Agricultural Innovation Program for Pakistan (AIP)

Final Semi-Annual Report

April 2019 – September 2019

aip.cimmyt.org

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1 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.

2 Acronyms

AIP	Agricultural Innovation Program
AJ&K	Azad Jammu And Kashmir
AR	Adaptive Research
AR4D	Agriculture Research for Development
ARI	Agriculture Research Institute
AARI	Ayub Agriculture Research Institute
ARS	Agriculture Research Station
AZRI	Arid Zone Research Institute
BARDC	Baluchistan Agriculture Research Development Center
BARI	Barani Agricultural Research Institute
BISA	Borlaug Institute for South Asia
BRSP	Baluchistan Rural Support Program
BUITEMS	Baluchistan University of Information Technology Engineering and Management Sciences
CA	Conservation Agriculture
CDRI	Crop Disease Research Institute
CDRI	Crop Disease Research Institute
CGIAR	Consultative Group of International Agricultural Research
CGS	Competitive Grants System
CIIT	COMSATS Institute of Information Technology
CIMMYT	International Maize and Wheat Improvement Center
CSD	Canteen Stores Department (Pak Army)
D.I.Khan	Dera Ismail Khan
DAR	Directorate of Agriculture
DNA	Deoxyribonucleic Acid
DG	Director General
DH	Doubled Haploid
DSR	Direct Seeding of Rice
DVC	Dairy Value Chain
FATA	Federally Administrated Tribal Area
FSCRD	Federal Seed Certification and Registration Department
FQ&SRI	Food quality & Safety Research Institute
FR	Frontier Region
FSD	Faisalabad
GB	Gilgit Baltistan
GOP	Government of Pakistan
GPS	Global Positioning System
GY	Grain Yield
Ha	Hector
HRD	Human Recourses Development

HTMA	Heat Stress Tolerant Maize for Asia
HYT	Heat Yield Trials
HQ	Head Quarter
HEC	Higher Education Commission
ICARDA	International Center for Agricultural Research in the Dry Areas
ICI	Imperial Chemical Industries
ICT	Informational Communication Technology
IITA	International Institute of Tropical Agriculture
ILRI	The International Livestock Research Institute
IPMP	Insect Pest Management Program
IRRI	International Rice Research Institute
IRS	Internationally Recruited Staff
JPL	Jullundur Private Limited
Kg	Kilogram
KP	Khyber Pakhtunkhwa
KPWYT	Khyber Pakhtunkhwa Wheat Yield Trial
KSK	Kala Shah Kaku
KQS	Kanzo Quality Seeds
KWC	Khawateen Welfare Council
L&DDD	Livestock & Dairy Development Department
LCC	Leaf Color Chart
LDRC	Livestock Development Research Centre
LR	Leaf Rust
MC	Multi-Crop
MFSC	Model Farm Services Center
MMRI	Maize And Millet Research Institute
MNFSR	Ministry of National food & Security
M&E	Monitoring and Evaluation
MRS	Maize Research Station
MNSUAM	Muhammad Nawaz Sharif, University of Agriculture Multan
MSF	Mission Strategic Framework
NARC	National Agriculture Research Center
NARS	National Agricultural Research Scientist
NDVI	Normalized Difference Vegetative Index
NE	Nutrient Expert
NGO	Non-Government Organization
NIA	Nuclear Institute of Agriculture
NIBGE	National Institute for Biotechnology and Genetic Engineering
NIFA	Nuclear Institute for Food & Agriculture
NRS	National Recruited Staff
NRSP	National Rural Support Program
NSTHRI	National Sugar and Tropical Horticulture Research Institute
NUYT	National Uniformity Yield Trial

OPVs	Open Pollinated Varieties
ODK	Open Data Kit
P.D. Khan	Pind Dadan Khan (Name of city)
PARC	Pakistan Agricultural Research Council
PASSCO	Pakistan Agricultural Storage & Services Cooperation
pH	Potential Hydrogen
PLD	Punjab Livestock Department
PPP	Public Private Partnership
PPR	Peste des Petits Ruminants
PSC	Punjab Seed Cooperation
PUWYT	Punjab Uniformity Wheat Yield Trial
PVA	Pro-Vitamin A
PSC	Petal Seed Company
PVS	Participatory Variety Selection
QAARI	Quaid-E-Awam Agriculture Research Institute
QPM	Quality Protein Maize
R&D	Research and Development
RA	Research Associate
RARI	Regional Agriculture Research Institute
RMP	Rafhan Maize Products
RPL	Rice Partners Limited
RRI	Rice & Research Institute
RSP	Rural Support Program
RA	Research Associate
SABWGPYT	South Asian Bread Wheat Genomic Prediction Yield Trials
SAGP-L	Sindh Agriculture Growth Project – Livestock Component
SAU	Sindh Agriculture University, Tandojam
SMTA	Standard Material Transfer Agreement
SDI	Sohni Dharti International
SPU	Semen Production Unit
SPSS	Statistical Package for Social Sciences
SSNM	Sight Specific Nutrient Management
t/Ha	Tons per Hector
TASP	Tropical Animal Science and Production
TCS	Tara Crop Sciences
UAF	University Of Agriculture, Faisalabad
UAP	The University of Agriculture Peshawar
UC	Union Council
UC Davis	University of California, Davis
UOS	University of Swabi
USAID	U.S. Agency for International Development
UVAS	University of Veterinary & Animal Sciences
VEC:	Variety Evaluation Committee

VRI	Vegetable Research Institute
WRI	Wheat Research Institute
YR	Yellow Rust
ZT	Zero Tillage
ZTHS	Zero Tillage Happy Seeder

3 Summary

Agricultural Innovation Program (AIP) successfully achieved its objectives and made significant contributions to Pakistan agriculture since its inception in 2013. In the last quarter, AIP livestock component being implemented by ILRI ended and documentation of the results and final project completion report is in process. Public research and development is critical to promoting innovation in the agriculture sector. Keeping in view the importance of sustainability and public sector R&D, AIP and PARC awarded forty (40) competitive grant (CG) projects to different public research institutions, universities and experts to work on innovative solutions to address the problems of farming communities. These organizations worked closely with AIP and PARC to ensure that objectives of their projects were achieved. Abstracts from their technical reports is part of this semiannual report that illustrate that these projects offered innovative approaches for addressing key issues of farmers. PARB was engaged in carrying out monitoring of CG projects in Punjab province while monitoring of CG projects in other provinces was ensured through experts of PARC. AIP results and reports also indicated that during the process, AIP not only worked for the benefits of the farming communities but also strengthened the skills of the stakeholders involved in service provision in project areas.

AIP maize keep continued working on the development of climate resilient maize germplasm, biofortified maize, maize tolerant to biotic stresses, and enhanced the maize seed sector of Pakistan. Currently AIP-maize partners are evaluating and validating over 348 maize products across different maize growing regions for adaptability and agronomic performance. These products included biofortified maize, heat stress resilient, and various maturity groups of white and yellow kernel maize hybrids. AIP partners from public sector are making the use of AIP provided Doubled Haploid (DH) technology by increasing the seed of parental material and evaluating its adaptability across the seasons. Maize stem borer mass rearing facility established with the support of the AIP at NARC is continuing to support national programs in the effort to screen maize germplasms tolerant to maize stem borer. For grain and seed storage, mass scale manufacturing of AIP introduced metal silos and its distribution among smallholder famers is also being initiated in partnership with NRSP.

AIP-Wheat out scaled high yielding and disease resistant varieties to smallholder farmers of Pakistan. These varieties performed well in respective areas and produced about 12%-40% more yield than local and obsolete varieties indicating that replacement of varieties can have improved yield and overall production in the country. This also demonstrated that with just replacement of varieties yield can be improved. A nutrient rich variety (Zincol-16) performed well in districts Swat and Buner and on the average produced about 2.8 tons/ ha. In Baluchistan province, on the average varieties NIFA Lama, Pirsabak-15 and Umeed-14 variety were top yielding among other wheat varieties. Umeed-14 proved to be best choice for farmers due to its resistance to disease and birds attack in the province. Through public and private network of partnership, AIP provided quality wheat seed to 1400 farmers including 15% women beneficiaries across Pakistan, especially in newly merged districts (NMD). Due to this intervention AIP produced 452 tons quality wheat seed, which can cover around 3700 ha area for the coming wheat season. AIP-Wheat also trained 479 farmers (7% women farmers) in GB and Baluchistan province on wheat seed production and marketing.

AIP agronomy in partnership with public and private sector organizations reached 1974 farmers during this reporting period through assisted application of improved planting techniques on 877 sites, provision of 23 Zero till Happy seeders (ZTHS) by Sharif Engineering Pvt., 450 DSR planters, training of 63 stakeholders and dissemination of improved techniques through field days to 1097 farmers in the project area. More than 665 farmers were supported for ZT wheat planting, ridge planting of wheat and LASER land levelling in Punjab, KP, Sindh and Baluchistan provinces that helped in saving irrigation water,

reducing cultivation cost and improving 12% yield. ZTHS helped farmers to plant wheat in combine harvested rice fields without burning of residue and obtained 0.2 t/ha more wheat grain yield in comparison with farmer practice of burning residue. Greenland Engineering manufactured and sold 450 DSR planters to farming community in the country that included 93 planters to African countries. This DSR planter not only save PKR. 5000 per acre planting cost but also improve 10-15% paddy yield in comparison with farmer practice of transplanting. AIP also facilitated 62 farmers on precision N management in wheat with green seeker and resulted in saving of 70 Kg Urea per hectare or 28 Kg urea per acre without yield reduction in comparison with farmer practice.

AIP-Socioeconomics completed a study on "estimation of the crop and livestock losses due to recent rain related disaster" in South Punjab province. The key findings indicated that majority of the farmers were not prepared for the climatic disasters as 99 percent of the farmers have no crop and livestock insurance scheme as well as any other social protection mechanism. For mitigating the climate change a number of steps such as sowing time shifting, information and access to climate resilient varieties, and credit facility from public and private sector needs to be taken by the public and private sectors including farming community. AIP organized a stakeholder's consultation workshops in all provinces for agricultural research, academia, extension, rural support program, service providers, communities, and farmers. A total of 80 participants from Balochistan, 100 from KP, 100 from Punjab and 100 from Sindh provinces, participated in these different workshops. The key findings in general indicated problems and issues included water scarcity, seed availability, low productivity, value addition, mechanization, capacity building and social inclusiveness. Small markets exist in the remote areas need to be linked with regular markets and with solvent and pulses industries. All need assessment reports for Balochistan, KP, Sindh and Punjab provinces were compiled.

AIP M&E is working to track interventions and measuring the effectiveness of the project. The data collected from the partners depicts a total 6156 beneficiaries were targeted during this reporting period. Gender wise breakdown indicated that 5664 (92%) men and 492(8%) women were benefited from the AIP activities.

4 Background

The 'Agricultural Innovation Program for Pakistan' (AIP) aimed 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 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 purpose is 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 are divided into four 'Science Windows' – cereals and cereal systems, livestock, vegetables and perennial horticulture. The key indicator of AIP's success will be the number of smallholder farmers who adopt or benefit from productivity or value-enhancing technologies. CIMMYT is the primary implementing partner and prime grantee; managing and taking overall responsibility for AIP and providing direct oversight of the agronomy, wheat and maize commissioned projects within the cereals and cereal systems science window. Four international partners (the International Livestock Research Institute, or ILRI; University of California, Davis; The World Vegetable Center, or AVRDC; and the International Rice Research Institute, or IRRI) lead on commissioned projects in livestock, tree fruits, vegetables and rice, respectively, while PARC serves as both the hosting partner and the lead on a province-inclusive competitive grants system. Combined, those organizations are CIMMYT's "primary partners."

5 AIP Maize

5.1 Major activities in relation to commissioned project

5.1.1 Introduction and Development of climatic resilient maize

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

- A total of **328 yellow kernel and 212 white kernel** climate resilient maize hybrids sourced from CIMMYT Mexico, Zimbabwe and India were introduced and evaluated.
- Advance Quality Protein, Provitamin A and Zinc biofortified maize hybrids sourced from CIMMYT Zimbabwe and Mexico were evaluated.
- In spring 2019 trials were grouped into late maturing, intermediate maturing and extra early maturing white and yellow hybrids under 23 sets which were evaluated in the different trial sites located in all provinces and territories of Pakistan.
- In Kharif 2019 trials were grouped into intermediate maturing single cross yellow maize hybrids under 20 sets which were evaluated in the different agro-ecological maize growing regions of Pakistan. (See attached Table 1A, 1B and Table 2 in appendices.)

5.1.2 Introduction and Status of Biofortified Maize in Pakistan

1 In Pakistan, malnutrition is endemic and children, in particular, are severely affected, with nearly half of all children in Pakistan being chronically undernourished. Chronic malnutrition commonly leads to a condition called stunting, which can permanently limit growth and development. Pakistan is among the countries with higher vitamin A and Zinc deficiencies, which affect cognition and can lead to otherwise preventable blindness. Since 2014, AIP has been testing CIMMYT-biofortified maize varieties in Pakistan to ensure that maize grow in local conditions. For spring 2019, AIP maize was able to get a new set of market ready biofortified maize products from CIMMYT Mexico including provitamin A and kernel Zinc enriched hybrids. It is also evaluating white QPM hybrids sourced from CIMMYT Southern Africa Breeding Program in Zimbabwe. NARS in collaboration of CIMMYT has already released two QPM hybrids where the commercial hybrid seed is under production. The official registration of the first Provitamin A hybrids is in progress where Provitamin A biofortified maize hybrids are being evaluated under National Uniformity Yield Trials (NUYT).

Seed Increase block of haploid inducer line at MMRI research farm, Yousafwala

5.1.3 Introduction and Status of Doubled Haploid Technology in Pakistan

AIP assists the partners to accelerate the maize breeding through induction of Double Haploid (DH) technology, which is the first ever coordinated initiative in Pakistan. MMRI-Yousafwala and UAF received seeds of CIMMYT's developed tropically adapted second generation haploid inducer lines, which is useful to development of large number of maize inbred lines in very short breeding cycle. Conventional methods require 6-8 generations (years), while the DH technique significantly shortens this period to 2-3 generations (years). Currently, both partners have increased the 5kg seed of inducer lines. Haploid induction rate for inducer lines was also found 5 to 6% in different cross combinations. However, 10 doubled haploid lines have been developed during the current phase of working and this number will increase to many folds in coming years.

5.1.4 Introduction of New Maize Inbred Lines

CIMMYT announced the release of a set of 26 new CIMMYT maize lines (CMLs) on October 4, 2018. These CMLs were developed by the CIMMYT Global Maize Program's multi-disciplinary teams of scientists at breeding locations in sub-Saharan Africa, Latin America and Asia. These lines are adapted to the tropical/subtropical maize production environments targeted by CIMMYT and partner institutions. AIP maize circulated the information and supported its partner to apply for the inbred lines. As a result, eight partners from NARS (CCRI and MMRI,) and seed companies (JPL, PakHibred, SDI, PSC) formally applied for the allocation and transfer of these materials under standard material transfer agreement (SMTA). So far three partners received the full set of the inbred lines from CIMMYT-Mexico and the rest are expected to receive the seeds anytime soon. Access to these inbred lines will enhance the capacity of local partners to develop new maize products that will help to stay competitive in the market. The inbred lines will further enrich Pakistan's maize gene pools and will be utilized with existing ones to come up with diversified maize products that can meet farmer's needs.

5.2 Second phase of production allocations

CIMMYT-Pakistan announced the submission of requests from local maize partners for product allocation in the 2nd round. Among the partners, MMRI, NARC, CCRI, ARS-Dadu, Agric. Dept. AJ&K, MNSUAM, ICI-Pakistan, Tara Crop Sci., KQS, Ali Akbar, HiSell, PakHibred and SDI submitted the requests for allocation of about 80 different maize products. Requested products were originally developed by different research hubs of CIMMYT i.e. CIMMYT-India, CIMMYT-Zimbabwe, CIMMYT-Coloumbia, and also International Institute for Tropical Agriculture (IITA). Early maturing, Low Nitrogen, Stem Borer Tolerant and Pro A biofortified OPVs/hybrids received from IITA. After clearance form quarantine department these materials will be handed over to the partners by the mid of January 2020. These materials include 9 OPVs (PVA SYN2, ACR 91SWWAN1-SR-C1, 2012 TZEE-WDTST, AMA TZBR-Y , TZBR Com1-YC, TZBR Com2-WC1, ACR 97TZL COM1-W Ln C1, LAPOSTA SEQUIA C6) and two hybrids (LY1501-5 and LY1501-6). However other products from CIMMYT are still under the consideration of Product Allocation Committee which is currently reviewing the allocation requests, and after necessary evaluations, committee will give the approval for product allocations. Addition of these products in the seed system will definitely broaden the genetic variability which will improve the yield and also buffering against biotic and abiotic stresses.

5.3 Addition of four maize OPVs in maize directory of Pakistan

MMRI, Yousafwala, one of the leading National Maize Partner of CIMMYT-Pakistan in public sector, come up with four new maize OPVs for small farmers across the country. Variety Evaluation Committee (VEC) recommended and Punjab Seed Counsel approved four maize OPVs with CIMMYT background for general cultivation as case filed by MMRI, Yousafwala. CIMMYT-PAK, Gohar-19, Sahiwal Gold, Pop-1 are the newly addition in OPVs in Pakistan. CIMMYT-Pak is short duration, high yielding white maize OPV which is renamed from "CZP132001". Gohar-19 is full season, high yielding white maize OPV and Sahiwal Gold is full season, high yielding yellow maize OPV. POP-1 is full season, high yielding popcorn maize OPV. Availability of seed of these four new OPVs will definitely help a lot to provide the high quality seed at low price to small farmers across all maize growing regions of the country.

CIMMYT PAK

Gohar-19

Sahiwal Gold

Pop 1

5.4 "Farmer Day" at Maize and Millets Research Institute (MMRI), Yousafwala

MMRI organized Farmer Day on the theme of 'Maize Production Technology' dated June 18, 2019 for 128 farmers across the province of Punjab on maize production technology facilitated through AIP, CIMMYT-Pakistan. Maize agronomists, entomologist, pathologists and breeders were the key note speakers on farmer day and they shared the solutions about problems in production technology and management of insects, pests and diseases.

Farmers training at MMRI

5.5 Participation in "International Seed Conference and Expert Consultation, Kathmandu Nepal"

Representatives from private seed companies and seed regulatory authority (FSC&RD) participated in International Seed Conference and Expert Consultation dated September 3-4, 2019 in Kathmandu Nepal. FSC&RD representative shared the challenges and solutions in variety approval and registration procedure and also emphasized the international collaboration like CIMMYT under AIP with local seed companies. Participants shared the experiences, lessons and accomplishments of AIP in Pakistan and also emphasized on the continuity of innovative work like AIP.

Glimpse of International Seed Conference and Expert Consultation 3-4, September 2019

5.6 Development of biotic stress tolerant maize

5.6.1 Status of maize stem borer mass rearing and screening facility

Maize stem borer (*Chilo partellus*) is a destructive insect pest of maize in Pakistan. Yield losses because of this pest are estimated to range 10 - 40% and in some severe incidences up to 60% losses have been reported. 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 different from place to place. However, a better alternative, is the use of maize stem borer resistant varieties. Maize germplasms that have inherent resistance 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 and avoiding environment (soil and water) pollution. Identification of host-plant resistance in maize is part of the commissioned projects. Under AIP, manipulation of the established laboratory for rearing of maize stem borer on the applied side, IPMP team with the collaboration of coordinator MSM&F, started an activity to screen the National Uniform Maize Yield (NUYT) Trials under optimum pressure of pest which could impart the level of resistance in different entries. Under this coordination Maize NUYT trials were conducted and more than 400 have been screened in last three years. The NUYT trails are part of registration process for new hybrids. The evaluation will greatly enhance the understanding of the scientists and the competent authority to select the tolerant material which will create an appropriate impact when delivered to famers by reducing the losses which are estimated at 60% under sever incidences.

5.6.2 Status of hermetic storage technologies (Metal Silos)

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. Apart from causing quantitative losses, 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, thus adversely impacting food and feed safety. 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. AIP is promoting the hermetic storage techniques in collaboration with NARC IPMP through introduction and training of farmers on proper use of metal silos. NRSP showed

interest in mass scale of metal silos and join the project under public private partnership. Initially the order for seven metal silos of different capacity ranging from 200-1000 Kg has been placed. These seven silos were distributed to the potential farmers in three tehsils Gujar Khan, Pind Dedan Khan and Talagang. CIMMYT-NARC continues to promote these silos in other provinces including AJ&K and Gilgit Baltistan. Three metal silos of three different categories were produced and delivered to the directorate of agricultural research under the respective provincial governments.

5.7 Enhancing the Maize Seed Sector

5.7.1 Seed increase for the newly introduced maize varieties

One of the major activities conducted was the start of seed micro increase of the parental lines/breeder seeds of the maize hybrids and OPVs distributed to partners under AIP. A total of 12 public and private AIP maize partners (ICI, TCS, JPL, NARC, MMRI, CCRI, UAF, ARI-AJK, ARI-GB, ARI-Quetta, Ali Akber, PSC) have produced pre basic and parental seeds. In addition to the seed increase, MMRI, JPL, CCRI, UAF and ARI-GB are in the process of officially releasing CIMMYT derived maize products which were allocated by AIP at various times. Summary tables of total maize seed produced & distributed by AIP partners during the reporting period.

Variety	Seed Increased (Kg)	Partners
HN-Gold	12500	NARC
Fakhr-e-NARC	1800	
YH1898	3300	MMRI
Pearl	3750	
Iqbal	1550	CCRI
Azam	1950	
Jalal	2800	
Pahari	3000	
Baber	3100	

Seed Increase	Kgs
TP1221	730
TP1222	56
TP1220	110
TP1217	100
TP1219	500
TP1217	138
ZM 309	1400
ZM401	532
CZP132006	105
CZP132012	59
CZP132011	920
CZP132001	1900
CZP132002	200
ZM521	900
QPHM200	970
QPHM300	458
HP1097-2	430
HP1097-11	532
HP1097-18	300
Parental Seed Increase	927
Total	**11267**

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 to the farmers. AIP facilitated the production of 33.7 tones seed of locally produced certified seed.

5.7.2 Consultative Meeting for proposed AIP-2

The consultative meetings of AIP-2 were organized by CIMMYT in collaboration with PARC in all provinces of Pakistan. AARI hosted the meeting in Faisalabad to highlight the needs and opportunities in Punjab province. The UAP coordinated the meeting in Peshawar, KP province. Directorate of Agricultural Research took lead in Tandojam Sindh province and Quetta Baluchistan province to prioritize the goals for AIP-2. The representatives were from diverse background which includes researchers, policy makers, seed companies, service providers and particularly progressive growers.

5.7.3 Collaboration with HTMA-2

AIP maize is also collaborating with another USAID supported program "Heat Stress Tolerant Maize for Asia- HTMA-2" which has been extended for 2nd phase. AIP is testing final stage products under its partners' network to identify best ones for commercialization. AIP partners currently testing 20 different sets of maize trials received from HTMA-2 at 15 different locations.

Annual Review Meeting (HTMA-2) Nepal

Field Visit – Nepal

5.7.4 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 province as well as to the tribal areas through the partnership and linkages created under AIP.

5.8 Salient Features of AIP-Maize since inception

- Network of 22 partners in four provinces, Azad Jammu Kashmir (AJ&K) & Gilgit Baltistan (GB)
- Multi Location evaluation of more than 3000 entries from 340 trials.
- Introduction and deployment of biofortified maize germplasm, which include pro vitamin A, kernel zinc and quality protein maize (QPM).
- NARC-CIMMYT released two quality protein maize hybrids for general cultivation for the first time in the history of Pakistan.
- MMRI-CIMMYT released four open pollinated varieties in Punjab province.
- More than 100 inbred lines were transferred for hybrids seed production and to strengthen the local maize breeding programs.
- IITA breed genetically improved, stress tolerant biofortified maize hybrids (2) and open pollinated varieties (6) transferred to the national seed system.
- Introduction of doubled haploid technology. CIMMYT's second generation tropically adapted haploid inducer lines were transferred to government research organizations.
- Technical skill development on the management of maize trials and data recording.

- Establishment of "National Maize Stem Borer Mass Rearing Facility". Facility facilitates and streamlined the national uniform maize yield trials (NUMYT) to screen and evaluate the candidate entries for stem borer tolerance.
- Facilitate the seed production of more than 150 tons at public research organizations.
- Provision of modern instrument and tools to the public sector to enhance efficiency/effectiveness of the local maize breeding programs. The equipment for example includes, growth chambers, moisture meters, laptops, printer and data analysis software. It also includes repair of microscopes, seed stores and farm implements.
- Capacity building of public and private sector through international trainings/conferences. More than 100 national scientists were entrained to refine their breeding skills at international training courses organized by CIMMYT INT.
- Introduction and demonstration of hermetic storage technology throughout the country including Azad Jammu & Kashmir (AJK) and Gilgit Baltistan.

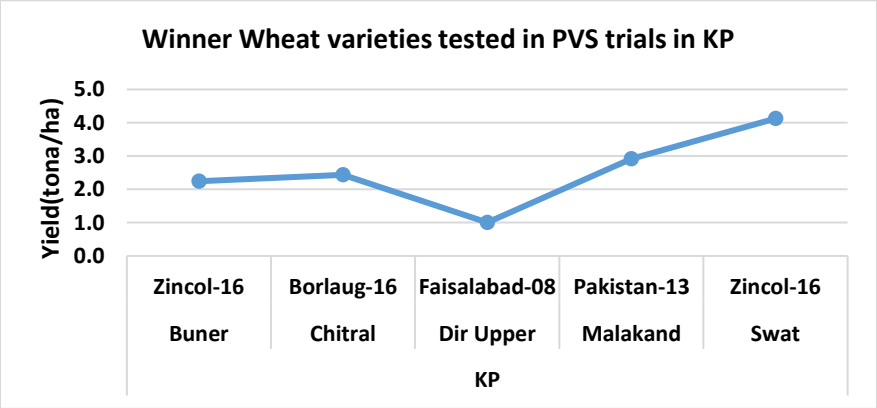
6 Wheat

6.1 Increasing Wheat Production through Rapid Diffusion of new High Yielding and Rust Resistant Wheat Varieties

6.1.1 Validating performance of newly released wheat varieties through Farmers' own perspectives

During 2018-19, twenty-five (25) PVS trials were conducted in northern districts of KP province. These districts usually have marginal varietal diversity as compared to central districts and this may limit choices of varietal selection for farmers. In these 25 trials, farmers were provided with high yielding, nutrient rich and disease resistant varieties. The aim was to help farmers grow this set of varieties under their own agronomic practices and select best variety according to their needs and preferences. Although, erratic rains during reproductive and harvesting time this season have hindered yield performance of the most prevailing varieties, some varieties still performed well on farmer's field. The following graph shows winner varieties in northern districts of KP, where PVS trials were evaluated.

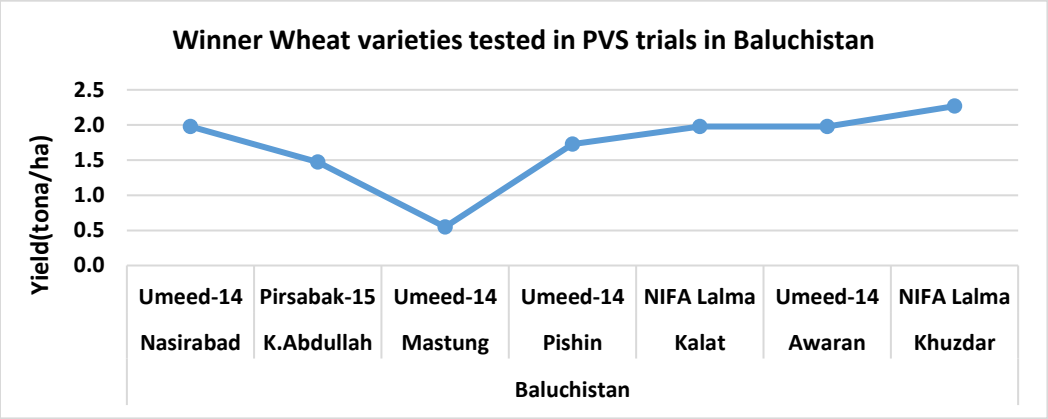
Yield (tons/ha) performance of new wheat varieties in KP in PVS trials)



Yield performance (tons/ha) is average of five (05) farmer fields. It is important to mention that Zincol-16 a zinc enriched variety provided better yield in Buner (2.3 tons/ha) and in Swat (4.1 tons/ha). This variety has 35 ppm (parts per million) zinc value and would be beneficial against hidden hunger for the children of these families.

In Baluchistan province these trials were conducted by ARI-Quetta on farmers' fields of district Nasir Abad, Killa Abdullah, Mastung, Pishin, kalat, Awaran and Khuzdar. In Baluchistan province, farmers experienced flood and severe hailstorm during the reproductive stage of wheat crop, however, still some of the varieties performed better. On the average NIFA Lama, Pirsabak-15 and Umeed-14 varieties were top yielding among other wheat varieties. Umeed-14 proved to be best choice for farmers of Baluchistan province, due to its resistance to disease and birds attack as presented in below figure - best performing varieties in different districts of Baluchistan province.

Yield (tons/ha) performance of new wheat varieties in Baluchistan in PVS trials



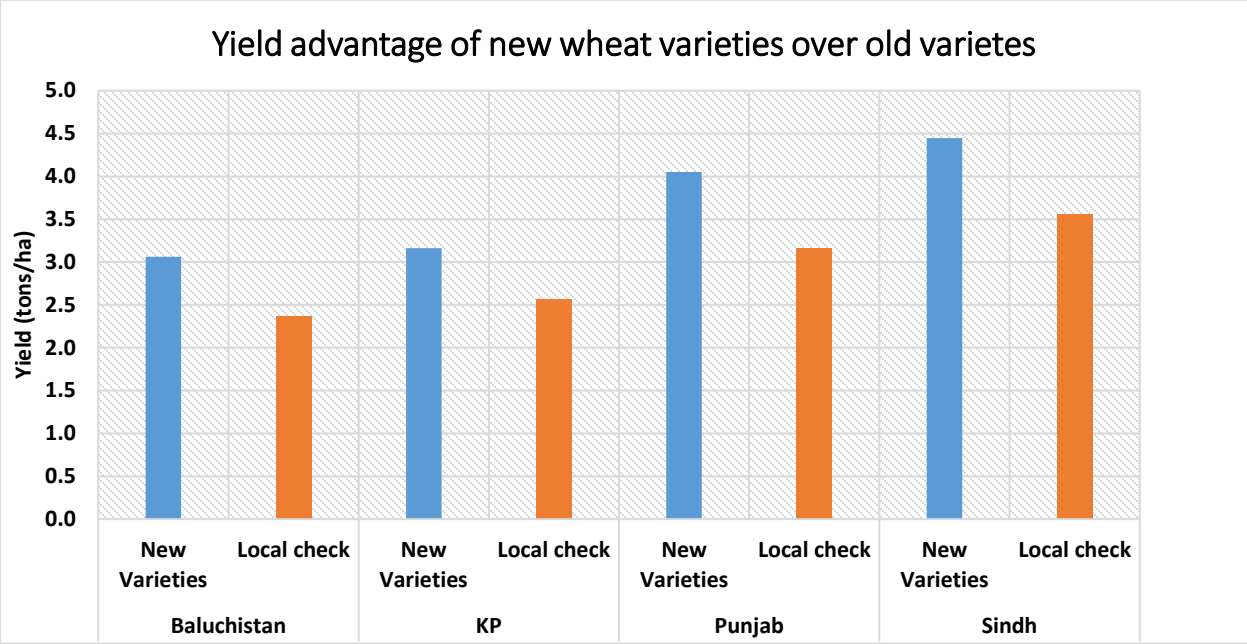
6.1.2 Rapid diffusion of new high yielding wheat varieties into farmers fields through Demo plots

Through public and private network of partnership AIP-Wheat provided about 1400 (15% women beneficiaries) farmers quality wheat seed across Pakistan, especially in newly merged districts (NMD). In the coming years NMDs will remain primary focus of CIMMYT in KP province if fund becomes available.

The aim of this activity was to incorporate new wheat varieties in the informal seed system, which will replace old wheat varieties and will benefit farmers in getting more yield than obsolete wheat varieties and thus improving his livelihood and national wheat production.

Shows the yield performance of new varieties over local checks across Pakistan.

Yield comparison between new and old wheat varieties



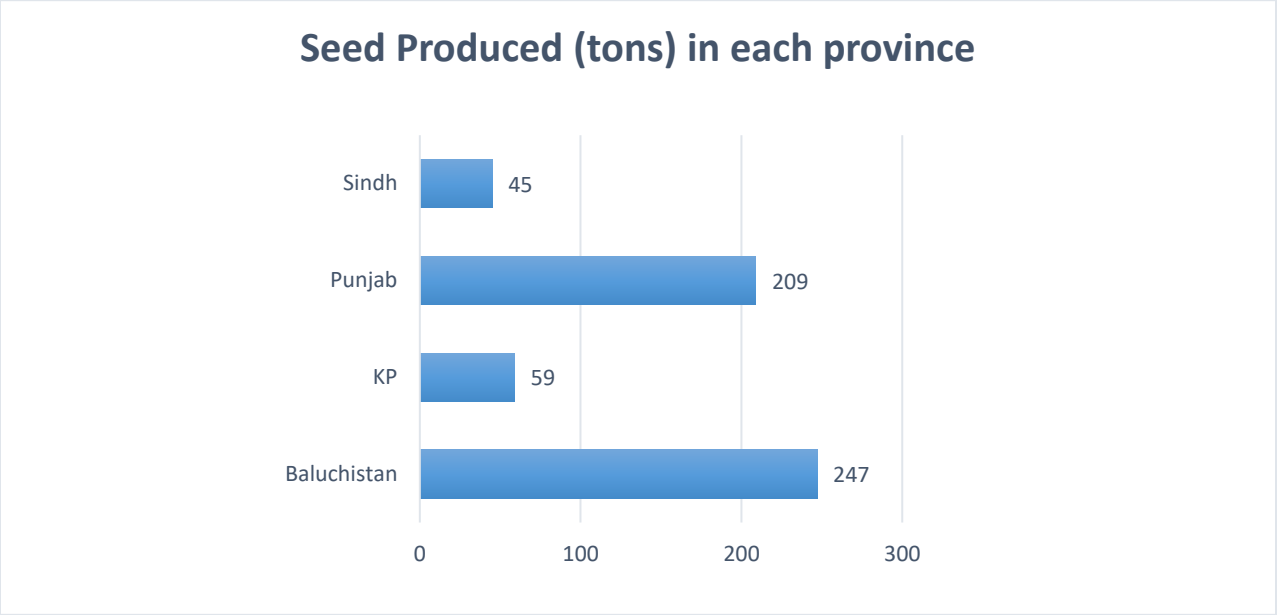
On the average, across Pakistan new wheat varieties were 26% more yielding than old varieties. In Bajour (erstwhile -FATA), Shahkar-13 with 3.8 tons/ha yield proved to be top yielding variety. However, in Mohmand (erstwhile-FATA), Pirsabak-15 with 4.3 tons/ha was best yielding variety. Due to this intervention AIP-Wheat produced 452 tons quality wheat seed, which can cover around 3700 ha area for the coming wheat season. With farmer to farmer flow, through this intervention the produced seed will play significant role in eradicating obsolete wheat varieties from the system.

6.1.3 Village based seed bank for recently released wheat varieties

In Pakistan about 70% wheat seed is from informal system, this contributes greatly to lowering national average yield. Majority of the farmers have limited access to quality seeds and many are reluctant to buy new seed. With the technical and financial support of AIP, public private partnership (PPP) and village based seed bank established and promoted is contributing significantly to address shortage of quality seed. Through this innovation private seed companies can get access to more early generation seed and thus they can produce increase quantity of certified seed for the next season. Village seed banks plays dynamic role in assisting local farmers. These banks are operated by farmers and provide quality wheat seeds on cheaper (11% lower rates than market) prices and sold surplus in the surrounding vicinity.

In partnership with private seed companies and farmers group, a total of 560 tons quality seed was produced across Pakistan. This seed is enough to cover 4600 ha area in the coming season. Famers will have easy access to this seed and can purchase this seed on 11% lower prices from their local seed banks. On the other hand, seed companies like Kashmala in Baluchistan province and Miankhel in KP province have agreed to provide seed to about 200 farmers on 50% lower prices helping in variety replacement efforts of AIP.

Summary of wheat seed produced during 2018-19 under AIP-wheat



6.2 Salient Features of AIP-Wheat since inception

- AIP-Wheat developed a wide spread network with 15 Public and 13 Private wheat partners to reach to smallholder farmers of far flung areas across Pakistan
- With the network of these 28 partners, AIP-Wheat has reached to poor farmers of 88 districts across Pakistan
- Organized first National Durum wheat workshop in 2014 and National Uniform Durum Wheat Yield Trial was started. Since, then about 35 Durum lines were selected & included into Durum Wheat National Uniform Yield Trial (DWNUYT)
- Quality seed of more than 25 high yielding and disease resistant wheat varieties were provided to small holder farmers in all four provinces, GB and AJK.
- Thorough a number of interventions more than 700 tons seed was distributed to ~30 thousands (20% women) small holder farmers. Farmers have reported 12%-40% yield gain due to these intervention
- Successfully launched Village seed banks with National Rural Support Program (NRS) in each province. This has provided quality wheat seeds to more than 2000 farmers on 11% lower price and has generated a handsome amount of 2.5 million rupees
- AIP-Wheat out scaled varieties are disease resistance and do not require heavy doses of Fungicides, which is healthy for both humans and environment.
- Trained about 10 thousand farmers (18% women) on quality wheat seed production and marketing, for a sustainable local seed system strengthening
- In collaboration with Food Quality & Safety Research Institute (FQ&SRI), Karachi and WRI-Faisalabad, AIP-Wheat analyzed 25 wheat varieties for their quality characteristics (including physicochemical properties, dough attributes and baking properties) and also categorized them into different classes for better use of end use qualities

- In partnership with public and private partnership, AIP interventions has produced more than 2800 tons quality seed, which is enough to cover more than 23 thousand ha area.
- AIP-Wheat has diffused enough seed of Zincol-16 to cover half a million hectares area. With 2.8 tons/ha average wheat yield of Pakistan, this will be enough to provide 20% more zinc enriched bread to 11.2 million people for a whole year.

6.3 Genomic Selection Trials for Developing heat resilient wheat Varieties

Continuing on the USAID-USDA funded wheat productivity enhancement program (WPEPA) and USAID funded South Asia focused project on identifying/Developing Climate Resilient, high yielding and farmer-accepted wheat varieties, AIP provided support from 2017-18 season to provide access to diverse wheat germplasm of Pakistan wheat community.

- Till current we evaluated about 3600 advanced wheat lines in five trials under both normal and late planting conditions and 2018-19 trials under normal planting across locations, selected desirable lines.
- Selected lines were distributed as Heat Yield Trials (HYT) among 25 public and private partners for multi-location testing and identification of desirable lines for commercial use and strengthening their own wheat breeding program.
- Till current (2018-19 wheat season), 21 advanced lines promoted to the national (NUWYT) and 28 lines to the provincial level trials (PUWYT) by different collaborators.
- Based on their multi location performance across the country in the national yield trial, two lines (HYT-60-5 and HYT-60-57) completed two years pre-release required evaluation in NUWYT, where one line HYT-60-5 is in the process of release by WRI-FSD.
- In wheat season 2018-19, 600 lines evaluated across three provinces (Punjab, Sindh and Khyber Pakhtunkhwa) identified 97 potential lines selected based on yield, disease, and other agronomic data of all locations.
- Theses 97 lines along with three checks will be planted at WRI-FSD and also shared as HYT-100 with 10 NARS as per their request which include CCRI-KP, ARS-SWABI, RARI-BPR, ARI-DI Khan, BARI-CWL, NIA-TJ, ARI-Tarnab, AZRI-Bhakkar, ARI-Quetta and WRI-SKD.
- Pakistan wheat experts also personally visited and selected 221 lines as per their site specific objectives from these 600 lines in SABWGPYT 2018-19 who were provided the seeds of these selected lines for inclusion in their 2019-20 yield trials and further selection.
- Similarly 2 lines from HYT-20 originally selected from SABWGPYT 2016-17 promoted to PUWYT 2019-20. One line HYT-55-33 (selection from SABWGPYT 2015-16) completed 1st year NUWYT 2018-19 and submitted for 2nd NUWYT 2019-20.
- Pakistani scientists also worked and trained with international experts who visited Pakistan and adds new ideas in selection for heat tolerance like the use of NDVI and CT techniques.
- Materials from SABWGPYT also supported directly or indirectly the research of various students like Mr. Suleman Badsha (PhD research Peshawar, KP), Mr. Shahood Saddiqi (PhD research Tando jam, Sindh), Mr. Fakhar Muhammad Ali (B.Sc research Hazara, KPK) etc.

Director wheat, WRI-AARI FSD and experts inspecting wheat lines to be promoted to 2nd year NUWYT 2018-19.

6.4 Capacity building Training

Training participants of wheat agronomic practices

In partnership with public research institutes and NGOs, AIP-Wheat organized several capacity building events. The aim of these events was to educate farmers on wheat standard agronomic practices, seed and varietal selection. In these events 479 farmers (7% women farmers) participated. Participants were educated on various on-farm research demonstrations, yield performance of new wheat varieties and post-harvest management. During the field visits farmers appreciated the wheat varieties recommended and promoted by AIP due to their better disease resistance and good crop stand. See table 3 for details of these events in Baluchistan province and GB.

6.5 Wheat Competitive Projects (Funded through Competitive Grants)

6.5.1 Natural variation for grain nutrient concentration of different wheat varieties under different agro-ecological regions of Sindh

Under competitive grant, a project is being implemented by Department of Agronomy, Sind Agriculture University Tandojam. Appropriate mineral availability is essential for all biological system. Cereals are an important source of micronutrient minerals. Through this project, a wide range of wheat germplasm at multi-locations were evaluated and found greater genetic diversity for all grain nutrients. Below are the varieties in table which were evaluated for various minerals:

Varieties	Tandojam				Thatta			
	Fe (mg kg^{-1})	Zn (mg kg^{-1})	Mn (mg kg^{-1})	Cu (mg kg^{-1})	Fe (mg kg^{-1})	Zn(mg kg^{-1})	Mn (mg kg^{-1})	Cu (mg kg^{-1})
TH-22	40.9	33.1	12.6	4.6	39.3	32.9	11.6	3.6
TH-05	37.7	37.2	17.4	5.5	38.5	39.1	18.2	5.2
SAU-09	34.8	35.3	15.7	4.4	34.4	32.4	17.4	5.3
TH-49	42.8	35.5	11.9	3.3	41.8	33.1	10.0	2.9
SAU-12	32.2	39.3	9.1	6.8	31.8	38.8	10.9	5.8
SAU-19	42.3	29.8	16.0	3.1	40.3	30.1	17.6	3.2
TH-34	40.6	33.7	13.7	3.8	41.4	32.8	15.2	3.8
TH-32	40.3	29.3	16.3	2.4	41.1	29.5	17.2	2.2
SAU-11	42.6	36.1	13.1	3.6	42.5	37.4	13.0	2.9

The results open the possibility of designing a specific breeding program for improving the nutritional value of wheat through the identification of parental lines with high minerals concentration in whole grains. Under the project trainings were conducted for students of SAU, Tandojam and field visits for breeders, researchers and farmers. A total of fifty breeders and researchers of seed development center SAU, Tandojam, ARI, NIA, Tandojam visited the field at Thatta, and Tandojam.

Demonstration of wheat trials for university students in filed

Agronomic Field data was collected for plant height (cm), tillers meter^{-2}, spike length (cm), flag length (cm) and flag width (cm) were collected from both locations Thatta and Tandojam from five randomly selected plants from each variety. A one-day training was organized for the students of SAU, Tandojam and public community on crop, and manage good practices. In this training, more than fifty trainees learned about wheat management, weed management, crop identification, taking agronomic data, observing crop behavior. A field activity was carried out at Tandojam location. Participations of women in different activities from sowing to data collection was ensured in the project.

6.5.2 Evaluation and identification of high yielding winter wheat genotypes

Under competitive grant, a project is being implemented by Department of Plant Breeding & Genetics, the University of Agriculture, Peshawar. Training was provided at Kalam and Miandam Swat. Three field days were conducted, one at each location including at Kalam & Miandam (Swat) and Skardu (GB) to demonstrated possible usage of winter wheat for dual-purpose of green forage in winter and grain production from same crop. In addition, a total of 59 students of BS and MS specializing in Plant Breeding & Genetics were also practically demonstrated the dual-purpose utility of winter wheat by forage clipping from winter wheat trials at UAP and its impact on crop growth and development. A woman student is pursuing her M.Sc (Hons) on winter wheat in the project with degree completion by December, 2019. In addition, three B.Sc. (Hons) and two M.Sc.(Hons)-previous year women students were also indirectly involved in the project trials at university.

A total 60 winter wheat lines selected during first year of project and were evaluated as 10 research trials at four locations (Uper and Lower Miandam (Swat), Kalam (Swat), Skardu (Gilgit Baltistan) and UAP. The number of genotypes in each trial ranged from 9 to 23, including 2 checks. Dual-purpose (Forage + grain) potential of winter wheat genotypes was determined by forage clipping. Several winter wheat genotypes showed the potential to be recommended for use as dual-purpose wheat in Miandam and Kalam. One student has already completed M.Sc.(Hons) degree during February 2019 under the project. Likewise, two B.Sc.(Hons) students completed their Internship research under the project in December 2018. Currently, two B.Sc. (Hons), two M.Sc.(Hons) and one Ph.D. students are undertaking research on winter wheat in the project.

6.5.3 Optimizing water and Nitrogen application through hydro priming, moisture stress and Nitrogen managements in wheat

A CG project is being implemented by Department of Agronomy, Bacha Khan University, Charsada. Wheat seed priming with water and PEG (Polyethylene Glycol) gave statistically significant results as compared to control (no priming) for phonological, agronomical and physiological parameters of wheat. Broadcast application of urea fertilizer was found waste of time, money, labour, promotion of weeds infestations followed by insects and pests as compared to placement method of urea fertilizer. Control irrigation was found better strategy in terms of saving precious irrigation water. Benefits were also found in terms of saving time for irrigation and irrigation of further additional land during that saved time. Furthermore, wheat crop growth stages were completed in specified times without delay. Land levelling is not widely adopted strategy for uniform distribution of irrigation water throughout field amongst farming community of KP province. For flood irrigation the main challenge is the slope and topographical features of the arable fields. In flood irrigation the water is not evenly distributed throughout the field profile due to uneven level of the land. Either most quantity of water is accumulated at one edge of the fields or center or in the last corner. Also due to these land inclinations/sloppy conditions runoff of nutrients negatively affect sustainability in agro ecosystem on large scales. It contaminates ground water in places where water table is not so much steep. Awareness is urgently required to cope with these circumstances amongst farmers and stakeholders. Levelling of the lands with laser levelers should be a common practice for farming as other cultural practices are followed for better and maximum crop yield.

Two workshops were conducted for farmers' awareness during the specified period. Two field days for the students. A woman student from department of agronomy and three women students from department of botany were involved in the project activities.

Field visit for wheat data recording and quality measures

7 Agronomy

7.1 Dissemination of Conservation Agriculture Technologies:

7.1.1 Partnership for out scaling CA technologies:

Total 13 partners collaborated for implementation of AIP- crop management activities included AZRI and WRI in Sindh province, WRI Faisalabad, AR Farm Gujranwala & Sheikhupura, ARS Bahawalpur and RRI Kala Shah Kaku in Punjab, MSC DI Khan, MFSC and CCRI Pirsabak in KP province, ARI Jaffarabad in Baluchistan, Wheat Program, NARC and NRSP. National partners helped in achieving the objectives of dissemination

ridge planting of wheat, ZT planting of wheat, LASER leveling, testing and multiplication of new CA planters and fertilizer management techniques in four provinces of the country.

7.1.2 Demonstration of CA technologies:

During wheat season of 2018-19, AIP- Agronomy collaborated with 13 partners in application of improved technologies on 665 farmers such as; Zero tillage wheat planting, ridge planting of wheat and LASER land leveling in Punjab, Sindh, KP and Baluchistan provinces of Pakistan.

Zero till wheat after maize in district Nowshera

a. Farmers experienced ZT wheat planting on 293 sites in districts of Jhal Magsi and Jaffarabad in Baluchistan, DI Khan in KP, and Faisalabad, Sheikhpura, Hafizabad and Nankana Sahib in Punjab province. A total of five farmers also experienced ZT wheat after maize in Nowshera district. The technology helped farmers in planting of wheat earlier without land preparation and obtained 0.5- 0.6 t/ha better wheat yield and saving of PKR. 7500/ha in cost of cultivation with ZT in comparison with farmer conventional practice of broadcasted seed in prepared land.

Zero till wheat planting in district Jaffarabad

b. AIP provided technical assistance and seed to 147 farmers who were instrumental in demonstration of ridge planting of wheat on 20 farms in five districts of Sindh province, 56 farms in eight districts of KP province, 68 farms in 10 districts of Punjab province and three farms in one district of Balochistan province. Data collected from farmer field trials and demonstrations showed that 10-15% higher number of tillers contributed towards 12 percent higher wheat grain yield with ridge planting in comparison with the farmer conventional practice of broadcasting. Ridge and furrow planting of wheat also showed saving of 30-40 percent water and helped in reducing lodging of crop during grain filling stage. Farmers adopting ridge planting technique had PKR. 10,500 per hectare more profit than non-adopters. See attached table 4

Ridge planting of wheat in SBA, Sindh

c. MFSC, in KP province provided LASER land leveler to 220 farmers who leveled 326 hectares of land in the districts of Lakki Marwat, Peshawar, Kohat, Tank, Swabi and Mardan. Adopters experienced an increase of 12-15 percent in grain yield and 25 percent in water saving on LASER leveled fields in comparison with not leveled field. In addition, Wheat Program NARC, facilitated planting of mung bean with Zero tillage and conventional practice on five farmer fields of one acre in Rawalpindi district of Punjab province.

LASER land leveling in Lakki Marwat, KP

7.1.3 Dissemination and promotion of technologies through field days/trainings

AIP, Agronomy, in partnership with national partners organized 15 field days including one in Baluchistan province, five in the KP province and nine in Punjab province for dissemination of improved techniques such as; LASER land leveling, ZT Happy seeder planted wheat, ZT planting in wheat based systems and ridge planted wheat. A total of 1097 farmers attended these events in Jaffarabad district of Balochistan province, Swabi Nowshera, Malakand, Upper and Lower Dir in KP province, Bahawalpur, Chiniot, Lodhran, Narowal, Sheikhpura, Chakwal and Gujjar Khan in Punjab province. Farmers have opportunity to interact with fellow farmers, observe field under improved practices that would help in adoption of these techniques and improve wheat and maize productivity *(Annexure 1)*.

Field day on ridge planting in Swabi, KP

Field day in Dir Lower, KP

7.2 Pilot Testing and Refinement of New CA Based Implements and Technologies:

Under this activity, ZTHS was modified and evaluated in the rice- wheat area of Pakistan. A total of 174 farmers planted wheat, maize and cotton through new seeders like ZTHS, MC bed planter and DSR planters and 66 stakeholders including farmers, operators and partner staff were trained on the use of new seeders.

7.2.1 Local modification of new CA planters and evaluation:

a) Sharif Engineering manufactured and sold 23 Zero till Happy seeder (ZTHS) with the price of PKR 200, 000 per planter in the rice- wheat area of Pakistan. This environment friendly technology enabled farmers to plant wheat in combine harvested rice fields through one operation without burning of rice residue.

ZTHS with wheels manufactured by Sharif Engineering, Faisalabad

b) Greenland engineering manufactured and sold 450 DSR planters to farming community in the country that included 93 planters to African countries. These DSR planters have inclined plate seeding system and can drill both seed and fertilizer in one pass, maintain an appropriate plant to plant distance without breaking the seed. Adoption of DSR would help farmers in saving water and labor, improve 10 percent plant population and rice productivity in comparison with transplanting of rice. Timely weed control is very important for the success of DSR technology.

Maize planting with precision planter in Nowshera

c) In 2018, AIP- CIMMYT in partnership with Greenland Engineers imported precision maize planter that has the ability to plant two rows of maize and fertilizer simultaneously. The planter has vertical seeding mechanism that facilitate precision planting by maintaining uniform plant to plant distance and improve plant population. The planter help farmer to increase planting area in less time, reduced the cost of planting through reduction in labor required for planting and placing fertilizer and improve maize grain yield.

7.2.2 Demonstration of new CA planter at farmer fields:

a) During 2018-19 wheat season, Zero till Happy seeder technology was demonstrated on 111 farmer fields in collaboration with AR Farms Gujranwala & Sheikhupura, RRI- KSK, WRI- Faisalabad and NRSP in the districts of Gujranwala, Sheikhupura, Nankana Sahib, Mandi Bahaw ud Din, Lahore, Hafizabad, Faisalabad, Sialkot and Sargodha in Punjab province and DI Khan district of KP province. Farmers using ZTHS for wheat planting saved PKR. 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 fuel cost 1750 PKR per acre with ZTHS technology in comparison with farmer practice.

ZTHS planting wheat in Hafizabad

b) National partners demonstrated the use of Multicrop bed planter for wheat planting on nine sites in the district of Bahawalpur in Punjab, Shaheed Benazir Abad in Sindh and Nowshera district in KP province. MC bed planter helped farmers in saving of irrigation and advantage of mechanized planting.

Wheat planted with MC bed planter at CCRI, Nowshera

c) Farmers in rice growing area of Punjab province are using Multicrop DSR planter for direct seeding of rice. A total of 560 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. National partners helped farmers to use multicrop DSR planter for direct seeding of rice on 38 sites in districts of Gujranwala, Mandi Bahauddin, Hafizabad, Gujrat, Sheikhupura, and Sialkot district in Punjab province. ARI Jaffarabad is also using DSR planter in Balochistan province. DSR through planter help farmers not only save PKR. 5000 per acre in planting cost but also improve 10-15% paddy yield in comparison with farmer practice of transplanting.

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

AIP agronomy conducted field trials in partnership with national partners, namely ARS Bahawalpur and Wheat Program NARC. These trials supported validation of new techniques, improved understanding of planting technique's effects in a particular cropping system perspective. After harvest of crop, finding from these trials are summarized as under:

1) **Evaluation of Different Planting Methods/Techniques in Cotton-Wheat System at ARS Bahawalpur, Punjab:** In wheat planted after cotton, Zero till relay planted wheat in standing cotton on beds or flat surface had a grain yield of 5.0 t/ha in comparison with 4.4 t/ha with the farmer practice of wheat planting on prepared land after cotton harvesting.

2) **Effect of Tillage and Residue on Productivity of Rainfed Wheat Cropping Systems at NARC Islamabad:** Field trial was conducted at NARC Islamabad with three cropping systems (Soybean-wheat, Mung-wheat and Sesbania-wheat), two tillage methods (conventional tillage and chisel plow) and two residue levels (residue retention and residue removal). Wheat grain yield was maximum after green manure followed by mung bean – wheat and soybean – wheat. In mung bean - wheat and soybean – wheat, additional grain of 1.2 and 1.6 t/ha was obtained.

7.4 Nutrient Management

During autumn 2019, LCC (Leaf Color Chart) was demonstrated on five farmer fields in Jaffarabad district of Balochistan province. The technique would help to promote balanced, site specific fertilizer management among farming community and improve farm productivity.

7.4.1 Use of Green seeker for N management in wheat

AIP- agronomy in collaboration with national partners evaluated crop sensor use for N (nitrogen) management in districts of DI Khan, Nowshera, and Swabi in KP province; Sakrand and Umerkot in Sind province; Faisalabad, Bahawalpur, Jehlum, Chakwal, Rawalpindi, Sheikhpura in Punjab province and Jaffarabad in Baluchistan province. Results from 62 sites indicated that farmers can save 76 kilograms of urea fertilizer per hectare with precision N management in comparison with farmer practice. This saving is equals to PKR.3000/ha in fertilizer cost without reduction in yield (See table 5)

GS use for N management in wheat

7.4.2 Dissemination of LCC use in rice crop in rice-wheat rea

Leaf color chart, SSNM technique, help farmers to apply Nitrogenous fertilizer according to demand of rice crop. A total of five on farm demonstration established in Jaffarabad district in Balochistan province. Farmers saved 82 kilograms' urea per hectare (33 Kg of urea per acre) in LCC managed rice plot in comparison with farmer practice of general recommendation. LCC use in rice crop is useful tool to reduce farmer cost of production.

7.5 Salient Features of AIP-agronomy since inception

- AIP agronomy has established partnership with 24 national partners in 45 districts (16 public sector and 08 private sector) for out scaling CA technologies.
- AIP agronomy in collaboration with national partners have reached to more than 29000 farmers through demonstration of zero tillage, ridge planting, DSR, better nutrient management, provision of planters, training of farmers and organizing farmer field days.
- AIP agronomy has distributed 32 ZT Happy Seeder among national partners (09) and farmers (23) on cost sharing basis in 2016 - 17. During 2018-19, Sharif Engineering has manufactured 34 more ZT Happy Seeders and sold to the farmers without any subsidy. Out of total 1.7 million hectares in Punjab, so far 411 farmers took advantage of this technology on approximately 4300 acres in 11 districts.
- Greenland Engineering with AIP support developed locally modified version "Green Multicrop DSR planter" to switch towards direct seeding of rice (DSR) to minimize the labor expenses. The company has produced and sold 690 DSR planters to farming community included 130 planters were exported to African countries (Kenya, Zambia, Mozambique, Uganda and Botswana). These drills were used on 0.40 million hectare and its potential area could be 1.9 million hectare.
- In Baluchistan, ZT wheat planting after rice initially introduced on 27 acres with 02 ZT drills which is now extended to more than 14000 acres. Two manufacturer in Baluchistan started manufacturing and sold more than 700 ZT drills to farmers. This resulted in reduction of rate by the service provider from RS. 1100 to Rs. 900/ acre for ZT wheat planting.

- Facilitated more than 433 farmers on site specific nutrient management (Green seeker in wheat and Leaf color chart in rice) to apply nitrogenous fertilizer according to demand of the crop. Moreover, GS (18) and LCC (1000) were distributed to partners and farmers.
- AIP agronomy supported Model Farm Services Centers (MFSC) for dissemination of LASER land leveling in KP and initially 87 farmers were benefited from this technology which is being extended to 763 farmers.
- Provided 100 push row planters to small farmers for maize planting in KP province. 536 farmers planted maize on 936 acres using these push row planters.

8 Livestock

8.1 Livestock Competitive Projects (Funded through Competitive Grants)

8.1.1 Detection of mycotoxin in poultry feed in Balochistan province and bio-control biodegradation using probiotic bacteria in feed formulation

Under competitive grant, a project is being implemented by Department of Microbiology, University of Balochistan. This project helped in the development of full-fledged functional and the only food microbiology laboratory in the department of microbiology which is also the only food microbiology laboratory in the Balochistan province. Under the project a total of eighteen field days and six trainings were conducted and tested multiple feed samples collected from different poultry farms for mycotoxins presence. In the project, graduate and undergraduate level 26 students have been trained for different practical skills in the field of food and feed microbiology. One PhD, two MPhil and multiple undergrad thesis work have been completed. A total of 15 women and 20 farmers involved in the project. Three original articles (one published and two under process) One review article (under review), one book chapter (accepted) has been extracted from this work, where acknowledgement for the project has been made in written. Presentations were provided in four conference at national level.

8.1.2 Development of rapid and sensitive test for on-site diagnosis of Peste des Petits Ruminants disease

A project is being implemented by National Institute for Biotechnology and Genetic Engineering (NIBGE). A total of five field days were arranged to observe clinical signs and symptoms of Peste des Petits Ruminants disease (PPR) in sheep and goat herds in Faisalabad district. Trainings on use of Reverse Transcriptase Loop Mediated Isothermal Amplification Assay (RT-LAMP) were provided to assistant disease investigation officers, veterinarians and technicians. Moreover, 92 samples that were positive by RT-LAMP were tested through Sandwich ELISA (ID.vet Innovative Diagnostics, France) and optical density (O.D.) was measured at 450 nm. ELISA detected PPR virus in 78 (84.7%) samples. Thus, RT-LAMP assay was found to be more sensitive than ELISA. RT-LAMP assay obviates the need for RNA extraction and cDNA synthesis steps and detects virus in samples within 30 minutes. Therefore, it enables veterinarians to timely start specific therapy and control measures to reduce mortality and morbidity. Two women staff included Principal Scientist / Co-Principal Investigator and M.Phil student were actively involved during project activities.

Field days to observe PPR disease in sheep and goat herds.

8.1.3 Investigating potential risks of zoonotic transmission of antibiotic resistant bacteria at human-animal interface

Under competitive grant, a project is being implemented by Institute of Microbiology, University of Faisalabad (UAF). One-Health approach used to determine transmission dynamics of antimicrobial resistant E. coli at human-animal interface in rural settings. A total of seven surveys conducted in Faisalabad suburbs and collected over 250 stool/fecal samples from small dairy/poultry holders and their animals. We have been able to publish 01 peer-review article Umair et al, 2019 Micro. Two women researchers were engaged in the project.

Overall, high rates of antibiotic resistance in both farmers and their animals were found. Higher percentage of Extended-Spectrum Beta-Lactamase (ESBL) producing E. coli was isolated from human 16/50 (32%) cattle 31/100 (31%) and poultry 24/100 (24%). In total 71 isolates were identified that harbor blaCTX-M gene confirmed by PCR, while blaTEM gene was found among 60% of isolates. None of the isolate carried metallic. However, close relationship between isolates was not found. Presence of ESBL-producing E. coli in different reservoirs is alarming and has the potential to impact both veterinary and human therapeutic options. The findings of this research will help scientists to identify ways to reduce the

risk of transmission of antimicrobial resistance through interventions such as reducing the unnecessary use of antibiotics (in livestock and in humans) as well as ensuring the appropriate disposal of livestock waste. Data will help public health officials, veterinarian and policy makers for the development and implementation of ‘‘One Health’’ national action plans for Antimicrobial Resistance (AMR) in Pakistan and countries with similar farming practices.

8.1.4 Comparing of Daily Weight Gain Ability of Cross Breeds of Balochistan Nari Master, Bag Nari and Red Sindhi Male Young Stock on Feeding of Same Ration at Beef Production Research Centre Sibi Pakistan.

Under competitive grant, a project is being implemented by Beef Production Research Centre Sibi Livestock and Dairy Development Department Government of Balochistan.

During the period two man veterinary Officers, two women veterinary officers as women partners, one women stock assistant, two DPLs, 35 private breeders and 50 Students of Lasbella University Water and Marine Sciences including five women students participated in training during Sibi fair 2018 and 2019.

Awareness field visits (23 days) were carried out time to time with two veterinary officer to mobilize the farmers about beef farming by using Balochistan Nari Master as fast weight gaining animal of average 1003 grams/per day as per results.

weighing of Bagi Nari

Deworming of Calve

All objectives of the research were successfully achieved including the daily weight gain of Balochistan Nari Master (BNM), Bagh Nari and Red Sindhi was observed 1003, 791 and 736 grams per day and the statistical analysis revealed that there is a significant difference among breeds and rations (P>0.95). BNM (Balanced Nutrient Management) is recommended as high weight gaining beef breed in Pakistan. Awareness among breeders was created by training and mobilizations that beef farming is a good source for the livelihood of the poor farmers. Cost benefit ratio was also calculated and expenses of feeding are same in all three breeds but weight gain in BNM is 100% high.

8.1.5 Development of Rapid and Cost Effective Assays for the Diagnosis of Prevalent Echinococcal Species in Pakistan

The Department of Biosciences, COMSATS University led a competitive project on development assays for the diagnosis of prevalent Echinococcal Species. Sampling and awareness activities conducted in districts of Multan and Bahawalpur, Punjab province. Briefing was provided to the high risk group population including 257 men and 20 women and 470 college level students who attended awareness program, 340 samples were collected from them. Rajanpur tehsil turned out to be the most affected with the highest seroprevalence 55.36% in the entire study area. Men were comparatively more affected (56.26%) as

compared to women (54.18%) while buffalos were the most affected animal species (21%). Various experimental achievements during this time includes sequencing of mitochondrial genome of the parasite and optimization of PCR-RFLP technique for identification of echinococcus species in Pakistan. SAT assay was further refined by using different antigenic fractions and validated by comparison with commercial ELISA. Furthermore, a Dot-ELISA was developed for rapid diagnosis and its efficiency is being assessed. Two women BS students, one woman MS student and four men MS students working on the condition in the humans/animals have successfully completed.

Interviewing farmers after taking sample

8.2 Camel milk value addition:

Under competitive grant a project is being implemented by Department of Dairy Technology, University of Veterinary & Animal Sciences, Lahore entitled **"**Enhancing nutritive value of Camel milk by introducing Camel milk Cheese sweets & dried cheese powder and hands on training of female farmers as Master Trainers in low income areas of Bahawalpur (Punjab)". The project trained 30 women Camel farmers as master trainers in Bahawalpur region in May and June, 2019; the objective was to provide hands on training to women camel farmers on "Value addition of Camel milk". The training focused on preparation of camel milk cheese, camel milk cheese sweets, camel milk cheese powder and flavored camel milk. A one-day training workshop was conducted on "Camel Milk Cheese Production and its Value addition" on September 30, 2019 for technology transfer and output of the project to the Dairy Industry. The Participant were from dairy and food sector included Engro Foods, Haleeb Foods, and others.

8.2.1 Effect of different antibiotics and steroidal residues in meat of chicken and their effect on humans in Punjab

Young researcher making cheese from camel milk


Processing of camel milk in laboratory

The University of Veterinary and Animal Sciences (UVAS), Lahore studied the effect of different antibiotics and steroidal residues in meat. The study components in this project involve survey for knowledge gap,

determination of hormones, and antibiotics in feed and chicken meat. Survey also focused on antimicrobial resistance by consuming different feeding patterns especially with chicken consumption. In this project research associate and students were trained for survey regarding knowledge gap and analytical analysis for hormones and antibiotics. A total of eight months were spent in field for questionnaire filling, sampling for feed and meat samples collection for analysis on different intervals in selected locations of the Punjab province. Women were involved in data collection for survey study of the knowledge gap of the consumers in hormones and antibiotics as well as sampling for antibiotics resistance study.

Assessment was done of food safety knowledge and practices of different stakeholders (consumer, food safety officers, veterinary officers, poultry growers, doctors'/health professionals and feed manufacturer). It also evaluated the presence of antibiotics and steroids in regular diet of chicken feed as well as meat available in Punjab province. Additionally, it determined the effect of consumption of theses antibiotics in development of antibiotics resistance in humans.

9 Vegetable/Pulses/Oilseed

9.1 Vegetable/pulses/oilseed Competitive Projects (Funded through Competitive Grants)

9.1.1 Use of waste water for irrigation of alternate crops other than vegetable crops

Under competitive grant, a project is being implemented by Institute of Soil Chemistry & Environ. Sci. (ISCES), Ayub Agri. Research Institute, Faisalabad. A comprehensive research study was conducted to monitor the heavy metals (lead, cadmium, chromium, nickel) in soil, wastewater and especially vegetables irrigated with wastewater in urban and peri-urban areas of Faisalabad. A total of 55 vegetables, 15 soil and 15 wastewater samples were collected from Tehsil Jaranwala. Total 49 wastewater samples collected from wastewater irrigated areas of Faisalabad and were analyzed for EC and pH. The results indicated that EC range is from 1.93-5.35 and pH range is from 7.63-9.29 in wastewater samples. An alternate crops like ornamental plants, floricultural crops were tested. Samples of 27 ornamentals, flowering and tree plant samples collected from green belts of Faisalabad for analysis. Results indicated that 96% samples were contaminated with cadmium (Cd) and chromium (Cr) followed by nickel (59%) and lead (37%). Total of 500 plants of different species including floriculture, ornamental and forest trees which were grown with wastewater irrigation and were successfully maintained at Farm Area of Soil Chemistry Section, AARI,

Field Experiment and flowers blooming under wastewater irrigations.

Faisalabad. Three women researchers were involved in this project and actively participated in sampling of wastewater, soil and vegetables, survey and sampling of ornamental plants, analysis of heavy metals and field demonstrations. The majority of research work completed and the remaining is being under progress.

9.1.2 Identification of Climate Resilient Chickpea Genotypes for Mitigating Climatic Impacts on Yield Potential

The Pulses Research Institute – AARI, Faisalabad conducted experiment to identify climate resilient chickpea. Three hundred genotypes were sown on three sowing dates in October, 2017 (Three temperature regimes) at GBRSS (Gram breeding research substation) Kalurkot with two replications at each sowing date. Fifteen desi genotypes and 15 kabuli genotypes were selected on the basis of the yield performance and yield related components in Rabi 2017-18. They were sown on three sowing dates in October and November, 2018 in two Preliminary yield trial re-evaluation trials (desi + kabuli) along with three checks in year 2 (Rabi 2018-19). Three hundred (300) genotypes (set II) are sown on three sowing dates in evaluation trial in October and November, 2018 in year II (Rabi 2018-19). For identification of climate resilient genotypes several field visits were conducted for collection of data and all lines were harvested at the end of April to mid of May. From both re-evaluation trial / preliminary yield trial of desi and kabuli six genotypes are selected and identified as climate resilient genotypes on the basis of performance in comparison to checks during April to September 2019. Thirty genotypes, 15 kabuli and 15 desi genotypes are selected/identified climate resilient after evaluation of 300 genotypes (set II). Four parents selected from (set I) were sown in hybridization program. Two women in seed cleaning of trials and seed preparation for different trials were trained.

Evaluation of Chickpea genotypes in the field for climate resilience Scientist collecting data in field.

9.1.3 Integrated approaches to manage parasitic weed in major cash crops in KP and Baluchistan provinces

Under competitive grant, a project is being implemented by Department of Weed Science, UAP. Efficacy of different techniques for the control of parasitic weed (Orobanche spp) in tomato crop was evaluated in two provinces of Pakistan (at Mardan in KP province and Qilla Saifulla in Balochistan province). Students from the UAP, University of Swabi, Agricultural extension department Balochistan province, and local farmers participated in conducting experiments, project trainings, workshops and seminars. They shared

the results of the experiments with each other. A total of 26 students and 22 farmers were involved in carrying out different activities. A PhD scholar completed his research work under this project two women, (master students) benefited from lab activities and field activities under the project. The parasitic species were collected, taxonomically identified and preserved in the Herbarium department of Weed Science. For the first time it was observed that Flaveria trinervia and Thalspi arvense act as host plants for Orobanche ramosa and Orobanche aegyptiaca, respectively in district Qilla Saifullah. A new host (Parthenium hysterophorus) was observed for Orobanche cernua in district Mardan. It was noted that presence of weeds can cause up to 76 % yield losses while Orobanche alone accounts for 68 % yield losses in tomato. However, the yield losses depend upon the type of weed, weeds density, Orobanche intensity of attack, seasonal and environmental factors. Orobanche sp was found to prefer dry soil for germination and growth. Integration of six days irrigation interval with pendimethaline 2.5 Kg a.i ha-1 and 120 kg Nitrogen ha-1 suppressed Orobanche sp and other weeds up to 95 %. In addition, plastics minimizes evapotranspiration, conserve soil moisture and suppress the weeds growth except Cyperus rotundus which is an eco-friendly approach and is a good alternative to herbicides.

Student given breifing about project activity

9.1.4 Establishment of Vegetable Seed Bank in Baluchistan province.

Under competitive grant, a project is being implemented by Directorate of Vegetable Seed Production-ARI Sariab, Quetta. Main objective of this project is to conserve the indigenous germplasm of vegetable crops. In this nexus initially a lab has been established at Directorate of Vegetable Seed Production. The Lab was inaugurated by Secretary Agriculture and Cooperative, Baluchistan. This lab will be act as repository of collected vegetable Seeds. Lab have all required facilities and is functional with updated equipment. The second objective of the project is collection of vegetable seeds. In this regard, Directorate of Vegetable Seed Production formulated a team comprised of Agronomist and Horticulturist. They visited the district Kharan and Chagi where they communicated message to farming communities to provide indigenous seed. In next step seeds will be collected according to zones. In each zone specific teams will be formulated and targets will be sets. Along with that the sensitization of Vegetable Seed bank is on priority because to make aware the farming communities about importance of Vegetable Seed bank and through this way the conservation of vegetable seeds will be transmitted at grass root level of province.

Collection of data from vegetable field

At initial level, farmer awareness campaign was initiated. This campaign was started from district Kharan and ended in district Qilla Saifullah. Team of Vegetable Seed bank conducted awareness campaign. In this

campaign, the team explained to the farming communities about the effectiveness of the indigenous seeds of vegetable crops. The local germplasm will be depleted from our entire region. These germplasm are real source of variation and very significant in term of any breeding programs. Farmers are requested to store seeds (indigenes) and strengthen this bank. Along with that, Vegetable Seed Bank team also published a comprehensive brochure which also disseminated among the communities of the province.

9.1.5 Establishment of High Value Fruit and Vegetable Nurseries in Sindh arid zone

The Arid Zone Research Institute (AARI), PARC Umerkot implemented a project on High Value Fruit and Vegetable Nurseries in Sindh. The variety of crops, fruits and vegetables are cultivated with canal water and rainwater. AARI developed technology package of high density Ber cultivation and fruit fly control. Institute developed Dandicut chili seed through selection methods. Under this project the chili (Dandicut) nurseries established at AARI, Umerkot and farmers' field. A total of 17 farmers participated in the project activities. Awareness created among farmers on application of fertilizer as basal dose and seed treatment with systemic fungicides and insecticides for prevention from diseases and insect's infestation and transplant of healthy sapling in the field. Under the project a healthy Chili Dandicut seed developed and used at farmer's field i.e. Javed Rajar farm Umerkot, Aziz Solnagi Pathanabad near Kunri, Choudhry Kabir farm, Mahmoodabad farm. After successful nursery establishment and while sapling was of ten to eleven centimeter, then it was transplanted for 40-45 days in the field. Established chilli plants are in better condition than farmer's crops.

Data collection from Farmers nursery

9.1.6 Molecular based genetic divergence in indigenous common bean of Himalaya Pakistan

Under competitive grant, a project is being implemented by Department of Plant Biology and Genetics-UAP. Under this project staff from agricultural research and extension departments, students and local farmers participated in conducting project activities. A total of four women were involved in carrying out different activities. In 2018, two students of B.Sc.(Hons) and M.Sc.(Hons) carried out their research work under this project, while other four students of M.Sc. (Hons) and two students of B.Sc. (Hons) are carrying out their research work under this project in 2019. During this tenure, collection of 550 accessions and their preliminary screening was carried out at 12 different locations for assessing their performance, adaptability and suitability across each environment. In the following year (2019), the accession identified (402) based on their performance, suitability and adaptability across different locations that were subjected to phenotypic characterization across six sites viz., Peshawar, Madyan (Swat), Chitral, Kaghan,

Data collection of common bean in Himalayan region by woman researcher

Gilgit, Hunza and Skardu. Out of these 402 accessions, 272 accessions had general adaptability across the target sites, while the remaining accessions were specifically adapted at some of these locations. The major multiplication trial is carried out at ARS, Kaghan where all of the 402 accession have been planted. While at other locations, accessions with specific adaption to a particular location along with the 272 generally adapted accessions have been planted. Performance of these accessions is so far better at all the test sites except Peshawar due to its hot climate, resulting the crop to mature earlier with minimum number of pods and lower seed set. Whereas, the performance of the common bean accessions at the remaining five locations is satisfactory and better production is being expected from them. Molecular characterization of these common bean accessions was carried out at NIGAB, NARC. Based on these studies substantial amount of genetic diversity was found in the tested germplasm which could be utilized to start breeding and developing bean varieties in the country.

9.1.7 Sustainable control of apple scab

Under competitive grant, a project is being implemented by NIFA, Tarnab. The objective of this project is to characterize apple scab fungus isolates for natural growth variability, sensitivity and resistance against Aliette and Topsin M fungicides. Through this characterize scab resistance in 17 local apple cultivars obtained that were previously raised and maintained as nursery at NIFA. In-vitro scab resistance screening tests of local apple cultivars was carried out. Three internees including two woman completed internship trainings. Successfully organized a one-day national seminar for farmers on “awareness on apple diseases and insect pests” in collaboration with ARI-Mingora. Awareness created on importance of apple and apple scab through demonstration of scab resistant genetic stocks, apple varieties and lab activities among staff of Human Resource Development Center (HRDC), Peshawar, Model Educational Institutes, Peshawar at NIFA. Previously submitted paper abstract was accepted for presentation at an international conference to be held in Peshawar. A radio talk was delivered and another was planned for November, 2019. Project progress was presented in NIFA annual in-house review 2019.

9.1.8 Increasing productivity of vegetable crops in district Swabi through comparative research program

Under competitive grant, a project is being implemented by ARS-Swabi. A total of four training were conducted for 158 farmers at Shewa district Swabi. Furthermore, an increase of 25 – 30% was observed in adopting modified cropping practices and growing off-season vegetables by the farmers during second year of the project. Twenty-four comparative research trials on tomato, cucumber, squash, bitter ground, chili and brinjal were carried out on farmer’s fields. Based on comparative research trials, improved cropping practices were transferred to the farming community. An increase of 20 – 50% in yield and income was observed in winter season as compared to autumn and early summer seasons for tomato, cucumber, squash, bitter ground, chili and brinjal. Vertical planting style for tomato, cucumber and bitter gourd gave 30 to 50% high yield and income as compared to the horizontal planting style.

An increase of 25 – 50% in yield and income of the farmers were observed as compared to the previous year. Eight screening experiments were carried out on tomato, cucumber, okra, squash, chili, bitter ground and brinjal to characterize the vegetable germplasm and identify the best performing plants. In okra best performing advance lines were selected and will be further evaluated for yield and disease resistance. Inter-varietal crosses were performed among okra varieties and 7 F1 hybrids were obtained. A total of 25 accessions of okra were evaluated for morphological characterization and disease resistance. Tomato segregating populations were also evaluated and best performing plants were identified.

9.1.9 Integrated Nutrient Management for Improving Production and Quality of Strawberry in Sindh Province.

Quaid-e-Awam Agriculture Research Institute, Larkana implemented a project on Strawberry in Sindh. The response of integrated use of organic and inorganic nutrients in improving the yield and quality of strawberry was investigated and an optimum dose was evaluated. A total of 100 growers, four labors, ten staff members, five extension workers, five businessmen related to strawberry, three NGOs, ten representatives of private fertilizer/pesticide companies actively participated in the project. Awareness about cultivation of strawberry in Sindh province was created among strawberry growing community through print material, seminars and field days. Production technology especially integrated nutrient management was transferred through different means. Production increased by 15%, income increased by 15%, fertility of soil increased by 1%, organic matter of soil increased by 10% and 2% women introduced strawberry in their fields.

Strawberry farmer examining the field

The women can play an important role in cultivation of strawberry after land preparation. The field operations of strawberry do not require heavy labour, therefore, women can be engaged in this field and a good output can be produced. Strawberry crop can provide a major source of employment for women. Women were introduced in the field of strawberry first time in Sindh province for the purpose of clean, neat, injury free and speedy picking of strawberries. The number of women involved was 15 (This project is research based and implemented on small scale; therefore, involvement of non-technical labour is limited). However, the strawberry is getting picked by women for the data collection purpose. On due consideration of strawberry picking by women; the farming community is emphasized to get their strawberry picked by women as they pick speedy, neat, clean and damage/injury free fruit as compared to men.

9.1.10 Strengthening of Mash Germplasm and Identification of High yielding and Disease Resistant Genotypes.

Under competitive grant, a project is being implemented by Pulses Research Institute-AARI, Faisalabad. During this tenure 137 lines from USA, 73 lines from PGRI and 70 local lines were sown on March 27, 2019. On the basis of yield and disease tolerance, 12 exotic genotypes were selected and sown in preliminary yield trail during spring and kharif (summer)-2018. Data was recorded for plant stand, days to 50% flowering, tolerance for Urdbean yellow mosaic virus, Mungbean leaf crinkle virus and yield. Trial entries were harvested during July, 2019. Pre-basic seed of Arooj-2011 produced during spring-2019, was provided to the seed companies/farmers to increase the production of mash. This will ultimately decrease the import of mash. Field visits on daily basis were made for the recording of data. F0 seed from kharif 2018 was sown during Spring 2019 and harvested during the month of July as F1 seed.

To evaluate the performance of genepool entries during Kharif 2019:

- 289 entries from genepool were sown
- 14 entries sown in preliminary yield trial

- F1 seed from spring 2019 sown
- Twenty-five promising genotypes were sown for screening against Mungbean Yellow Mosaic Virus (MYMV) and Urdbean Leaf Crinkle Virus(ULCV).
- Hybridization to develop desirable traits is in progress.
- For pre basic seed production a block of 14 kanals of variety Arooj-2011 was sown
- Certification process by FSC &RD is in Progress.

Three women (1 research associate and 2 DPLs) worked for this project. Research associate worked for the assistance of all research activities while DPLs worked for Lab and field.

Sowing of Mash trials

Scientist recording data observations in trial field.

9.1.11 Establishment of colonal repository of coconut and its propagation for upscaling in coastal areas

Under competitive grant, a project is being implemented by Institute of Plant Introduction, SARC Karachi. Initial survey was conducted for review and varietal identification of local plantation. Most of block plantation is at irrigated area of district Thatta in Gharo, MirpurSakro, Garho, Ghorrabari Talukas. Some block plantation also exists around Memon-goth under tube well irrigation in district Malir of Karachi. Scattered gardens of coconut also exist in the city while people have planted some trees in their houses or in their streets. These plantation is done without selected varietal composition, rather planted whatever coconut was available in the market. Some of the new farmers have selected varietal composition but at small scale with limited young trees. Overall Srilankan (green tall) variety is most

Developed Indonesian nuts nursery at IPI

Showing unproductive trees at let stop

dominant which is around 70% while other varieties are from Bangladesh, Indonesia and Malaysia. Most of the farmers complained scarcity of irrigation water, while poor technical knowhow, regarding coconut was observed. The farms are generally very old and dried up with poor agronomic and nutrient management. Due to poor production, the farmers are reluctant to manage the old, low yielding and very tall trees. Hence it was felt that new improved type of coconut with known yield potential along with technical knowledge may help coconut cultivation on commercial scale. The reason behind not having promising cultivars/quality varieties; is the restrictions and phyto-sanitation issues on import of live plants/seed nuts. Coconut Research Institute Sirilanka, was requested to help acquire coconut seed nuts, they were of view that it could most probably be imported via germplasm exchange program of International Plant Genetic Resources Institute (IGPRI). For this purpose, the case was discussed with Chairman PARC and a letter was written to SAARC by the chairman for the provision of seed nuts or plants, response is awaited. Private suppliers at international level were also approached, but due to limited available funds and number of seed nuts they were reluctant to supply. Available coconuts imported for domestic consumption were earmarked for its source country and were targeted for germination and nursery development for adding up new varieties into coconut germplasm. Therefore, only Srilankan and Malysian seed nuts were acquired and a total of 70 saplings have been developed and are being maintained for proper growth and will be shifted/added into the existing coconut germplasm at Institute of Plant Introduction (IPI) farm. A local farmer is also selected from whom seed of dwarf varieties could be acquired while its fruits get mature. A nursery development facility at IPI has been improved. The nursery shed was repaired accordingly.

9.1.12 Production of Off-season Vegetables in Siren and Konsh valleys of District Mansehra

Under competitive grant, a project is being implemented by ARS, Mansehra, Baffa. The project identified suitable pockets for off-season vegetable production in Siran and Konsh valleys of district Mansehra and introduce a new cropping system from mono cropping to double cropping in the project target areas. Production technologies were developed for off season vegetables (Radish, Turnip, French Beans, coriander, Peas and Potato). New and improved hybrids and open pollinated varieties were evaluated in the target areas. The project created awareness and build capacity of farmers for off season vegetable production through field demonstrations and training. One-day training for 26 women farmers was organized on innovative off-season cultivation of French Bean, Turnip, Coriander, Peas, and Potato. Two women are the recipients of off-season vegetable trials package. The project provided high quality seeds (Hybrid & OPV), fungicide, insecticides, organic/inorganic fertilizer and bio-stimulant.

Women farmers during training session

Farmers harvesting off season vegetables from field

Innovative off-season vegetable production technology disseminated in adjoining area through field days and trainings. The scientist of ARS-Baffa, Mansehra supervised the activity from sowing till harvesting and also regularly visited the sites for providing on site consultation to farmers and field-based hands-on training to strengthen their technical knowledge. One field assistant was deputed in the area for quick response to address the problems. The off-season vegetable cultivation is one of the best option to increase farm income leading to food, nutrition and ecological security and as well as poverty elevation in the area.

9.1.13 Enhancement of Groundnut production through agronomic techniques in Quetta Zone

Under competitive grant a project is being implemented by Extension Department, Directorate of Agriculture Research (Oilseeds) ARI, Quetta. Under this project, students and local farmers at different locations of Quetta Zone collaborated to conduct the project activities. Groundnut crop was grown as demo plots at famers' fields of district Chaghi, Noshki, Pishin, and Quetta. Research trials were conducted at Research field of ARI, Quetta during 2018 and 2019. A student of M.Sc. (Hons) carried out his research work under this project. A total of sixteen (16) seminars / field days were conducted at Noshki, Chaghi, Quetta, Pishin and Killa Abudllah districts of Quetta division for introduction and promotion of groundnut as a new crop in area. Whereas, 706 beneficiaries of Quetta zone were benefited by participating in seminars/field days, provision of seeds and fertilizers. Seeds of groundnut varieties (BARI-2016, BARI-2011, BARI-2000 and Golden) were provided to selective farmers for demo plots. Due to warmer climate and sandy soil of district Chaghi, groundnut exposed tremendous yield results (>1500 kg ha-1) followed by district Noshki (1000-1200 kg ha-1). Crop grown on sandy patches of district Pishin revealed better yield results (up to 900 kg ha-1), while maximum yield of 750 kg ha-1 was recorded at Quetta. Results of research experiments conducted during 2018 revealed that Golden, Potohar, BARI-2000 and 10AK002 were high yielding varieties. It was found that best time for sowing is between 15th April to 30th April for groundnut production in Quetta zone, 20-30 kg N /ha and 80-100 kg P/ha was optimum N:P combination

Farmers field day held at Pishin on 25th August 2019

A view of research trials conducted at ARI, Quetta during 2019

Harvesting and data collection of research trials at ARI, Quetta on 15th October, 2019.

A group photo of participants on farmers field day conducted at Noshki on 7th September, 2019

for higher yield of groundnut. However, application of Gypsum and Sulphur Bentonite (elemental sulphur) as Sulphur source fertilizers resulted highest dry pod yield of groundnut.

9.1.14 Boosting banana production through tissue culture of high yielding varieties

The National Sugar and Tropical Horticulture Research Institute (NSTHRI), PARC implemented a project on banana out-scaling. Banana is major fruit crop of Sindh. The crop is mostly grown through corm/stem, is an unviable practice. The pure and disease free healthy seed is one of the main issues of low yield. The tissue culture technology is very successful tool to produce healthy seed of banana. A total of 3,500 tissue culture plants were given to growers and 4,000 tissue plants were ready to distribute. And 12,000 healthy shoots were under process of multiplication and development of tissue culture plants.

Banana tissue culture plants/Jars in growth room at Tissue Culture Lab PARC-NSTHRI Thatta

Basic material (cultures) for development of tissue culture plants is available for long term. The pure and healthy disease free tissue culture plants will improve the yield and quality of banana. It will also be helpful in controlling the diseases of banana like banana bunchy top virus (BBTV) and Fusarium oxysporum (banana wilt disease). Ultimately, it will be beneficial for the climate by reducing pesticide use. The Co-PI of the project was woman researcher. A total of 25 women students of University, College and NGOs visited tissue culture laboratory. They were involved indirectly by gaining/enhancing their knowledge.

Banana culturing in laminar flow cabinet at Tissue Culture Lab PARC-NSTHRI Thatta

The tissue culture of banana is a very sensitive work. The contamination was the main issue. It reduced the working efficiency of laboratory. It was overcome through strict caring and fumigation with formalin (CH_2O).

9.1.15 Irrigation system efficiency of apple orchards in district Ziarat

Under competitive grant, a project is being implemented by Water Management & Agriculture Research Institute, Sariab-Quetta. Under this project a survey was completed of the area of three selected sites. Field was visited to find out a suitable place/orchard to conduct trail and three were finalized as per requirement of trial. The farmers were involved in consultation process. Soil samples were analyzed for texture analysis and bulk density that helped in irrigation scheduling. Irrigation scheduling was prepared for the selected field according to the area of each tree. Equipment were installed and calibrated in order to get more precise results. A total of four field days and training program were arranged for 100-120 farmers to train them on the use of the equipment for water saving.

Field selection for trail was a challenging issue as demand-based water supply was needed and small land holdings was also a hurdle for farmers to offer their fields for experiment. Calibration was also a challenging issue to use and set the equipment according to given field environment or climatic conditions.

9.1.16 Induction of blight and virus resistance in tomato

Under competitive grant, a project is being implemented by Nuclear Institute for Agriculture and Biology-NIAB, Faisalabad. Three high yielding candidate hybrids viz. NBH-5, NBH-148 and NBH-149 were contributed in multi-location trials to assess the stability and adaptability in Punjab Province (for the purpose of approval for general cultivation). Hybrid NBH-149 was re-characterized for the 2nd round of DUS (Distinctness, uniformity and stability) while NBH-5 for the 1st round by FSC&RD, Islamabad. All these promising hybrids have been proved to be tolerant to tomato mosaic virus while a number of other hybrids and lines tolerant to early blight and tomato mosaic viruses are under evaluation in preliminary yield trials. About half kg F1 seed of approved tomato hybrids NIAB Gohar AND NIAB Jauhar was produced for commercial cultivation.

High yielding and disease tolerant tomato hybrid variety: NIAB

Tomato is highly sensitive to fungal and viral disease. However, encouraging results were seen in induction of fungal and virus resistance by developing hybrids of tomato through crossing. Earlier, two hybrids viz. NIAB GOHAR & NIAB JAUHAR were developed and approved under the AIP project.

DUS study (on hybrid NBH-149 by Federal Seed Certification & Registration Department,

A total of four women students (one PHD and three MPhil) and two male students (one PHD and one MPhil) are doing their thesis research. One hundred tomato growers/individuals have been made aware of local hybrids NIAB GOHAR and NIAB JAUHAR through Farmer's day at NIAB.

9.1.17 Research and development of pome fruit rootstock production under the agro-climatic conditions of Hazara division

Under competitive grant, a project is being implemented by Agricultural Research Station Baffa, Mansehra. Major achievement of the project includes an introduction of stool bed and sucker production in the target areas, capacity building of farmers regarding rootstock and fruit nursery plants production, promotions of fruit nursery plants, promotion of orchard culture in the target areas, awareness regarding beneficial effects of fruits on health.

The project area is conducive for fruits production so the cropping system of the area will be easily changed from mono cropping trend to fruit growing culture by introduction of different fruits species. Nursery is thriving well in the sub-mountainous agro-climatic conditions of district Mansehra. This is a new venture where farmer can get more than 6000 true to type and disease free plants from 1 kanal area with less labor. This venture is a profitable provision for increase in income of small land holding farmers. As the fruit plants culturing is promoted through the project it will help in making the area green with plantation of fruit orchard and nurseries which will positively affect the local environment.

Capacity building session for farmers

farmers ploughing the pome fruit root stock field

9.1.18 Vegetable nursery production and supply system for kitchen gardening

Under competitive grant, a project is being implemented by MNS University of Agriculture, Multan. Vegetables grown in the peri-urban areas are mostly irrigated by sewerage water and contains residues of these toxic compounds causing many diseases like cancer, diarrhoea and hepatitis etc. in human beings. As vegetables grown commercially using sewerage water are contaminated with compounds toxic to human health therefore growing vegetables as kitchen gardening needs to be promoted for producing healthy vegetables at household level. Growing vegetables through seed is a problem and is not very successful for kitchen gardening. The project focus was to promote kitchen gardening by establishing a system for provision of healthy nurseries and vegetable production. Both men and women students were involved in various activities of the project. Their capacity was built on nursery media preparation, multi-pot tray filling, sowing and nursery management. Under the project Vegetable nurseries produced and displayed in eight international and national conferences, workshops, seminars, agriculture and expos. Programs for awareness of society for healthy plant based foods and promotion of kitchen gardening for self-sufficiency in vegetables were conducted at academic institutes, urban facilities and

Women students during the visit of nurseries and demo plots

Expos for community awareness

villages. Vegetables were grown on different vertical structures and developed for promotion of innovative trends in kitchen gardening. Ten demonstration plots were established with public private partnership for awareness among the communities on healthy vegetable production at the household level using roof tops.

10 Socioeconomics Studies

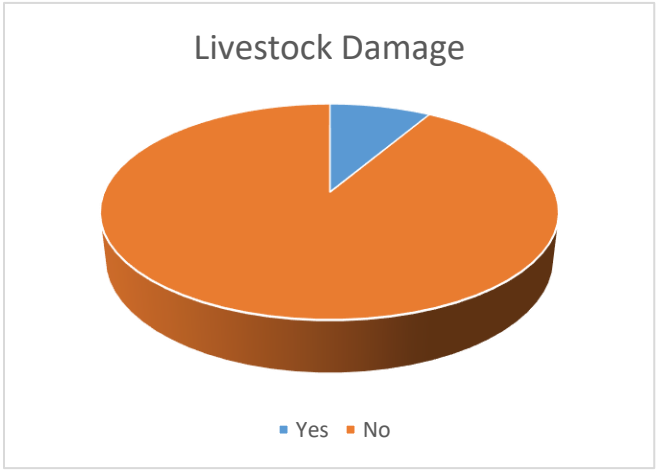
AIP-Socioeconomics (SEP) contributed in the completion of the following studies.

- Estimation of the crop and livestock losses due to recent rain related disaster
- Future technologies/innovations need assessment analysis for Balochistan, KP, Sindh, and Punjab provinces

10.1 Estimation of the crop and livestock losses due to recent rain related disaster

The current study sampling frame was South and Central Punjab and respondents were selected randomly in effected area. Due to changing climatic conditions the erratic and uncertain climatic events occurs quite frequently as compared to past. This year the South Punjab region was severely affected by erratic rains and hailstorm and as per media sources[1] damages were about 150,000 tons of wheat crop in Punjab. CIMMYT team carried out survey to document the losses. The main objective of the study was to estimate and document the losses to crops and livestock due to sudden rainfalls in South Punjab. The survey was carried out using short questionnaire. The data was collected from a total of 112 farmers covering eight districts of Punjab including Layyah, D. G. khan, Rajanpur, Muzaffargarh, Multan, Khanewal, Faisalabad and Chiniot.

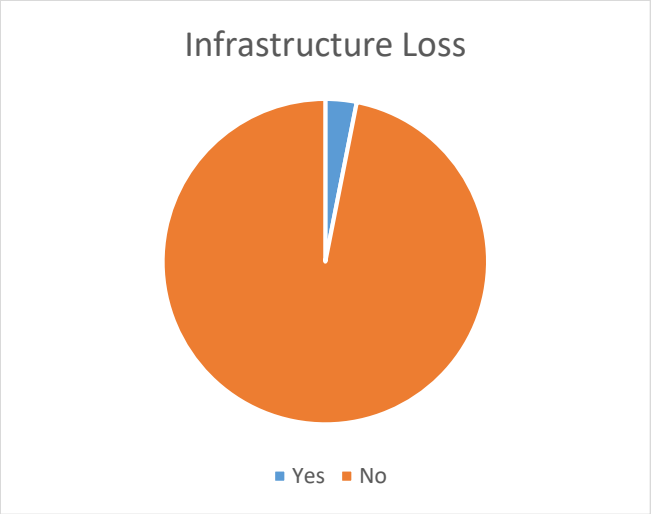
Figure 1: Farmer in khanewal district describing wheat loss due to recent rains



[1] https://www.thenews.com.pk/print/458828-stormy-weather-damages-150-000-tons-of-wheat-crop-in-punjab

The survey findings indicated that wheat crop was severely affected due to erratic rainfall and hailstorm. The crop was ready for harvesting when the erratic rainfalls occurred. The erratic rainfalls caused crop lodging, grain shattering and breakage of spikelet leading to overall yield reduction. There was a lot of variations, in some cases the crop fully destroyed and in some cases the losses were comparatively less. On average 25-30 percent crop was destroyed due to rainfall and hailstorm. In highly effected areas, farmers were unable to harvest single grain of the crop due to its condition. More than 90 percent of the wheat crop loss was estimated in highly hailstorm hit areas i.e. Multan, Khanewal (from Shuja abad to Mian Channu belt) and some parts of Layyah districts. Not even a single spike was seen in the field and broken grains sprouted again from the field in damaged areas of Multan, Muzaffargarh and Khanewal districts. Livestock and infrastructure loss (8.5%) was also reported in the hailstorm-hit areas, small ruminants were more effected as compared to the large ruminants because they usually graze outside in the fields during day time.

10.2 Key Findings

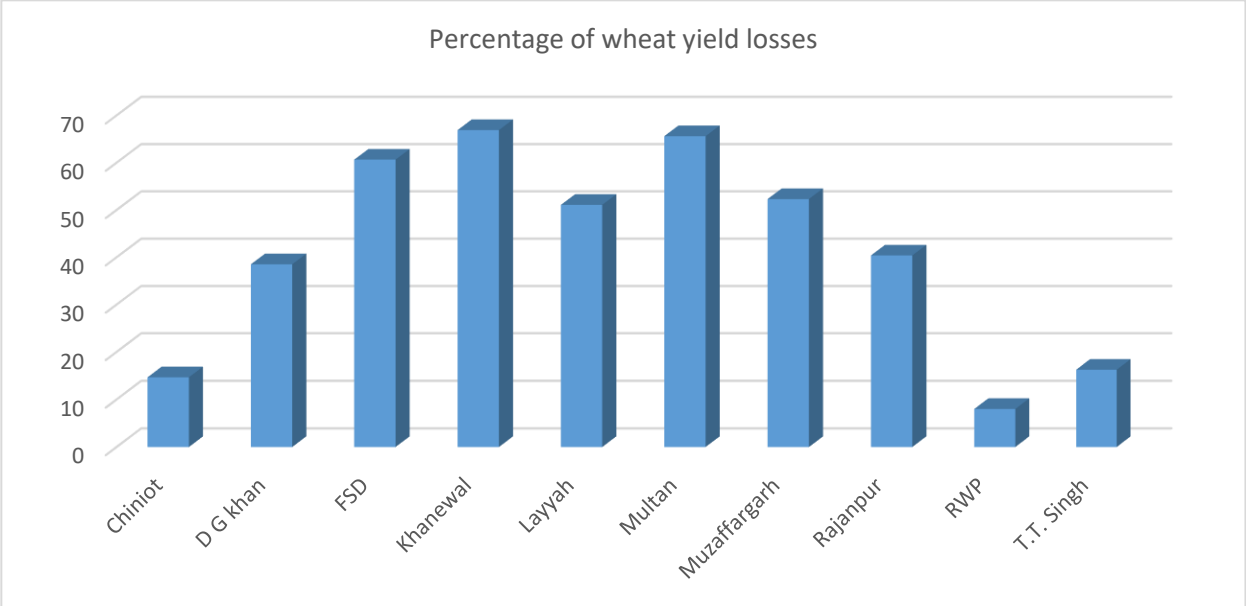


The study findings indicated that changes in climatic events like rainfall patterns, temperature etc. are becoming one of the major threat for crop production and its productivity. Overall the climate changes have significant livelihood impacts on the small holder farmers leading to increase in food insecurity and poverty. The farmers need to be updated about the climate changes.

The government institutions e.g. agricultural extension, metrology department and other relevant departments need to educate farmers about the changing climatic conditions.

There is a need to carry out research on the climate resilient varieties and these varieties needs to be provided to the farming community through quality seed production and setting up demonstration plots in farmers' fields to create awareness about new climate resilient varieties and production technologies.

The farmers need to be assisted with the credit facility both from the public and private sectors.



Currently about 99 percent of the farmers are deprived from the insurance facility. For enhancing the social protection beside cash transfers i.e. Benazir Income Support Program (BISP), the crop and livestock insurance schemes needs to be introduced among the farming community to combat the climate challenge. Immediate relief needs to be provided to the farming community during disasters. The immediate relief can be both in the form of the cash and wheat, especially in the more affected areas i.e. Multan, Khanewal, Muzzafargarh and Rajanpur districts.

10.2.1 Need Assessment Analysis in Balochistan province

A series of workshops were carried out jointly by PARC and CIMMYT in collaboration with provincial partners. The main aims of these workshops were to present achievements of AIP-1 to the stakeholders and to set priorities for the next phase subject to fund availability. The first consultative workshop of this series was carried out in Quetta for 80 stakeholders representing agricultural research, academia, extension, rural support program, service providers, community based organizations and farming community.

The questionnaire was based on set of variables included key issues, problems and intensity / severity. A total of seven problems identified which are mentioned here priority wise. These included low productivity and its management i.e. climate change, soil fertility and low yield of the crops including fodder shortage, post-harvest, value addition, marketing, mechanization. The mechanization includes all the machinery especially the laser land leveling as there exist a lot of demand and potential for laser land leveling technology. The need of capacity building is the important issue as farmers mostly lack awareness and knowledge about various technologies and management practices. In addition, the farmers lack information about the marketing prices.

To overcome the water scarcity problem, there is a need of introduction of improved water management practices, low delta crops and high efficiency irrigation system (HEIS). Furthermore, availability of seed for the crops, fruits and vegetables, therefore, improved germplasm needs to be shared with the research institutes. Their capacity need to be enhanced with the establishment of seed production groups at the far flung areas at village level. (See Table 6)

10.2.2 Need Assessment Analysis in KP province

In KP province the stakeholder's consultation workshop was jointly organized by PARC and CIMMYT in collaboration and partnership with provincial agricultural research system and UAP. More than 100 stakeholders representing agricultural research, academia, extension, rural support program, service providers, community based organizations and representatives of farming community participated in the workshop.

The issue with the highest frequency has been ranked as number one issue/problem and so on. According to analysis, the number one problem is the non-availability of healthy seed, seedling and fruit plants followed by the low productivity of crops due to multiple factors including climate change, fallow land, input quality and timely availability and crop zoning etc. Water scarcity is the third issue/problem while post-harvest, value addition and marketing are the fourth issue/problem. Social inclusion including increased poverty, malnutrition/hidden hunger, security issues, capacity building of farmers and less budget/resources are the fifth issue/problem. The integrated pest management (IPM) is the sixth issue/problem where attack of the fruit fly and fussarium blight in wheat are the more damaging. The diminishing local breeds, disease spread and fodder shortage in small ruminants is also one of the important issue. (See Table 7)

10.2.3 Need Assessment Analysis Sindh province

In Sindh province workshop was jointly organized by PARC and CIMMYT in collaboration with provincial agricultural research system and University of Agriculture, Tando Jam. More than 100 stakeholders representing agricultural research, academia, extension, rural support program, service providers, community based organizations and representatives of farming community participated in the workshop.

According to frequency-based analysis, the number one problem is the water scarcity, the second most important issue/problem is the seed quality and availability. The third most important issue/problem is the small ruminants breeding, disease spread and fodder shortage. The salinity is the fourth most important issue/problem. The indiscriminate use of pesticide is the fifth most important issue/problem. The post-harvest value addition and marketing is the sixth most important issue/problem. The others issues/problem include low productivity, mechanization, capacity building (knowledge/technology) and social inclusiveness (gender participation) respectively in Sindh province. (See Table 8)

10.2.4 Need Assessment Analysis in Punjab province

In Punjab province, PARC and CIMMYT, in collaboration and partnership with AARI, and UAF on April 2, 2019. The main aim of the workshop was to inform the stakeholders on the AIP-I achievements and set priorities for the AIP-II with their inputs at the initial stage. More than 100 stakeholders participated from agricultural research, academia, extension, rural support programs, service providers, community based organizations and representatives of the farming community.

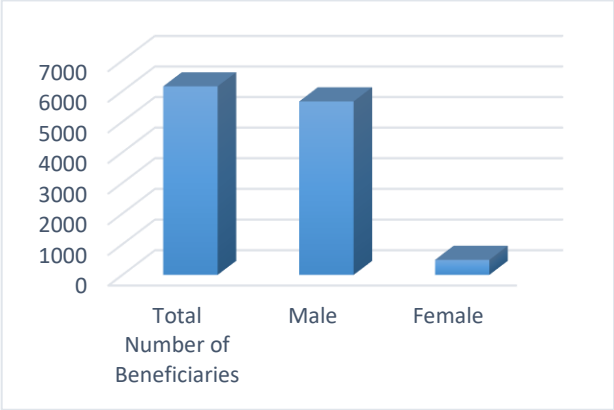
For quantitative information, a one-page questionnaire was used to collect data from the participants to carry out a needs assessment analysis. Two approaches were used: frequency based and weighting score based. Results were similar from both approaches. Geographically, the participants represented all the agro-ecological/cropping regions of the Punjab. About 14% of the participants were from the Northern Punjab, 18% of participants represented South Punjab while the majority of the participants were from the Central Punjab.

The number one issue/problem in the Punjab province is low productivity due to multiple factors including salinity, costly inputs and varying climate. The second most important issue/problem is water scarcity, as there is less canal water availability at the tail ends and falling water tables. The water management

practices including water course lining, laser land leveling and high efficiency irrigation system needs to be promoted on a large scale. Non-availability of improved quality seed of field and vegetable crops, as well as true to type fruit plants, is a serious issue, which leads to low productivity. Access to cheap mechanization is the fourth most important issue/problem, and that may be addressed through focusing capacity building for service providers. The incidence of insects, pests and diseases, as well as weeds and aflatoxin, are the fifth most important issues, which need to be managed through adopting integrated pest management approaches. Livestock and small ruminant issues, including feeding, breeding and diseases management are the sixth most important issue/problem. Accesses to markets, along with low and fluctuating commodity prices of produce are the seventh most important issue/problem. Social inclusiveness i.e. focusing youth and gender, is the eighth most important issue/problem and both these must be part of all agricultural activities at the farm and family level. (See Table 9)

11 Monitoring and Evaluation

AIP M&E is working to track interventions and outputs systematically, and measuring the effectiveness of the project. According to the performance indicators, quarterly data across sectors and from all existing AIP components i.e. CIMMYT (Wheat, Maize, Agronomy, Socioeconomics), and PARC-AIP competitive grants were collected during the reporting period. The data collected from the partners depicts 6156 beneficiaries were targeted (as shown in the graph) during the reporting period. Gender wise breakdown showed that 5664(92%) males and 492(8%) females were benefited from the AIP-activities.



Moreover, data on component outcome indicators were collected and reported to higher management (See Table 10)

12 Personnel/Management Update

The AIP no cost extension (NCE) period ended September 30, 2019 and also two years of AIP-PARC funded competitive grants. However, the AIP-PARC competitive grant receipts did not utilize fully the allocated fund. In addition, CIMMYT has been keeping USAID updated on the challenges AIP faced during the implementation of PARC mandated component. A per USAID and government of Pakistan understanding, the AIP project design included PARC (Government of Pakistan) component on competitive grant. CIMMYT remitted Year-I budget (818,611 USD) to Sate Bank of Pakistan (SBP) in September 2014 and PARC received PKR. 83,765,844.07 (USD 818,611 equivalent) in AIP Assignment Account 007792-9 maintained with National Bank of Pakistan (NBP), Main Civic Center Branch, Islamabad. PARC however, could not utilize the funds due to Finance Division, GOP procedural directions and other administrative issues. CIMMYT in consultation with USAID is making efforts on continuous basis to repatriate the fund and make it available for use as per USAID agreement. Three staff members from administration of CIMMYT Pakistan participated in the admin week in June, 2019. Research Associate Agronomy visited CIMMYT HQ- El Batan Texcoco in Mexico to attend training course on conservation agriculture- based innovation systems.

13 External Factors

- Under AIP Maize-Complications of import permit issuance procedures are creating hurdles in routine-wise import of germplasm.

14 Challenges/Risk

Security risk particularly in newly merged districts of KP province remained a concern during reporting period. However, AIP-agronomy has started their activity through the collaborators and/or aligned departments to disseminate conservation agriculture technologies in the most difficult parts of KP Province.

15 Contribution to USAID Gender Objectives

To contribute to USAID gender objectives, AIP encourages the participation of women in all possible ways. In collaboration with national partners a total of five women participated in project activities under AIP-Agronomy.

AIP Wheat assisted 16% women by providing high yielding and disease resistance varieties. With increase yield potential, these varieties will be instrumental in providing extra food for these resource poor families. In several capacity building events around 7% women participated, which will help them in understanding better agronomic practices and ultimately will assess them in getting more yield.

16 Environmental Compliance

- Most of AIP-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. AIP partners are able to produce high yield from drought tolerant varieties in less than five irrigations per crop cycle which are commonly 10-12 irrigations per crop cycle.
- Due to temperature rise as result of climate changes, insect pest attack is also reported to increase in different crops. Therefore, AIP has supported the evaluation and identification of insect pest resistant maize genotypes to comply with increased insect pest infestations.
- 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 germplasm 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 farmer's money, but could potentially significantly reduce greenhouse gas emissions.
- Extensive use insecticides, pesticides and fertilizers are also huge source of soil and under-ground water pollution. AIP is facilitating the Identification and deployment of insect pest resistant and

fertilizer efficient utilizing genotypes which will definitely help to mitigate the environment pollution.

- 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.
- High yielding early maturing varieties are also being evaluated for their performance across diverse localities. These early maturing varieties are capable of avoiding the terminal water or heat stress through stress avoidance mechanism. The identified varieties will be allocated to partners under the AIP program for registration, further seed scale up and dissemination.
- AIP - Wheat out scaled newly released, rust resistant and high yielding wheat varieties, which do not require fungicides, thus reduce pollution to Soil and Environment as well as Humans and animals. In Barani areas drought tolerant varieties have been distributed which require less water. This puts less pressure for water demand and also produce attractive grain yield.
- Under agronomy- Improved techniques under AIP agronomy are mostly resource conserving and focus on reduction in burning of crop residue, reduced tillage, water saving and fertilizer saving thus contributing towards better and clean environment.

17 Lessons Learned

AIP Maize:

- Kharif season is more preferred than spring season for seed production due to the thermal heat that affects pollen shading and viability during spring season.
- Hands-on training of stakeholders for seed production and maintenance of parental lines is important.
- Hermetic storage and stem borer mass rearing and screening facility are very useful respectively for proper seed storage and variety approval through national uniformity trials.
- Synchronization of flowering in allocated parental material for hybrid seed production, is effecting the seed production due to genotype × season and genotype × location interactions.

AIP Wheat:

- Village based seed system can play vital role in eradication of old varieties provided that seed banks are functional in the area
- With just varietal replacement wheat yield can be increased more than 20% in NMDs

18 Communications

During this reporting period, AIPs' Communications highlighted the AIP's interventions that include arranging successful events, highlighting interventions through 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.

پشاور ایمنل نیوٹریشن زرعی یونیورسٹی میں دوروزہ تربیتی ورکشاپ

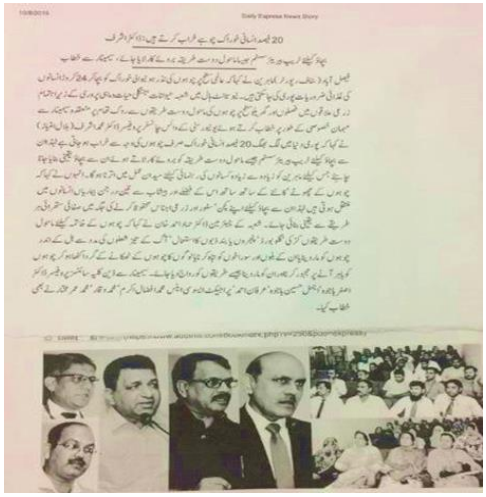
جانوروں کو نکی سائیلج کھلانے سے زیادہ پیداوار حاصل کی جاسکتی ہے، مقررین

سوات (نیوز رپورٹر) جانوروں کو نکی سائیلج کھلانے سے اضافی کم قیمت پر زیادہ پیداوار حاصل کی جاسکتی ہے، ڈاکٹر نذیر احمد خان، ڈیپارٹمنٹ آف اینمل نیوٹریشن زرعی یونیورسٹی پشاور میں یو ایس ایڈ کے تعاون سے دوروزہ تربیتی ورکشاپ کا انعقاد ہوا جس میں وائس چانسلر پروفیسر ڈاکٹر نذیر احمد نے خصوصی طور پر شرکت کی، ورکشاپ میں درجنوں طلباء معروف سائنسدانوں کے لیکچرز اور مایہ ناز سرجنز کے عملی تربیت سے مستفید ہوئے نکی کے سائیلج بنانے اور جانوروں میں کیٹوالگانے کے موضوع پر دوروزہ ورکشاپ زرعی یونیورسٹی کے ڈیپارٹمنٹ آف اینمل نیوٹریشن کے اسسٹنٹ پروفیسر ڈاکٹر نذیر احمد خان کے تحقیقی پراجیکٹ کے زیر اہتمام منعقد کیا گیا ورکشاپ یو ایس ایڈ کے انگریکلچر اینو ویشن پروگرام (AIP) کے تعاون سے عملی بنایا گیا ورکشاپ میں جانوروں کیلئے نکی سے سائیلج (چارہ) بنانے اور اسکی غذائی اہمیت اور معیاری پیداوار پر تفصیلی بحث کی گئی ورکشاپ میں پی ایچ ڈی سکالرز کے سائیلج پر تجربات کے نتائج پر روشنی ڈالی گئی نیز جانوروں کیلئے اس مفید اور اضافی اہم خوراک کی اہمیت اور پاکستان فیڈ انڈسٹری میں سائیلج کا حصہ پر بھی تفصیلی بحث کی گئی، ورکشاپ میں ریسرچ کے طلباء کیلئے جانوروں میں کیٹوالگانے کیلئے صوبہ کے مایہ ناز ورٹرنری سرجن ڈاکٹر سربلند خان (DDL SWAT) نے کرائی ورکشاپ میں پروفیسر ڈاکٹر نذیر احمد وائس چانسلر زرعی یونیورسٹی پشاور، ڈاکٹر محمد طاہر، چیئرمین ڈیپارٹمنٹ آف اینمل نیوٹریشن، ڈاکٹر نذیر احمد خان اسسٹنٹ پروفیسر اور پرنسپل انویسٹی گیٹر برائے مذکورہ پراجیکٹ، ڈاکٹر مشرا اور دیگر پروفیسرز نے لیکچرز دیئے نیز ڈاکٹر نذیر احمد خان کے پی ایچ ڈی سٹوڈنٹس ڈاکٹر خالد فاروق اور ڈاکٹر نادر خان نے نکی سائیلج پر تجربات کے نتائج پیش کئے ورکشاپ کے اختتام پر تمام طلباء و طالبات کو سرٹیفکیٹس دیئے گئے۔

Branding material of maize, wheat and PARC CGS partners was developed according to USAID branding and marking guidelines. These include banners, backdrops and standees for various events under these components.

Coordination with partners was done related to branding, communications and action oriented for proper AIP branding (use of logos, branding stripe for banners, standees & project signage).

Under the AIP livestock component news were appeared in national print media. .



Vegetable Nursery Project implemented by MNS University of Agriculture, Multan under USAID AIP PARC competitive grant gained media coverage in different occasions The awareness campaigns for vegetable kitchen gardening were also launched on electronic media and print media including Abb-Tak TV, Rohi TV, Channel Five, Express TV, Samma Tv, 24 News, Khabrian newspaper and FM-101.

AIP PARC competitive grants partners produced branding material like banners, brochures, signage and standees were developed as per USAID and AIP branding guidelines and also related news appeared in national and local newspapers and clipping were shared with stakeholders and archived.

Project signage and publications were developed according to USAID AIP branding guidelines:

19 Appendices

19.1 AIP Maize Appendix

1. Events Calendar for Meeting Held

Sr. No	Meeting Name	Date	Person Responsible	Venue	Partners	Outcomes
1	Consultative Meeting AIP-2	2 April 2019	CIMMYT	Faisalabad	AARI	Stakeholders consultative workshop for priorities setting Opportunities, Needs & Potential, Agricultural Innovations – Phase II
2	International Seed Conference	3-4 Sept. 2019	CIMMYT	Katmandu Nepal	NARS & Indigenous Seed Companies	International Seed Conference and Expert Consultation

Table 1 A, AIP Maize: Summary of climate resilient maize trials being conducted during Spring 2019

No	**Trial code**	**Trial description**	**No of entries**	**No. of sets distributed**	**Source**
1	AdvQPM17	Advance Quality Protein Maize Three-way Cross yellow hybrids	60	2	CIMMYT-Zimbabwe
2	EHYB17	Extra Early Three-way Cross hybrids	50	3	CIMMYT-Zimbabwe
3	IHYB17	Intermediate Maturing Three-way Cross White Hybrids	50	1	CIMMYT-Zimbabwe
4	IHYB18	Intermediate Maturing Three-way Cross White Hybrids	42	1	CIMMYT-Zimbabwe
5	EHYB18	Extra Early Three-way Cross White Hybrids	45	3	CIMMYT-Zimbabwe
6	18CHTPROA	Provitamin A Enriched Orange maize Three-way Cross Hybrids	30	3	CIMMYT-Mexico
7	01AS-18TSCTWCWN	Three-way White Normal Hybrids	25	4	CIMMYT-Mexico
8	03AS-18TSCTWCWZN	Three-way Zinc Biofortified Hybrids	18	2	CIMMYT-Mexico
9	04-18TTWCYN	Three-way Yellow Normal Hybrids	28	4	CIMMYT-Mexico

Table 1 B, AIP Maize: Summary of climate resilient maize trials being conducted during Kharif 2019

No	**Trial code**	**Trial description**	**No of entries**	**No. of sets distributed**	**Source**
1	MLT	Medium-maturity, yellow single-cross hybrids	20	10	CIMMYT-India
2	CRT	Medium-maturity, yellow single-cross hybrids	25	10	CIMMYT-India

Table 2 AIP-maize: List of partners participated in the evaluation of spring and kharif maize trials (2019)

Sr. No.	**Organization**	**Province**	**Ownership**	**No. of trials**
1	National Agricultural Research Center (NARC), Islamabad	ICT	Public	5
2	Cereal Crops Research Institute (CCRI), Nowshera	KP	"	5
3	Maize and Millets Research Institute (MMRI), Yousafwala	Punjab	"	2
4	The University of Agriculture, Peshawar	KP	"	1
5	University of Agriculture, Faisalabad	Punjab	"	4
6	Muhammad Nawaz Sharif, University of Agriculture, Multan	"	"	3
7	Jullundur Private Limited, Arifwala	"	Private	2
8	Tara Crop Sciences, Sahiwal	"	"	3
9	Kanzo Quality Seeds, Sahiwal	"	"	2
10	Sohni Dharti International, Sahiwal	"	"	4
11	ICI Pakistan, Sahiwal	"	"	1
12	Pak HiBred Private Limited	"	"	3
13	Ali Akber Seeds Private Limited, Faisalabad	"	"	3
14	Petal Seeds Private Limited	KP	"	1
15	Hi Sell Seeds Industry	Punjab	"	1

19.2 AIP Wheat Appendix

Table 3, AIP Wheat: Detail of capacity building events

Province	***Partner***	***Event(s)***	***No. of Participants***	***No. of female Participants***
Baluchistan	*ARI, Quetta*	*Farmer Field day*	*70*	*0*
Baluchistan	*BARDC Quetta*	*Farmer Field day*	*40*	*0*
Baluchistan	*BARDC Quetta*	*Farmer Field day*	*72*	*0*
GB	*AKRSP*	*Quality wheat seed Production*	*196*	*27*
GB	*AKRSP*	*Farmer Field day*	*70*	*4*
		Total	***448***	***31***

19.3 AIP Agronomy Appendix

Table 4 AIP Agronomy: Ridge planting of wheat in various districts of Pakistan.

Province	Districts	Demonstration (No)
Sindh	Mitiari, Shaheed Benazir Abad, Noshero Feroz, Sanghar, and Umerkot	20

Khyber Pakhtunkhwa	Banuu, Swat, Mardan, Lakki Marwat, Swabi, Buner, Nowshera, and DI Khan	56
Punjab	Jhelum, Bhakkar, Khushab, PD Khan, Bahawalpur, Muzaffar Gar, Lodhran, Gujrat, Pakpattan and Sahiwal	68
Balochistan	Jaffarabad	03

Table 5 AIP Agronomy: National partner's collaboration on Green Seeker use for N management in wheat in Pakistan

Province	**Partners**	**District**
Punjab	ARS – Bahawalpur, RRI – Kala Shah Kaku, NRSP, Wheat - NARC, Adaptive Farms Punjab and WRI – Faisalabad	Faisalabad; Bahawalpur; Jehlum; Chakwal; Rawalpindi; Sheikhupura and Gujranwala;
KP	CCRI – Pirsabak; Miankhel Seed – DI Khan and MFSC – KP	Nowshera, Swabi and DI Khan
Sindh	AZRI – Umerkot and WRIS – Sakrand	Umerkot and Sakrand
Balochistan	DAR – Balochistan; ARI – BARDC	Jaffarabad

Annexure 1. Details regarding farmer field days conducted

S.No	Hosting partner	Event title	Location	Date	Participants (No)
1	RRI, KSK	ZTHS planted wheat	Sheikhpura	02.04.2019	71
2	ARI, Jaffarabad	Zero tillage wheat planting	Goth Mir Allah Bakhsh Rahujo, Jaffarabad	03.04.2019	75
3	MFSC, Peshawar - KP	Ridge sowing of wheat	Adizai, Dir lower	04.04.2019	54
4	MFSC, Peshawar - KP	Quality wheat seed & best management practices	Koper, Malakand	04.04.2019	60
5	MFSC, Peshawar - KP	Quality wheat seed & best management practices	Darora, Dir Upper	05.04.2019	60
6	ARS, Bahawalpur	Ridge sowing of wheat	Lodhran	06.04.2019	80
7	WRI, Faisalabad	ZTHS planted wheat	Chiniot	11.04.2019	65
8	ARS, Bahawalpur	Ridge sowing of wheat	Bahawalpur	11.04.2019	83
9	NARC, Wheat Program	Wheat seed & best management practices	Chakwal	14.04.2019	81
10	NARC, Wheat Program	Wheat seed & best management practices	Gujjar Khan	16.04.2019	74
11	ARS, Bahawalpur	Ridge sowing of wheat	Bahawalpur	22.04.2019	86
12	RRI, KSK	ZTHS planted wheat	Sheikhpura	22.04.2019	77
13	ARF, Gujranwala	ZTHS planted wheat	Narowal	25.04.2019	102
14	CCRI, Nowshera – KP	Ridge sowing of wheat	Bamkhel, Swabi	30.04.2019	63
15	CCRI, Nowshera – KP	Training on wheat diseases & production technology	CCRI, Pirsabak, Nowshera	03.05.2019	66

19.4 AIP SEP Appendix

Table 6 AIP SEP: Balochistan Need Assessment Analysis

S #	Issue/Problem	Frequency Base	Rank	Weighing Score	Rank
1	Water scarcity	42	1	95	1
2	Seed	27	2	55	2
3	Low production and its management (climate change / soil fertility/classification/IPM)	28	3	43	4
4	Post-harvest, value addition and marketing	19	4	35	3
5	Mechanization	17	5	30	5
6	Capacity building (knowledge/technology)	16	6	26	6
7	Social inclusiveness (gender participation / institutional support)	2	7	8	7

Table 7 AIP SEP: KP Need Assessment Analysis

S #	**Issue/Problem**	**Frequency Base**	**Rank**	**Weighing Score**	**Rank**
1	Seed	25	1	49	1
2	Low production (climate change, fallow land, input quality and availability, zoning, machinery etc.)	23	2	46	2
3	Water	16	3	35	3
4	Post harvesting, value addition and marketing	11	4	14	6
5	Social Inclusion	9	5	16	5
6	IPM	7	6	21	4
7	Small Ruminants (Breeding, disease spread, Fodder Shortage)	3	7	13	7

Table 8 AIP SEP: Frequency and Weighting Score Based Need Assessment Analysis					
S #	**Issue/Problem**	**Frequency Base**	**Rank**	**Weighing Score**	**Rank**
1	Water scarcity	25	1	49	1
2	Seed quality & availability	23	2	46	2
3	Small Ruminants (breeding, disease spread, fodder Shortage)	19	3	36	4
4	Salinity	16	4	38	3
5	Indiscriminate use of pesticides (IPM)	14	5	25	6
6	Post-harvest, value addition & marketing	13	6	27	5
7	Low crop productivity (climate, inputs etc.)	10	7	17	8
8	Mechanization (all stages)	9	8	18	7
9	Capacity building (knowledge / technology)	7	9	13	9
10	Social inclusiveness (gender participation)	3	10	7	10

Table 9 AIP SEP: Frequency and Weighting Score Based Needs Assessment Analysis					
S #	Issue/Problem	Frequency Base	Rank	Weighing Score	Rank
1	Production technology constraints leads to low productivity	44	1	67	1
2	Water scarcity	23	2	48	2
3	Seed quality and availability	22	3	44	3
4	Lacking mechanization	17	4	39	4
5	Indiscriminate use of pesticides	16	5	35	5
6	Livestock/small ruminants	14	6	29	6
7	Marketing issues	7	7	18	7
8	Social inclusiveness	3	8	6	8

19.5 AIP M&E Appendix

Table 10 AIP M&E Output indicator: April-18 to September-18	
Indicator	Beneficiary (No)
Number of farmers linked with/benefiting from agriculture extension services through scaled up extension system	603
Number of improved production and agriculture management technologies/practices transferred/made available to farmers	250
Number of demonstration plots/farms/trials established for farmers' awareness on improved agriculture technology and management practices	347
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.	5874
Number of new breeding lines/cultivars/rootstock of cereal and horticulture crops at development stage	2584
Number of training events arranged for interventions under different value chains	11
Number of farmers linked with public/private business development service providers (Input supply facilities, industries) through established partnerships	1203

Number of farmer selling products (cereals, vegetables, fruits, milk and small ruminants) value added , production cost decreased a as a result of Project interventions	671
Number of workshops carried out to disseminate new and improved agricultural products	2
Number of new/improved products identified and disseminated through value chain interventions	59
Number of entities (including national scientists, academics, value chain actors etc.) received training on concepts of value chain	30
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	20
Number of farmers linked with/benefiting from agriculture extension services through scaled up extension system	740
Number of improved production and agriculture management technologies/practices transferred/made available to farmers	9
Number of demonstration plots/farms/trials established for farmers' awareness on improved agriculture technology and management practices	2103
Number of farmers received information on improved agricultural management practices through demonstrations/field days/trials	2584
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	987
Number of farmers linked with input/service providers for improved production services/inputs	158
Number of new breeding lines/cultivars/rootstock of cereal and horticulture crops at development stage	57
Number of farmers linked with public/private business development service providers (Input supply facilities, industries) through established partnerships	75
Number of farmer selling products (cereals, vegetables, fruits, milk and small ruminants) value added , production cost decreased a as a result of Project interventions	258
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	46