrogen stress and stem borer tolerant maize varieties. The identified varieties will be allocated to partners under the AIP program for registration, further seed scale up and dissemination.

AIP wheat popularized newly released, rust resistant and high yielding wheat varieties, farmer's responses from post-harvest assessment of new wheat varieties provided basis for the replacement of old and obsolete varieties by new ones ultimately minimize the use of pesticides. Few varieties have drought tolerance and require less water. This practice remained effective with water shortage. There is no adverse environmental impact of growing these wheat varieties in Pakistan.

All IRRI breeding material (germplasm) are improved indica and Basmati rice having different biotic (Bacterial Leaf Blight, BLB) and abiotic (submergence, heat, drought, salinity) stress resistance/tolerance genes. Most of IRRI breeding material (germplasm) are climate smart varieties/lines which can best perform under stress environments. IRRI's germplasm which are tolerant to heat, submergence, and drought (water stress) will benefit farmers living in hot, drought

(water scarce) environments and flood prone areas. In addition, all IRRI breeding materials which are under evaluation at varying private and public institutions in Pakistan were developed through conventional breeding techniques, hence, they don't need additional inputs or extra environmental/biosafety care as compared to germplasms developed through non-conventional breeding techniques.

In Asia including Pakistan major rice establishment method is transplanting rice nursery in puddled fields and kept the soil flooded for major part of its growth period. Flooded rice fields produce approximately 20–40 Mt of CH_4 per year, or about 10–12% of anthropogenic emissions from the agriculture sector globally. CH_4 has Global Warming Potential (GWP) 25 times higher than CO_2. Alternate wetting and drying (AWD) the rice field can reduce water use by up to 30%. AWD is assumed to reduce methane (CH_4) emissions by an average of 48% compared to continuous flooding (IPCC, 2006). Direct seeding of rice is done by three methods dry direct seeding, wet direct seeding and water seeding. Dry-seeding of rice (DSR) is sowing of dry seeds into dry soils. Irrigations were applied with intermittent intervals and there will be no standing water during the whole period of crop growth. It can reduce CH_4 emission from 24 to 79 per cent with 40-44 per cent decline in GWP. Therefore, AIP-Rice are introducing the climate smart and environment friendly varieties and rice production technologies which will conserve the resources and have a greater contribution in protecting the environment from climate change

14 Communications:

In this reporting period AIPs' communications highlighted the program interventions which included arranging successful events, persuasive stories and maintaining media presence. Under AIP, due emphasis has been given to communicate the project activities to local and international stakeholders following the branding and marking guidelines of USAID. Some of the mediums used to communicate the AIP activities are listed below:

- Publications (research papers, certificates, newsletter , one-pager, banners, standees, backdrops)
- Social Media (Flicker, Facebook, Twitter)
- Web-media
- Events

Branding material of Maize, Wheat, Agronomy, Rice and Livestock was produced according to USAID branding and marking guidelines. These include banners, backdrops and standees for various events under these components. (See Communication appendix 16.6)

14.1.1 Dawn Agri Expo 2017:

AIP participated in Dawn Agriculture Expo 2017, organized annually by the DAWN Media Group in Lahore on April 04-05, 2017. This expo serves as an awareness platform for all business and government sectors, directly or indirectly involved with agriculture and food industry of Pakistan. AIP had displayed the published communication material of its all components and interventions include wheat & maize varieties, drip irrigation system at stall which was visited by thousands of visitors and framers from across the country. A special newspaper supplement report was published to document this expo:

http://agri.dawn.com/wp-content/uploads/2017/04/Food_&_Agri_REDUSE_SIZE_2017.pdf
http://agri.dawn.com/

14.1.2 AIP Media Visit:

USAID under its communication program has organized a visit of media personnel, journalist from mainstream print & electronic media, to highlights and document the interventions and achievements of the USAID funded-Agricultural Innovation Program at NARC premises. Partners of the AIP participated in the event and interact with media. Brief presentation of AIP, components' stalls and field visit followed by interviews and media coverage were the key activities during the visit.

Media coverage of the visit:

https://drive.google.com/open?id=0BygPKtNOdVhIWE1sWWZfWHVHQzA

15 Lessons Learned

The following are the lesson learned during the reporting period:

- Disease attack on the DSR plots is due to high plant population and dry conditions (less water applied).
- 100 demonstration plots of AWD on an area of 900 acres (700 acres in Nankana Sahib and 200 acres in Sheikhupura) were also established at farmers' field in Punjab during the year 2017. Data from 2014-2016 depicted that maximum 36 percent water saving was recorded with AWD with an average 20-25% water reduction. As AWD crop did not lodge, AWD fields have 3-5 percent higher yield as compared to conventional irrigated fields and practices. Kahrif season is more preferred than spring season for seed production due to the thermal heat that affects pollen shading and viability during spring season.
- Training on seed production and parental lines maintenance is important.
- Hermetic storage and maize stem borer mass rearing facility for the national uniformity trials is very important.
- Grain yield of majority of new wheat varieties is not distinctly superior to most popularly grown wheat varieties. This is an important feedback to national and international wheat breeding research communities.
- Integrating organized, semi-organized and informal seed systems is the best way of strengthening wheat seed system in Pakistan with proper quality control safety nets in place
- Pre rust emergence spray of fungicides is effective in reducing yield loss from rust is 45%-50%.
- Genetic diversity for grain yield in durum wheat lines included in the DWNUYT is limited and there is a need to look for new germplasm with more wider genetic base.
- Under AIP agronomy the Maize planting with push row planter has gained acceptance among smallholders farmers in KP province. For its adoption, partnership established with Petal Seeds and 100 planters distributed to farmers and service providers on cost sharing basis.

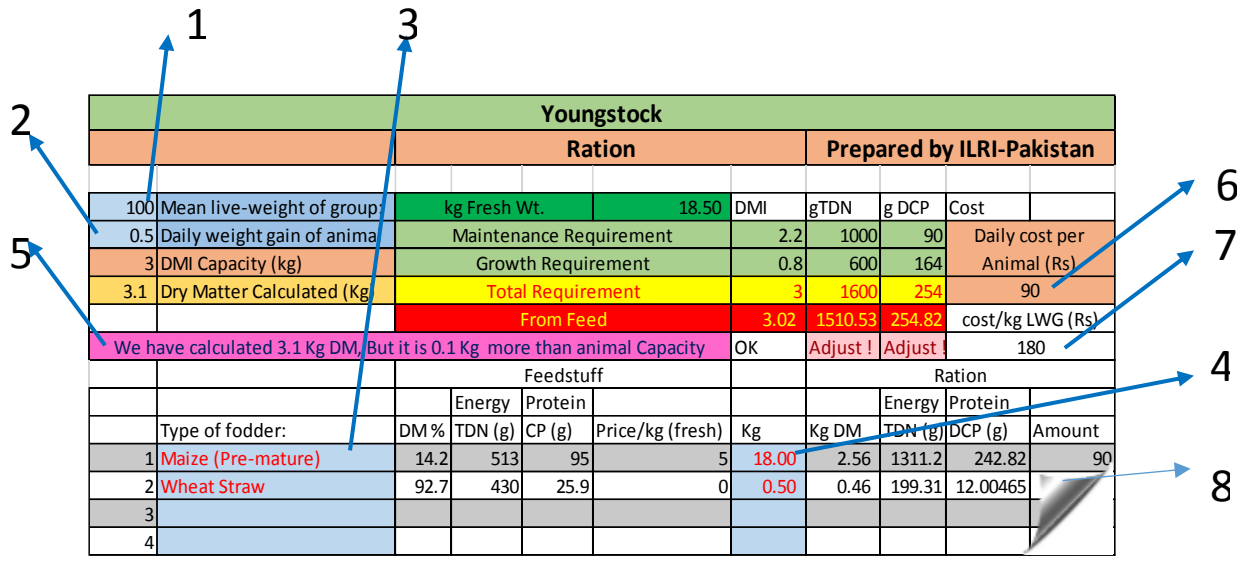
16 Appendices

16.1 Livestock

Development of Innovative Tools for Balanced Rationing for Feedlot Farming Industry in Pakistan:

This program comprises upon eight basic steps. These are;

1. Enter mean weight of animals
2. Enter mean daily weight gain of animals
3. Select the available feed from drop down menu
4. Enter the quantity of feed
5. Read the row carefully, “Adjust” indicates to manipulate the amount of feed (4) in such a way all (DMI, gTDN and gDCP) convert to “ok”
6. Shows daily cost per animal in rupees
7. Shows cost per kilogram of live weight gain in rupees
8. Turn the page to enter feed prices



16.2 MAIZE

16.2.1 AIP-maize partners participated in the evaluation of spring maize trials (2017).

The trials listed below also included biofortified maize varieties which will be discussed in the next section.

No	Partner name	Province	Ownership	No. of trials
1	Jullundur Private Limited (JPL)	Punjab	Private	5
2	Four Brothers Group (4B)	,,	Private	2
3	Ali Akbar Group Pvt (AAG)	"	Private	1
4	ICI-Pakistan (ICI)	"	Private	5
5	Tara Crop Sciences Pvt (TCS)	"	Private	3
6	Kanzo Quality Seeds Pvt (KQS)	"	Private	2
7	Sohni Dharti International Pvt (SDI)	''	Private	5
8	Hi Sell Seeds Pvt (HiSS)	,,	Private	2
9	Maxim International	''	Private	2
10	Maize and Millet Research Institute (MMRI)	Punjab	Public	5
11	Cereal Crops Research Institute (CCRI)	KPK	Public	7
12	National Agricultural Research Institute (NARC)	ICT	Public	7
13	University of Agriculture, Faisalabad (UAF)	Punjab	Public	2
14	University of Agriculture, Peshawar (UAP)	KPK	Public	1
15	Muhammad Nawaz Sharif Univ. of Agriculture	Punjab	Public	1

16.2.2 List of biofortified maize hybrids evaluation in Pakistan

Evaluation of heat stress No	Trial Name/code	Trial description	No of entries	No. of reps	No. of sets	Remark/Seed source
1	16TTWCWN	Advanced three way cross white hybrids	36	3	2	CIMMYT Mexico
2	17CHTPROA	Provitamin A enriched yellow maize hybrids	25	2	2	Biofortified maize from CIMMYT Mexico
3	17EIHYBY	New set of single cross yellow hybrids adapted to subtropical environment (early to intermediate maturity)	30	2	2	CIMMYT Mexico
4	16TLXTWN	Intermediate maturing single cross white hybrids	72	2	2	CIMMYT Mexico
5	EHYB17	Early/extra early maturing white hybrids	50	3	4	Widely adapted stress tolerant germplasm with

						tropical and temp. introgressions from CIMMYT Zimbabwe
6	IHYB17	Intermediate maturing white hybrids	50	3	5	Widely adapted stress tolerant germplasm with tropical and temp. introgressions from CIMMYT Zimbabwe
7	LHYB17	Late maturing white hybrids	36	3	6	Widely adapted stress tolerant germplasm with tropical and temp. introgressions from CIMMYT Zimbabwe
Total			299		23	

16.2.3 Summary of climate resilient maize trials conducted during spring 2017

No	Trial Name/code	Trial description	No of entries	No. of reps	No. of sets	Remark/Seed source
1	02-16TTWCWN	Advanced three way cross white hybrids	36	3	4	CIMMYT Mexico
2	03-16TTWCYN	Advanced three way cross yellow hybrids	36	3	3	CIMMYT Mexico
3	16TLXTWN	Intermediate maturing single cross white hybrids	72	2	8	CIMMYT Mexico
4	16TLXTYN	Intermediate maturing single cross yellow hybrids	72	2	4	CIMMYT Mexico
5	16TSCTWCYN	Elite single and three way cross yellow hybrids	28	3	1	CIMMYT Mexico
6	EHYB16/17	Early/extra early maturing white hybrids	55	3	11	Widely adapted stress tolerant germplasm with tropical and temp. introgressions from CIMMYT Zimbabwe
7	IHYB16/17	Intermediate maturing white hybrids	64	3	13	Widely adapted stress tolerant germplasm with tropical and temp. introgressions from CIMMYT Zimbabwe
8	LHYB16/17	Late maturing white hybrids	55	3	13	Widely adapted stress tolerant germplasm with tropical and temp. introgressions from CIMMYT Zimbabwe
9	SXHT17	New single cross white kernel hybrids	42	2	6	Widely adapted single cross white hybrids from CIMMYT Zimbabwe
10	MLT-HTMA	Heat stress tolerant hybrids	20	2	9	CIMMYT-India
Total			480		72	

16.2.4 Events Calendar for Meeting Held

S. No.	Meeting Name	Date	Purpose	Person Responsible	Venue	Partners	Brief Outcome
1	National maize workshop of Pakistan	11-13 April 2017	Review of Pakistan's maize sector	Maize improvement and Seed System specialist	NARC and Ambassador Hotel, Islamabad	PARC, AIP maize partners as well as maize stakeholders of Pakistan	AIP maize progress and achievements shared, the first maize exhibition conducted, further networking created and existing one strengthened among value chain actors. ,
2	CIMMYT Pakistan management committee meeting	20 April. 2017	Country office management updates and discussion on staff related issues	CIMMYT country rep	NARC/CSI committee room	CMC members	Updates on office operations and staff related matters.
3	GMP Seed roadmap meeting	8-13 April 2017	Meeting on seed roadmap development	Maize improvement and Seed System specialist	Kathmandu-Nepal	GMP south Asia colleagues	Discussion on GMP activities in SA
4	National maize travelling seminar Phase I	22-26 May 2017	Evaluation of spring maize and interaction with partners.	Maize improvement and Seed System specialist	Various partners sites in central and southern Punjab, Pakistan	AIP maize partners from all provinces of Pakistan and other value chain actors	Experience sharing and lessons learning on production progress and constraints of maize in Pakistan
5	International maize training	19-29 June 2017	New skills and knowledge on maize technology and advances	Five AIP maize partners from MMRI, CCRI, UAF and Pak Hi-Bred Plc	Nairobi-Kenya	CIMMYT-Kenya	Knowledge on double haploid techniques and advances in maize breeding
6	USAID media event	18 July 2017	To create publicity on the activities of AIP	AIP team	NARC	Local media and USAID	Sharing of AIP activities to the public
7	National maize travelling seminar Phase II	25-26 July 2017	Evaluation of maize and interaction with partners.	Maize improvement and Seed System specialist	Various partners sites in KPK nad ICT, Pakistan	AIP maize partners from all provinces of Pakistan and other value chain actors	Experience sharing and lessons learning on production progress and constraints of maize in Pakistan

16.3 Agronomy

16.3.1 Detail of Field days organized in Pakistan under AIP Agronomy.

S.No	Partner	Event Title (Training/Exposure Visit, Field day etc.)	Date	District	Participants
1	ARI - Balochistan	Zero tillage wheat planting	02.04.2017	Jaffarabad	55
2	AR Farm Sheikhupura	Zero till happy seeder planted wheat	03.04.2017	Warburton, Nankana sahib	106
3	AR Farm Sheikhupura	Zero till happy seeder planted wheat	04.04.2017	Jandiala, Sheikhupura	102
4	AR Farm Vehari	Field day on bed planting of Maize	05.04.2017	AR Farm Vehari	273
5	AR Farm Vehari	Field day on Green seeker N management in wheat	05.04.2017	Vehari	156
6	AR Farm Gujranwala	Field day on ZTHS planted wheat	06.04.2017	Ghakkar, Gujranwala	36
7	AR Farm Vehari	Field day on ridge planting of wheat	06.04.2017	Sahiwal	117
8	ARI-BARDC	Zero tillage wheat field day	07.04.2017	Jaffarabad	38
9	NARC - Wheat	Wheat planting in mung-wheat system	10.04.2017	Gujar Khan, Rawalpindi	112
10	AR Farm Gujranwala	Field day on ZTHS planted wheat	15.04.2017	Ghakkar, Gujranwala	92
11	CCRI	Field day on AIP Agronomy Trials	18.04.2017	Pirsabak, Nowshera	94
12	NRSP	Field day on GS N management in wheat	19.04.2017	Swabi	26
13	MFSC	Field day on Laser Land Levelling	28.04.2017	Azakhel, Nowshera	72
14	ARI-BARDC-Balochistan	Zero tillage wheat in Balochistan	06.05.2017	Quetta / Jaffarabad	145
15	MFSC – KP	Field day on Ridge Planting & GS N Management	09.05.2017	Pirsabak, Nowshera	88
16	MFSC - KP	Field day on Ridge Planting	18.05.2017	Maini, Swabi	55
17	AR Farm Sheikhupura	DSR field day	22.09.2017	Sheikhupura	79
18	MFSC – KP	Field day on mechanized maize planted field	25.09.2017	Nowshera	75
19	MFSC – KP	Field day on mechanized maize planted field	25.09.2017	Nowshera	75
20	WRI - Faisalabad	Direct seeding of rice & LCC field day	28.09.2017	Nankana Sahib	68
21	MFSC – KP	Field day on push row planted maize	30.09.2017	Buner	52
					1916

16.3.2 Details of training / meetings held during April – September 2017

Partner	Event Title (Training/Exposure Visit, Field day etc.)	Date	Location	Participants
AR Farm Sheikhupura	Training on LCC use in rice	08.05.2017	Dera Gujaran, Sheikhupura	11
WRI - Faisalabad	Leaf color Chart use in rice crop training	26.07.2017	Raza Nagar Bhawana, Chiniot	59
AR Farm Sheikhupura	Leaf color chart use in rice training	28.07.2017	AR Farm Sheikhupura	18
AR Farm Gujranwala	Multicrop DSR planter use for rice planting training	05.05.2017	Vario, Sialkot	36
MFSC	Push row planter and bed planter use for maize planting	18.07.2017	MFSC farm, Nowshera	41
WRI - Faisalabad	MC Bed planter training	07.08.2017	Chak 39/JB, Faisalabad	23
PARC - CIMMYT	AIP Agronomy: National Meeting - 2017	02.08.2017	Islamabad	81
RRI-KSK	National Partner Meeting: Rice-wheat area of the Punjab	26.05.2017	RRI-KSK	34

16.4 Competitive Grants funded under AIP-PARC component in the provinces

Livestock Projects
Balochistan
Comparing of Daily Weight Gain Ability of Cross Breeds of Balochistan Nari Master, Bagh Nari and Red Sindhi Male Young Stocks on Feeding of Same Ration at Beef Production research Centre Sibi Balochistan
Detection of mycotoxin in poultry feed of Balochistan and its bio-control biodegradation with the help of probiotic bacteria in feed formulation
Enhancement and promotion of silage making for efficient dairy farming in rural areas of Balochistan
Khyber Pakhtunkhwa
Optimizing the Utilization of Maize Silage in Smallholders and Commercialization of Dairy and Fattening Rations in Relation to Feed-Use Efficiency, Animal Performance and Farm Profitability
Development of rapid and cost-effective assays for the diagnosis of prevalent echinococcus species in Pakistan
Punjab
Effect of Different antibiotics and Steroidal Residue in Meat of Chicken and their effect on Humans in Punjab, Pakistan
Development of rapid and sensitive test for on-site diagnosis of Pest des Petits Ruminants (PPR) disease

Enhancing nutritive value of Camel milk by introducing Camel milk cheese sweats and dried cheese powder
Investigating potential risks of zoonotic transmission of antibiotic resistant bacteria at human-animal interface
Sindh
Conservation and Screening of genetic diversity of Pateri goat and financial empowerment of poor farmers through its rearing.

Crop Sector Projects
Punjab
Induction of blight and virus resistance in tomato
Identification of climate resilient chickpea genotypes for mitigating impacts on yield potential
Strengthening of Mash germplasm for identification of high yielding and disease resistant genotypes
Vegetable nursery production and supply system for kitchen gardening
To identify the areas where waste water is the only available source for irrigation and to propose the alternate crops other than vegetable crops for growing under waste water
Demonstration and Management of Citrus Scab and Citrus Canker Though Balanced Nutrition at Farmers Field
Best Cotton Picking Practices for Female Workers Using Mechanical Hand Picker
Control of Some Potential Rodent Pests Using Eco-Sustainable Technologies For Crop and Indoor Environments in the Selected Agro-Ecological Zones of Punjab, Pakistan
Balochistan
Establishment of Vegetable Seed Bank at ARI, Quetta
Development and Indigenization of techniques and procedures for developing certified fruit plant nurseries
Boosting irrigation system efficiency of apple orchards in Ziarat
Enhancement of Groundnut production through Agronomic Techniques in Quetta Zone
Development of post-harvest technology to increase shelf life of fruit and vegetables
Efficient Use of Water and Crop Production Through Laser Land Leveling Technology in Balochistan
Sindh
Natural Variation for grain nutrient concentration, proteins and dietary fiber of different wheat varieties under different agro ecological regions of Sindh
Establishment of high value fruit and vegetable nurseries in Sindh
Enhance maize yield in Sindh through introduction of climatic resilient maize hybrids/OPV

Integrated nutrient Management for improving production and quality of strawberry in Sind
Boosting banana production through tissue culture of high yielding varieties
Establishment of colonal repository of coconut and its propagation for upscaling in coastal areas
Khyber Pakhtunkhwa
Molecular based genetic divergence in indigenous common bean of Himalaya Pakistan
Optimizing water and nitrogen application through hydropriming, moisture stress and slow released fertilizer in wheat
Increasing productivity of vegetable crops in district Swabi through comparative research program
Integrated approaches to manage parasitic weed Broomrape (Orobanche sp.) in major cash crops in KPK and Balochistan provinces
Developing aquaponics system to produce safe, organic food in a sustainable and environment friendly way
Sustainable control of apple scab
Production of off-season vegetable in Siran and Konsh Valleys of district Mansehra
Research and development of pome fruits rootstock production in the agro climatic conditions of Mansehra
Evaluation and identification of high yielding winter wheat genotypes
Gilgit Baltistan
Maize Productivity Enhancement Through development and dissemination of area specific improved production technologies in G.B

16.5 M&E

Progress on output indicators during the reporting period

Indicator	Beneficiaries
Number of farmers linked with/benefiting from agriculture extension services through scaled up extension system	3811
Number of improved production and agriculture management technologies/practices transferred/made available to farmers	2498
Number of demonstration plots/farms/trials established for farmers' awareness on improved agriculture technology and management practices	2264
Number of farmers received information on improved agricultural management practices through demonstrations/field days/trials	14322
Number of farmers and others getting assistance (sperm,) ruminants up take and , seed villages, seed partners, new seed varieties/cultivars/rootstock of cereal, horticultural and agronomic crops transferred to farmers) supported/established to disseminate seed of improved high yielding varieties.	3116
Number of farmers linked with input/service providers for improved production services/inputs	3505

Number of new breeding lines/cultivars/rootstock of cereal and horticulture crops at development stage	722
Number of partnerships developed with input suppliers/companies for development of production inputs/services (PPR vaccine, Semen, new varieties)	22
Number of training events arranged for interventions under different value chains	7
Number of farmers linked with public/private business development service providers (Input supply facilities, industries) through established partnerships	3461
Number of farmer selling products (cereals, vegetables, fruits, milk and small ruminants) value added , production cost decreased a as a result of Project interventions	3202
Number of workshops carried out to disseminate new and improved agricultural products	4
Number of new/improved products identified and disseminated through value chain interventions	3
Number of entities (including national scientists, academics, value chain actors etc.) received training on concepts of value chain	66
Number of training events arranged in agriculture production and management (livestock, cereals and horticulture) on skill improvement of farmers, NARS scientists, extension workers and others	30

16.6 Communication

16.6.1 Radio Show:

A radio show from Peshawar station was aired in May 2017 to highlight USAID efforts in the agricultural sector in Pakistan through AIP:

- https://www.facebook.com/USAIDPakistan/photos/a.440871662600387.101186.440868732600680/1464395940247949/?type=3&theater
- https://soundcloud.com/user-492007892/1-usaid-radio-show-aap-hun-our-behtar-zindagi-part-1-11-05-17
- https://soundcloud.com/user-492007892/1-usaid-radio-show-aap-hun-our-behtar-zindagi-part-2-11-05-17

16.6.2 AIP Scholars' on USAID social media:

Two very persuasive stories were posted on USAID's Facebook page related to AIP funded scholars:

- https://www.facebook.com/USAIDPakistan/photos/a.440871662600387.101186.440868732600680/1569185749768967/?type=3&theater
- https://www.facebook.com/USAIDPakistan/photos/a.440871662600387.101186.440868732600680/1569983886355820/?type=3&theater

16.6.3 Agronomy:

AIP agronomy has publicized its following activities:

- New planters promote environmentally-friendly farming in Pakistan: http://www.cimmyt.org/new-planters-promote-environmentally-friendly-farming-in-pakistan/
- Cross-sector collaboration needed to boost wheat production in Pakistan: http://www.cimmyt.org/cross-sector-collaboration-needed-to-boost-wheat-production-in-pakistan/
- AIP – Agronomy National Meeting – 2017 was covered in several newspaper across the country. http://pakobserver.net/cimmyt-provide-zero-tillage-happy-seeder-farmers/ http://dailytimes.com.pk/islamabad/03-Aug-17/parc-usaid-organise-national-meeting-on-conservation-agriculture

http://par.com.pk/news/parc-trains-100000-farmers-in-last-4-years
https://www.pakistanpoint.com/en/pakistan/news/parc-through-aip-trained-about-100000-farmer-170649.html
http://par.com.pk/news/cimmyt-to-provide-zero-tillage-happy-seeder-for-farmers
https://profit.pakistantoday.com.pk/2017/08/14/parc-trains-100000-farmers-in-last-4-years/

16.6.4 Maize:

Under AIP maize due emphasis has been given to communicate the project activities to local and international stakeholders following the communication guidelines of USAID. The following mediums were utilized to communicate the AIP maize activities:

- CIMMYT *News (http://www.cimmyt.org/press_release/delegates-discuss-new-quality-protein-maize-at-pakistan-workshop/)*
- CIMMYT News (http://www.cimmyt.org/maize-biofortification-fights-malnutrition-in-pakistan/)
- CIMMYT News (http://www.cimmyt.org/breaking-ground-abdurahman-beshir-is-revitalizing-pakistans-maize-sector/
- CIMMYT News (http://www.cimmyt.org/public-private-partnerships-boost-maize-productivity-in-pakistan/)
- http://fp.brecorder.com/2017/04/20170412167419/
- http://www.parc.gov.pk/index.php/en/2014-01-22-03-27-22/11-news-events/1438-parc-cimmyt-usaid-hold-national-maize-workshop-to-review-progress-and-future-plan
- https://www.usaid.gov/pakistan/news-information/press-releases/usaid-make-pakistan-self-sufficient-maize-seed-production
- http://nation.com.pk/islamabad/12-Apr-2017/national-maize-workshop-kicked-off
- http://nationalcourier.pk/business/innovations-agri-sector-reducing-poverty-level-bosan/
- https://twitter.com/i/web/status/851754932671795202
- https://pakistannewsindex.com/%EF%BB%BFusaid-to-make-pakistan-self-sufficient-in-maize-seed-production/
- http://leadpakistan.com.pk/news/usaid-to-make-pakistan-self-sufficient-in-maize-seed-production/
- http://www.pressreader.com/pakistan/daily-messenger/20170412/281977492485767
- http://tvi.com.pk/pakistan-aims-to-become-self-sufficient-in-maize-seed-production/
- https://www.dawn.com/news/1331728
- https://www.facebook.com/USAIDPakistan/photos/a.440871662600387.101186.440868732600680/1463521583668718/?type=3&theater
- https://www.dawn.com/news/1340302/capitalising-on-record-maize-production
- https://www.facebook.com/notes/usaid-pakistan/usaid-to-make-pakistan-self-sufficient-in-maize-seed-production/1435055923181951/

16.6.5 Livestock

Media Coverage on Azikheli Buffalo Beauty and Milk Competition is given below:

- http://zamaswat.net/2017/04/24/buffaloes-competition-ended-at-khwazakhela/
- https://www.facebook.com/Mashriqtvswat/videos/1312841922166489/
- http://zamaswat.net/2017/04/24/buffaloes-competition-ended-at-khwazakhela/
- https://www.facebook.com/shumalnews/videos/778485275639871/
- http://shumalnews.com/2017/04/23/swat-animals-mela/
- https://www.youtube.com/watch?v=P9QXpmDxjg4

16.6.6 AIP Livestock Publications

- To-date has produced 30 Factsheets covering all aspects of dairy cattle and buffalo nutrition and management in English and Urdu languages. The first 10 factsheets have also been translated to Sindh language.

- Feeding guide in Sindh language was produced and distributed to farmers in Thatta, Sindh.
- During the reporting period 5 research reports were produced and printed.
- Software for feeding management of feedlots was produced.
- Training manual on Ultrasonography for small and large ruminants was published.
- Extension guide for feeding cattle and buffaloes was produced and now been translated into Urdu.

The International Livestock Research Institute has been regularly publishing various news and/or blogs on AIP-livestock activities. The following important reported activities are;

- Economic impacts of AIP-Livestock interventions in Punjab, Pakistan
  http://sustainable-livestock.ilri.org/2016/08/17/aip-impacts/
- Livestock are 'the future of Pakistan's smallholder farmers'—PARC chairman
  https://clippings.ilri.org/2016/09/30/livestock-are-the-future-of-pakistans-smallholder-farmers-parc-chairman/
- Increasing goat productivity through improved breeding bucks in Bahawalpur, Pakistan
  http://sustainable-livestock.ilri.org/2016/08/17/aip-bucks/
- Economic benefits of anthelmintic treatment for small ruminants in Pakistan
  http://sustainable-livestock.ilri.org/2016/08/17/aip-anthelmintic/
- Training manual on artificial insemination in goats for Pakistan
  http://sustainable-livestock.ilri.org/2015/08/10/ai-manual-pakistan/

16.6.7 **Wheat**

Zincol Wheat variety story appeared on CIMMYT News webpage, highlighted an important innovation of AIP in wheat sector:
http://www.cimmyt.org/farmers-in-pakistan-benefit-from-new-zinc-enriched-high-yielding-wheat/
On World Earth Day AIP Wheat component photo was shared on social media of USAID
https://www.facebook.com/USAIDPakistan/photos/a.440871662600387.101186.440868732600680/1445294468824763/?type=3&theater
Another wheat distribution story was posted by USAID on its social media page highlighting the program successes in wheat sector:
https://www.facebook.com/USAIDPakistan/photos/a.440871662600387.101186.440868732600680/1597956203558588/?type=3&theater
Other social media stories also emphasized the importance of wheat component of the program:
https://www.facebook.com/USAIDPakistan/photos/a.440871662600387.101186.440868732600680/1564780186876190/?type=3&theater
The News, a leading newspaper, published a story focusing AIP contribution in agriculture sector in Pakistan:
https://www.thenews.com.pk/print/224445-50-Pakistanis-are-attached-with-agricultural-sector
AIP Wheat Publications:
Krishna Dev Joshi , Ghulam Ullah , Attiq Ur Rehman , Muhammad Makky Javaid , Javed Ahmad , Makhdoom Hussain , Angela Pacheco , Ibni Amin Khalil and Amanullah Baloch. Wheat Yield Response to Foliar Fungicide Application against Leaf Rust Caused by Puccinia triticina Journal of Agricultural Science and Technology A 7 (2017) 160-168 doi: 10.17265/2161-6256/2017.03.003

16.6.8 **Rice:**

AIP story on rice appeared on IRRI web news:
http://news.irri.org/2017/04/bacterial-blight-management-is-crucial.html