Agricultural Innovation Program for Pakistan (AIP)

Semi-Annual Report

April 1 to October 31, 2018

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
A.I.	Artificial Insemination
AR	Adaptive Research
AR4D	Agriculture Research for Development
ARI	Agriculture Research Institute
ARS	Agriculture Research station
AZRI	Arid Zone Research Institute
BARDC	Balochistan Agriculture Research Development Center
BARI	Barani Agricultural Research Institute
BISA	Borlaug Institute for South Asia
BRSP	Balochistan Rural Support Program
CA	Conservation Agriculture
CCRI	Cereal Crops Research Institute
CDRI	Crop Disease Research Institute
CDRI	Crop Disease Research Institute
CGIAR	Consultative Group of International Agricultural Research
CIIT	COMSATS Institute of Information Technology
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
DG	Director General
DH	Doubled Haploid
DSR	Direct Seeding of Rice
DVC	Dairy Value Chain
FATA	Federally Administrated Tribal Region
FQSRI	Food Quality Safety Research Institute
FR	Frontier Region
FSD	Faisalabad

GB	Gilgit Baltistan
GHS	Green House Gases
GOP	Government of Pakistan
GPS	Global Positioning System
GY	Grain Yield
Ha	Hector
HRD	Human Recourses Development
HTMA	Heat Stress Tolerance 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
NOC	No Objection Certificate
NRS	National Recruited Staff
NRSP	National Rural Support Program
NSTHRI	National Sugar and Tropical Horticulture Research Institute
NUYT	National Uniformity Yield Trial
NUMYT	National Uniformity Maize Yield Trials
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	Present 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 Center
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
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
TDN	Total Digestible Nutrients
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
VRI	Vegetable Research Institute
WRI	Wheat Research Institute
YR	Yellow Rust
ZT	Zero Tillage
ZTHS	Zero Tillage Happy Seeder

3 Summary

Agricultural Innovation Program for Pakistan (AIP) achieved the set targets for the reporting period. Innovation is the main focus of project in the agriculture sector through new seed varieties, new technologies (mechanization, irrigation systems), and value chain development (durum wheat, and livestock). AIP facilitated building a strong partnership with PARC and wide range of stakeholders and partners from public, private sectors, farmer associations, women, nongovernmental organizations (NGOs), and research institutes that resulted in contributing towards exchange of information, sharing experiences, participation in joint ventures and achieving project goals. AIP, PARC competitive grants contributed to innovation by benefiting farmers and women through 40 multi-sectorial research projects that are being implemented by local partners included agriculture research and extension. Project ensured women maximum participation in the project interventions across Pakistan and built their capacity through trainings to effectively perform their role in boosting agriculture sector.

Under AIP Maize, a total of 52 finished maize products were allocated to public and private institutions. The parental lines of these allocated maize products are being subjected to direct multiplication for dissemination to farmers as well as being used in different breeding programs to diversify the indigenous maize germplasm. AIP Maize support has resulted in increase of 32.36 tons of Open Pollinated Varieties (OPVs) and hybrid seed for farmer. At present AIP-Maize partners are evaluating and validating over 150 maize products. These products included biofortified maize, heat stress resilient, and various maturity groups of white and yellow kernel maize hybrids. AIP also introduced the doubled haploid (DH) technology for the first time in Pakistan. DH technology is very useful for acceleration of maize breeding with enhanced genetic gains. Six different trainings and workshops were organized for 158 students including 42 women. Six private seed companies are supported by AIP-Maize to develop skills for efficient management of seed business. Three young maize breeders got opportunity to participate in an international training course in Uganda.

AIP-Wheat out scaled 18 High yielding and disease resistant varieties to smallholder farmers. The overall average yield of these varieties was 3.8 tons per ha, that is 35% higher than the national average yield of Pakistan. Through village based seed production and demo plots 1729 tons quality wheat seed was produced, that will cover 17290 ha area in 2018-19 wheat season. To develop heat tolerant varieties under changing climate conditions, CIMMYT in partnership with WRI-Faisalabad tested 600 new wheat varieties under heat stress conditions and identified 67 lines for further testing as HYT-70 across ten locations in Pakistan. Pakistan's food industry faces many challenges in getting a consistent supply and right quality of flour for their products. To address industry needs a multi-stakeholders national workshop on Pakistan wheat quality was organized at Wheat Research Institute, Faisalabad to connect all stakeholders with each other and discuss challenges and opportunities in the development of an improved wheat value chain in Pakistan.

AIP agronomy component partnership continued with 23 national partners included 16 public sector agricultural research & extension organizations and 7 private sector seed & fertilizer companies such as Engro Fertilizers. This partnership helped to reach 4628 farmers through assisted application of improved techniques on 735 sites, provision of 19 Zero Till Happy Seeders (ZTHS), 350 Direct Seeding of Rice (DSR) planters, and training of 377 stakeholders and dissemination of improved techniques through field days to 1845 farmers. More than 521 farmers were supported for ZT wheat planting, ridge planting of wheat and LASER land levelling in Punjab, KP, Sindh and Balochistan provinces. It helped in saving irrigation water, reducing cultivation cost and improving 10 -15% yield. An AIP local partner Sharif Engineering Pvt. provided 19 ZTHS to farmers on cost sharing basis that were used for planting of wheat in heavy rice residue. A ZTHS helped farmers in planting wheat in combine harvested rice residue without burning of

residue and resulted in 0.2 t/ha more wheat grain yield in comparison with farmer practice of broadcasting after residue burning/ heavy tillage and contributed to smog control in target areas. AIP partner Greenland Engineering Pvt. manufactured and sold 350 DSR planters to farming communities in the country and exported 50 planters to African countries. This DSR planter save PKR. 5000 per acre in planting cost and also improve 10-15% paddy yield in comparison with farmer practice of transplanting. Contributing to inputs cost reduction, AIP facilitated 100 farmers on precision of nutrient management in wheat with green seeker and results showed that farmers saved 70 Kg urea per hectare or 28 Kg urea per acre without yield reduction in comparison with farmer practice.

AIP Socioeconomics component conducted studies on wheat value chain and maize value chain in Pakistan. The data was collected from various stakeholders involved in the wheat value chain included producers, dealers, whole sellers, millers and various stakeholders in maize producing areas of Pakistan.

AIP-Livestock conducted a research trial for 34 milking animals to validate and evaluate the relationship of three animal-side tests; namely Electronic Mastitis Detector, California Mastitis Test & Surf field Mastitis Test. The information helps to reduced 10-30% financial losses of milk production due to mastitis. AIP also compared the efficacy of four different commercial binders (Novasil Clay, Milbond, Toxisorb and China Clay) to bind aflatoxins in cotton seed cake. A series of ten training programs on Feeds & Feeding and Animal Health Management were conducted for 342 farmers including 126 women in Tharparkar, Umer Kot, Shaheed Benazirabad and Naushahro Feroze. Three days training was conducted for the FATA veterinarians at UAP, Peshawar.

AIP-M&E collected data on MSF outcome indicators on quarterly basis and reported to USAID on PakInfo. AIP actively worked in a collaborative manner and assisted 9058 farmers including 819 women farmers during the reporting period.

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 is vested in a unique consortium of CGIAR Centers and the Pakistan Agricultural Research Council (PARC), led by the International Maize and Wheat Improvement Center (CIMMYT). AIP 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 is divided into four 'Science Windows' – cereals and cereal systems, livestock, vegetables and perennial horticulture. The key indicator of AIP's success will be the number of smallholder farmers who adopt or benefit from productivity or value-enhancing technologies. CIMMYT is the primary implementing partner and prime grantee; managing and taking overall responsibility for AIP and providing direct oversight of the agronomy, wheat and maize commissioned projects within the cereals and cereal systems science window. International partners of AIP included the International Livestock Research Institute, or ILRI and University of California, Davis lead on commissioned projects, 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 Maize

5.1 Development / introduction of climate resilient and nutritionally biofortified maize

The following climate resilient and nutritionally biofortified maize trials were sown and are currently at different stages of maturity. Data will be collected from all evaluation sites at harvesting time that will start in November 2018.

- A total of 153 yellow and white kernel maize hybrids were sourced from CIMMYT Mexico and CIMMYT India. These are climate resilient, adaptable to different agro-ecologies and have enhanced nutritional quality. During kharif season in 2018, trials were grouped into Zinc biofortified, Zinc biofortified with QPM (quality protein maize) background, three-way cross hybrids, low land tropical white and heat stress tolerant. These maize trials comprising of 20 sets, are being evaluated in the different trial sites located in all major maize growing regions of Pakistan (see table 1 and 2 of annexure 19.1).

Fig 1 Sowing of AIP trials at research farm of MMRI

Fig 2 Field preparation for sowing of AIP trials at research farm of ICI-Pakistan

5.2 Progress on approval and registration for commercial cultivation of biofortified maize pro-vitamin A enriched hybrid maize in Pakistan

Pakistan is facing the serious issue of malnutrition where about 40% children are malnourished. To overcome the prevailing vitamin A deficiency, AIP successfully introduced the high yielding provitamin A biofortified maize genotypes in Pakistan. AIP allocated three (HP1097-2, HP1097-11, HP1097-18) promising provitamin A biofortified maize hybrids to University of Agriculture Faisalabad (UAF). Pakistan is the first country in South Asia to receive these provitamin A biofortified maize hybrids from CIMMYT. UAF is currently increasing the parental seed and producing the hybrid seed of allocated products. UAF is also conducting the National Uniformity Maize Yield Trials (NUMYT) in

Fig 3 PVA hybrid seed increasing field at UAF

coordination with Maize Coordinator, PARC to proceed for approval and registration of provitamin A biofortified maize hybrids. UAF is conducting multi-location trials for indigenously produced hybrid seed of allocated products to acclimatize the genotypes with indigenous environmental conditions.

5.3 Progress on approval and registration for commercial cultivation of high yielding white open pollinated maize varieties in Pakistan

Farmers in the northern areas of Pakistan and remote areas of Punjab still prefer the cultivation of open pollinated varieties (OPVs) of maize. OPVs are preferred due to small land holdings, lower seed price compared to hybrids, and repeatable use of seed generation after generation for high productivity. AIP-Maize coordinated the introduction, evaluation and acclimatization of OPVs. A total of 14 OPVs were allocated to research partners after thorough multi-location evaluations. Local partners included Maize and Millets Research Institute (MMRI), Four Brother Group (4B) Pvt. are currently proceeding for variety approval and registration process of OPVs for general cultivation. Four Brother Group (4B) has increased 100kg seed of OPVs and will start the National Uniformity Yield Trials (NUYT) from next season. MMRI has completed the NUYT and spot examination for approval and registration. After approval and registration, these high yielding and early maturing maize OPVs will be distributed to farmers in the northern areas of Pakistan and small holder farmers in Punjab.

Fig 4 Adaptation and seed increase of haploid inducer lines at MMRI research farm

5.4 Exploitation of doubled haploid (DH) technology in maize breeding in Pakistan

DH technology is useful for acceleration of maize breeding for higher genetic gains. AIP facilitated the introduction of CIMMYT's Second Generation Tropically Adapted Haploid Inducer Lines (CIM2GTAILs) for the first time in Pakistan. These haploid inducer lines were allocated to MMRI-Yousafwala and UAF. Both institutes are currently conducting the adaptability trials and increasing the seed of haploid inducer lines. DH lines from source populations produced during kharif-2018 season. Conventional methods require 6-8 generations (years), while the DH technique significantly shortens this period to 2-3 generations (years). DH lines developed through DH technology have the characteristics features of distinctiveness, uniformity and stability. Large number of the DH lines developed through DH technology will definitely harbor higher genetic gains for breeding against abiotic stress tolerance, disease resistance and quality improvement.

5.5 Development/or introduction of biotic stress tolerant maize

5.5.1 Activities of national stem borer mass rearing facility

AIP facilitated the establishment of stem borer mass rearing facility in IPMP (Integrated Pest Management Program), NARC. Currently the lab facility is fully operational and performing several important research activities. NUYT of maize were conducted by PARC, comprising of 155 yellow maize hybrids, 62 white maize hybrids, 14 OPVs, 5 sweet corn varieties and 11GM-Hybrid set I and 11GM-Hybrid set II to evaluate the level of resistance among the test entries against maize stem borer under artificial infestation. A total

of 40 trainees from Punjab Agricultural Extension Department were trained on rearing procedure of maize stem borer and handling of metal bins. An experimental study was conducted on "Effect of different incubation temperature and duration on hatching percentage and development time of Chilo partellus eggs". Four internees from various universities were trained on rearing techniques of maize stem borer laboratory under controlled conditions and screening of maize germplasm for resistance against maize stem borer (MSB). One postgraduate student from NARC completed his research study on biological parameters of maize stem borer on five different genotypes and screening under artificial infestation against MSB. Based on the experimentations in the MSB lab one research paper entitled "Biological studies of *Chilo partellus* (Lepidoptera: Crambidae) on natural diet under laboratory conditions" is published in International Journal of Biosciences.

Fig 5 Training of Punjab Agricultural Extension Officers in Stem Borer Mass Rearing Lab, IPMP, NARC.

5.5.2 Efforts for promotion and mass scale distribution of metal silos

Traditional storage practices in developing countries cannot guarantee the protection against major storage pests of staple food crops like maize. It leads to 20-30% grain losses, particularly due to post-harvest insect pests and grain pathogens. AIP introduced the hermatic storage technology in the form of metal silos for air tight grain storage. IPMP program of NARC with AIP support is currently conducting the research activities and awareness trainings for extension workers, students and internees to highlight the importance of metal silos. NRSP showed interests in mass scale manufacturing and distribution of metal silos and to join the project under public private partnership.

Fig 6 Training participants on metal silos at IPMP-NARC

5.6 Enhancing the maize seed sector

5.6.1 Seed micro increase for the newly introduced maize varieties

Under AIP-Maize one of the major activities conducted was the micro increase of the parental lines/breeder seeds of the new maize hybrids and OPVs distributed to partners. A total of nine public and private partners of AIP Maize included ICI, TCS, JPL, NARC, MMRI, CCRI, UAF, ARI-AJK, ARI-Quetta have produced the pre basic and parental seeds (see table 3 of annexure 19.1). 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 28.6 tones seed of locally produced certified seed (see table 4 of annexure 19.1)

5.7 Expansion of local maize breeding with support of AIP

AIP has allocated 52 promising maize products to the partners from public and private seed sector. Partners are currently working on the 52 allocated maize products for expansion of the local maize breeding program with support of AIP. Parental seed of allocated products is being multiplied, new cross combinations are being tested and several products are at different stages of approval and registration. Multi-location testing of developed products for genotype × environment interaction and stability analysis is going on smoothly. Breeding and evaluation activities with support of AIP allocated products are definitely useful to improve the local maize breeding program.

5.8 Capacity building

5.8.1 Training course on hybrid & OPV seed production of maize

AIP supported the training course on seed production of hybrid and open pollinated varieties of maize that was organized by Maize and Millets Research Institute (MMRI), Yousafwala Sahiwal on 13-September-2018. More than 50 participants both from public and private seed sector participated in the above subjected training course. Practical knowledge and experiences for development & maintenance of inbred lines, production of hybrid and OPVs seeds were shared with the participants. Seed Certification and Registration prerequisites under Federal Seed Certification and Registration Department were also shared with participants. Post-harvest handling of the maize seed to retain the seed quality, germination and viability was also the learning outcome of the training course.

Fig 7 Training course on seed production of maize

5.8.2 Capacity building of undergraduate internee students of plant breeding & genetics (PB&G) and seed science & technology (SS&T)

Six undergraduate students joined the MMRI as part of internship program. They were trained on maize plant observation, data acquisition for different agronomic traits and basic field layouts on AIP allocated maize trials. They were given insights of maize breeding program along with hands on skills of selfing and crossing of maize breeding material. The key learning outcomes included OPVs and hybrid development procedures, approval and registration

Fig 8 Group photo of internee students with MMRI & CIMMYT-Pakistan researchers

protocols, patents, plant breeder rights, contribution of public, private and international research organizations in maize research for development.

5.8.3 Provision of instruments to academic and public research institutes to modernize the maize research in Pakistan

AIP-Maize partners from public sector were facilitated with provision of instruments through direct and indirect procurements. A total of seven partners were selected for provision of the incubation chambers through direct procurement under AIP. They were UAF, UAP, MNSUAM, NARC-Islamabad, CCRI-Nowshera, ARI-Quetta and DAR-GB. Incubation chambers were delivered to selected partners on June 20, 2018. Financial support was provided to all public sector partners for procurement of analytical weighing balance, electrical weighing balance, digital spring balance, moisture meter and seed counters. These instruments will provide opportunity to precise and accelerate the data acquisition from maize breeding and evaluation trials. Public sector will be able to work more efficiently with enhanced capacity whereas, private sector can avail the benefits through establishment of strong public-private partnership.

5.8.4 Hands on training of students for operational handling of modern instruments

AIP Maize facilitated the hands on training of 152 students included 42 females on July 2 & 3, 2018 on use of allocated instruments for research precision. These training sessions provided the students with practical insights of handling the instruments and conducting different types of research experiments by using the AIP sponsored lab instruments. Sponsored incubation chambers have the characteristics features of controlled heating, cooling, humidifying and illumination panels with spacious internal compartments. Additionally these incubation chambers have digital microcomputer user-friendly programmable technology to regulate the temperature, humidity and illumination for specified periods. These incubation chambers are useful for plant growth and tissue culture, seed germination & viability test. It can also perform seedling growth evaluation, culture testing of microorganism, feeding of insects, testing of water quality monitor and illumination for several research purposes. Researchers can perform all of these above mentioned operations with high accuracy and precision in maize research.

Fig 9 Hands on training of postgraduate students of UAF for practical application of incubation chamber

Fig 10 Research experiments of postgraduate students of PBG-UAF in AIP sponsored incubation chamber

5.8.5 Participation of young maize breeders in "new maize breeders training course" held in Uganda

AIP supported three young maize breeders from public sector included NARC Islamabad, MMRI Yousafwala, CCRI Nowshera, to participate in two weeks "New Maize Breeders Training Course". Training was organized by CIMMYT and IITA, in collaboration with National Agricultural Research Organization (NARO), Uganda. Learning outcomes of the training were; theoretical aspects and background for maize breeding, breeding for yield and tolerance / resistance to abiotic & biotic stresses, breeding for quality traits. Participants were also briefed on advanced technologies in maize breeding, biometrics for plant breeders, evaluation and release of new stress tolerant hybrids, and basics of seed production. Gender aspects related to maize breeding was also part of training. They visited fields and laboratories for practical insights of maize breeding. Participants of the training are now implementing the tools and technologies learned during training course for improving their institutional (local & coordinated) maize breeding programs.

5.8.6 Participation of private seed companies in "international training workshop on seed business management" hosted by CIMMYT-Nepal

AIP Maize supported the local seed companies engaged in maize research to enhance their skills for precise management of seed business to have higher gains and to fill the gaps in the seed business. AIP facilitated the seven representatives from six private seed companies (Jullundur Private Limited, Sohni Dharti International, ICI Pakistan, Tara Crop Sciences, Pak HiBred Pvt. Ltd and Petal Seeds Company) to participate in the three-days "International Training Workshop on Seed Business Management" organized by CIMMYT-Nepal, on April 23 to 25, 2018. Learning outcomes of the training workshop were the development & management of market-oriented seed businesses with prime emphasize on maize seed system. Participants got opportunity to build the skills on improvement of technical, financial and seed market management capabilities. Participants were also conveyed with the prerequisites of a competitive seed business using case studies from Africa and Asia. Participants of the training were also provided with the opportunity to interact with the experts involved in successful seed business.

Fig 11 Participants of International Training on Seed Business management, Kathmandu, Nepal

5.9 Provision of platform for international collaborations for research & development

National Maize Stem Borer (*Chilo partellus*) Mass Rearing and Screening Facility was established with AIP support in Integrated Pest Management Program (IPMP), NARC on October 25, 2016 and is working

Fig 12 Delegate from Syngenta visiting the National Stem Borer Mass Rearing Facility, IPMP, NARC

efficiently. This stem borer mass rearing lab is a platform for development of international collaborations. Recently, delegates from Yunnan Academy of Agricultural Sciences (YAAS), China and Syngenta Agrochemical Company visited the National Maize Stem Borer Mass Rearing Facility. Delegates highly appreciated the AIP's contribution for the establishment of the facility, and also showed deep interest to collaborate with stem borer lab for studying the host plant resistance and biological control of stem borer in diverse maize germplasm.

5.10 Public private partnership under AIP maize

Currently AIP maize component has 19 partners including nine (9) private and ten (10) public institutions working on maize research for development in Pakistan. All these partners are actively participating under the AIP's maize variety evaluation and validation network includes sharing of performance data of different trials. Two private seed companies and one academic institute also submitted requests for establishment of partnership with CIMMYT under AIP for Pakistan. In addition five private seed companies (JPL, ICI-Pakistan, Tara Crop Science, Petal Seeds, Kanzo Quality Seeds) and two public research institutions (NARC and UAF) extended their services to AJ&K, GB and Balochistan through the partnership and linkages created under AIP.

6 Wheat

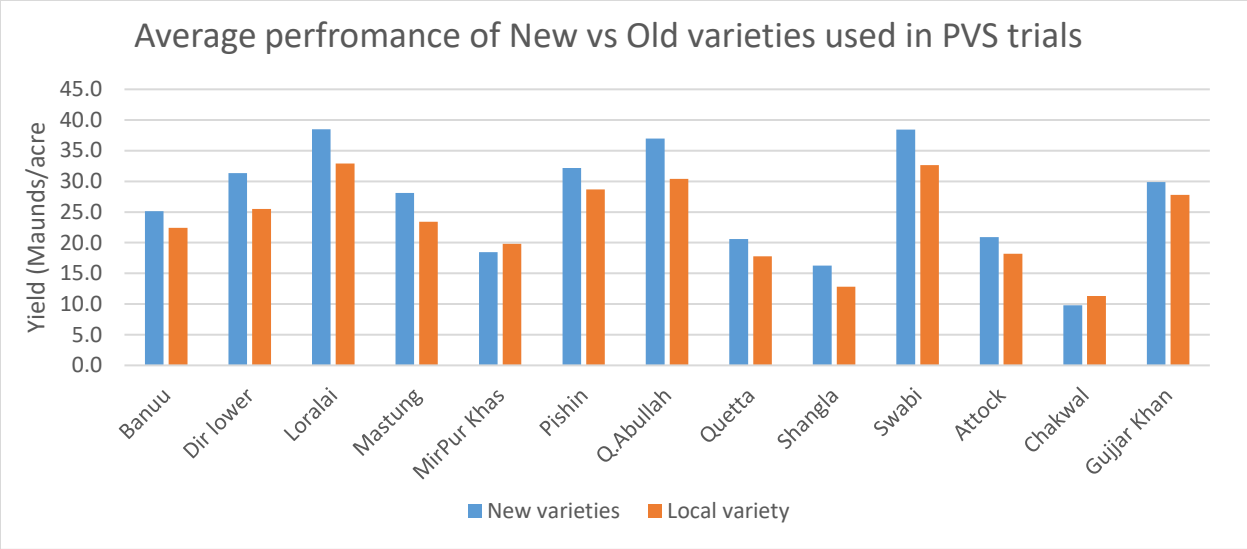
6.1 Increasing wheat production through rapid diffusion of new high yielding and rust resistant wheat varieties

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

A total of 115 farmers conducted Participatory Varietal Selection (PVS) trials across Pakistan. Special focus was given to far flung areas of Balochistan, Sindh and parts of KP and Punjab provinces. These trials provide maximum choices to select a suitable wheat variety from a set of varieties. This also helps in diversifying wheat germplasm in the area and creates a buffer zone against wheat diseases like rusts. AIP-wheat distributed 18 new high yielding, disease resistant wheat varieties in these trials. (The graph shows how these varieties performed compared to local varieties).

There is only one case in Sindh province, where local variety TD-1 provided about 6% more yield than new varieties. From these trials it was revealed that new wheat varieties offered 16.6% more yield to farmers. With 38 Munds/acre Khaista-17, Pakhtunkhwa-15 and Pirsabak-15 were leading varieties in KP province.

In Balochistan province, Umeed-14 provided 40 Munds/acre yield followed by Benazir-13 with 31.5 Munds/acre. In district Mirpur Khas, Benazir-13 with 21.6 Munds/acre was winner variety in Sindh

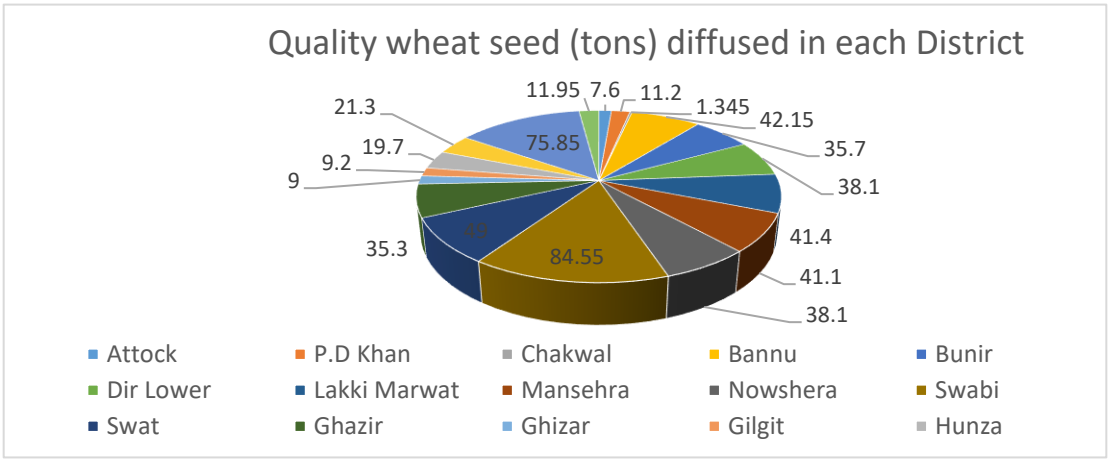


Performance of new wheat varieties in PVS trials

province. In Punjab province, especially in Potohar area, Paksitan-13 with 21.6 Munds/acre yield is the winner variety. Based on these results, it is therefore recommended to grow new wheat varieties that offer more yield and disease resistance capabilities.

6.1.2 Rapid diffusion of new high yielding wheat varieties to farmers fields through demo plots

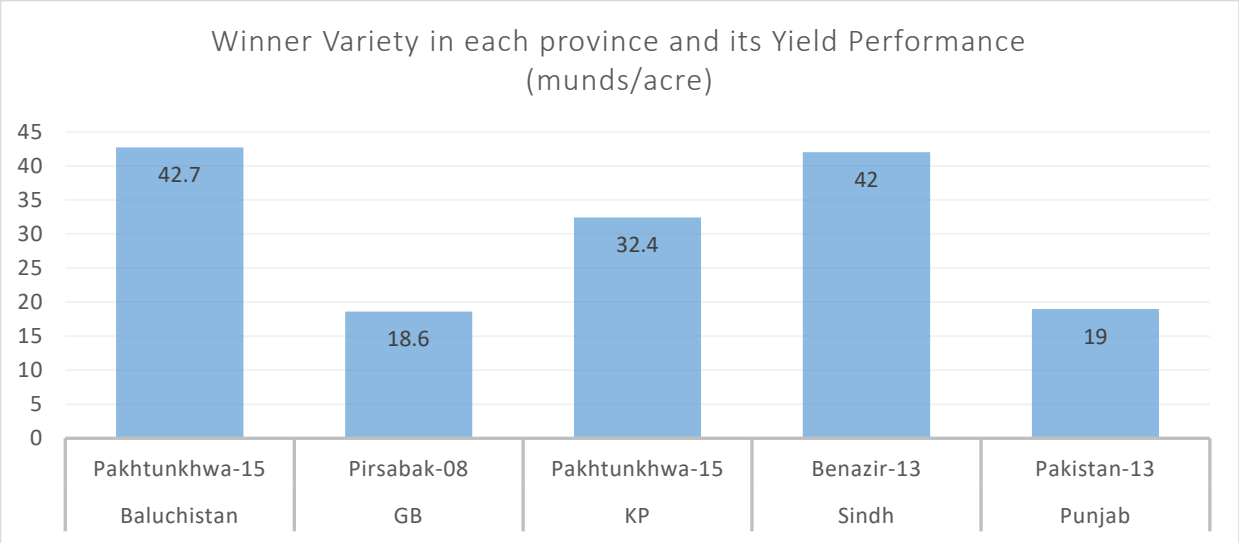
AIP-wheat assisted more than 1855 farmers across Pakistan including 496 (26.7%) women during 2017-18 wheat season. A total of 21.3 tons quality wheat seed of new disease resistant and high yielding varieties was distributed among small holder farmers of 42 districts in all provinces. Several partners like, NRSP, AKRSP, MFSC-KP and Public research institutes across Pakistan conducted these demo plots with small holder farmers. The aim of this activity was to incorporate new wheat varieties in the informal seed system. This will replace old wheat varieties and will benefit farmers by having 20% more yield. The following graphs shows yield performance of these varieties and quality seed incorporated in the informal wheat system of Pakistan.



Quality wheat seed incorporated in the informal seed system during 2017-18

The overall average yield of these top performing varieties is 3.8 tons/ha, which is 35% higher than national average wheat yield of Pakistan. This displays very strong message, that we can improve our national yield with just replacing the variety.

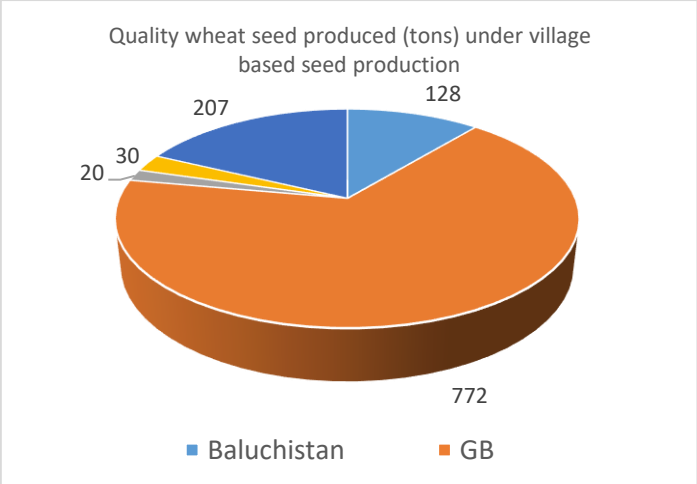
Through this intervention AIP-Wheat diffused 572.5 tons quality wheat seed across the country. This seed is enough to cover 5752 ha area in next season. With farmer to farmer flow through this intervention produced seed will play vital role in eradicating obsolete wheat varieties from the system in medium to long term.



Yield performance of Wheat varieties used in Demo plots

6.2 Village based seed enterprise of recently released wheat varieties

The informal wheat seed system in Pakistan is about 70% which means 70% wheat seed is improper and contribute greatly to lower 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-Wheat, village based seed production contributes significantly to overcome this scenario. Village seed banks plays dynamic role in assisting local farmers. These banks are operated by farmers and provide quality wheat seeds on lower prices (11% lower than market) not only to its members but also in neighborhood.



Summary of wheat seed produced during 2017-18 under AIP-Wheat

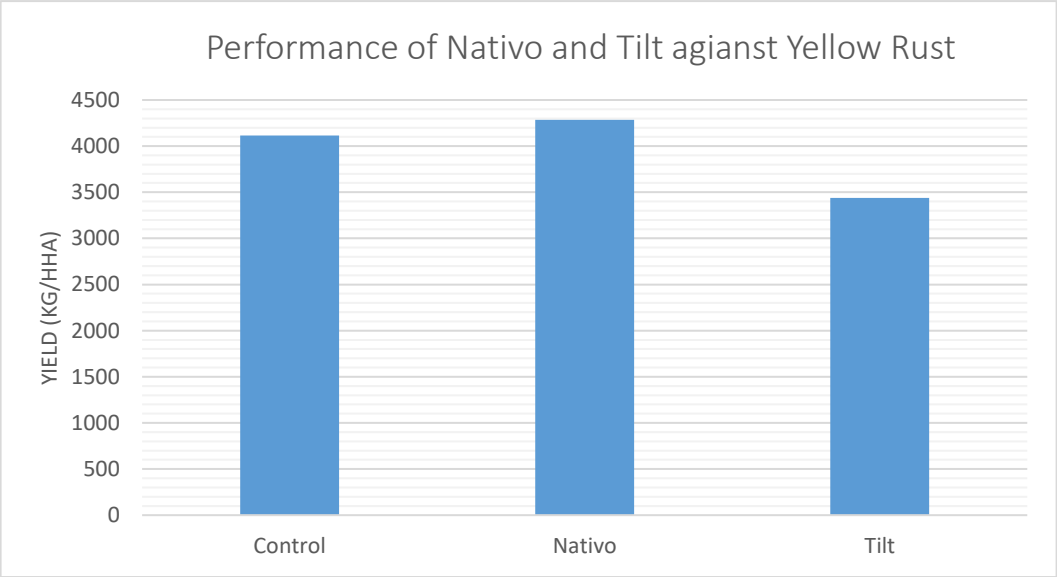
During 2017-18, 450 seed growers including 11 women, planted seed of new high yielding, rust resistant wheat varieties covering about 49 districts all over Pakistan. A total of 20.55 tons quality wheat seed was distributed across the country in village based seed production intervention that covered about 205.5 ha area.

A total of 1156.7 tons wheat seed was produced under this intervention. This seed is enough to cover 11567 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. (The graph shows total seed produced under this intervention).

6.3 Effective fungicides introduced, evaluated and registered for controlling wheat rusts

6.3.1 Yield loss assessment of wheat due to rust disease using fungicides

A total of 15 demonstration trials were conducted, five in KP and ten in Punjab provinces, for yellow and Leaf rust respectively. Two most efficacious fungicides Nativo and Tilt were used in these demo plots. One acre plot of the farmers was divided into three equal portions and two of them were sprayed with Nativo and Tilt while third was maintained as unsprayed control. Result from KP province for Yellow rust is summarized in the following graph. From the average of five locations Nativo saved 4% yield as compared to non-sprayed plots. As a general rule, old varieties is not recommended, that requires fungicides, but if the rust attack occurs, fungicides saves yield losses especial Nativo.



Afficacy of fungicides used in fungicide trial

6.4 Classification of Pakistani wheat varieties for value added food products

Pakistan's food industry faces many challenges in getting a consistent supply and right quality of flour for their products. This is primarily due to a weak supply chain and high production costs. On the other hand breeding programs tend to develop cultivars mostly for more yield and disease resistance with less focus on end-use quality. During September, 2018 a multi stakeholder national workshop was organized at WRI Faisalabad. A total of 36 participants attended this workshop. In this workshop giant food industries like Hilal Foods, English biscuit manufacturer and Amal foods participated along with wheat breeders. The workshop, therefore, served as a platform for stakeholders to connect with each other and discuss challenges to address the gaps in the development of an improved wheat value chain in Pakistan

With support from AIP, preliminary findings from the study on the screening of wheat cultivars conducted by PARC and the WRI were discussed. Results of 25 analyzed varieties showed that these are fit for different food products like Pizza, biscuits and cakes, but we currently do not have fully functional value chain to constantly supply quality flour to industries. Participants were updated on the current challenges of the wheat processing industry. Preliminary models were discussed for moving national wheat breeding program towards quality, nutritional value and bio fortification. New strategies were suggested for

Fig 13 Participants of Pakistan wheat quality workshop in Faisalabad

improving the categorization of cultivars according to their potential end-uses. All stakeholders agreed to continue working together to improve the wheat value chain and develop a road map for the upcoming wheat harvest.

6.5 Developing heat resilient wheat Lines/Varieties

Continuing on the efforts 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 assisted Pakistan wheat community to have access to diverse wheat germplasm. Full-scale yield plots for the 540 SABWPYT lines plus checks (600 entries, 1200 plots) were planted in replicated alpha-lattice trials at Wheat research institute Faisalabad (WRI-FSD) with two sowing dates. Entries were evaluated for grain yield, grain weight, and agronomic and physiological traits (heading, maturity, height, disease resistance, lodging, NDVI and CT). Based on yield, disease resistance and other traits of importance we selected 67 potential lines from these 600 entries to be tested in 2018-19 wheat season at WRI-FSD and also distributed among 10 national collaborators for multi-location testing and selection of desirable lines for their target environments. Candidate lines tested for the last five years (2013-2018) identified 5 lines for national level and 6 lines for provincial level yield trials 2017-18 (see table 5 of annexure 19.1) as potential varieties for release to farmers in near future.

Based on last year multi location performance across the country in the national yield trial, WRI-FSD submitted 2 lines (HYT-60-5 and HYT-60-57 for evaluation in 2nd year national trials during 2018-19 for final evaluation and release as new variety. To encourage private sector wheat R &D 10 kg seed of 3 high yielding advanced lines was provided to the Kashmala Agro Seed Company (KAS) Pvt. Baluchistan for strengthening their breeding program and their possible release in the province. Trials for 2018-19 season received from CIMMYT and sowing will be done in late November, 2019 at WRI-FSD.

6.6 Capacity building training

A total of nine trainings were organized for 617 farmers, researchers, private seed companies and food industries like Hilal Foods across the country. Two trainings for 100 famers were conducted on usage of hermetic bags for seed storage of wheat. These bags are environmental friendly and maintain seed quality and health for longer time. Four field days were also organized in Balochistan province for 371 farmers on new wheat varieties and their yield advantages. These events helped farmers in understating selection of suitable varieties, related agronomic practices and steps in quality seed production (see below table).

Fig 14 Training on hermetic bag usage

Detail of capacity building events			
Province	Event	No. of events	Participants
KP	Training on quality seed production	1	31
GB	Field day	1	44
Balochistan	Field day	6	326
Punjab	Training on Hermetic bags seed storage	2	110
Punjab	Wheat Quality workshop	1	36
ICT	AIP annual	1	70

6.7 Competitive grants-wheat

6.7.1 Natural variation for grain nutrient concentration, proteins and dietary fiber of different wheat varieties under different agro ecological regions of Sindh.

Under PARC-AIP competitive grant a project is being implemented by Sindh Agriculture University, Tandojam. A total of 57 wheat varieties were collected from different research institutes of Pakistan and sowing of these varieties was carried out. Meteorological data of Tandojam location was collected from Tandojam weather station and analyzed. It was observed that many varieties that have great yield potential to produce maximum yield under two and three irrigation that can help to increase 10% income of farmers and reduction in application of water.

Following participants from different categories participated in different research activities throughout the year:

Total target achieved:				
Category of participants	Farmers	Staff	Students	Women/Female students
Total number of participants	7	3	55	10

6.7.2 Evaluation and identification of high yielding winter wheat genotypes

The Department of Plant Breeding and Genetics, the University of Agriculture, Peshawar is implementing this ccompetitive grant project. The geographical areas included Kalam, Miandam, Upper Swat and Upper Chitral. Introduction of dual-purpose winter wheat in the Northern areas will help in green forage

Fig 15 PARC-AIP project research field visited by students

Fig 16 Sowing of research material for the PARC-AIP project at Tandojam

availability for livestock during winters and will also boost the total wheat production. A total of 363 winter wheat genotypes received as International Winter Wheat Yield Trials for Irrigated/semi-arid areas (21st IWWYT-IR & 20th IWWYT-SA), facultative winter wheat observation nursery for Irrigated/Semi-Arid Areas (25th FAWWON-IR & 25th FAWWON-SA) and 18th ELITE Trial were evaluated at Miandam (five trials) and Kalam (two trials) in Upper Swat, Chitral (two trials) and UAP (two trials). Trials at UAP were used for seed increase and to educate students. Three B.Sc. (Hons) students and one M.Sc.(Hons) student (thesis) are specializing in plant breeding and genetics undertook internship projects on winter wheat.

6.7.3 Optimizing water and nitrogen application through hydro-priming, moisture stress and various nitrogen managements in wheat

Under competitive grant a project is being implemented by Department of Agronomy, Bacha Khan University, Charsadda in KP province. The project activities are related on application and study of irrigation water in wheat. Seven students including one female student trained under the project. The outcome of the project would benefit the farmers by minimizing inputs like water application, fertilizers, pesticides and herbicides. Moreover irrigation water will be available for cultivation of other crops.

Fig 17 Students collection data in Bacha Khan University, Charsadda.

7 Crop Management - Agronomy

7.1 Dissemination of conservation agriculture technologies

AIP agronomy conducted demonstration of zero till planting, direct seeding of rice and LASER land leveling on 150 farms in Punjab and KP provinces. A total of 21 field days were organized for 1845 farmers in 12 districts of Punjab and 13 districts of KP provinces. Field days provided an opportunity to farmers to observe effects of improved agronomic practices on yield and other benefits like; water saving with LASER land leveling, dry seeding of rice and ridge planting; reduction in cost of cultivation with Zero tillage; ease in working and time saving with small machinery use and direct seeding of rice; and saving in nitrogen fertilizer with use of LCC in rice on their farms or fellow farmer fields.

7.1.1 Partnership for out scaling CA technologies

AIP agronomy collaborated with 23 national partners included 16 public sector agricultural research & extension organizations and 7 private sector seed & fertilizer companies such as / Engro Fertilizers, Rice Partners Limited (RPL), Petal Seeds, and machinery manufacturers like Greenland Engineers. National partners helped in achieving the objectives of dissemination of ridge planting of wheat, ZT planting of wheat and LASER levelling, testing and local production of Multicrop DSR planter, push row planters and efficient fertilizer management techniques for wheat and rice in Pakistan.

7.1.2 Demonstration of CA technologies

National partners assisted farmers in demonstration of improved technologies on 150 farms in the target area of the project. MFSC is a combined collaboration of farmers' committees and facilitators of the agriculture extension department, helped farmers in the districts of D.I. Khan, Kohat, Tank and Nowshera on LASER land leveling of 225 hectares. In addition, AZRI Bhakkar, Wheat Program NARC and CCRI Nowshera facilitated planting of mung bean and guar with Zero till and / conventional practice on 16 sites in the districts of Bhakkar, Nowshera, Rawalpindi and Chakwal districts of Punjab and KP provinces.

Fig 18 Ridge planting of wheat

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

a) Farmers experienced wheat planting with zero tillage drill after the rice crop on 254 farms in the districts of Jhal Magsi and Jaffarabad in Balochistan, Thatta, Sujawal and Jacobabad in Sindh, D.I. Khan in KP and Faisalabad in Punjab provinces. AIP in collaboration with national partners supported service providers in district Jaffarabad of Balochistan province for upscaling of ZT planting of wheat after rice. Farmers adopted Zero till wheat in Balochistan province and planted wheat timely. These farmers saved PKR 7500/ha in cost of cultivation and got 0.3 – 0.6 t/ha more wheat grain in comparison with farmer practice of broadcasting after land preparation on these poorly drained soils. During meeting held on September 4&5, 2018, national partners from Balochistan province mentioned that there are approximately 500 ZT drills owned by farmers and service providers in Balochistan province.

b) AIP, Agronomy provided seed and technical support for demonstration of ridge planting of wheat to 164 farmers including 34 in Sindh, 33 in KP, 95 in Punjab and two in Balochistan province. Results from farmer's field during last two years indicated that ridge planting of wheat in irrigated area of Pakistan, helped farmers to obtain 0.30 t / ha more grain yield, 38%, water saving and ease in irrigation management in comparison with farmer practice of broadcasting on flat surface.

c) MFSC, provided LASER land leveler services to farmers in the districts of D.I. Khan, Kohat, Tank and Nowshera in KP province and leveled 225 acres lands. Farmers facilitated by MFSC experienced an increase of 15% in grain yield and 28% in water saving on LASER leveled fields in comparison with not leveled fields.

Fig 19 Field day on LASER land leveling at Kohat

7.1.3 Dissemination and promotion of technologies through field days / trainings

National partners organized a total of 21 field days / demonstrations including 12 in KP and 13 in Punjab provinces. The purpose of the these field days were dissemination of information of improved practices that included; LASER land leveling, ZT Happy seeder planted wheat, Zero till wheat planting after rice / mung, ridge planted wheat, maize planting with push row planter and multicrop bed planter. Furthermore, use of green seeker for nitrogen management in wheat, LCC use in rice and direct seeding of rice through multicrop DSR planter were also highlighted in these events. These field days were attended by more than 1845 farmers in the districts of Nowshera, Swabi, Mardan, Kohat, D.I. Khan, Lower Dir, Swat, Abbottabad, Batagram and Buner in KP province, Sheikhupura, Bahawalpur, Hafizabad, Bhakkar and Chiniot in Punjab province (see annexure 19.2). Farmers visited fields under improved practices, and adopters shared experiences with their fellow farmers and agriculture professionals that help in the process of adoption of better management techniques in wheat, maize and rice.

Fig 20 Field day on small scale machinery at DI Khan

7.2 Pilot testing and refinement of new CA-based implements and technologies

Greenland Engineers manufactured and sold 350 Multicrop Zero till DSR planters to farmers with the price of PKR. 120,000 per planter in Pakistan. A total of 184 farmers used improved planters on their farms. Out of these, ten farmers planted maize and cotton with MC bed planters, and 68 farmers planted direct seeded rice with MC Planter in Punjab, Sindh and KP provinces and 104 smallholder farmers used push row planter for maize planting in the KP province. A total of 100 farmers and agriculture staff were trained on use of small push row planter and MC bed planter for maize planting and MC DSR planter use for DSR in Punjab and KP provinces.

7.2.1 Local manufacturing of new CA planters and evaluation

During 2018 rice planting season, Greenland Engineering manufactured and sold 350 DSR planters to farming community in the country that included 50 planters to African countries. This DSR planter with inclined plate seeding system had helped rice farmers to start shift from transplanting to direct seeding of rice in Punjab province.

7.2.2 Demonstration of new CA planter at farmer fields

a) National partner demonstrated use of Multicrop bed planter for maize planting in Punjab and KP provinces on ten sites. ARS Bahawalpur and WRI Sakrand demonstrated cotton bed planting with MC bed planter on two sites in districts of Shaheed Benazir Abad in Sindh province and Bahawalpur district in Punjab province.
b) Farmers in rice growing area of Punjab province are using Multicrop DSR planter for direct seeding of rice. More than 500 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, Engro Fertilizers, NRSP, RRI, AR Farms Sheikhupura and Gujranwala, helped farmers to use Multicrop DSR planter for direct seeding of rice on 68 sites in districts of Gujranwala, Mandi Bahauddin, Hafizabad, Gujrat, Sheikhupura, and Sialkot district in Punjab province. Engro Fertilizers is also using DSR planter in Sindh 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.
c) In partnership with MFSC 104 smallholder farmers planted maize with push row planter in Swabi, Mardan, Swatt, Buner, Chitral, Dir Lower, Dir Upper, Manshra and Nowshera districts of KP province. Farmer can plant 25000 – 28000 seed in one acre and apply 25-50 Kg fertilizer per acre with push row planter in single operation. With the help of push row planter, maize farmers planted one acre in 3-4 hours and saved PKR. 500 per acre labor cost.
d) During wheat season, more than 100 farmers used ZTHS technology and national partners AR Farms Gujranwala & Sheikhupura, NRSP, Rice Research Institute (RRI) – Kala Shah Kaku (KSK), Engro Fertilizers and WRI – Faisalabad assisted farmers on ZTHS technology in the districts of Gujranwala, Sheikhupura, Nankana Sahib, Jhang, Lahore, Hafizabad and Sialkot in rice-wheat area of the Punjab province. Farmers using ZTHS technology for wheat planting adopter saved PKR. 12500 / ha in land cultivation and planting cost and obtained 0.20 t / ha additional wheat grain yield in comparison with farmer practice of burning residue and heavy tillage.

7.3 Evaluation of conservation agriculture-based crop management techniques methods in different cropping systems

7.3.1 Field trials in wheat based cropping systems in Pakistan

Under AIP Agronomy, field trials were conducted in rice-wheat, cotton-wheat and rain fed wheat cropping systems in partnership with national partners namely ARS Bahawalpur, RRI Kala Shah Kaku, and Wheat Program NARC. These trials supported validation of new techniques and improved understanding of

planting techniques effects in a particular cropping system. After three years, finding from these trials are summarized as under:

Fig 21 Wheat Planting with ZTHS

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 grain yield of 5.0 t/ha in comparison with 4.4 t/ha with farmer practice of wheat planting on prepared land after cotton harvesting.

2. **Evaluation of different residue management and planting techniques under heavy residue environment of rice-wheat cropping system at RRI KSK, Sheikhupura, Punjab province:** This field trial of planting techniques and residue management at Kala Shah Kaku in rice-wheat cropping system showed that DSR after tillage followed by ZTHS planted wheat in full residue had system productivity of 7.6 t/ha in comparison 6.7 t/ha with farmer practice of transplanted rice and broadcasted wheat after residue burning and heavy tillage. Average wheat grain yield planted with ZTHS in residue were 3.7 t/ha in comparison with 3.0 t /ha with conventional planting after residue burning.

3. **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.

7.3.2 Strengthening of ca research partners through capacity building and information sharing.

AIP Agronomy & Wheat meeting 2018 was jointly organized with PARC on September 4&5. Twenty national partners from all over Pakistan shared progress on AIP's agronomy activities, and discussed issues and future activities. The inaugural session was attended by 70 agriculture professionals from various provincial and federal research institutes, agriculture extension, universities, private companies and international research centers, involved in agronomy & wheat research and dissemination of technologies and seed among the farming community. Dr Yusuf Zafar, Chairman, PARC said at the inaugural session meeting that "Crop productivity must be increased through research on innovative crop management techniques, varietal development and dissemination of better techniques and seed to farming community through active involvement of public and private sector in Pakistan." He appreciated CIMMYT and national partners' efforts in development and dissemination of improved agronomic practices under AIP. Dr Yusuf Zafar said that agriculture professionals must focus their energies on new areas like precision agriculture, decision support system, improving water productivity and mechanization for small and medium farmers.

Dr. Md. Imtiaz, CIMMYT Country Representative for Pakistan and AIP Project Leader, informed participants that 23 national public and private sector partners are collaborating on crop management and wheat seed under USAID funded AIP. CIMMYT is also collaborating with private sector and machinery manufacturers, are locally producing Zero Till Happy Seeders and direct seeding of rice planters.

Imtiaz Hussain, Program Leader Wheat – NARC informed the participants that conservation agriculture techniques like zero tillage wheat and ridge planting of wheat are being disseminated in the country under AIP for Pakistan.

Fig 22 Group photo of AIP Agronomy and wheat meeting, Islamabad.

Under AIP agronomy component, CIMMYT, in collaboration with national partners, assisted more than 25000 farmers through demonstration of zero tillage, ridge planting, DSR, better nutrient management, provision of planters, training of farmers and organizing farmer field days. These techniques are helping farmers in saving water, avoiding residue burning, reducing cost of production and improving profits.

The concluding session was held on September 5 and participants of the national meeting recommended that addition of straw spreader should be promoted with rice combine harvester that will help in smooth working of ZTHS in combine harvested fields. ZTHS and direct seeding of rice with DSR planter should be promoted through involvement of agricultural service providers in rice-wheat area. In Balochistan province support to farmers and service providers could increase adoption of Zero tillage wheat planting after rice and LASER land leveling. AIP in collaboration with partners will continue its focus on dissemination of improved water saving and nutrient management techniques and capacity building of farmers, national staff and agricultural service providers in the project area. In concluding session, it was recommended that AIP second phase may focus on Bio fortification, climate smart agriculture, decision support tools, gender involvement, knowledge delivery, appropriate mechanization, nutrient management, weed management and water productivity.

7.4 Nutrient management

Local partners included Engro Fertilizers, AR Farm Punjab and WRI Faisalabad demonstrated LCC use in rice crop on 20 farms and these partners facilitated visit of 140 farmers to these demonstrations in districts of Shiekhupura and Faisalabad. Improved nutrient management techniques would help farmers in promotion of balanced, site specific fertilizer management among farming community and improvement of crop productivity.

7.4.1 Evaluation and demonstration of SSNM in collaboration with national partners

AIP Agronomy in collaboration with national partners facilitated 100 wheat farmers in demonstration of Green seeker assisted N management in wheat districts of Punjab, Balochistan, KP, and Sindh provinces. Results from on farm demonstrations located in districts of Bhakkar, Bahawalpur, Sheikhupura, Gujranwala, Faisalabad and Vehari in Punjab, D.I. Khan, Nowshera and Swabi in KP and Jaffarabad in Balochistan province showed that farmer saved 32 Kg N/ha with precision N management in comparison

with farmer practice. Farmers saved 70 Kg Urea per hectare or 28 Kg urea per acre for irrigated wheat crop.

7.4.2 Dissemination of ICC use in rice crop Rice-Wheat cropping system

Leaf color chart, SSNM technique, help farmers to apply Nitrogenous fertilizer according to demand of rice crop. Results from on farm LCC managed N used demonstration showed that there were no reduction in rice yield with the saving of 26 - 34 Kg urea per acre. Two trainings were conducted by AR farm Sheikhupura and WRI Faisalabad on the use of LCC for N management in rice crop that were attended by more than 140 farmers and support staff in districts of Sheikhupura and Faisalabad.

Fig 23 Green seeker use for measuring NDVI

8 Socioeconomics (SEP)

The AIP, socioeconomics component carried out three studies during April-September 2018 period. Among these studies two are completed while third study is in progress. The details of the studies are as under

8.1 Study on wheat value chain in Pakistan

Under AIP-SEP the first study was carried out on wheat value chain in Pakistan. Main objective of the study was to identify incentives, bottlenecks, constraints and key roles of various actors involved in wheat value chain. A set of stakeholders involved in wheat value chain in Pakistan were identified i.e. producers, consumers, dealers, seed companies, millers and Pakistan agricultural storage and services cooperation (PASSCO). A set of questionnaire was prepared for each stakeholder. The data was collected from 170 respondents covering all the various cropping zones i.e. arid zone, rice-wheat, mixed and cotton-wheat. About 13 districts were surveyed to collect the data. Currently the data entry, analysis and report writing is in progress. The study will be completed by November, 2018. The sampling details is given in the below table.

Distribution of respondents in wheat value chain		
Stakeholder	Sample size	Sampling Frame
Producers	69	Rawalpindi, Chakwal, Attock, Sheikhupura, Gujranwala, Narowal, Sargodha, Faisalabad, Jhang, Sahiwal, Khanewal, Vehari, Rahim Yar Khan.
Consumers	43	
Dealers	19	
Seed Companies	19	
Millers	19	
PASSCO	3	
Total	170	

8.2 Study on maize value chain in Pakistan

The second study was carried out by AIP-SEP on maize value chain in Pakistan. The main objective of the study was to identify various stakeholders and their contributions and share in the maize value chain. The

stakeholders included producers, dealers, poultry feed mill, silage, maize oil, miller and consumers. The data was collected from 120 stakeholders. The number of districts surveyed include Sahiwal, Pakpattan, Okara, Toba Tek Singh, Sargodha, Faisalabad and Kasur. Currently the data entry, analysis and report writing is in Progress. The study will be completed by December, 2018. See below table

8.3 Study on climate resilient wheat and maize varieties

The main purpose of this study is to document the farmer's willingness, demand and perception about the climate resilient wheat and maize varieties. A comprehensive questionnaire was developed and pretested. Currently the questionnaire is being refined in the light of the pre testing results and after that the formal survey will be initiated in early November. The data will be collected from 240 farmers mainly focusing the rain fed areas because the climate change affects are more severe in the arid areas as compared to irrigated areas.

Distribution of respondents in maize value chain		
Stakeholder	Sample Size	Sampling Frame
Dealers	17	Sahiwal, Pakpattan, Okara, Toba Tek Singh, Sargodha, Faisalabad, Kasur
Producers	40	
Poultry Feed Mill	3	
Silage	3	
Maize Oil	3	
Miller/Chaki	5	
Consumer	40	
Total	120	

For the current survey the electronic data collection device i.e. ODK will be used to collect the data. ODK (Open Data Kit) software for the study entitled "Feasibility of the quality protein maize (QPM) in Pakistan". The electronic data collection method has a number of advantages over the conventional paper based method. It does not need paper based questionnaire. The questionnaire can be designed according to the need and number of checks can be applied for the data accuracy. The data can be entered and stored simultaneously and analysis can be done easily. The information on Global Positioning System (GPS) locations and images can also be collected. The data collected can be synchronized to a local cloud server which can provide easy access to aggregated data. The future plan is to out-scaled this tool to the national partners and provide associated training how to use ODK.

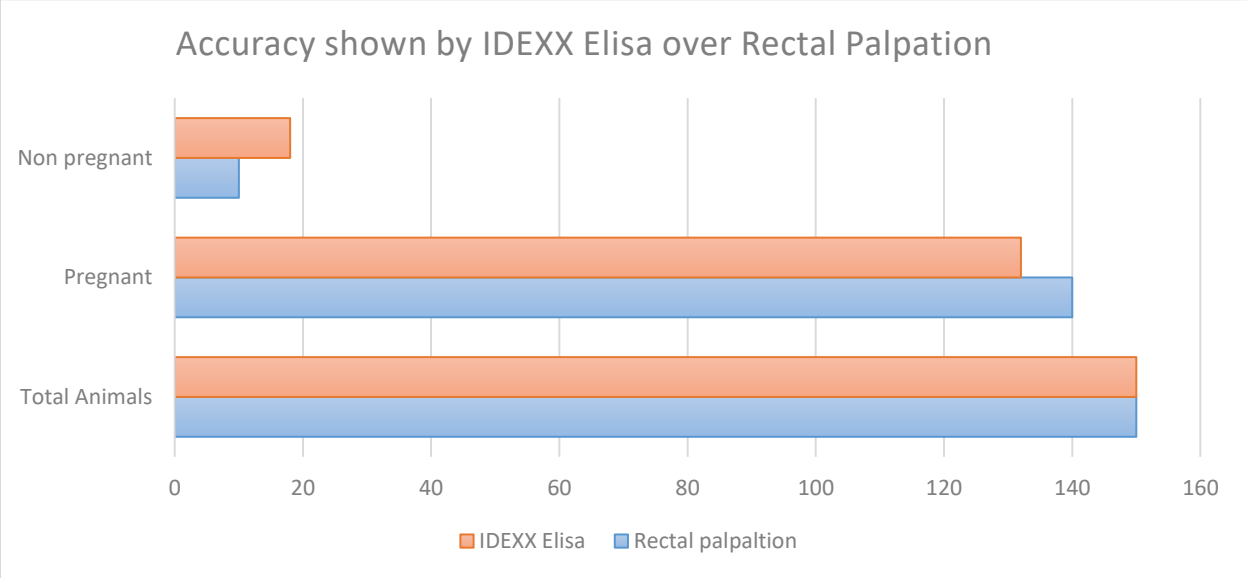
8.4 Capacity building

AIP-SEP in collaboration with COMSATS Institute of Information Technology (CIIT) Lahore campus organized a training on September 27, 2018 regarding "Orientation to SPSS and STATA. In total about 41 faculty members and students including 65 % women attended the training. The concluding session was chaired by Director, Comsat (Lahore Campus). He appreciated the efforts of USAID, AIP and CIMMYT in building the capacity of the COMSATS faculty members, scholars, scientists and researchers. The training will help the scholars and researchers in their future research work. During the training software SPSS and STATA were distributed among the participants.

9 Livestock - Dairy Value Chain

9.1 Furtherance of early pregnancy diagnosis in bovine using modern diagnostic technologies

In dairy herds, economic profitability is directly related to the reproductive performance of cows and milk yield. Identification of non-pregnant animals at the earliest day post-breeding is of prime importance for maintaining an optimum calving interval. AIP-Livestock earlier done a comparative study of early pregnancy diagnosis based on bovine pregnancy associated glycoproteins (PAGs), progesterone concentration and ultrasonography in dairy cattle and buffalo. In continuation of its projection, another trial was conducted on June 23, 2018 at Sarbuland dairy farm, Faisalabad for IDEXX Elisa analysis of PAGs. Total 150 animals were selected in which 10 were non-pregnant. Blood serum was collected for analysis and results showed 83% accuracy with rectal palpation record. The rationality of this research is to ensure animal welfare by reducing rectal palpation, stress and providing the farmer with one kit diagnostic technique to improve management and care of pregnant animals for better production and reproduction.



9.2 Detection of sub-clinical mastitis in dairy animals via alternative approach

Sub-clinical mastitis is one of the most problematic disease of dairy animals causing huge economic losses to the dairy industry in the country. Its detection is important because of longer duration, difficult to detect and damage to animal udder. AIP conducted a research trial on April 17-25, 2018 to determine the validities and evaluate the relationship of three animal-side tests; namely Electronic Mastitis Detector, California Mastitis Test & Surf field Mastitis Test with Somatic Cell Count for diagnosis of sub-clinical mastitis. A total of 136 milk samples from each quarter of 34 animals (24 cows, & 10 buffaloes) were screened directly at the herd level. Results showed that the use of electronic mastitis detector is easy, accurate, users friendly, and more sensitive in detecting of sub-clinical

Fig 24 Sub-clinical mastitis detection in bovine milk

mastitis. Its timely use can give precautionary information regarding udder health, management decision and helps to reduced 10-30% financial losses of milk production due to mastitis.

9.3 Reckoning the bioavailability of mineral mixture and benefits reflecting better herd health

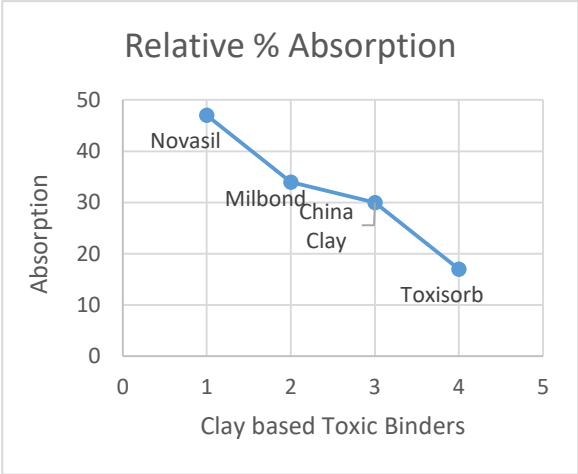
Minerals are essential for optimum health of dairy animals. Its deficiencies can lead to disease and so can mineral excesses. AIP-Livestock proposed a multidisciplinary approach of providing essential minerals to lactating stock over three month duration from April to July, 2018. Fifteen animals (six cattle & nine buffaloes) from a dairy farm in Dhok Sheikhan, Islamabad were included in the study; ten animals supplemented with ''Anmol Mineral Mixture'' @ 100g/animal/day and five animals as control. The targeted elements were macro minerals, responsible for substantial enhancement of reproductive performance and ultimately lactation length. For bioavailability perusal, blood collected to measure serum-mineral profile on monthly basis. The overall result was favorable to maintain mineral balance in serum profile. Among five, the inclusion of sodium, potassium & magnesium shows highly significant results. Calcium level was also maintained, but phosphorous showed totally unexpected result, reversing the basic study objective. The conclusive objective of all efforts is proper mineral supplementation that delivers numerous benefits in the lactating herd in improving reproductive performance, minimize the effect of metabolic disorders on fertility, decreased somatic cell count, fewer days open, fewer services per conception, and increased percentage of cows pregnant at 150 days in milk.

Fig 25 Blood collection from animal in serum gel vacutainer

9.4 A delve to dwindle the aflatoxin m1 in bovine's milk by reducing afb1 in feed using toxin binder

After National policy dialogue on aflatoxins, AIP-Livestock in collaboration with animal nutrition lab NARC, conducted dual purpose research trial during June- August 2018, by using Aflatoxin ELISA kit. The trial was aimed at contaminant reduction potential of clay as a toxin binder in the feed sample and effective use of clay to reduce milk contamination in ruminants. For the first part of study, aspergillus contaminated animal feed with Aflatoxin B1 were collected from Islamabad local market. Comparison of six different commercial binders along with Novasil Clay were analyzed for the effective reduction or prevention of the mycotoxicity in cotton seed cake and bread pieces, keeping the charcoal as standards.

The lab results were applied practically and in-vivo study was also completed, to reduce AFM1 toxicity in milk. In this scenario AIP took a nascent step by adding AF toxic binder on daily feed basis to the lactating animals. Suspected farms were surveyed in vicinity of ICT and milk samples were collected. Total four binders (NS, M, C &TOX) were selected for 24 animals in duration of 7 days. With the help of ProGnosis ELISA kit milk samples were analyzed. The overall results were highly favorable and well appreciated. Sophisticated feeding guides were approached via indirect method of toxin control in milk giving easy to adopt and cost effective slant to livestock holders. Expect to see ultimate lift in healthy lactation yield, reduced vet medicine bills, improved fertility and cost saving feeding for farmers.



In-vivo study results of toxin binders

Fig 26 Feed and milk samples collection from farms and Elisa testing of aflatoxins

9.5 Sensitizing dairy farmers on animal health management and feed & feeding practices in Sindh province

Fig 27 Different activities under sensitizing of dairy farmers in Sindh

Generally, smallholder farmers in Pakistan have limited feed resources available for ruminant livestock, especially in dry/desert areas. AIP in collaboration with Department of Livestock, Sindh and the Sindh Agriculture Growth Program (Livestock component) conducted a series of training programs for improving animal productivity through optimum utilization of available feed resources and better animal health care practices. A series of ten, two-days farmer training programs on Feeds & Feeding and Animal Health Management including biosecurity were conducted during the months of June, July and August 2018. The trainings were conducted in four districts

(Tharparkar, Umer Kot, Shaheed Benazirabad and Naushahro Feroze) with ten milk producer groups belonging to ten villages. A total of 342 farmers participated in the trainings including 126 were women. These trainings aimed at radiating basal diet requirements according to animal production and to maintain animal health status by using proper biosecurity measures and timely vaccination schedules that will eventually enhance the productivity of dairy animals and provide better incomes to dairy farmers.

9.6 Small ruminant value chain

9.6.1 Training on artificial insemination for fata veterinarian at UAP, Peshawar

Fig 28 Semen collection from buck and AI in goat

The Federally Administered Tribal Areas (FATA) was previously a semi-autonomous tribal region in north-western Pakistan and now it is part of the Khyber Pakhtunkhwa (KP). This region is blessed with varieties of sheep and goats breeds but the rearing and mating management is still not improved due to lack of awareness. To fill this gaps, AIP conducted a three days training for the FATA veterinarians April 10-12, 2018, at UAP, Peshawar. This program was aimed at sustainably conserving genetic diversity in indigenous sheep and goats along with improved fertility, disease free, cost effective and timely mating at the farmer's door step. In this training veterinary officers from different agencies like Orakzai: two, Kurram: three, Mohamand: three, Khyber: two, Bajawar: six, FR Kohat: five, Bannu: two, South Waziristan: three and one from Dera Ismail Khan participated. The idea of A.I. in goats was pleasantly new for them and great interest was shown towards mutual discussions, more focusing practical demonstrations. Director livestock FATA motivated all the participants to disseminate AI technique at grass root level with target number of animals as quality genetics is vital for small ruminant breeding success.

9.6.2 International bio-technology brain storming workshop on animal genomics

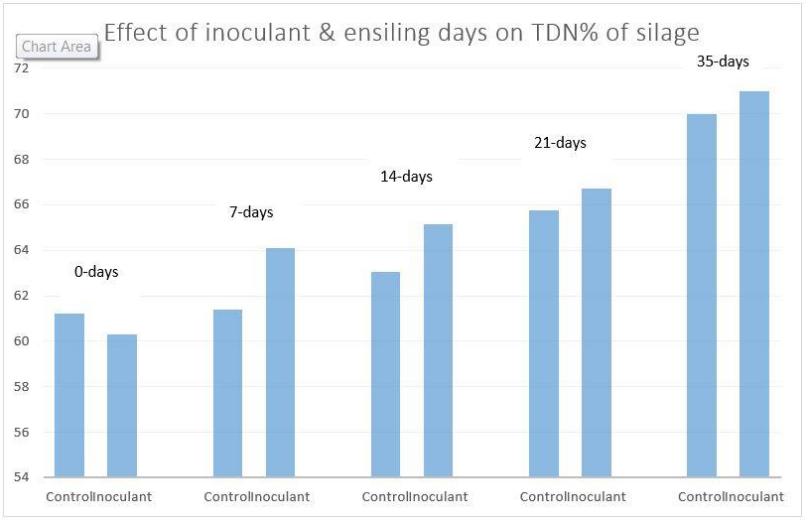
Fig 29 Participants of International Bio-Technology Brain Storming Workshop on Animal Genomics

AIP conducted on September 11, 2018 an International Bio-technology brainstorming workshop on animal Genomics, held at NARC under the collaboration of Animal Sciences Division, PARC, Pakistan. From 16 organizations across the country 45 participants attended the event. Country representative ILRI, M.N.M. Ibrahim and chairman, PARC Dr. Yusuf Zafar, delivered inaugural speech on historical events of bio-technology, global view & future vision. Member PARC, Dr. Johar Ali,

reviewed comprehensive trends in animal genomics. Genomics expert from China Dr. Han Jialin, delivered a detailed talk on "Livestock genetic adaptation to climate changes via long term selection" on Skype. Director General, NARC Dr. Ghulam Muhammad Ali, briefed about genomes research under taken by scientists of National Institute for Genomics and Advanced biotechnology (NIGAB), NARC. Ms. Ome-Kasoom Afridi from Korean University presented a poster on "Recombinant DNA Technology & Genetic Engineering Trend in South Korea". This event provided an excellent platform for creating awareness among participants from different provinces / institutions for research undertaken on animal genomics and provided a bright perspective for collaborative research programs on same lines at international level.

9.7 Feed, fodder and rangeland

9.7.1 An effort to elevate silage nutrition using effective inoculants



Fodder is seasonal and only available for 4-6 months of a year and supply 70% less than the demand. Availability of quality fodder is a serious concern in Pakistan. Compared to current fodders available in Pakistan, silage offers far superior nutrition, significantly enhancing livestock milk yields and improving overall animal health. AIP addressed this need and identified the trigger points for better silage leveraging. For this purpose, AIP conducted a research study during the period of May-June, 2018. The objectives of this study were to assess the effect of three different inoculants, on the microbiological, fermentation, and the proximate value of maize crop silage. The effect of microbial inoculants (Pioneer and Christine Hansen) on the fermentation, chemical and nutritive value of maize silage was studied under laboratory conditions. The silage was collected from Qaisar Rafiq (Rafiq Agrico, Sahiwal, Pakistan) and analyzed using AgriNIR at Islamabad. Untreated silage samples served as control and taken for, chemical, fermentation and nutritive composition analysis before the division into ensiling plastic bags. After inoculation chopped maize was ensiled in 40 plastic bags divided into four groups. The ten bags per treatment were opened on days 0, 7, 14, 21 and 28 days of ensiling separately, for chemical, fermentation and nutritive composition analyses. Samples were analyzed for dry matter (DM), neutral detergent fiber (NDF), acid detergent fiber (ADF), starch, ash and crude protein (CP). The effect of inoculant and days of ensiling on Total Digestible Nutrients (TDN%) is shown below. After seven days of ensiling, the TDN of the inoculated silages were better as compared to un- inoculated silages (61% vs 64%). A similar trend was observed with 14, 21 and 35 days of ensiling. Even though no studies have been conducted in Pakistan to justify the claim that the advantage of inoculants is that the silage can be opened in seven days, our study confirm that inoculated silage can be opened if needed at seven days of ensiling and the silage is of better quality compared to un-inoculated. However, the best quality silage of above 70% TDN could be obtained at 35 days ensiling period.

Fig 30 Silage ensiling and AgriNIR analysis

9.8 Competetive grants- livestock

9.8.1 Development of rapid and cost-effective assays for the diagnosis of prevalent echinococcal species in Pakistan

COMSATS University Islamabad implemented this project in Punjab, KP, AJ&K, and Federal Capital Islamabad. During the implementation of the project several districts of KP and Punjab provinces including the capital region and some parts of Azad Kashmir were investigated for disease burden estimation of Echinococcosis in different animal species and human population. Twelve (12) Students of master and PhD level from seven (7) different universities were engaged in research work while awareness seminars were conducted in different universities as well as in the field with target audience/participants of more than two thousand (2000). Genotyping of Echinococcal species and crud antigen isolation and their use for development of Immunoassays development is being assessed. An awareness campaign was carried out in different Livestock Mandis (wholesale markets) of Rawalpindi, Islamabad and various districts of KP province. The participants were briefed on the risks and the preventive measures that needs to be undertaken during and after slaughtering of animals. Project was presented during two days conference on ' PARASITES: A SERIOUS THREAT TO HUMAN AND LIVESTOCK' on March 14 and 15, 2018. The work was presented during the first International conference on strategies for therapeutics, control and prevention of dengue and other infectious diseases in Pakistan' held on March 1&2 at the University of Swabi, KP province.

Fig 31 MS scholar performing practical work at Molecular Virology Lab

9.8.2 Enhancing nutritive value of camel milk by introducing camel milk cheese, sweets and dried chees

The department of Dairy Technology, University of Veterinary & Sciences, Lahore is implementing a project on camel milk nutritive value. During this period, hands on training were provided to women to become master trainers in low income areas of Bahawalpur Punjab province in Pattoki. Camel milk based cheese and sweets were prepared by using camel milk through various coagulation methods.

Fig 32 Display of camel milk cheese and training

9.8.3 Optimizing the utilization of maize silages in smallholders and commercial dairy and fattening rations in relation to feed-use efficiency, animal performance and farm profitability

University of Agriculture Peshawar, KP province trained 40 farmers, four MSc students, one PhD student, one extension worker, and four women on silage production and feeding to dairy and fattening animals**.** Novel high yielding and highly-nutritive fodders, namely, maize silage, ryegrass and berseem were introduced and established on-farm for the first time in the remote areas of Swat. Moreover, through the feeding trails and trainings the farmers were trained on the feeding of proper blend of these fodders to dairy and fattening animals. Introduced high yielding and highly nutritious farm grown maize silage and rye grass to small holder dairy. Milk production increase by two (2 Liter/day that is 12%) was noted as an average per animal by feeding of maize silage and berseem 64:40 ratio**.** Daily weight gain of the fattening calves was improved by 150 g/day (17%) with feeding of maize silage and ryegrass mixture in the 50:50 ratio In addition farmers saved PKR 75/day/animal by saving the cost of three kg of concentrate for dairy cows. For the fattening calves one kg concentrate (Rs 25) was saved per day/animal.

Fig 33 High quality maize silage produced and fed to animals at Shah Dairy Farm in Swat

Figure 34 Recording data on weighing gain of the calf

9.8.4 Detection of mycotoxin in poultry feed of Balochistan

Microbiology of the University of Balochistan Sariab road Quetta conducted training for 12 research students and 21 DPLs for the sampling interventions, processing, detection of fungal species and mycotoxins in the feed samples. Field visits were conducted for the sampling of feeds and awareness session of poultry farmers. The isolated samples were processed further in laboratory for isolation and detection of fungi and mycotoxins. Seven women and nine farmers were involved in the project activities. The project activities and achievements for innovation were presented in a session of 3rd invention to Innovation summits organized by University of Balochistan on April 24 and 25 2018.

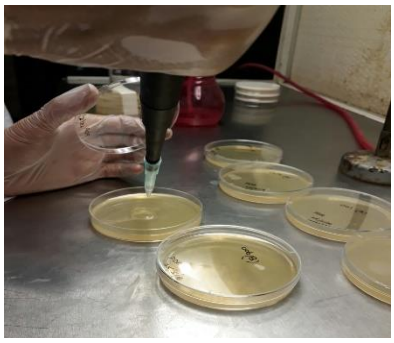



Fig 35 Detection of mycotoxin in poultry feed in poultry farms in Balochistan

10 Competitive Grant System- Horticulture

10.1 Fruits

10.1.1 Research and development of pome fruits rootstock production in the agro-climatic conditions of Hazara division

Agriculture Research Station Mansehra, Baffa planted stool beds on three different sites and are in excellent conditions. Project involved nine staff and extension workers, four farmers directly while 90-100 farmers indirectly. Capacity of farmers were built on rootstock and fruit nursery plants production. The targeted areas are conducive for fruits and disease free fruit nursery plants production. The project activities will promote orchard culture in the area that may help farmers in 20-25% increase in income.

Fig 36 Carriage of planting material to the target sites

Fig 37 Plantation of stool bed under the Pome fruit projects

Fig 38 Pest control in stool bed under the Pome fruit project

Fig 39 Fixation of poles for fencing of stool bed under the Pome fruit

10.1.2 Enhancement of groundnut production through agronomic techniques in Quetta zone

Under the competitive grant project a total of 221 farmers/staff/extension workers/students were involved in the project. Groundnut varieties were acquired / purchased from Groundnut Research Station Attock, Oilseed Research Program NARC, ARI Tarnab Peshawar, BARI Chakwal, ARI Mingora Swat and local market of Sukker. Sites and farmers were selected for demo plots and research trials. Seeds and fertilizers were provided to selected farmers of different locations of targeted area. Awareness Seminars/field days/trails were conducted in Quetta. Brochures were distributed among farmers. Crop is successfully grown at different locations of Quetta zone with satisfactory condition. Currently groundnut was grown as demo plots in limited areas at different sites of Quetta division and in future will be extended to other areas.

Fig 40 Farmer's awareness seminar at Bostan District Pishin.

Fig 41 Groundnut crop successfully grown at farmer's field in Pishin

10.1.3 Developing aquaponics system to produce safe, organic food in a sustainable and environment friendly way

Under competitive grant a project is being implemented by the University of Agriculture Peshawar several farmers and commercial growers have visited the research area to see the construction of aquaponics system from execution to completion of the basic infrastructure. Three staff members from livestock and fisheries department were engaged in the project. More than ten (under-graduate) and two (Post-graduate) students were involved. They were trained on the aquaponics system construction and seed nursery raising for the hydroponic plant beds. Two of the women faculty members from horticulture

Fig 42 Cutting holes in Styrofoam sheets for plantation, seeding and transplanting lettuce crop.

Fig 43 Internal and external views of the newly constructed aquaponics system facility.

department were also involved in the project and will assist in trainings of women, especially in aquaponics kitchen gardening.

10.1.4 Demonstration and management of citrus scab and citrus canker through balanced nutrition at farmer's field in districts Toba Tek Singh and Sargodha in Punjab province

Under competitive grant a project is being implemented by Soil Fertility Research Institute, Thokar Niaz Baig, Lahore. A total of 12 citrus orchard sites have been selected at farmer fields in major citrus growing regions i.e. Sargodha and T.T Singh included four orchard sites in Toba Tek Singh and eight in Sargodha district. Soil and plant analysis was carried out for identifying existing nutrient level in soils and plant. Citrus yield data will be collected with and without intervention at the end of December.

Fig 44 Diseased citrus fruit without intervention

Fig 45 Shiny and healthy fruit with balanced nutrition

10.1.5 Integrated nutrient management for improving production and quality of strawberry in Sindh province

The implementer Quaid-e-Awan Agriculture Research Institute, Naudero, Larkana conducted the research activities included base line survey, soil sampling and analysis and collection of seed from swat growers. Collection of data were carried out with collaboration of 100 growers/farmers, ten staff members, five extension workers, five related with the business of strawberries, three representatives of NGOs, ten from Fertilizer/Pesticide companies and five women. The strawberries in the field is normally picked by women as they pick fruits carefully without damage/injury free. The response of integrated use of organic and inorganic nutrients in improving the yield and quality of strawberry was investigated and an optimum dose of fertilizer was evaluated. A seminar was arranged near experimental field of the project for 129 strawberry stakeholders. Awareness was created through dissemination of printed material. It is expected that this project will help 18% increase in the production and 20% increase in the income of the growers.

10.1.6 Sustainable control of apple scab

NIFA, Tarnab, Peshawer, KP engaged 212 apple growers during scab surveys at different sites in Swat. Surveys were carried out to develop baseline data of scab prevalence, incidence and severity along with varietal deployment, orchard age and other descriptive information's in apple growing regions of Matta, Khwaza Khela, Charbagh, Kabal and Bahrain tehsils of Swat. Awareness was created among 212 apple growers on importance, identification/diagnosis and management of scab issue in the surveyed tehsils. A total of 189 suspected apple scab samples were collected in three batches from surveyed tehsils of Swat. Forty seven scab fungus isolates were detected from the first batch collections and ten each belonging to Beha and Nalkot areas of Swat. They were investigated for comparative variability in replicated

experiments using three growth parameters (i.e. radial growth, colony area and growth rate) while the remaining 27 isolates from this batch were purified and maintained. In vitro apple detached leaf assay standardization is under progress using four treatments. Five hundred locally adopted rootstocks (i.e. M.26 and MM.111) were raised at NIFA Farm. A total of 292 apparently healthy buds were transferred.


Fig 46, 47 Scab data and disease sample collection & students field training activities in apple growing regions of Swat, Khyber Pakhtunkhwa, Pakistan

10.1.7 Boosting irrigation system efficiency of apple orchards in district Ziarat

Directorate of Water Management & HEIS, ARI Sariab, Quetta organized a training for 135 farmers, staff, extension workers, students on the use of the equipment for water saving. Soil samples were collected and analyzed for texture analysis and bulk density that will help in irrigation scheduling, determination of WHC (Water Holding Capacity), FC (Field Capacity) and AW (Available Water). WHC was determined in the field and Lab by special equipment. Irrigation scheduling was prepared for the selected field according to the area of each tree. Equipment were installed and before data collection and start of trail it was calibrated in order to get more precise results. Water depth to each treatment was applied accordingly and depth was measure for application as per irrigation. Final data collection of the fruits and different parameters is in progress.

10.2 Vegetable

10.2.1 Integrated approaches to manage broomrape (orobanche spp.) In tomato in KP and Balochistan provinces

Department of Weed Science, the University of Agriculture Peshawar conducted field surveys and sites were selected for *Orobanche* sp management in tomato. Nurseries of tomato were raised and field experimented were conducted at Qilla Saifullah Balochistan and Mardan KP province. There were three factors and sixteen treatments including physical, cultural and herbicidal application for suppression of *Orobanche* in tomato. A total of 70 farmers participated in the activities including 40 farmers in Balochistan province and 30 farmers in KP province. Ten under graduate students and three faculty members from the department of weed science participated in the workshop and other field activities. The use of black plastic showed the best in term of controlling the Orobanche sp in tomato. Farmers were invited to observe and were briefed about the application of herbicides, safety measures and the possibility of controlling Orobanche.

It was observed that frequent irrigation discourages *Orobanche* growth while drought conditions in field encourages Orobanche germination and growth. It was revealed that weed infestation including Orobanche can cause up to 50 percent losses in tomato. The entire experimental outcomes data were shared with farmers in workshop and field days including the following information recorded from the experimental data analysis.

Maximum yield recorded VS control (Weedy check) treatments and irrigation effect			
Blocks	Black plastic (T1) Average Yield tons ha^{-1}	Weedy check (T16) Average Yield tons ha^{-1}	% yield losses
01 Irrigation/ 10 days	12.88	5.54	56.98 %
02 Irrigation/10 days	15.58	5.09	67.32 %
03 Irrigation/10 days	10.49	3.45	67.11 %

Fig 48 field day in Qilla Saifullah, Baluchistasn

Fig 49 Orobanche infestation in Mardan experimental site

10.2.2 Establishment of high value fruit and vegetable nurseries in Sindh

Under a project, chili (Dandicut) nurseries were established at Arid Zone Research Institute, Umerkot and at farmer's field. More than 17 farmers were trained on application of fertilizer as basal dose and seed treatment with systemic fungicides and insecticides. The objective was to make them aware in prevention of diseases and insects infestation and transplant healthy sapling in the field. The nursery has been transplanted at different farmer's field for the quality produce. The trained farmers adopt the technology and harvested the good healthy nursery. Additionally, 15000 seedling of grafted ber were developed with coordination of Public Private Partnership. Now the saplings are ready for the transplanting. The DG Water Management Balochistan demanded 15000 grafted Ber at PKR.40/plant and same will be provided by the nursery owner. The farmers, NGOs and this institute purchases more than 2000 ber saplings with same rate from the same nursery.

Figure 50 training for women farmer on Date palm plantation and its Management Practices

Four locations in has been finalized to introduce the Grafted Ber and Date Palm (Asel). The plantation of Grafted ber and Date palm has been completed at Thar desert i.e. Village Sawai Kohli, Sonal Bah, Qasim ji Dhani, and Tardos. One day training program on "Date palm plantation and its Management Practices"

was organized at village Sawai Kohli near tehsel Chachro on August 31 2018 for 35 women and 45 men farmers.

10.2.3 Identification of the areas where waste water is the only available source for irrigation and to propose the alternate crops other than vegetable crops for growing under waste water

The project is being implement by Institute of Soil Chemistry and Environmental Sciences, AARI, Faisalabad and addressing the environmental issues of heavy metal pollution caused by untreated waste water irrigation to vegetables and fodders. The project determines the heavy metals (Pb, Cd, Ni, Cr, Mn, Fe and Zn) status in wastewater, soil, vegetable/fodder, floriculture and ornamental plants. Survey was conducted of those soils where vegetables are being produced with waste water irrigation. A total of 300 plants of different species were propagated in floriculture, ornamental plants, shrubs and forest trees under waste water irrigation and testing of their survival rate is under progress. These plants are continuously irrigated with this untreated waste water which is used for vegetable production. The demonstration was conducted for farmers at each sampling site about the use of wastewater for vegetable/fodder production and their detrimental effects on human and animal health. A total of 40 wastewater samples collected from wastewater irrigated areas of Faisalabad and analyzed for heavy metals cadmium, chromium, and manganese and nickel contents. The results showed that cadmium contents were ranged from 0.0-0.16 ppm, chromium 0.12-8.02 ppm, manganese (Mn) 0.0 to 16.66 ppm and nickel ranged from 0.14 to 0.87 ppm in wastewater samples. The vegetable and fodder samples were also collected from the areas where wastewater is being used for irrigation purposes and a total of 56 vegetable/fodder samples were analyzed for heavy metals (cadmium, chromium) contents. The data revealed low quality of the produce either vegetable or fodder which are produced from untreated wastewater irrigation and used for food and feed.

Figure 51 Experimental area and nursery plants at Farm House

Fig 52 Heavy metals analysis work

10.2.4 Molecular based genetic divergence in indigenous common bean of Himalaya being implemented by NIGAB

Under competetive grant a project is being implemented by NIGAB NARC Islamabad in AJ&K, Swat, Upper Dir, Chitral and GB. At all these locations, eight students are involved in project activities including three women. The project involved five research departments i.e. NARC Station at Jaglot, Gilgit, Babusar Potato research station at Chilas, Baffa Research Station at Mansehra, Kaghan research station and NIGAB at NARC Islamabad. Furthermore, two agriculture departments at Skardu and Chitral, extension department at Hunza valley, agriculture departments of KP, University of Poonch AJ&K and Shaheed Benazir Bhutto university Sheringel were also involved. At Baffa, major multiplication and characterization trial were planted that consist of 791 accessions. These sowings were done in order to check the adaptability and

suitability of the genotypes across various regions and identifying the best performing accessions across each environment. A synopsis entitled as “Genetic diversity in indigenous common bean based on molecular markers” for MSc.(Hons.) programme has been approved under this project. Molecular work is in progress and DNA extraction of 550 accessions have been done to date by standard CTAB DNA extraction protocol.

10.2.5 Vegetable nursery production and supply system for kitchen gardening

Fig 53 Operating polymerase chain reaction machine, NIGAB, NARC

Fig 54 Sowing at farmer field, khwazakhela, swat

Under the competitive grant a project is being implemented by MNSUMS, Multan, Punjab province. A nursery tunnel was constructed for raising of seasonal and off-seasonal vegetables including tomato, chili, pepper, brinjal, gourds, pumpkin, vegetable marrow Luffa and melons. Construction of permanent nursery tunnel with fogger attachment was completed and healthy and ready to transplant vegetable nursery was provided to community and farmers for the promotion of homebased gardening.

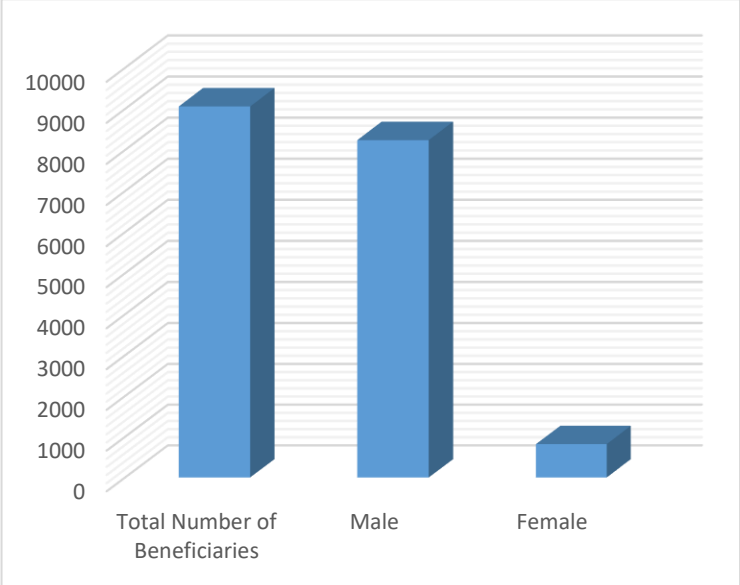
Sale points of vegetable nursery at different prominent places was established and by using web, Online–Marketing of vegetable nursery web portal was also developed. Use of social media platforms was helpful in awareness and marketing (Whatsapp group, facebook page) and interaction with vegetable growers. Awareness material (brochure) was developed for growing of winter vegetables. Seminars in schools,

Fig 55 Different activities related to seasonal and of seasonal vegetables at MNSUMS

colleges, universities, farmer fields, hotels and hospitals were organized with the coverage of electronic and print media for masses**.**

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 partners i.e. CIMMYT (Wheat, Maize, Agronomy), ILRI and PARC-AIP grants were collected during the reporting period. The data collected from the partners depicts 9058 beneficiaries were targeted (as shown in the graph) during the reporting period. Gender wise breakdown showed that 8239 (91%) males and 819 (9%) females were benefited from the AIP-activities.



Moreover data on component outcome indicators were collected and reported to higher management (see annexure 19.3)

12 Personnel/Management Update

- Under AIP Agronomy, Mr. Ansaar Ahmed, Research Associate Wheat visited KALRO- Njoro in Kenya to attend 10th Annual training course on "Standardization of Stem rust note taking and evaluation of germplasm with emphasis on emerging threats of Yellow rust and Leaf rust" held from September 29 to October 9, 2018.
- Under AIP-Livestock, Mr. Ijaz Khan, Project Admin completed his tenure, and Mr. Kamran Khan Finance Manager took over additional duties as Project Admin cum Finance. AIP-Livestock engaged two post-internees and seven internees from Sindh Agriculture University Tandojam to assist AIP -ILRI activities in Sindh province.
- AIP sponsored PhD scholars studying in various land grant Universities in US were granted 4-5 months no-cost extension as per supervisor recommendation to complete their studies.

13 External Factors

- Participants from Pakistan were unable to participate in the 13th Asian Maize Conference due to visa rejection by hosting country i.e. India.
- Complications of import permit issuance procedures are creating hurdles in routine-wise import of germplasm.
- Extremely severe & unexpected rains and thunderstorms during or after the sowing of maize trials during kharif season affected the germination and seedling establishment. Even re-sowing of the trials with remnant seed was done at some locations
- Under SEP, a survey was in progress and due to security risk on 9th and 10th Muharram (Ashura), the wheat and maize value chain surveys were divided into two parts. One part was completed before Ashura and the other was initiated right after Ashura.

14 Challenges/Risk

- Security risks particularly in Sindh and Balochistan provinces remained a concern during reporting period.
- The socioeconomic survey team engaged the local partners and enumerators as they have knowledge and information of the various rural areas
- The pending international INGOs issues and the delay in getting NOC for the Host Country Agreement between GoP and ILRI have created the hindrance in actively working with livestock farmers. However, AIP-livestock has started their activity through the collaborators and/or aligned departments to reach the small herders in the most difficult of parts of Pakistan.
- The availability of materials for aquaponics system was a big challenge. The materials were locally made from GI-Sheets (Galvanized Iron) purchased from the local market. Aquaponics experts (skilled workers) were not available for assistance in construction and installation of the system. Installation of the system was achieved utilizing own human resources.
- Lack of highly specialized techniques in off-season vegetable production was challenge included lack of knowledge among farmers for proper usage of fertilizers and pesticides and poor soil fertility management. The project provided high quality seeds (Hybrid &OPV), fungicide, insecticides, organic/inorganic fertilizer and bio-stimulant.
- Monsoon rains were giving crop hard time to common bean as this crop do not require much irrigations and there is a chance of *fusarium* infestation in the standing crop.
- It was challenging to convince the farmers for production of groundnut. To make them agree to participate in the project they were briefed on project and its benefits through discussion and question/answer during farmer's meeting and awareness seminars.

15 Contributions to USAID gender objectives

AIP encourages women participation in the project interventions in all possible ways.

- Under wheat during the reporting period 13% women participated in various workshops and trainings related to wheat quality and yield improvement.
- AIP maize is evaluating protein and vitamin A enriched maize varieties in Pakistan. Vitamin A deficiency is seriously affecting the health of women and children. In this regard three ProA enriched maize hybrids have been allocated to UAP for commercial production. These hybrids, once approved by the national system, believed to increase the availability of low cost biofortfied foods in the market that in turn will contribute for the nutritional wellbeing of women, children and other deprived communities
- Female researchers are involved in the operational activities of the Stem Borer Mass Rearing lab activities. More than 50 female students were part of the instrument handling trainings. Learning outcomes of these trainings will enable females to conduct their research experiments very effectively.
- AIP-SEP in collaboration with Comsat Institute of Information Technology (CIIT) Lahore campus organized a training on September 27, 2018 regarding "Orientation to SPSS and STATA. In total 41 faculty members and students including 65 % women attended the training.
- During reporting period, AIP-ILRI has trained a total of 216 women members from Milk Producer Group in ten villages of Sindh province.
- Under AIP agronomy, a total of five women participated in project activities.

- The field operations of strawberry do not require heavy labour, therefore, women can also be engaged to cultivate this crop and a good output can be produced. Strawberry crop can provide a major source of employment for women.

16 Environmental Compliance

- Under Wheat component, AIP out scaled newly released, rust resistant and high yielding wheat varieties, which do not require fungicides, thus reduce pollution to soil and environment. In Barani areas drought tolerant varieties have been distributed which require less water. This puts less pressure for water demand and enhance production.
- Most of CIMMYT's maize germplasm are climate smart varieties that best perform under stress environments. CIMMYT's germplasm 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.
- In agriculture, nitrous oxide is emitted when people add nitrogen to the soil through the use of synthetic fertilizers. 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.
- Extensive use of 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 that 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.
- 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.
- AIP agronomy is disseminating Zero tillage, ridge planting of wheat, upscaling of new planters like, Multicrop DSR planter, Zero tillage happy seeder and push row planter and precision nutrient managements. These new techniques helped farmers to reduce tillage, water and fertilizer use, avoid burning of residue and ultimately improve environment through reduced GHG emissions.

17 Lessons Learned

- Under agronomy improved production techniques can only be disseminated on larger area through collaboration of service providers and this was experienced in Jaffarabad for ZT wheat planting and ZTHS planting in Faisalabad and Sheikhupura area. Therefore, project would focus on provision of planters to service providers.
- AIP-wheat stated that in case of no rust incidence fungicide application is useless. Village based seed can play vital role in eradication of old varieties provided that seed banks are functional in the area.

Under competitive grant the following lesson's learned

- Project on Integrated approaches to manage Broomrape (*Orobanche* spp.) in tomato in KP and Balochistan provinces identified two new host weeds (Thlaspi arvensis and Flaveria trinervia) and

reported for the first time in the area to be a great source of Orobanche prevalence. Cultural and conventional methods were practiced and proved to be the best non-chemical control method.

- Project implemented by COMSATS documented the lesson's learned is that the main and most important step for the prevention of a zoonotic disease is creating awareness by involving locals and educated community.
- Sindh province has potential in strawberry. If the farming community is aware fully about production and modern technologies of strawberry their living standard and local trade can be enhanced.
- Under Pome project, it is stated that the Mansehra division is conducive for fruits production so the copping system of the area will be easily changed from mono cropping trend to fruit growing culture by introduction of different fruits species.
- 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. Selection of seed is most important factor because this determine the productivity of crop and vegetable in demand should be cultivated which results in high returns. The planting has to be done timely, accurately and wisely which is key to success.
- The project on Molecular based genetic divergence in indigenous common bean stated that susceptibility of common bean to pest attacks and diseases like aphids, leaf hoppers, leaf feeding insects if not control timely, can rapidly retard plant growth.

18 Communications

In this reporting period AIPs' Communications proactively highlighted the AIP's interventions included arrangement of 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. Some of the mediums used to communicate the AIP activities are listed below:

- Publications (newsletters , brochures, souvenirs, banners, standees, back-drop)
- Social Media (Flicker, Facebook, Twitter, Instagram)
- CIMMYT's web news
- Events

Branding material of Maize, Wheat, Agronomy and PARC CGS partners was produced according to USAID branding and marking guidelines. These include banners, backdrops and standees for various events under these components.

Branding and communications related skype and teleconferences were arranged with partner for proper AIP branding (use of logos, branding stripe for banners, standees & project signage) and guidelines for taking action oriented photos were shared with partners.

18.1 Dawn Agri expo 2018:

AIP set up a stall at Dawn Agri Expo 2018 organized by USAID and USDA in Lahore and presented the agricultural successes in agricultural technology and provided a platform for Pakistani farmers, government and other stakeholders to explore and connect to innovative technologies for improvement of major crops/livestock sectors of Pakistan and other linked products and services.

Links of the event related news were below:

Fig 56 Project Manager briefing media about AIP success

- USAID weekly news Item
- Electronic media – interviews/news packages (photo)
- Radio show (LIVE) of Dawn FM radio channel
- Newspaper supplement (DAWN)
- CIMMYT Web News: https://www.cimmyt.org/cimmyt-at-dawn-pakistan-agri-expo-2018
- Facebook: https://www.facebook.com/WeEatWheat
- Flickr: https://www.flickr.com/photos/cimmytpakistan/sets/72157690802363460
- Twitter: https://twitter.com/CIMMYT/status/994233790779219968
- Instagram: https://www.instagram.com/p/Bij8xeeD2vQ/?hl=en

18.2 Cook's challenge:

USAID under its communication section recorded a grand finale program to document and highlight the interventions and achievements of the USAID programs in Pakistan particularly in agriculture sector focusing AIP. This program, named "Cooks' Challenge" was participated by U.S. Government representatives - Deputy Head of the U.S. Mission in Pakistan, USAID Mission Director along with Chairman PARC highlighted the key successes of AIP.

The program was aired on all mainstream electronic media channels in prime time. The program related recoding and publicity links are as under:

https://www.youtube.com/watch?v=QJfSz7SDsRM

https://www.facebook.com/USAIDPakistan/photos/a.440871662600387.101186.440868732600680/1849725221715017/?type=3&theater

https://www.facebook.com/USAIDPakistan/photos/a.440871662600387.101186.440868732600680/1850762454944627/?type=3&theater

https://twitter.com/USAID_Pakistan/status/1003954769155813376

https://twitter.com/USAID_Pakistan/status/1003592330216124416

https://twitter.com/USAID_Pakistan/status/1003169457173356544

18.3 Wheat

https://twitter.com/i/topics/news/e374344758?cn=ZmxleGlibGVfcmVjcw%3D%3D&refsrc=email

https://web.facebook.com/CIMMYT/photos/a.333170283394.157061.28893663394/10156583611583395/?type=3&theater

https://wheat.org/2018-agricultural-innovation-program-meeting-cimmyt-and-partners-achievements-in-pakistan/

https://www.facebook.com/302037479875529/posts/1905928526153075/

http://inside.cimmyt.org/corporatecommunications/group%20blog/Lists/Posts/Post.aspx?ID=1000&

18.4 Maize

Breeding for provitamin A biofortification of maize (*Zea mays* L.).

https://onlinelibrary.wiley.com/doi/abs/10.1111/pbr.12618?af=R.

CIMMYT helps national programs to enhance maize breeding efficiency in Pakistan.

https://www.cimmyt.org/cimmyt-helps-national-programs-to-enhance-maize-breeding-efficiency-in-pakistan

Maize partners collaborate to maintain yield gain momentum in Pakistan.

https://www.cimmyt.org/maize-partners-collaborate-to-maintain-yield-gain-momentum-in-pakistan/

Abstracts accepted for publication in 13th Asian Maize Conference, 2018

- Assessment of Agronomic Performance of Kernel Zinc Fortified Maize Genotypes in Pakistan
- Open Pollinated Maize Varieties: Do They Have Scope in South Asia? Lessons from Pakistan
- Grain Yield Performance of Heat Stress Tolerant Maize Hybrids Under Heat Prone Areas of Pakistan
- White Maize Hybrids to Mitigate Climate Change in Pakistan

18.5 Agronomy

'Impact of Ridge-Furrow Planting in Pakistan: Empirical Evidence from the Farmers Field'

https://www.hindawi.com/journals/ija/2018/3798037/

Effect of Bed Planting and Zero Tillage on Productivity and Water Use of Irrigated Maize Wheat Cropping System in Khyber Pakhtunkhwa Province of Pakistan.

http://researcherslinks.com/current-issues/Effect-of-Bed-Planting-and-Zero-Tillage-on-Productivity-and-Water-Use-of-Irrigated-Maize-Wheat-Cropping-System-in-Khyber-Pakhtunkhwa-Province-of-Pakistan/14/1/1713

AIP – Agronomy arranged national meeting at Islamabad on 4-5 September 2018.

https://wheat.org/2018-agricultural-innovation-program-meeting-cimmyt-and-partners-achievements-in-pakistan/

18.6 Livestock

AIP Livestock Publications:

- Extension Manual for feeding cattle and buffaloes which was produced in English has been translated into Sindhi and published.
- To-date has produced 48 Factsheets covering all aspects of dairy cattle and buffalo nutrition, health care and management in English and Urdu languages, and have been translated to Sindhi language.
- AI training manual in Goats was translated to Sindhi and published.
- During the reporting period 5 research reports were produced and printed.

Journal Publications:

1. Impact of grazing on soil, vegetation and ewe production performances in a semi-arid rangeland. (2018). Muhammad Islam, Abdul Razzaq, Shamim Gul, Sarfraz Ahmad, Taj Muhammad, Sawsan Hassan, Barbara Rischkowsky, M.N.M. Ibrahim and Mounir Louhaichi. ***J. Mt. Sci. (2018) 15(4): 685-694***. http://jms.imde.ac.cn
2. The influence of protection from grazing on Cholistan Desert vegetation, Pakistan. (2018) Muhammad Zubair, Ahmar Saleem, Mirza Asim Baig, Muhammad Islam, Abdul Razaq, Shamim Gul, Sarfarz Ahmad, Hloniphani P. Moyo, Sawsan Hassan, Barbara Rischkowsky, Mohamed N.M. Ibrahim and Mounir Louhaichi. **Rangelands 40(5):136—145.**
    a. https://authors.elsevier.com/c/1XwHxhDeUkItL
3. Sustaining Small-holder Dairy Production Systems under Diverse Feeding Strategies in Pakistan. (2018). M.S. Ashraf, Z. Manzoor, Z. Mustafa, N. Khan and M.N.M. Ibrahim. Submitted to "Tropical Animal Health & Production" special issue.
4. Heterogeneous Demand for Aflatoxin-Free Raw Milk: Evidence from Pakistan. (2018). Abedullah, Shahzad Kouser and Mohammad Nawaz Mohammad Ibrahim. Submitted to "**Tropical Animal Health & Production**" special issue.
5. Comparative analysis of Electronic Mastitis Detector with conventional methods for the detection of bovine sub-clinical mastitis in Pakistan. (2018). A. Ali, F. Yasin and M.N.M. Ibrahim. Submitted to "**Tropical Animal Health & Production**" special issue.

18.7 Vegetable

Vegetable nursery produced by MNSUAM AIP CG was displayed on the stalls during nationwide events. Different foreign and local dignitaries, faculty, scientists and farmers visited vegetable nursery stall. The project was appreciated for community service regarding clean vegetable production at household level.

Major print and electronic media channels visited the stall and covered the activity for dissemination of information to the public through media.

Radio Talk show on “Vegetable Nursery Production and Supply System for Kitchen Gardening” was conducted on FM 101 Multan for awareness about the project to masses.

A web portal (linked with MNSUAM’s Website) is developed and is currently live/available to receive online orders.

Link of the web portal http://mnsuam.edu.pk/Nursery/index.html

Fig 57 Radio show on vegetable production awareness

19 Appendices

19.1 Annexure maize

Table 1: Summary of climate resilient maize trials conducted during Kharif 2018						
No	Trials Name/Code	Trials Description	No. of entries	No. of reps	No. of Sets	Remarks/Seed source
1	02AS-17TSCTWCYN	Three way cross yellow hybrids	18	2	2	CIMMYT-Mexico
2	03AS-17TSCTWCWZN	Three way cross - white - zinc biofortified hybrids	18	2	2	CIMMYT-Mexico
3	08-17TLXTFACTWQZN	Three way cross – QPM – Zinc biofortified	28	2	2	CIMMYT-Mexico
4	09-17TLXTFACTWN	Low land tropical white maize trial	64	2	4	CIMMYT-Mexico
5	MLT-PAK	Heat Tolerant Maize Hybrids	25	2	10	CIMMYT-India

Table 2: AIP-maize partners participated in the evaluation of kharif maize trials (2018)				
Sr. No.	Partner Name	Province	Ownership	No. of trials
1	Jullundur Private Limited (JPL)	Punjab	Private	2
2	Four Brothers Group (4B)	"	"	1
3	Ali Akbar Group Pvt (AAG)	"	"	1
4	ICI-Pakistan (ICI)	"	"	1
5	Tara Crop Sciences Pvt (TCS)	"	"	1
6	Kanzo Quality Seeds Pvt (KQS)	"	"	1
7	Sohni Dharti International Pvt (SDI)	"	"	1
8	Pak Hibred (Pvt) Ltd	"	"	1
9	Hi Sell Seeds Pvt	"	"	1
10	Maize and Millet Research Institute (MMRI)	"	Public	2
11	Cereal Crops Research Institute (CCRI)	KP	Public	3
12	National Agricultural Research Institute (NARC)	ICT	Public	3
13	University of Agriculture, Faisalabad (UAF)	Punjab	Public	1
14	Muhammad Nawaz Sharif Univ. of Agriculture Multan	Punjab	Public	1

Table 3: Seed produced by AIP-Maize partners with allocated products	
OPV/Hybrid/Parent seeds	Amount of seed produced (Kg)
TP1219	150
TP1217	131
ZM 309	500
ZM401	134
CZP132006	45
CZP132012	43
CZP132011	110
CZP132001	500
CZP132002	100
ZM521	10
TP1221	44
QPHM200	245
QPHM300	221
HP1097-2	123
HP1097-11	145
HP1097-18	101
Various parental seeds	1105
Total seed produced	3707
Breeder seed and inbred lines produced under the AIP maize during Spring2018	

Table 4: Summary of total maize seed produced & distributed by AIP partners		
Partner name	Variety name	Amount of seed Produced (Kg)
NARC	HN-Gold	10950
	Fakhar-e-NARC	1500
MMRI	YH1898	3661
	Pearl	4550
CCRI	Iqbal	760
	Azam	890
	Jalal	1890
	Pahari	1750
	Baber	2700
Total		28651

Table 5. Details of trials selected from SABWGPYT (2013-18) and shared with national partners					
Trial name	1st year	2nd year	3rd year	4th Year	5th Year
SABWGPYT2013-14	540 lines	77 (HYT-80)	24 (HYT-27)	2 in NUWYT 3 in KPWYT	2 in NUWYT
SABWGPYT2014-15	600	57 (HYT-60)	17 (HYT-20)	3 in NUWYT 2 in PUWYT 3 in KPWYT	5 in NUWYT
SABWGPYT2015-16	600	52 (HYT-55)	28 (HYT-30)	2 in PUWYT	5 in PUWYT 1 in NUWYT
SABWGPYT2016-17	600	63 (HYT-65)	17 (HYT-20)	-	-
SABWGPYT-17-18	600	67 (HYT-70)	-	-	

19.2 Annexure agronomy

Location	Name of trial*	No. of genotypes	Planting details
Miandam (Upper Swat) 5 Trials	21st IWWYT-IR	40 (39 WW lines + 1 check)	RCB design with 2 reps; 2 rows of 5 m length per genotype
	ii. 20th IWWYT-SA	36 (35 WW lines + 1 check)	Un-replicated; 1 row of 5 m length per genotype
	iii. 25th FAWWON-IR	165 (164 WW lines + 1 check)	Un-replicated; 1 row of 5 m length per genotype
	iv. 25th FAWWON-SA	116 (115 WW lines + 1 check)	Un-replicated; 1 row of 5 m length per genotype
	v.18th ELITE Trial	11 (10 WW lines + 1 check)	RCB design with 3 reps; 3 rows of 5 m length per genotype
Kalam (Upper Swat)	i. 25th FAWWON-IR	165 (164 WW lines + 1 check)	Un-replicated; 1 row of 5 m length per genotype
2 Trials	ii.18th ELITE Trial	11 (10 WW lines + 1 check)	RCB design with 3 reps; 3 rows of 5 m length per genotype
Uni. of Agri., Peshawar	i. 25th FAWWON-IR	165 (164 WW lines + 1 check)	Un-replicated; 1 row of 5 m length per genotype
2 Trials	ii.18th ELITE Trial	12 (10 WW lines + 2 checks)	RCB design with 3 reps; 5 rows of 5 m length per genotype

* **IWWYT-IR:** International Winter Wheat Yield Trial for Irrigated Areas; **IWWYT-SA:** International Winter Wheat Yield Trial for Semi-Arid Area; **FAWWON-IR:** Facultative Winter Wheat Observation Nursery for Irrigated Areas; **FAWWON-SA:** Facultative Winter Wheat Observation Nursery for Semi-Arid Area.

19.3 Annexure monitoring and evaluation

Output indicator: April-18 to September-18	
Indicator	Beneficiaries (No)
Number of farmers linked with/benefiting from agriculture extension services through scaled up extension system	887
Number of improved production and agriculture management technologies/practices transferred/made available to farmers	305
Number of demonstration plots/farms/trials established for farmers' awareness on improved agriculture technology and management practices	555
Number of farmers received information on improved agricultural management practices through demonstrations/field days/trials	7354
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.	3849
Number of farmers linked with input/service providers for improved production services/inputs	1004
Number of new breeding lines/cultivars/rootstock of cereal and horticulture crops at development stage	581
Number of partnerships developed with input suppliers/companies for development of production inputs/services (PPR vaccine, Semen, new varieties)	24
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	1802
Number of farmer selling products (cereals, vegetables, fruits, milk and small ruminants) value added , production cost decreased a as a result of Project interventions	900
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	82
Number of entities (including national scientists, academics, value chain actors etc.) received training on concepts of value chain	51
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	32
Number of farmers linked with/benefiting from agriculture extension services through scaled up extension system	1099
Number of improved production and agriculture management technologies/practices transferred/made available to farmers	14
Number of demonstration plots/farms/trials established for farmers' awareness on improved agriculture technology and management practices	2641
Number of farmers received information on improved agricultural management practices through demonstrations/field days/trials	4908

Output indicator: April-18 to September-18	
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.	1538
Number of farmers linked with input/service providers for improved production services/inputs	402
Number of new breeding lines/cultivars/rootstock of cereal and horticulture crops at development stage	85
Number of partnerships developed with input suppliers/companies for development of production inputs/services (PPR vaccine, Semen, new varieties)	1
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	122
Number of farmer selling products (cereals, vegetables, fruits, milk and small ruminants) value added , production cost decreased a as a result of Project interventions	326
Number of training events arranged on concepts of value chain and value chain assessment/analysis	1
Number of entities (including national scientists, academics, value chain actors etc.) received training on concepts of value chain	6
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	86