12th Annual Progress Report
of
Agricultural Linkages Programme

Name of Project:	**Angora Rabbit Farming as High Value Livelihood Source for Pakistani Women**
Name of PI/Institute:	**Dr Muhammad Afzal** Senior Scientific Officer, LRS, ASI, NARC, Islamabad
Duration:	18.01.2010 to 31.12.2013
Financial Status:	Total Cost: Rs.4.568 million Funds Released: Rs.3.594 million Funds Utilized: Rs.2.969 million

Objectives:

- To study the performance of Angora rabbit under Pakistani conditions.
- Develop Angora rabbit farming as high value livelihood source particularly for women in Pakistan

Achievements:

A model Angora rabbitry has been established at NARC. Twenty five (25) rabbits were imported from Nepal with the cooperation of ICIMOD in June 2010. Concentrated feed was formulated and prepared at feed technology unit, NARC for these rabbits. Concentrated feed is 150-200 grams per rabbit per day and green fodder consumption is 400 to 600 grams per rabbit per day. Green fodder includes maize, mulberry leaves, barley leaves, grass leaves, oats leaves, lucerne and barseem.

The wool of rabbit is sheared when it is approx. 3-4 inches long. After shearing, rabbits are especially cared for 15 days. Shearing is avoided before breeding process. Some time males and females were kept together but normally kept them in separate cages. Doe (female) takes 28 to 30 days to kindle after mating. Does were shifted to special nest boxes, after 24 days of mating. These cages/nest boxes have two partitions, one for doe and other for baby angoras, where it can feed its babies.

After initial survey for distribution of Angora rabbits for promotion of Angora rabbit farming conducted in Punjab, Khyber Pakhtunkhwa and Azad Jammu & Kashmir, approximately 294 rabbits were distributed to farmers. Different training sessions were also conducted in Punjab, Khyber Pakhtunkhwa and Azad Jammu & Kashmir. Five families in each area were trained on rabbit farming.

Different Angora rabbit wool products were developed like shawls & scarf's with the cooperation of PATCO. The findings of the project concluded that rabbit farming is another

livestock activity with great scope as it is relatively easy, rewarding and takes little space compared to other livestock activities. Rabbit farming can also provide a very valuable additional source of income in the rural areas.

Angora Rabit

Weaving of wool from Angora Rabit

Preparation of shawls from the wool of Angora Rabit

Different products made by Angora wool

Name of Project: **Use of Exogenous Fibrolytic Enzyme: Influence on Chemical Composition, Digestion Kinetics of Fodder Grass Silage and Buffalo Performance**

Name of PI/Institute: **Dr Mahr-un-Nisa**
Assistant Professor, Institute of Animal Nutrition and Feed Technology, University of Agriculture, Faisalabad

Duration: 01.07.2012 to 30.06.2015

Financial Status: Total Cost: Rs.6.480 million
Funds Released: Rs.2.183 million
Funds Utilized: Rs.2.183 million

Objectives:

- Chemical composition and digestion kinetics of FG (fodder grass) as influenced by varying levels of fibrolytic enzymes.
- Effect of varying levels of exogenous fibrolytic enzymes on ruminal characteristics, in-vivo digestibility and blood metabolites of Nili-Ravi buffalo bulls fed FG silage.
- Growth and fattening performance of Nili-Ravi calves as influenced by diets varying in silage to concentrate ratio with or without exogenous fibrolytic enzymes.
- Influence of diets varying in silage to concentrate ratio with or without exogenous fibrolytic enzymes on milk production and its composition in Nili-Ravi buffaloes.

Achievements:

Inadequate and irregular supply of quality fodder is one of the major factors affecting the ruminant animal productivity. Ensiling fodder with enzyme will not only ensure its availability round the year but will also help to maintain its quality. Enhanced feeding value of silage by application of fibrolytic enzyme to be undertaken under the project will improve the digestibility of forage based diet leading to economical milk and meat production.

Based on chemical composition and digestion kinetics results, the enzyme level yielding best result is selected to ensile the grass on larger scale. Six iso-nitrogenous total mixed rations were prepared using 50, 60 and 70% oat grass silage. The direct fed enzyme levels yielding best results in metabolic trial were used in these trials. One hour prior to feeding, each diet was treated with or without enzyme. Animals were housed on a concrete floor in separate pans. Each experiment was continued for 3 months. Animals were fed twice a day at ad libitum. The daily dry matter (DM) intake and weekly weight gain are recorded. Three students doing M. Phil are involved in the project for their research work required.

Name of Project:	**Improved Utilization of Beetal Goats through Open Nucleus Breeding Scheme**
Name of PI/Institute:	**Dr Muhammad Sajjad Khan** Prof., Dept. of Animal Breeding and Genetics, University of Agriculture, Faisalabad
Duration:	17.05.2012 to 16.05.2015
Financial Status:	Total Cost: Rs.1.942 million Funds Released: Rs.1.220 million Funds Utilized: Rs.1.114 million

Objectives:

- To devise strategy of breed improvement in the two strains of Beetal goats through participatory approach under open nucleus breeding system, specially;
  - Recording of flocks of two Beetal strains viz; Makhi-Cheeni and Faisalabadi
  - Selection of superior does and bucks of breeding in the registered flocks
  - Distribution of superior bucks in field for genetic improvement.

Achievements:

Two new flocks each of Makhi-Cheeni and Faisalabadi Beetal goats were registered and recorded during the year under report for breed improvement. New kids born out of registered does (42 + 123 kids) were also registered and measured for phenotypic traits.

Farmers were trained for vaccination, tattooing, deworming and recording of their animals. Farmers meeting regarding documentation of breeding objectives were also held. Project facilitated the formation and registration of an association of goat farmers with the name of "Goat Breeders Association of Pakistan".

Name of Project: **Up-gradation of Our Local Rabbit for Meat Production**

Name of PI/Institute: **Dr Sarzamin Khan**
Associate Professor, Department of Poultry Sciences, The University of Agriculture, Peshawar

Duration: 24.05.2012 to 23.05.2015

Financial Status: Total Cost: Rs.3.922 million
Funds Released: Rs.2.779 million
Funds Utilized: Rs.2.534 million

Objectives:

- To assess the meat production potential of our local rabbits under farm condition.
- To asses the cost benefit ratio of rabbit farming
- To evaluate the future of rabbit farming for introduction among local farmers through development of a local breed and optimum set of local condition.

Achievements:

An elaborated survey was conducted in different regions of the province and documented the status of rabbit farming with reference to breeds, rabbit production practices and its acceptability as meat animal. The data was analysed and submitted for publication which is under review with Sarhad Journal of Agriculture. The progress/ activities conducted during report period are as follows:

- Collected rabbits from different regions of the province
- Tagging and registration of animals
- Collection and procurement of rabbit feed ingredients
- Production of green fodder for the rabbits throughout the year
- Formulation and production of rabbit breeding and fattening rations
- Adaptation of rabbits to breeding cages
- Breeding of rabbits under farm condition and with farmers in field
- Adaptation of pregnant rabbits in maternity cages for parturition
- Rearing of rabbit kids under farm condition observing their requirements and diseases
- Fattening of rabbit kids under farm conditions using palliated feed
- Study on various meat traits of rabbits produced under farm condition
- Development of rabbit breeding lines of our local rabbit varieties.
- Rabbit meat was introduced and sampled to boys hostel in the University

Name of Project: **Evaluation of Microorganisms, Clays and Herbs for Mycotoxin Degradation and their Effect upon Nutrient Availability in Chicken**

Name of PI/Institute: **Dr Muhammad Zargham Khan**
Professor, Department of Pathology, Faculty of Veterinary Sciences, University of Agriculture, Faisalabad

Duration: 01.07.2012 to 30.06.2015

Financial Status:
Total Cost: Rs.7.081 million
Funds Released: Rs.4.622 million
Funds Utilized: Rs.4.508 million

Objectives:

- To evaluate the aflatoxin inactivating/ binding potential of locally available mycotoxin binding/ inactivating agents like bentonite clay, distillery sludge and yeast and *Siblinum marianum* in poultry birds.
- To evaluate the ochratoxin inactivating/ binding potential of locally available mycotoxin binding/ inactivating agents like bentonite clay, distillery sludge and yeast and *Siblinum marianum* in poultry birds.

Achievements:

Eight experiments were conducted on broiler chicks to evaluate mycotoxin binding/ inactivating potential of locally available substance used in poultry feed. Experimental feeds were contaminated with known levels of Aflatoxin B1 (AFB1) (0.2, 0.4 & 0.6 mg/kg) or Ochratoxin A (OTA) (0.15, 0.3 & 1.0 mg/kg). Different candidate substances including bentonite clay (5, 10 & 20 g/kg), distillery sludge (DS) (5, 10 & 20 g/kg), milk thistle plant (MT) (5, 10 & 20 g/kg) and baker's yeast (1 & 5 g/kg) were incorporated in the poultry feeds along with AFB1 or OTA. Different parameters studied included body weight, clinical disease, mortality, organs weight, serum chemistry, gross and microscopic pathology, AF1 and OTA residues in liver.

The preliminary results revealed that feeding of OTA and AFB1 in all experiments, in comparison with control birds, resulted in a significant decrease in body weight gain, decreased relative weight of Bursa of Fabricius, increased relative weight of liver, lower humeral and cellular immune responses. The serum chemistry revealed adverse effects upon liver, kidneys and protein metabolism.

Feeding of bentonite (SB) did not or only partially ameliorated the toxic effects of OTA in terms of body weight, immune responses, relative weight of bursa and serum chemistry.

Concurrent feeding of SB with AFB1 showed an ameliorative effect as indicated by improved body weights, relative weight of bursa and immune responses.

Feeding of distillery sludge (DS) ameliorated the deleterious effects of both OTA and AFB1 as evidenced by significant increase in body weight, relative weight of bursa of Fabricius, immune responses and serum chemistry. In some groups the body weight of DS fed birds even higher than that of control birds.

Feeding of milk thistle seeds along with OTA and AFB1did not improve mycotoxins induced lower body weights.

In the project 02 students are doing their research work of M. Phil and 01 for Ph.D.

Name of Project: **Evaluation of Bio-available Phosphorus in Indigenous Feedstuffs for Poultry (NARC Coordinating Unit - Comp. I)**

Name of PI/Institute: **Dr Muhammad Iqbal Anjum**
SSO, Animal Nutrition Programme, ASI, NARC, Islamabad

Duration: 01.07.2012 to 30.06.2014

Financial Status:
Total Cost: Rs.2.265 million
Funds Released: Rs.1.885 million
Funds Utilized: Rs.1.840 million

Objectives:

- To generate database on phytate P of all plants source poultry feedstuffs i.e. cereal grains, cereal by products and vegetable meals.
- To determine bio-availability of P in all plant source poultry feedstuffs i.e. cereal grains, cereal by products and vegetable meals.
- To determine bio-efficacy of exogenous phytase enzyme from different origin i.e. bacteria, fungi and yeast in broiler chicks.
- To determine bio-efficacy of two best exogenous phytase enzymes in broiler chicks through demonstration trial at private broiler farm of Islamabad Feeds Pvt Ltd. Rawalpindi.

Achievements:

Samples of plant source poultry feedstuffs i.e., cereal grains (corn, wheat, rice, sorghum, millet), cereal by products (wheat bran, rice polish) and vegetable meals (corn gluten meal 30 and 60%, canola meal, rapeseed meal, soybean meal, sunflower meal, guar meal, cottonseed meal) collected from primary producers in Punjab province, analysed for proximate composition, macro-minerals, aflatoxin and gross energy. Cereal grains contained moisture content in the range of 9.70 to 14.30 % lowest in wheat and highest in millet.

Twenty four layer male (cockerels) were purchased for metabolic trials. Fifteen metabolic trials were conducted to determine the bio-availability of phytate P of plant source poultry feedstuffs using cockerels by quick bioassay technique developed by Sibbald (1986).

Two growth trials on broiler chickens were carried out in battery cages to determine the effects of fungi based phytase enzymes supplementation to the diets containing low di-calcium phosphate and low dietary energy. In first experiment, 200 broiler day old chicks were divided into three treatments with 5 replicates in each treatment having 13 chicks per replicate. In second growth trial 200 broiler day old chicks were divided into three treatments with 5 replicates in each treatment having 13 chicks per replicate. Data on various aspect was recorded and analysed.

Poultry feedstuffs samples collected by two coordinated-units Comp-II (Sind) and Comp-III (Rawalakot) were also analysed for proximate composition, macro minerals, aflatoxin and gross energy contents and phytate contents of feedstuffs and fecal were determined by using cockerels. These results were provided to respective component of coordinated units.

The studies conducted under the project concludes that, Proximate analysis of plant source poultry feedstuffs showed maximum moisture content, crude protein, ether extract and nitrogen free extract, crude fibre, gross energy, aflatoxin, total phosphorus and calcium in millet, corn gluten meal 60%, rice polish, sunflower meal, rice broken, cottonseed meal, corn gluten meal 30% and rapeseed meal, respectively. Results of metabolic trials indicated that the quantity of undigested phytate P was lower in cereal compared to cereal byproducts and vegetable meals. However, undigested phytate P levels in cereals by products and vegetable meals were almost similar. Results of both growth trials on broiler chickens indicated that supplementation of fungi based phytase SSF and Quantum Blue enzymes to the diets containing low di-calcium phosphate as well as low dietary energy had positive effects on weight gain and feed conversion ratio compared to chickens fed non-phytase supplemented diets.

Name of Project: **Evaluation of Bio-available Phosphorus in Indigenous Feedstuffs for Poultry (University College of Agriculture, Rawlakot, AJK Comp. II)**

Name of PI/Institute: **Dr Jameel Akbar**
Lecturer, Department of Livestock & Poultry Production, Faculty of Veterinary & Animal Sciences, The University of Poonch, Rawalakot, (AJ&K)

Duration: 01.07.2012 to 30.06.2014

Financial Status: Total Cost: Rs.2.750 million
Funds Released: Rs.0.257 million
Funds Utilized: Rs.0.065 million

Objectives:

- To determine bio-efficacy of exogenous phytase enzymes from yeast origin in broiler chicks.

Achievements:

A 35 days research trial was conducted on experimental poultry farm Mutialmera, University of Poonch, Rawalakot as per protocol defined in the project proposal. A total of 450 birds were divided into 03 treatment groups with 03 replicates each. Diet "A" was control feed with no exogenous phytase, diet "B" was negative control with a little higher energy content and no added phytase while diet "C" was supplemented with yeast based phytase enzyme. The birds were reared on floor and data was collected for weight gain, feed intake and feed gain ratio. The results showed that there was a significant difference in weight gains in group supplemented with yeast based phytase. It is evident from the results that group "C" has higher weight gain as compared to other groups. Similarly the diet supplemented with enzyme had higher feed intake and feed to gain ratio was significantly lower for group "C". The results of the study conclude that the addition of yeast based phytase enzyme in feed results in increase in weight gain and also increases the feed intake. The feed conversion ratio also decreased due to addition of exogenous phytase in local feed stuffs. So phytase inclusion in diet reduced the feed cost and improved the production performance of bird.

Name of Project: **Evaluation of Bio-available Phosphorus in Indigenous Feedstuffs for Poultry (Feed Dev. Centre, PARC, Naudero, Larkana Comp. III)**

Name of PI/Institute: **Dr Shahbaz Javaid**
SSO, Feed Development Centre, PARC, Naudero, Larkana

Duration: 01.07.2012 to 30.06.2014

Financial Status: Total Cost: Rs.2.750 million
Funds Released: Rs.0.276 million
Funds Utilized: Rs.0.084 million

Objectives:

- To generate data on phytate P of all plant source poultry feedstuffs i.e. cereal grains, cereal by products and vegetable meals.
- To determine bio-availability of P in all plant source poultry feedstuffs i.e., cereal grains, cereal by products and vegetable meals
- To determine bio-efficacy of exogenous phytase enzymes from differen origin i.e. bacteria fungi and yeast in broiler chicks.
- To determine bio-efficacy of two best exogenous phytase enzymes in broiler chicks through demonstration trial at private broiler farm of Islamabad Feeds Pvt. Ltd., Rawalpindi..

Achievements:

To generate and compile database on phytate-P and bio-availability of P of all local plant source poultry feedstuffs and to determine bio-efficacy of phytase enzyme from bacteria origin in broiler chicks, three to four samples each of cereals (rice, wheat and maize) and cereal by products (rice polish, wheat bran) were collected from different parts of Sindh province including Larkana, Shikarpur, Sukkur and Jacobabad. The samples of vegetable meals (cotton seed meal, rape seed meal, canola meal, sunflower meal) were collected from Karachi. These samples were analysed in laboratory of Animal Nutrition Programme at NARC, Islamabad for proximate composition, energy value and percent availability of P. Three to four samples of each feedstuff were analysed.

Table-A: Proximate composition, energy and phosphorus and phytate-P content of feedstuffs analysed at NARC, Islamabad

Feedstuff	Dry Matter	Crude Protein	Crude Fat	Crude Fibre	Ash	ME (Kcal/Kg)	P (%)	Phytate-P
Rice	89.17 to 89.87	9.12 to 9.67	2.23 to 2.87	0.90 to 1.23	0.98 to 1.16	2.72 to 2.85	0.81 to 0.97	61.68 to 62.43
Wheat	89.95 to	10.89 to	3.22 to	3.17 to	2.45 to	2.69 to	0.55 to	63.03 to

	90.73	11.80	3.61	3.52	3.05	2.80	0.73	63.70
Maize	89.10 to 90.89	8.57 to 9.23	3.11 to 3.97	2.33 to 3.72	1.10 to 1.89	2.77 to 2.98	0.17 to 0.22	63.44 to 64.16
Rice polish	88.21 to 90.52	11.12 to 12.87	12.39 to 16.11	10.89 to 12.38	8.90 to 11.02	2.67 to 2.99	1.02 to 1.23	81.45 to 82.95
Wheat bran	87.29 to 90.19	13.87 to 14.98	5.98 to 7.65	7.33 to 8.21	6.11 to 8.03	2.61 to 2.80	0.71 to 0.87	72.20 to 73.98
Cotton seed meal	91.31 to 92.97	38.01 to 40.19	4.67 to 5.86	8.98 to 9.59	7.22 to 7.90	2.77 to 2.89	0.24 to 0.27	69.65 to 71.23
Rape seed meal	91.11 to 92.51	32.12 to 33.67	1.59 to 2.03	8.71 to 9.88	8.43 to 9.23	2.69 to 2.87	0.73 to 0.85	72.19 to 73.95
Canola meal	90.99 to 91.89	33.87 to 35.02	1.30 to 1.67	11.74 to 12.97	6.88 to 7.94	2.44 to 2.61	0.78 to 0.97	71.88 to 72.46
Sunflower meal	89.56 to 91.04	28. 11 to 29.87	1.43 to 1.76	20.54 to 22.03	7.11 to 8.32	2.03 to 2.18	0.69 to 0.92	77.55 to 79.50

On the basis of above mentioned analysis, a database on proximate composition, energy value and P content of local plant source feedstuff of Sindh province used in poultry feed formulation is available.

Two growth performance trials using broiler chicks were conducted to assess the bio-efficacy of that enzyme using three types of dietry treatments as under:

1. A control diet having normal feed formulation (commerciall feed)
2. A negative control diet without supplimentation of any P source
3. A normal diet supplimented with bacterial based phytase enzyme

Weight gain and feed : gain ratio were significantly higher in birds fed diet supplemented with phytase enzyme as compared to other diets. However, there was non-significant difference in feed intake among the groups. The overall improvement of about 13 % was observed in growth performance of birds fed with diet supplemented with pyhtase enzyme.

Name of Project: **Development of Models for the Control of PPR in Pakistan and PPR Vaccine Using Local Isolate (Coordinating Unit, NARC-Comp. I)**

Name of PI/Institute: **Dr Aamer Bin Zahur**
PSO, ASI, NARC, Islamabad

Duration: 01.11.2012 to 31.10.2015

Financial Status: Total Cost: Rs.23.549 million
Funds Released: Rs.9.001 million
Funds Utilized: Rs.8.028 million

Objectives:

- Develop model for the control of PPR virus infection through vaccination among sheep and goats population in high risk tehsils of the country
- Systematic socio economic impact assessment and economic analysis of PPR vaccination programme
- Monitoring of viral activity in target districts with special emphasis on the changes in virulence of PPR virus circulating in small ruminants population
- Development of PPR vaccine using local isolate
- Awareness campaign and capacity building of staff

Achievements:

The high risk tehsils in provinces selected were; Drosh of District Chitral in Khyber Pakhtunkhaw province, Umerkot in Sindh province, Bela in district Lasbela, Balochistan, Chilas in district Diamer, in Giligit Baltistan and Barnala in Bhimber, AJK for developing model for control of PPR virus infection through vaccination among sheep and goats population.

A survey was conducted in the target tehsils *viz* tehsil Umerkot in Sindh (6 villages), tehsil Chillas of district Diamer in Gilgit Baltistan (2 villages) and tehsil Barnala in AJK (5 villages) to estimate the prevalence of PPR.

PPR Prevalence Study in target tehsils

Provi.	Distt.	Vill.	Goat	+Ve	AP	TP	Sheep	+Ve	AP	TP	Total	Posi.	AP	TP
Sindh	Umerkot	6	63	32	50.79	54.30	21	8	38.10	40.28	84	40	47.62	50.79
AJK	Bhimber	5	95	49	51.58	55.16	13	6	46.15	49.18	108	55	50.93	54.44
G.B	Diamir	2	30	14	46.67	49.74	15	7	46.67	49.74	45	21	46.67	49.74

AP= apparent prevalence, TP= True prevalence

AJK = Azad Jammu Kashmir, GB = Gilgit Baltistan

Vaccination teams were formulated and also develop vaccine bank in target tehsils. Mass vaccination was conducted in high risk tehsils as per given detail:

S. No	Province	Tehsil	No. of doses distributed
1	Sindh	Umerkot	2,00,000
2	Khyber Pakhtunkhwa	Drosh, Chitral	2,00,000
3	Balochistan	Bela, Lasbela	2,00,000
4	Gilgit Baltistan	Chilas, Diamer	2,10,000
5	AJK	Barnala, Bhimber	1,50,000
6	Animal Health NARC	ICT	40,000

A total of fourteen suspected field outbreaks of PPR were investigated by resource persons in the L&DD Dept. through out the country. These outbreaks were confirmed by clinical signs, post mortem findings, HA test, RT-PCR and c-ELISA

The direct detection of PPR virus using swab samples collected on filter paper has successfully been optimized. A local isolate of PPR PAK-Fjg-07/NARC found more immunogenic was selected for attenuation on Vero cell and subsequent vaccine production. To date 17 serial passages has been conducted on Vero cells.

A brochure in Urdu language *"PPR disease in sheep and goats"* published for awareness campaign for control of PPR and distributed among farmers and veterinary staff etc. Four workshop; two in Barnala of AJK, one each in Umerkot of Sindh and Chilas, Gilgit Baltistan were also arranged as awareness campaign, attended by livestock officers, veterinary officers and technical staff besides NGOs and small ruminants farmers.

Name of Project: **Development of Models for the Control of PPR in Pakistan and PPR Vaccine Using Local Isolate (L&DD Dept., Sindh - Comp. III)**

Name of PI/Institute: **Dr Zahid Rajput**
Vet. Officer, L&DD Dept., Sindh, Hyderabad

Duration: 01.12.2012 to 30.11.2015

Financial Status: Total Cost: Rs.2.616 million
Funds Released: Rs.1.297 million
Funds Utilized: Rs.1.144 million

Objectives:

- Develop model for the control of PPR virus infection through vaccination among sheep and goats population in high risk tehsil in district Mithi, Tharparkar of the Sindh province
- Systematic socio economic impact assessment and economic analysis of PPR vaccination programme
- Monitoring of viral activity in target district with special emphasis on the changes in virulence of PPR virus circulating in small ruminants population
- Awareness campaign and capacity building of field staff

Achievements:

PPR containment procedures were implemented and demonstrated to the field veterinary staff in tehsil Umarkot. Training imparted through demonstration and enhanced the capability of field veterinary staff in sample collection and vaccination. Total 10 Stock Assistants of were trained in sample collection. A vaccine bank established in Umarkot by supplying 200,000 doses of PPR vaccine. Carpet vaccination of 1,92,500 (Goats: 129601 and Sheep: 62899) animals was conducted in target tehsil. Treatment facility also provided to sick animal in the area (302 large and 1288 small). During the campaign, 1680 (74 large and 1606) ruminants were also drenched against internal parasites. A total of 19 samples (Serum, ocular/nasal swabs and tissue) were collected during the outbreak investigation and were shipped to Animal Health Lab. NARC, Islamabad. One hundred (118) sera samples for sero-monitoring were collected and also dispatched to AH labs, NARC, Islamabad. Awareness workshops were arranged with the collaboration of FAO at Hyderabad and Umarkot. As a result of workshop, the farmers participated, received information regarding PPR disease and its control at their door steps.

Name of Project: **Development of Models for the Control of PPR in Pakistan and PPR Vaccine Using Local Isolate (L&DD Dept., Khyber Pakhtunkhwa - Comp. IV)**

Name of PI/Institute: **Dr Ehsan Ullah Khan**
Director, Animal Health, L&DD Department, Khyber Pakhtunkhwa, Peshawar

Duration: 01.11.2012 to 31.10.2015

Financial Status: Total Cost: Rs.2.616 million
Funds Released: Rs.0.253 million
Funds Utilized: Rs.0.146 million

Objectives:

- Develop model for the control of PPR virus infection through vaccination among sheep and goats population in high risk tehsil in district Chitral of the Khyber Pakhtunkhwa province
- Systematic socio economic impact assessment and economic analysis of PPR vaccination programme
- Monitoring of viral activity in target districts with special emphasis on the changes in virulence of PPR virus circulating in small ruminants population
- Awareness campaign and capacity building of field staff

Achievements:

Tehsil Drosh of district Chitral, Khyber Pakhtunkhwa has been selected high risk area for PPR virus infection in sheep and goats in consultation with project coordinating unit. Vaccination teams were established in the target area viz Chitral in Khyber Pakhtunkhwa. Vaccine bank established in Drosh by receiving 200,000 doses of PPR vaccine.

Training to the rapid response comprising team veterinary and para veterinary staff imparted to tackle emergencies by implementing outbreak control measures in the area. During the report period, mass vaccination against PPR was conducted in all of the susceptible animals in target tehsil. Three suspected outbreaks of PPR were investigated in the target tehsil. The clinical examination of the diseased animals was carried out in each of the affected flock and necropsy was conducted and animal found dead.

Name of Project: **Development of Models for the Control of PPR in Pakistan and PPR Vaccine Using Local Isolate (L&DD Dept., Balochistan - Comp. V)**

Name of PI/Institute: **Dr Gohram Khalid Baloch**
Deputy Director (Livestock) L&DD Department Lasbella, Balochistan.

Duration: 01.11.2012 to 31.10.2015

Financial Status: Total Cost: Rs.2.616 million
Funds Released: Rs.0.253 million
Funds Utilized: Rs.0.209 million

Objectives:

- Develop model for the control of PPR virus infection through vaccination among sheep and goats population in high risk tehsil Bela in district Lasbela of the Balochistan Province
- Systematic socio economic impact assessment and economic analysis of PPR vaccination programme
- Monitoring of viral activity in target district with special emphasis on the changes in virulence of PPR virus circulating in small ruminants population
- Awareness campaign and capacity building of field staff

Achievements:

Outbreak investigation, vaccination, sero-monitoring and sample collection were the major activities of reporting year. A total of two suspected field outbreaks were investigated in target tehsil Bela. The clinical signs were recorded and the outbreak control measures were advised to the farmers. A vaccine bank was established in Bela tehsil by supplying 200,000 doses of PPR vaccine. Mass vaccination was carried out in target tehsil and a total of 1,90,500 animals (128601 goats & 61899 sheep) were vaccinated during the period under report. After successful vaccination against PPR disease the sero-monitoring was carried out and serum samples were collected first time after 30 days. The preliminary results revealed that there is a successful control of PPR in the targeted villages. A total of nineteen (19) samples (Serum, ocular/nasal swabs and tissue) were collected during the outbreak investigation. All samples were shipped to the AHP laboratories under cold conditions.

Name of Project: **Development of Models for the Control of PPR in Pakistan and PPR Vaccine Using Local Isolate (L&DD Dept., Gilgit - Baltistan - Comp. VI)**

Name of PI/Institute: **Dr Aziz ur Rehman**
Deputy Director, L&DD Department, Gilgit - Baltistan

Duration: 01.11.2012 to 31.10.2015

Financial Status:
Total Cost: Rs.2.616 million
Funds Released: Rs.0.885 million
Funds Utilized: Rs.0.823 million

Objectives:

- Develop model for the control of PPR virus infection through vaccination among sheep and goats population in high risk tehsil Astore in Chillas, district Diamir, Gilgit Baltistan
- Systematic socio economic impact assessment and economic analysis of PPR vaccination programme
- Monitoring of viral activity in target districts with special emphasis on the changes in virulence of PPR virus circulating in small ruminants population
- Awareness campaign and capacity building of field staff

Achievements:

Small ruminants of target tehsil Chilas, District Diamer were vaccinated for PPR vaccine. Age specific vaccination was conducted in target area and a total of 80,700 lambs, kids and newly introduced animals were vaccinated to break the transmission cycle of PPR virus. PPR containment procedures were implemented and demonstrated to field veterinary staff. The number of PPR outbreaks in the target tehsil has been reduced after PPR vaccination. A total of three suspected field outbreaks of PPR were investigated. Two (02) were confirmed by clinical examination of the diseased animals. The outbreaks were confirmed by clinical signs, post mortem findings, HA test, RT-PCR and c-ELISA. A total of 100 sera was dispatched to AH labs NARC. The analysis of the sera revealed 97/100 positive for PPR vaccine antibodies. It is anticipated that the transmission of PPR virus will ceased to occur in target areas due to vaccination and implementation of zoo sanitary measures in the end of project period.

Name of Project: **Development of Models for the Control of PPR in Pakistan and PPR Vaccine Using Local Isolate (Dept. of A. H, AJK,- Comp. VII)**

Name of PI/Institute: **Dr Adnan Rashid Malik**
Assistant Director (Tech), Department of Animal Husbandry, AJK, Muzaffarabad

Duration: 01.11.2012 to 31.10.2015

Financial Status:
Total Cost: Rs. 2.616 million
Funds Released: Rs. 1.124 million
Funds Utilized: Rs. 0.787 million

Objectives:

- Develop model for the control of PPR virus infection through vaccination among sheep and goats population in high risk tehsil in district Bhimber of the AJK
- Systematic socio economic impact assessment and economic analysis of PPR vaccination programme
- Monitoring of viral activity in target district with special emphasis on the changes in virulence of PPR virus circulating in small ruminants population
- Awareness campaign and capacity building of field staff

Achievements:

During report period, two suspected field outbreaks were investigated in target tehsil Barnala. Clinical examination of the diseased animals was carried out in each of the affected flock. The outbreak measures were advised to the farmers. As vaccine bank by supplying 150,000 doses of PPR has been established, a total of one lack animals were vaccinated. Age specific vaccination conducted in target tehsil to 8500 lambs, kids and newly introduced animals to break the transmission cycle of PPR virus. A total of 15 samples (ocular/nasal swabs, tissue) were collected during the outbreak investigation and shipped to AH programme labs, NARC under cold condition. One hundred sera samples for sero-monitoring were collected and sent to AH labs, NARC.

Name of Project: **Surveillance Pathogenesis and Management Strategies Against Major Emerging Avian Diseases (NARC Coordinating Unit, NARC - Comp. I)**

Name of PI/Institute: **Dr Athar Abbas**
Scientific Officer, National Reference Lab. for Poultry Disease (NRLPD), ASI, NARC, Islamabad

Duration: 01.10.2012 to 30.09.2015

Financial Status: Total Cost: Rs.24.041 million
Funds Released: Rs.10.968 million
Funds Utilized: Rs.9.581 million

Objectives:

The overall objective is to improve poultry health management practices through disease monitoring, investigating researchable issues and imparting training to stake holders for increasing its productivity for achieving food security and safety.

- Establishment of major avian disease surveillance and Lab Information Management System at Federal and provincial levels.
- Strengthening of diagnostic facilities by harmonization of lab procedures at federal and provincial levels through capacity building.
- Conduct research experiments/trials focusing pathogenesis, disease control strategies and Zoonotic role of the selected avian pathogens

Achievements:

National Avian Diseases Surveillance Network established against Selected Avian Pathogens of Poultry in Pakistan i.e., Avian Influenza Viruses (AIV), Newcastle Diseases Virus (NDV), Infectious Bronchitis Virus (IBV) and Salmonella. A total of 12922 (Serum = 5350, Swabs = 6380, Tissues = 991, Environmental = 201) samples from poultry origin received from the provincial collaborating institutes were analysed at NRLPD.

One hundred and thirty (130) poultry pathogens were isolated from the analysis of surveillance samples received from provinces. (NDV = 42, AIV = 31, Salmonella = 6, IBV = 9, E. coli = 39, Pasteurella = 3). A new variant of AIV serotype H14N3 was detected and first time reported from the wild bird of LBM from Karachi in Pakistan. A highly virulent and pathogenic variant of NDV genotype VII-f was isolated and reported for the first time in Pakistan.

Outbreak investigation was carried out at Tharparkar in June 2013 to investigate the cause of heavy mortality of wild peacocks reported over the years due to NDV. Recommendations and report was disseminated to the concerned authorities at provincial level for onward suitable

actions to control the disease in the reported areas.

A total of 36 NDV isolates were sequenced for 2 genes each (Fusion and HN gene). A total of 8 NDV isolates were biologically characterized for intravenous pathogenicity index (ICPI) and mean death time (MDT) to determine the pathogenic potential of the field isolates. A new Low Pathogenic AIV-H4N6 isolated in 2012 was sequenced for 3 genes (HA, NA and NS) under the project for its phylogenetic and sequence analysis to determine its evolution and ecology in the country.

A 2-days national training to provincial field staff was conducted and 15 participants were trained for samples collection, shipment, storage and data collection under surveillance of poultry diseases.

Name of Project: **Surveillance Pathogenesis and Management Strategies Against Major Emerging Avian Diseases (PRI, Rawalpindi - Comp. II)**

Name of PI/Institute: **Dr Abdul Rehman**
SRO/Director, PRI, Rawalpindi

Duration: 01.10.2012 to 30.09.2015

Financial Status:
Total Cost: Rs.1.957 million
Funds Released: Rs.0.225 million
Funds Utilized: Rs.0.225 million

Objectives:

The overall objective is to contibute towards improving poultry health management practives through surveillance, training and reseach for increasing its productivity and brining food security and safety to the public.

- Undertake provincial field surveillance activities regarding AI, IB, ND & avain Salmonellosis and coordinate with NRLPD for sharing data and field samples for strengthening National LIMS.
- Harmonization of diagnostic procedures at provincial labs in coordination with the federal NRLPD-Lab.
- Conduct research experiments/trials focusing epidemiology, pathogen typing and pathogennesis of the selected avain pathogens.

Achievements:

Seven regional surveillance units were established in Rawalpindi, Gujranwala, Lahore, Sahiwal, Multan, Faisalabad and Sargodha for mapping of disease burden. Disease reporting system set up through regional surveillance officers for early disease diagnosis and planning to control the disease

Samples were collected and evaluated for poultry diseases:

- Total samples collected: 8701 (Serum : 4904, Swab: 2832 and Tissue: 965)
- Total pathogen isolations: 20 (NDV: 04, AIV H9: 16)
- Samples sent to NRLPD: 646 (Serum: 130, Swab: 229 and Tissue: 287)

Studied different isolated pathogen (NDV and AIV H9N2) which will help in planning the vaccination schedule and other management practices.

The significant findings of the study conducted are:

- Isolation of new AIV-H9N2 sybtype form all type of poultry and widely spread in the country.
- Establishment of new highly virulent genotype of NDV in field in all type of commercial poultry.
- Sero-conversion against AIV-H9N2 and NDV in the field in all type of poultry is an indication of endemic situation of AIV-H9N2 and NDV in the country.
- No sero-conversion against HPAIV H5 or H7 detected during the reporting period.

Name of Project: **Surveillance Pathogenesis and Management Strategies Against Major Emerging Avian Diseases (PRI, Korangi, Karachi - Comp. III)**

Name of PI/Institute: **Dr Rashid Farooq**
SRO, Poultry Research Institute, Singer Chorangi, Korangi, Karachi

Duration: 01.10.2012 to 30.09.2015

Financial Status: Total Cost: Rs.2.730 million
Funds Released: Rs.1.320 million
Funds Utilized: Rs.0.439 million

Objectives:

The overall objective is to contibute towards improving poultry health management practives through surveillance, training and reseach for increasing its productivity and brining food security and safety to the public.

- Undertake provincial field surveillance activities regarding AI, IB, ND & Avian Salmonellosis and coordinate with NRLPD for sharing data and field samples for strengthening National LIMS
- Harmonization of diagnostic procedure at provincial labs in coordination with the federal NRLPD lab
- Conduct research experiments/ trials focusing epidemiology , pathogen typing and pathogenesis of selected avian pathogens

Achievements:

Five Surveillance units were established in Karachi, Mirpurkhas, Thatta, Dadu and Sukkur for reporting outbreak in the area. Total 11610 samples were collected from different areas of Sindh, out of which 3050 were sent to NRLPD, Islamabad while remaining were analysed at provincial laboratory.

Three field officers were trained for sample collection. Two officers and two lab attendants trained for HI test and sample processing. A lab officer was trained at NRLPD for ELISA and HI. Three training were imparted to the field staff and poultry workers on sample collection, prevention and shipment. The training enhances the sample collection activity and quality. Corner meetings were conducted in different pockets of poultry rising areas, helping transfer of knowledge regarding to vaccination, bio-security and status of circulating pathogens. High conversation was observed for H9 and ND. Monitoring and evaluation was helpful for better understanding of pathogens load in the area.

ND, H9 viruses were isolated from different areas of Sindh, including Peacocks at Tharparker. H14 is isolated at NRLPD from samples collected from the live bird market, Karachi.

Name of Project: **Surveillance Pathogenesis and Management Strategies Against Major Emerging Avian Diseases (Diseases Investigation Lab., Peshawar - Comp. IV)**

Name of PI/Institute: **Dr Malik Ayaz Wazir**
Disease Investigation Officer, Diseases Investigation Lab. Peshawar

Duration: 01.10.2012 to 30.09.2015

Financial Status: Total Cost: Rs.2.880 million
Funds Released: Rs.0.930 million
Funds Utilized: Rs.0.929 million

Objectives:

The overall objective is to contibute towards improving poultry health management practives through surveillance, training and reseach for increasing its productivity and brining food security and safety to the public.

- Undertake provincial field surveillance activities regarding AI, IB, ND & Avian Salmonellosis and coordinate with NRLPD for sharing data and field samples for strengthening National LIMS
- Harmonization of diagnostic procedure at provincial labs in coordination with the federal NRLPD lab
- Conduct research experiments/ trials focusing epidemiology , pathogen typing and pathogenesis of selected avian pathogens

Achievements:

One provincial surveillance unit at Directorate General (Extension), L&DD Department, Khyber Pakhtukhwa and six regional surveillance units in Peshawar, Abbottabad, Bannu, Lower Dir, Swat and Lakki Marwat were established for selected poultry diseases.

A total number of 7991 samples for evaluation of poultry disease were collected during the report period from different areas of the province and either tested a Provincial Laboratory, Peshawar or sent to National Reference Laboratory for Poultry Diseases for further confirmation and virus isolation. Provincial Diagnostic Laboratory, Peshawar has been strengthened and involved in serological tests. 2616 number serum samples were tested at the provincial laboratory.

The diagnostic procedures for various poultry diseases of infectious and zoonotic nature at Provincial Diagnostic Laboratory, Peshawar have been standardized. Currently Provincial laboratory is carrying out serological test ELISA and HA/HI for Avian Influenza, ND and IB as per recommended protocols of NRLPD, Islamabad. The diagnostic reagents like Antigens for HI, Antigens for plate agglutination test procured from NRLPD, Islamabad. Plate test for

diagnosis of Salmonella has also been established at Provincial Lab on trial basis. Slight variations from the NRLPD results observed and will be harmonized. Provincial Diagnostic Laboratory Peshawar has been involved in screening of samples using serological tests and suspected samples were sent to NRLPD for final diagnosis of specific pathogens.

One day training for field veterinarian on "Surveillance of Avian Diseases and Samples collection, processing & shipment" was held in Peshawar in which 20 field veterinarians participated.

Name of Project:	**Surveillance Pathogenesis and Management Strategies Against Major Emerging Avian Diseases (Diseases Investigation Lab., Quetta,- Comp. V)**
Name of PI/Institute:	**Dr Abdul Bari** Disease Investigation Officer, Diseases Investigation Lab, Quetta
Duration:	01.10.2012 to 30.09.2015
Financial Status:	Total Cost: Rs.2.460 million Funds Released: Rs.0.625 million Funds Utilized: Rs.0.375 million (up to 31/12/2013)

Objectives:

The overall objective is to contibute towards improving poultry health management practives through surveillance, training and reseach for increasing its productivity and brining food security and safety to the public.

- Undertake provincial field surveillance activities regarding AI, IB, ND & Avian Salmonellosis and coordinate with NRLPD for sharing data and field samples for strengthening National LIMS
- Harmonization of diagnostic procedure at provincial labs in coordination with the federal NRLPD lab
- Conduct research experiments/ trials focusing epidemiology , pathogen typing and pathogenesis of selected avian pathogens

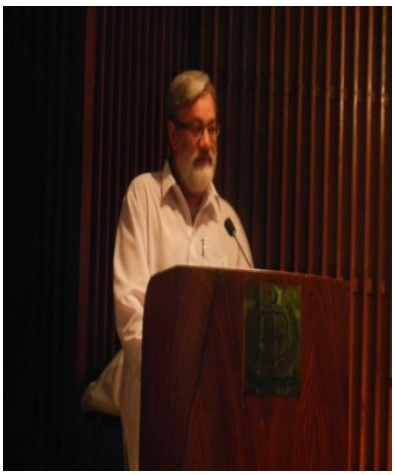
Achievements:

In Balochistan, three teams (Veterinarian & Para Veterinary Staff) in Quetta, hub and Loralai, trained in surveillance work were deputed to collect samples from commercial and Rural Poultry Birds on regular basis and submitted to the National Reference Lab. for Poultry Diseases (NRLPD Islamabad) for confirmation/diagnosis of Avian Influenza and other poultry diseases.

During the period January-June, 2014, 1716 samples (Serum: 572, Swab: 572, Tissue: 572) were collected and sent to Islamabad.

Three field officers were trained for sample collection, by NRLPD and two lab attendants for sample processing. A lab officer was also trained at NRLPD for ELISA and HI. Two training were imparted to the field staff and poultry workers on sample collection, prevention and shipment. The training enhances the sample collection activity and quality. No significant sero-conversation was observed for H9 and ND.



Name of Project: **Surveillance Pathogenesis and Management Strategies Against Major Emerging Avian Diseases (Diseases Investigation Lab., Gilgit - Comp. VI)**

Name of PI/Institute: **Dr Sher Zaman**
Poultry Dev. Officer, Diseases Investigation Lab, Gilgit

Duration: 01.10.2012 to 30.09.2015

Financial Status: Total Cost: Rs.1.740 million
Funds Released: Rs.0.722 million
Funds Utilized: Rs.0.453 million

Objectives:

The overall objective is to contibute towards improving poultry health management practives through surveillance, training and reseach for increasing its productivity and brining food security and safety to the public.

- Undertake provincial field surveillance activities regarding AI, IB, ND & Avian Salmonellosis and coordinate with NRLPD for sharing data and field samples for strengthening National LIMS
- Harmonization of diagnostic procedure at provincial labs in coordination with the federal NRLPD lab
- Conduct research experiments/ trials focusing epidemiology , pathogen typing and pathogenesis of selected avian pathogens

Achievement:

A total number of 333 samples were collected from different district of Gilgit - Baltistan (GB) for monitoring and evaluation of circulation Avian Pathogens to be helpful in disease control strategies and sent to NRLPD, NARC for isolation of pathogens. The samples collected form field did not show any sero-conversion.

In order to give awareness to rural womenfolk about major emerging avian diseases and their control, during reporting period visited 07 districts of GB and conducted meeting with each district heads. As a result, selected 07 lab and field staff for implementation of project activities in GB. Also conducted survey of 07 commercial poultry farms in three districts and collected basic information of commercial birds as source of supply of commercial chicks, purpose of poultry farming, most common poultry related problems, marketing of poultry, disease outbreak record, source of medication/ vaccination and trained/ untrained manpower engaged in commercial poultry fanning etc.

Two awareness programmes have been conducted in two district of GB, (Gilgit/ Hunza/ Nagar), attended by 65 women directly involved in rural/domestic poultry management.

Name of Project: **Production Performance and Reproductive Efficiency Enhancement of Indigenous Goats and Sheep in Turbat Area under Optimum Feeding, Breeding and Health Management**

Name of PI/Institute: **Mr Nazeer Ahmad**
SO, Livestock Research Institute, PARC, Turbat

Duration: 05.06.2012 to 30.06.2015

Financial Status:
Total Cost: Rs.7.350 million
Funds Released: Rs.4.014 million
Funds Utilized: Rs.2.468 million

Objectives:

- Improvement of production performance and reproductive efficiency of native goats and sheep under optimum feeding, breeding and health management.

- Training of farmers in feeding and health management practices and distribution of prototype, genetically superior selected breeding-bucks/rams among farmers.

Achievements:

Farmers were randomly selected/ registered and inputs regarding the optimum feeding breeding and health management of native goats and sheep were ensured after different statistical models. During the reporting period, comparative performance of sheep and goats farmers flocks were assessed with different feeding practices during the particular production cycles. The results showed that the sheep and goats fed with supplemental feed produced higher milk than grazing. Similarly the wool and hairs production of sheep and goats respectively fed with supplemental feed was higher. A total 6000 small ruminants were vaccinated against infectious diseases, 1600 dipped for external parasites and 3000 drenched against internal parasites respectively.

Seminar and workshop (8) were organized in LRI Turbat for farmers' awareness on animal health and lamb/kid management.

Name of Project: **Improving Reproductive Efficiency of Sahiwal Cows and Nili-Ravi Buffaloes through Oestrus Synchronization and Timed Artificial Insemination at NARC (Component-I-Coordinated Unit, NARC)**

Name of PI/Institute: **Dr M. Anwar**
Principal Scientific Officer/PL (ARP), Animal Sciences Institute NARC, Islamabad

Duration: 01.10.2012 to 30.09.2015

Financial Status:
Total Cost: Rs.8.100 million
Funds Released: Rs.3.747 million
Funds Utilized: Rs.2.893 million

Objectives:

- Compare hormonal protocols (including progestagens, PGF2α) and management factors (biostimulation, wallowing and housing) for induction of fertile estrus in Nili-Ravi buffalo during peak and low breeding seasons.

- Compare hormonal protocols (including progestagens, GnRH and PGF2α) and management factors (biostimulation) for induction of fertile estrus in Sahiwal cows.

Achievements:

Information related to the effect of biostimulation in combination with oestrus synchronization protocols in buffalos was generated during year-1 of the project. During this year efficiency of oestrus synchronization protocols with or without biostimulation in buffaloes was compared in the field by involving farmers in District Mirpur of AJK. Work was also initiated in non descript cows, starting with a trial under control condition at NARC. Then the technique of oestrus synchronization was taken to and tested at farmer level in district Rawalpindi, Mianwali and Muzaffargarh.

The study conducted in low breeding season of buffalo evaluated pregnancy rate and oestrus response of buffaloes to two oestrus synchronization protocols, (GnRH + CIDR and CIDR alone). Animals were further classified into bull exposed and bull not exposed groups. Conception rate in synchronized animals was significantly higher in bull exposed buffaloes.

The study conducted with cows at NARC in low breeding season evaluated pregnancy rate and oestrus response of animals to oestrus synchronization with CIDR. Animals were further split into bull exposed and bull not exposed groups. Bull exposure had a non significant effect on conception rate in cows treated with CIDR for oestrus synchronization.

The study conclude thus, bull exposure along with GnRH may be used to attain an improved conception rate in buffaloes synchronized for heat with CIDR during low breeding season,

however a good management, good body condition of animals and balanced feeding seems a prerequisite for the best fertility. More than 35% conception rate may be achieved in cows after oestrus synchronization and timed insemination with frozen thawed semen during winter (reported as a low breeding season for cows in Pakistan). A good conception rate (>70%) may be achieved in cows after oestrus synchronization and timed insemination with frozen thawed semen during summer.

Name of Project: **Improving Reproductive Efficiency of Thari Cows and Kundi Buffaloes through Oestrus Synchronization and Timed Artificial Insemination in Sindh (Component II - Sindh Agri. University, Tandojam)**

Name of PI/Institute: **Prof. Dr Aqeel Ahmed Memon**
Assistant Professor, Department of Animal Reproduction, Sindh Agriculture University, Tandojam

Duration: 01.10.2012 to 30.09.2015

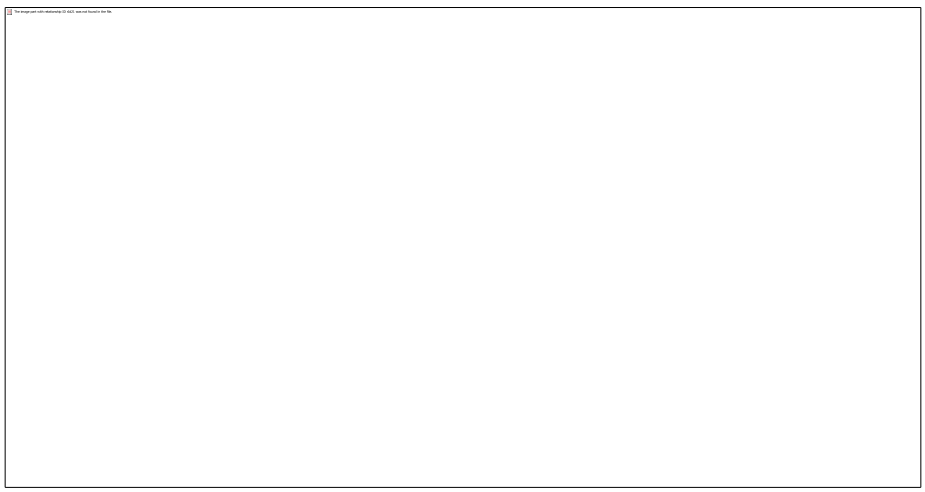
Financial Status: Total Cost: Rs.6.040 million
Funds Released: Rs.1.850 million
Funds Utilized: Rs.0.804 million

Objectives:

- Compare hormonal (CIDR, Ovsynch and PGF2α) and managemental factors (biostimulation, wallowing and housing) for induction of fertile estrus in buffalo (Kundi) during winter and summer seasons.
- Compare hormonal (CIDR, Ovsynch and PGF2α) and managemental factors (biostimulation) for induction of fertile estrus in cows (Thari/ Red Sindhi) cows in Sindh.

Achievements:

An experiment on "*Estrus synchronization in Kundhi buffaloes during peak breeding season"* was conducted at and around Kundhi Buffalo Farm Rohri. Kundhi Buffaloes were either treated with Ovsynch or GnRH + CIDR protocols or kept as control. Estrus response and conception rate did not differ among the treatment groups (P>0.05), however they were lower in control group. (Fig. 1)



Kundhi Buffalo Farm at Sukkur (Sindh)

Fig. 1.Estrus response and conception rate in Kundhi Buffaloes following oestrus synchronization with Ovsynch or GnRH + CIDR during peak breeding season

Study in another experiment "*Estrus synchronization in Thari cows during peak breeding season"* was performed at Thari Cattle Farm, Nabisar Road, Umerkot and its surrounding (Sindh). Similarly as observed in Kundhi buffaloes, Thari cows were either treated with Ovsynch or GnRH + CIDR protocols or kept as control. Estrus response and conception rate did not differ between treatment groups (P>0.05), however they were lower in control group (Fig. 2). Two students are also involved in the project and doing research for M. Phil study.

Thari Cattle Farm Nabisir Road Umerkot (Sindh)

Fig. 2. Estrus response and conception rate in Thari cows following estrus synchronization with Ovsynch or GnRH + CIDR during peak breeding season

Name of Project:	**Improving Reproductive Efficiency of Cows (Bhangnari & Crossbred) through Oestrus Synchronization and Timed Artificial Insemination in Balochistan (Component III-Balochistan)**
Name of PI/Institute:	**Prof. Dr Muhammad Azam Kakar** Dean, Faculty of Veterinary & Animal Sciences Lasbella University of Agriculture, Water & Marine Sciences, Uthal Balochistan
Duration:	15.03.2013 to 14.03.2016
Financial Status:	Total Cost: Rs.n 6.680 million Funds Released: Rs.0.560 million Funds Utilized: Rs.-

Objectives:

- Compare hormonal (CIDR, Ovsynch and PGF2A) and managemental factors for induction of fertile estrus in cows (Bhangnari & Crossbred).

Achievements:

The project was awarded to the PI working in Balochistan University of Information Technology, Engineering and Management Sciences, Quetta. On posting of the PI at Lasbela, the project was shifted to Lasbela University of Agriculture, Water and Marine Sciences and releases were made. The PI has again left the University and repatriated in his parent department i.e. livestock department. The university has agreed to shift the project there as PI is expert in the relevant field and no other expert to act PI at Lasbela University is available. The university has informed that they will remit the funds. After the fund is remitted by Lasbela University, project will be shifted to the livestock department.

Name of Project: **Improving Reproductive Efficiency of Non-descript Cows through Oestrus Synchronization and Timed Artificial Insemination in Gilgit - Baltistan (Component IV - MARC, Juglote, Gilgit) AS125**

Name of PI/Institute: **Mr. Faridullah Khan**
Senior Scientific Officer, Mountain Agri. Research Centre (MARC) Juglote, Gilgit

Duration: 01.10.2012 to 30.09.2015

Financial Status: Total Cost: Rs.5.670 million
Funds Released: Rs.4.244 million
Funds Utilized: Rs.3.297 million

Objectives:

Overall Objectives/ Goals:

Improved reproductive efficiency of Non-descript cows through oestrus control and AI in Gilgit - Baltistan

Specific Objectives:

- Compare hormonal (CIDR, Ovsynch and PGF2α) and managemental factors for induction of fertile estrus in Non-descript cows.

Achievements:

The activities of direct bull crossing, insemination and treatment with heat injection were conducted during April, May and June 2014 but minimum cows showed heat sign. Total one hundred and eleven (111) cows were directly crossed with mature Jersey and Frisian bulls. Out of 111 cows, 07 were repeated. Conception rate will be checked after three month of date of crossing. The conception rate of cows directly cross with breeding bull is expected more then 95%.

Total of 122 cows were treated with different protocol i.e. Leutalyse, Cyclomate and Prostenal for heat induction and inseminated were = 37 (29%). These cows were inseminated during the month of April, May and June 2014, their conception rate will be checked later on.

Name of Project: **Improving Reproductive Efficiency of Sahiwal and Cholistani Cows through Estrus Synchronization and Timed Artificial Insemination (UV&AS Component V)**

Name of PI/Institute: **Prof Dr Nasim Ahmad**
Faculty of Vet. & Animal Sciences, Dept. of Theriogenology
University of Veterinary & Animal Sciences, Lahore

Duration: 01.04.2013 to 31.03.2016

Financial Status: Total Cost: Rs.9.849 million
Funds Released: Rs.6.493 million-
Funds Utilized: Rs.4.846 million

Objectives:

- To compare methods of estrus synchronization (CIDR, Ovsynch and PGF2α) on estrus response and fertility in Cholistani cows.

- To determine pattern of ovarian blood flow during different phases of estrous cycle using Doppler ultrasound and during post breeding period in order to differentiate pregnant and non pregnant Sahiwal cattle.

- Determination of plasma progesterone level in blood and CL size during different phases of estrous cycle and during post breeding period and relate it with ovarian blood flow in Sahiwal cattle.

Achievements:

To determine the effect of various synchronization protocols on estrus behavior, ovulation, and fertility of Cholistani and Sahiwal cattle, three experiments were conducted during the period under report. The objective of first experiment was to determine if the reproductive efficiency of chronically repeat breeder Sahiwal cows (on an average each cows had taken about eight services but remained open) can be improved using estrus synchronization protocols (CIDR, Ovsynch, PG). Results indicated that only one of the fourteen cows became pregnant. Thus suggesting that treatment with antibiotic and followed by sexual rest should be first given followed by estrus synchronization. In second experiment, objective was to determine the effect of three synchronization protocols (PG, Ovsynch, CIDR) on estrus response, ovulation and pregnancy rate sin Sahiwal cattle. Result indicated that pregnancy rate was higher in Ovsynch treated cows 37% (17/46) as compared CIDR 22% (11/44) and PG 23% (8/34). Overall pregnancy rate was 27%. In third experiment objective was determine the effect of two synchronization protocols (Ovsynch and CIDR) on estrus response, ovulation and pregnancy rates in Cholistani cow. In third experiment, it is concluded that Cholistani cows overall respond well in terms of estrus signs and CIDR protocol is more effective than the OVS in terms of pregnancy rate.

Hormones for synchronization were procured for the project and are being used in different experiments related to the project. Research and office equipment like Colour Doppler Ultrasound Machine, ELISA reader, computer, camera and fridge were purchased. The PI participated in the "International Cow Fertility Conference" in Westport, Ireland and presented two posters on synchronization in dairy buffaloes. The activities included organizing a 'one day farmer's awareness seminar on reproductive management of dairy animals' in a village (Kallodi) Gojra. Viable contacts were established with RCCSC, Jhang, four Government Livestock Farms (Jugaitpeer, Kallur Koot, Khacha Khoo, Fazilpur) and two commercial Sahiwal cattle farms (Jhang and Bohwana). An M. Phil thesis (Mubbashar Hassan) was successfully completed that was based on project activities.

Name of Project: **Improving Reproductive Efficiency of Achai Cows through Oestrus Synchronization and Timed Artificial Insemination (Khyber Pakhtunkhwa Component VI)**

Name of PI/Institute: **Dr Hassan Khan**
Deputy Director (Farm), Achai Cattle Conservation & Deve. Programmes, Livestock & Dairy Development Department, Khyber Pakhtunkhwa, Peshawar

Duration: 01.06.2013 to 30.05.2016

Financial Status:
Total Cost: Rs.4.505 million
Funds Released: Rs.0.088 million
Funds Utilized: Rs.0.088 million

Objectives:

Compare hormonal (CIDR, Ovsynch and PGF2α) and managemental factors for induction of fertile estrus in Achai cows.

Achievements:

The funds were released to the project in June, 2013, but activities could not initiated due to opening of project bank account in time. Initially consumable item and stationary were published to start work. Field visits to selected area in Palai, Swegalai and Badwan were made and selected 102 animals to be used for first trial for development of effective estrus synchronization protocol for Achai cows.

Name of Project: **Intensification of Fish Culture to Increase Per Unit Area Fish Production in Farm Ponds Using Different Managemental Inputs (NARC Coordinating Unit Comp. I)**

Name of PI/Institute: **Dr Muhammad Afzal Bhatti**
PSO, Aquaculture and Fisheries, Animal Sciences Institute NARC, Islamabad

Duration: 01.10.2012 to 30.09.2015

Financial Status: Total Cost: Rs.12.375 million
Funds Released: Rs.7.159 million
Funds Utilized: Rs.7.099 million

Objectives:

- Evaluation of balanced fish feed at varying protein levels for growth of fry and fingerlings of carps under polyculture system.
- Development of cost effective supplementary feed for grows out fish under varying stocking densities.
- Dissemination of intensive fish culture technology to the fish farmer in the country.

Achievements:

Following experiments were conducted during the period under report

Effects of balance fish feed on the growth of carps with varying levels of Crude Protein formulated from locally available feed ingredients: Trial were conducted to evaluate the balanced diet on the growth of carps with varying levels of crude protein formulated from locally available feed ingredients in glass aquaria. Three artificial diets were formulated based on different crude protein (CP) level i.e 20%, 25% and 30% CP. After 09 months final data was collected at the time of harvesting. The data indicated that the production level was better at high stocking density @ 2100 fish/acre i.e. 2054 kg/acre with artificial feeding followed by stocking density of 1800 fish/acre where production was found to be 1834 kg/acre with 66% increase in the production where as production of 1511 kgs was obtained pond with stocking density of 1500 fingerling/acre. All the parameter of water quality was found to be normal in range.

Study the growth performance of carps fed on supplementary fish feeds containing varying levels of proteins i.e. 15, 20 and 25 % CP: The growth performance of all species fed with 25% CP was found to be higher. Feed containing 25% CP artificial diet level was found to be satisfactory feeding level. The fish stocked were silver carp (40%), grass carp (20%) rohu (30%) and mori (10%). The data indicated that the best production shown in treatment 3 i.e. 25 % CP (89.35 kgs) followed by treatment 2 i.e. 20% 84.86 kgs and treatment 1 i.e.15% 67.39 kgs.

Comparison of efficiency of balanced fish feed formulated from locally available feed ingredients having 25%, 30 % and 35 % crude protein for the growth of fry: In this experiment fish feed containing 25%, 30 % and 35 % CP of artificial diet were used in earthen ponds for a period of 6 months. The stocking density was 20,000 fry/ acre for a period of two months. After two months, the stocking were reduced to 10,000 fish /acre for four months. The feed were offered @ 5% body weight fish fry stocked. After 03 months data showed better growth in treatment 3 i.e. 35% CP. Trials are under way.

Name of Project: **Intensification of Fish Culture to Increase Per Unit Area Fish Production in Farm Ponds Using Different Managemental Inputs (Fisheries Complex Govt of Balochistan - Comp. II)**

Name of PI/Institute: **Mr Khalil ur Rehman**
Deputy Director, Inland Fisheries, Govt of Balochistan, Fisheries Complex Ward No 8, Dera Murad Jamali

Duration: 01.10.2012 to 30.09.2015

Financial Status: Total Cost: Rs.4.839 million
Funds Released: Rs.1.764 million
Funds Utilized: Rs.1.760 million

Objectives:

- Evaluation of balanced fish feed at varying protein levels for growth of fry and fingerlings of carps under polyculture system.
- Development of cost effective supplementary feed for grows out fish under varying stocking densities.
- Dissemination of intensive fish culture technology to the fish farmer in the country.

Achievements:

Trials to evaluate the production performance of carps at various stocking density were conducted at farmer's field in different villages at Dera Murad Jamali. The experimental design consists of three treatments of stocking densities 1200, 1600, and 2000 fish/ acre in private sector at Dera Murad Jamali. The fish which were stocked in private sector fish ponds were silver carp (30%), grass carp (15%), rohu (25%), mori and gulfam (10%). The data indicated that the best production was shown in supplementary feed i.e. 25% CP.

The species combination stocked in fish ponds of fish Rohu 60%, Catla Catla 30% and Mori 10% were stocked in private sector in different villages at Naseerabad District for progressive fish farmers. The trials were conducted to study of growth performance of carps fed on supplementary fish feed containing varying levels of Crude protein i.e. 20, 25 and 30% CP. The size of fish at the time of stocking were 3-4 inches.

Name of Project: **Intensification of Fish Culture to Increase Per Unit Area Fish Production in Farm Ponds Using Different Managemental Inputs (Uni. of Peshawar, Khyber Pakhtunkhwa - Comp. III)**

Name of PI/Institute: **Mr Zaigham Hassan**
Assistant Professor, Department of Zoology, University of Peshawar, Khyber Pakhtunkhwa

Duration: 01.11.2012 to 31.10.2015

Financial Status: Total Cost: Rs.4.338 million
Funds Released: Rs.1.828 million
Funds Utilized: Rs.1.728 million

Objectives:

- Evaluation of balanced fish feed at varying protein levels for growth of fry and fingerlings of carps under polyculture system.
- Development of cost effective supplementary feed for grows out fish under varying stocking densities.
- Dissemination of intensive fish culture technology to the fish farmer in the country.

Achievements:

Survey was conducted in different districts of Khyber Pakhtunkhwa including Peshawar, Mardan, Nowshera, Tangi and Charsadda. A total of 28 fish ponds and two fish hatcheries were visited to collect information about the existing fish farming practices in the province. According to existing practices in Khyber Pakhtunkhwa fish farmers generally stock 2000-3000 fingerlings/acre regarding their size 1-2 inches. If the size is about 3 inches then generally 1800/ acre is stocked. The yield in KP varies between 1000-1200 Kg/ acre as per the management efficiency of the farmer, occasionally reaching 1500 Kg/acre. Mortality rate is very high in Khyber Pakhtunkhwa.

After collection of the initial data three fish farms were selected for the project at farmer's field at Charsadda, Tangi and Mardan. Trials were conducted to evaluate the balanced diet on the growth of carps with varying levels of crude protein formulated from locally available feed ingredients in aquaria. For this purpose three artificial diets (NARC formulation) were formulated based on different crude protein (CP) level i.e. 20 %, 25% and 30 % CP. The growth performance of all species of treatments having 30% CP and 25% CP were similar and found to be non-significant with each other. Hence feed containing 25% CP was found to be satisfactory for fish growth instead of 30% CP.

To evaluate the production performance of carps at various stocking density, trials were

conducted at selected farmers' field at village Zyam (Tangi), Miankhel (Mardan) and Shabara (Charsadda). The experimental design consists of three treatments of stocking densities 2000, 2500, and 3000 fish/acre. The species combination stocked in fish ponds of fish were Silver Carp 33%, Rohu 17%, Grass Carp 33% and Mori 17%. In 90 days trial data indicates that the production level is better at high stocking density with artificial feeding and production of 1975 kg fish/acre is expected at stocking density of 3000 fish/acre followed by stocking density of 2500 fish/acre where production is expected to be 1533 kg/acre whereas low stocking with a density of 2000 fish/acre gave only 1156 kg/acre. As average production of KP is about 1200 kg/acre, hence experiment proves that by providing formulated balanced supplementary feed, an increase of 64.5% in the production is possible.

Name of Project:	**Intensification of Fish Culture to Increase Per Unit Area Fish Production in Farm Ponds Using Different Managemental Inputs (Uni. of Sindh, Jamshoro - Comp. IV)**
Name of PI/Institute:	**Dr Naeem Tariq Narejo** Professor (Fisheries), Department of Fresh Water Biology & Fisheries, University of Sindh, Jamshoro
Duration:	01.10.2012 to 30.09.2015
Financial Status:	Total Cost: Rs.4.338 million Funds Released: Rs.1.475 million Funds Utilized: Rs.1.189 million

Objectives:

- Evaluation of balanced fish feed at varying protein levels for growth of fry and fingerlings of carps under polyculture system.
- Development of cost effective supplementary feed for grows out fish under varying stocking densities.
- Dissemination of intensive fish culture technology to the fish farmer in the country.

Achievements:

To identify fish farmers for participation in intensification of fish culture to increase per unit area fish production in farm ponds using different management inputs, survey of various districts i.e. Khairpur, Naushero Feroz, Dadu, Badin and Thatta was conducted. Three farmers, one each from Khairpur, Thatta and Badin agreed to participate in the project. Experiments were conducted to see the growth response of three indigenous carps species *(L. rohita, C. catla and C. mrrigala*) fed with experimental diet containing 30% crude protein (iso-caloric) in terms of initial and final mean weight gain, percentage weight gain, specific growth rate (SGR), food conversion rate (FCR), survival rate and production of the experimental fishes. The water quality parameters and their monthly fluctuations recorded throughout the study period. Experiments to see the effect of stocking density (1200, 1600 and 2000 fish/pond) on growth and survival rate of experimental fish was also conducted.

It was observed from the results of the investigations that the highest growth rate and survival of the experimental fish was observed from the ponds of University of Sindh, Jamshoro followed by the ponds of district Badin and lowest growth and survival was recorded from ponds of Chilya Thatta. The results of the study indicated that a stocking density (1200 fish/ pond) might be suitable for the culture of (*L. rohita, C. catla and C. mrrigala*) under polyculture system with high density.

Name of Project: **Intensification of Fish Culture to Increase Per Unit Area Fish Production in Farm Ponds Using Different Managemental Inputs (Bahauddin Zakarya Uni. Multan, Punjab, - Comp. V)**

Name of PI/Institute: **Dr Muhammad Naeem**
Assistant Professor (Fisheries), Institute of Pure & Applied Biology, Bahauddin Zakarya Uni., Multan

Duration: 01.10.2012 to 30.09.2015

Financial Status: Total Cost: Rs.4.360 million
Funds Released: Rs.2.143 million
Funds Utilized: Rs.1.541 million

Objectives:

- Evaluation of balanced fish feed at varying protein levels for growth of fry and fingerlings of carps under polyculture system.
- Development of cost effective supplementary feed for grows out fish under varying stocking densities.
- Dissemination of intensive fish culture technology to the fish farmer in the country.

Achievements:

Five experimental diets were prepared containing 15%, 20%, 30%, and 35% crude protein (CP) by using locally available ingredients like Fish Meal, Soybean Meal, Sunflower Meal, Canola Meal, Rice Polish, Wheat Bran, Di-calcium phosphate, Corn gluten 30%, Corn gluten 60%, Sarson Meal, Soybean oil and Vitamin premix.

To evaluate the growth performance of carps by feeding different crude protein (CP) level i.e. 15%, 20% and 25% CP, activity was conducted at Bahauddin Zakariya University Fish Ponds (Site I); Govt. Fish Seed Nursery Unit Peerowal (Site II), and Govt. Fish Hatchery, Mianchannu (Site III) in earthen ponds. Stocking species were Rohu (*Labeo rohita*), Thaila (*Catla catla*) and Mori (*Cirrhinus mirigala*) @ 60%, 30%, and 10% respectively wit stocking density of 2000 fish/acre. The feed was supplied @ 40% of body weight. Results of the experiment showed that, all the studied carps *(L. rohita, C. catla and C. mirigala*) in the experiment indicted better growth with 25% of CP, and Thaila (*C. catla*) indicated the best growth in this experiment, followed by Rohu (*L. Rohita*) at all three experimental sites.

To evaluate the growth performance of carps by feeding different crude protein (CP) level i.e. 25%, 60%, and 35% CP, activity was conducted at Govt. Nursery Unit, Shujaabad Road, Multan (Site I); Govt. Fish Seed Nursery Unit, Peerowal (Site II); and Mushtaq Fish Farm, Muradabad, Muzafargarh (Site III) in earthen ponds. In this experiment, the stocking density was 20,000 fry/ acre for a period of two months. After two months stocking was reduced to 10,000 fish/ acre for remaining four months. Stocking species were Rohu (*Labeo rohita*) and

Mori (*Cirrhinus mirigala*) @ 90% and 10% respectively. The feed was supplied @ 5% of body weight. Results of this activity showed that both of the studied species in the experiment indicated best growth with 25% of CP. Mori, (*C. mirigala*) indicated the best growth at site I and III, followed by Rohu (*L. rohita*). However, at experimental site-II, *L. rohita* indicated a little more growth than that of C. *mirigala*.

The studies conducted led to the conclusion that, the carps (*Labeo rohita, Catla catla* and *Cirrhnus mirigala*) fed with experimental diet containing 15, 20 and 25% crude protein (CP) indicated best growth with 25% of CP. Thaila (*C. catla*) indicated the best growth in this experiment, followed by Rohu (*L. rohita*) at all three experimental sites. In activity II, both of the studied species (*Labeo rohita* and *Cirrhinus mirigala*) feed with experimental diet containing 25, 30 and 35% crude protein (CP) indicated best growth with 25% of CP. Mori (C. mirigala) indicated the best growth at site I and III, followed by Rohu (*L. rohita*). However, at experimental site-II, *L. rohita* indicated a little more growth than that of *C. mirigala.*

Name of Project: **Development of Mechanized Multipurpose Nursery Raising Facility at NARC, Islamabad**

Name of PI/Institute: **Mr Shabbir Ahmad Kalwar**
PSO, Agricultural and Biological Engineering Institute (ABEI), NARC

Duration: 01.03.2012 to 28.02.2015

Financial Status: Total Cost: Rs.38.982 million
Funds Released: Rs.5.127 million
Funds Utilized: Rs.5.127 million

Objectives:

- To develop a mechanized multipurpose nursery raising technology
- To establish infrastructure for timely and cost-efficient nursery raising methods and to raise and maintain all type of nursery plants under shade/green house for large scale
- To demonstrate and disseminate the technology among the local manufactures, commercial nursery growers, Government bodies, farmers and NGOs.

Achievements:

Technical design calculations and installation drawings of shed house was completed as first step of the project. Relevant litreature collected and prepared standard procedures for nursery growing plants, ingredients of compost, physical requirements and their ratios according to plant species and pot size. Prepared guidelines for compost at commercial scale. Also prepared detailed specifications of shading nets and their ratios for different seasonal vegetables, fruits, forest, ornamental and medicinal plants.

Made a graphical representation of data on trends of light intensities round the year around Islamabad areas. The light intensity requirements for different plants, vegetables, fruits, forest and medicinal plants have been identified.

Prepared/compiled draft booklet in detail with the help of all stake holders and project team on nursery raising techniques and growing at commercial scale level of commercial valued trees, horticultural, floriculture, medicinal plants, indoor & out door plants and vegetables such as local, English, botanical name, plant to plant distance, sowing/planting time, flowering time, harvesting time, annual yield, type of soil and ratios of different compounds and irrigation requirement etc. After draft version of the booklet, further amendments are in progress.

Name of Project: **Modeling for Targeted Weed Management Through Exploitation of Competition Indices for Wheat in Khyber Pakhtunkhwa**

Name of PI/Institute: **Dr Muhammad Azim Khan**
Prof., Dept. of Weed Sciences, The University of Agriculture, Peshawar

Duration: 17.03.2012 to 30.06.2015

Financial Status: Total Cost: Rs.5.692 million
Funds Released: Rs.5.137 million
Funds Utilized: Rs.4.356 million

Objectives:

- To categorize and enlist major weeds based on their importance values in different agro climatic regions of Khyber Pakhtunkhwa
- To figure out yield losses due to weeds in wheat for different regions of Khyber Pakhtunkhwa
- To develop strategy for weed management through use of competition indices for different agro-ecological regions of the project area
- To find out competition indices of major weeds of wheat using ecological designs

Achievements:

A comprehensive field study *"prediction of grain yield losses and implication for economic weed management in Khyber Pakhtunkhwa"* was conducted during the reporting period on wheat crop. The focus in the field research study was to check the effect of different densities of major two weeds including *Rumex dentatues*, *Phalaris minor*, *Rumex crispus*, *Phalaris minor, Silybum marianum, Neslia apiculata* on total dry matter and grains yield of wheat at different agro-ecological regions (D. I. Khan, Lakki Marawat, Kohat, Peshawar, Mardan, Swat, Mansehra and Chitral) respectively. A total 32 experiments (four at each location) were conducted in the form of replacement and additive designs. The results substantiated the aggressiveness of all weeds that sharply reduced the grain and total dry matter yield of wheat at each location.

Two weeds were selected on the basis of their density, coverage and frequency for further studies. Two ecological designs like additive design and replacement series experiments were conducted for each weed species at each location. It was observed that few weed species were more aggressive as compared to other. Wheat also proved aggressive at several places. It was noted that grassy as well as broadleaf weeds were highly competitive with wheat crop. All three responses were observed. Hence it is clear that increasing *Avena fatva* and specific weeds density from 0.100 and decreasing wheat density from 100.0 significant yield losses were observed. It should be known that a larger value of RCC is an indicative of

aggressiveness of one species to other and vice versa. So it is clear, specie A (Wheat) is more aggressive with respect to specie B especially in treatments where 90 wheat seeds were applied with 10 Avena seeds m^{-2}, and so on. However, if in case the combined yield of two species in a mixture cannot be reliably predicted from pure stands, then RY is more appropriate to be used in such cases. While in some plots it is greater than 1, mean both the species avoid competition i.e. depend on different resources or maintain symbiotic relationship, it is also prominent that in one of the treatment the RY is 1 which indicate that the same resources were utilized by both the species. Similarly it is also prominent from the experimental data that the RCC of one specie with respect to other specie is affected and the highest RCC and aggressiveness of wheat was found in Lakki Marwat, Kohat and Peshawar where 90 wheat seeds and 10 mentioned weeds seeds m^{-2} were used, the lowest RCC was observed in other remaining locations where *Avena fatua* and other specific weeds density were maximum and wheat were minimum. The RCC relation indicates that in some treatments wheat is more aggressive and competitive against weeds at higher density. While at lower density of wheat (10 seeds) and weeds 90 seeds m^{-2} the higher RCC for weeds indicates an inverse relation.

Name of Project: **Promotion of Safflower (*Carthamus tinctorius*) through Participatory Approach in Pothwar**

Name of PI/Institute: **Dr Fayyaz-ul-Hassan**
Professor, Department of Agronomy, PMAS Arid Agriculture University, Rawalpindi

Duration: 01.07.2012 to 30.06.2015

Financial Status: Total Cost: Rs.3.077 million
Funds Released: Rs.1.911 million
Funds Utilized: Rs.1.840 million

Objectives:

- Collection, multiplication and characterization of exotic germplasm of safflower
- Adaptability evaluation of collected exotic germplasm of safflower
- Multiplication of already tested/ adopted genotypes of safflower
- Popularization of safflower through participatory approach in Pothwar
- To impart practical training to students relevant to safflower cultivation

Achievements:

The present studies were initiated to explore the potential and evaluation of spiny and spineless promising line/cultivars of local and exotic origin under rainfed conditions and distribution of seed of potential cultivars among the farming community of Pothwar. Germplasm collected from NARC was multiplied for sufficient seed production to be distributed among the farmers of Pothwar. Now after multiplication sufficient quantity is available to sow these spineless lines in coming season.

Collected germplasm was evaluated on the various characteristics for adaptability to Pothwar. Some of the lines performed well in the indigenous environment and these lines will be carrying forward for seed multiplication in sufficient quantity to grow on large scale and also will be tested on other locations (Talagang, Chakwal, Attock, Gujjar Khan, Dina) for their adaptability.

Already tested and adopted genotypes (SAF-30, SAF-31, SAF-32, SAF-28, SAF-129, SAF-130, Leed-00, Thori-78) were sown and harvested at University Research Farm, Chakwal road and farmers field at Gujar Khan, Attock, Taxila, Dina and Talagang and their sufficient quantity is now available for future use.

Already tested and adopted genotypes were distributed among the progressive farmers in consultation with the Agriculture Extension Department and seed were distributed for multiplication at different locations in Pothwar for seed multiplication and introduction of the crop to enhance the local oil production. Fellow farmers in the same locality were also given complete briefing on production of safflower.

Name of Project: **Development of an Effective Phytoremedial Technology for Metal Contaminated Calcareous Soils**

Name of PI/Institute: **Dr Shazia Iftikhar**
Associate Professor, Department of Environmental Science
Fatimah Jinnah Women University, Rawalpindi

Duration: 01. 03. 2012 to 28. 02. 2015

Financial Status:
Total Cost: Rs.5.477 million
Funds Released: Rs.4.011 million
Funds Utilized: Rs.3.996 million

Objectives:

- Assessment of heavy contamination load in soil and crop produced in peri-urban areas being irrigated with untreated wastewater.
- Test the various chelates and tolerant fungal strains for their metal extraction and solubilizing efficiency.
- Explore the natural and chemically enhanced phytoextraction potential of native plant species.
- Develop a model in order to predict the interactions between plant, contaminants and soil characteristics using data and other information

Achievements:

During reporting period the work conducted under objectives "Test the various chelates and tolerant fungal strains for their metal extraction and solubilizing efficiency" has evaluated the solubility of Cu, Pb, Cd and Cr in calcareous soil after the addition of chemical agent (EDTA, DTPA and NTA) and biological agent (fungi) sufficient to remove the metals and to make the heavy metals available for plants uptake for assisting the phytoremediation technology. Chelates were applied @ 0, 1.25, 2.5 and 5 mM kg^{-1} soil. Shaking was done for 6, 24, 48 and 120 hours at 125 rpm and incubation experiments were done by applying above doses of chelates and incubating for 0.25, 1, 2, 5, 7, 10, 20 and 30 days. After processing filtrates were analysed for the detection of heavy metals with the help of flam atomic absorption spectroscopy and with graphite furnace. Similarly for fungi incubation experiments were conducted to study the effect of the fungal isolates (*Aspergillus niger, Aspergillus flavus, Apergillus fumigates, Aspergillus terrus, Curvularia sp., Penecillium* and *Fusarium* species)

In shacking experiment with chelates, maximum Cu, Pb, Cd and Cr were solubilized by DTPA extractant. DTPA is, therefore, good for solubilization and in turn remediation of contaminated soils. It was concluded that with increasing chelating agent doses, metals availability was increased and 5.0 mM doses of EDTA, DTPA and NTA was noticed the best optimum dose for further experiments. For shaking time significant results were

achieved at 120 hours by applying EDTA and NTA where as DTPA behaved well at 24 hours.

In incubation experiments, more Cu and Cd was extracted by DTPA 6.65 and 6.67 ppm respectively. Whereas EDTA was proved good extractant for Pb which has solubilized maximum concentration of Pb (22,816 ppm). Maximum concentration of Cr (1.335 ppm) was solubilized by NTA as compared to EDTA and DTPA. For incubation experiment, day 20 and 30 were more suitable for solubilization of metals.

Incubation experiments conducted with fungal species resulted that *Penecillium* sp. was effective in remediation of Cd, Pb and Cu and the order of effectiveness was Pb>Cd>Cu.

For *Aspergillus niger*, maximum solubilization ability was noticed for Cr then Cd, Cu and Pb. It was also noticed that *Aspergillus niger* performed better than *Penecillium sp* for Cu, Cr and Cd, however, for Pb *Penecillium* sp. was more effective.

Aspergillus flavus was best candidate for removal of Pb from metal contaminated soil. It is obvious from the result that, as compared to *Aspergillus niger* specie *Aspergillus flavus* is less effective.

Affectivity of *Curvularia* sp, in removing metals followed the following order Pb>Cr>Cd>Cu. It was concluded that *Aspergillus terrus* was more efficient for remediation of Cr then Pb, Cd and Cu. The effectiveness of *Aspergillus fumigates* in removing metals followed the following order Cr>Pb>Cd>Cu. It was concluded that *Aspergillus* sp. was best candidate for removal of Pb from metal contaminated soil then for Cr, Cd and Cu.

In overall experiment conducted for metals removal by fungal species, it was seen that *Aspergillus niger* is most suitable candidate for remediation of metals polluted agricultural soil in case of Cu (16 mg/kg), Cd (33 mg/kg) and Cr (142 mg/kg). Whereas, *Curvularis* sp. showed best response for Pb (36 mg/kg) among all the isolates tested.

Name of Project: **Development and Evaluation of Indigenous Sunflower Hybrids in Different Ecological Zones**

Name of PI/Institute: **Dr Muhammad Ayub Khan**
PSO, Oilseed Programmes, NARC

Duration: 01.04.2012 to 31.03.2015

Financial Status: Total Cost: Rs.4.848 million
Funds Released: Rs.2.899 million
Funds Utilized: Rs.2.822 million

Objectives:

- Sustaining and strengthening breeding programme on sunflower
- Development and evaluation of locally developed sunflower hybrids in various ecologies of the country.
- Adaptive research/ on-farm testing of the indigenous sunflower hybrids for demonstration and transfer of improved production technologies to sunflower growers

Achievements:

A total of 177 inbred lines of sunflower were planted for generation advancement, maintenance and to stabilize the level of purity.

Season	**Inbreds**	**Planting Date**
Spring 2013	61	26.02.2013
Autumn 2013	24	01.08.2013
Spring 2014	92	06.03.2014
Total	**177**	

Parent lines of 57 hybrid combinations were planted at NARC during three different growing seasons. For hybrid combinations development, different CMS and R lines were used to test the combining ability of inbred lines. The flowers of both the restorers and CMS lines were selfed and crossed by hand pollinated at 50 and 75% anthesis to ensure good seed set.

Season	**Hybreds**	**Planting Date**
Spring 2013	17	26.02.2013
Autumn 2013	15	31.07.2013
Spring 2014	25	06.03.2014
Total	**57**	

A total of 118 hybrid combinations were evaluated during spring, 2013, autumn, 2013 and were planted in different experiments. Hysun-33, NK-S-278 and PARSUN-3 were included as check for comparing the performance of local hybrids.

Season	**Hybreds**	**Experiments**	**Planting Date**
Spring 2013	46	Two	17.03.2013
Autumn 2013	24	One	31.07.2013
Spring 2014	48	Three	05.03.2014
Total	118		

Data were recorded on seed yield, days to flowering (initiation, completion) and maturity, plant height, head diameter, 100 seed weight, oil contents and disease infestation.

Twenty four sunflower hybrids of diverse origin (including 9 local) were evaluated during spring, 2013 at 16 different provincial research stations/institutes and farms of private seed companies. However, results were received from 12 locations. Hysun-33 and NK-278 were included as check in both seasons. Data were recorded on seed yield, days to flower initiation, flower completion, maturity, head diameter, hundred seed weight and oil contents.

Name of Project: **Development and Evaluation of Indigenous Canola Hybrids in Different Ecological Zones**

Name of PI/Institute: **Dr Abdul Rashid**
PSO, Oilseed Programme, NARC

Duration: 01.04.2012 to 31.03.2015

Financial Status: Total Cost: Rs.4.369 million
Funds Released: Rs.2.292 million
Funds Utilized: Rs.2.098 million

Objectives:

- Development and maintenance of A, B and R lines
- Development and evaluation of new hybrid combinations
- Testing of locally developed canola hybrids in various ecologies of the country for the selection of new potential ones.

Achievements:

A total of 145 single plants from different restorer lines were planted in progeny rows for further selection and improvement. At flowering 5-6 inflorescences from each CMS line and B line were covered with cloth bags. In the following days, bagged inflorescences of CMS lines were crossed with their respective B lines. In restorer, 1-2 vigorous plants from each row were covered with cloth bags for self-pollination. At maturity, crossed seed from each CMS line and self-pollination seed from each maintainer and restorer lines was harvested separately.

Sufficient seed quantity of CMS and B line was harvested. In restorer lines, one self-pollinated plant from each line was individually harvested. In addition, 23 backcrosses (BC_3) were successfully made and sufficient seed of each backcross was harvested. In fertility restoration crosses, abundant pollen production was observed in 87 crosses at flowering stage. This seed of CMS lines will be utilized to make new hybrid combinations by crossing with new homozygous restorer line(s). The seed of CMS lines will also be used to produce hybrid seed of promising hybrid.

The seed of parental lines (A, B and R) of PARC Canola Hybrid was prepared for planting at NARC. A plot of 80 x 50 m^2 was selected in isolation at NARC. Fertilizers @ 90 N and 60 P_2O_5 kg/ha was applied and incorporated at the time of seedbed preparations. The CMS and B lines were planted in 3:1 ratio on 21-10-2013. Honey bee hives were placed beside the crop at flowering stage for good cross-pollination. At maturity, A, B and R lines were harvested and threshed separately. Total 400 kg seed of CMS, 10 kg seed of B-line was obtained from seed increase block of parental lines and 40 kg seed of restorer was obtained from hybrid seed

production blocks of PARC Canola Hybrid. This seed of CMS and restorer lines will be used to plant commercial seed production blocks of PARC Canola Hybrid in Rabi 2014-15.

One field of 58x35m^2 was selected in isolation distance at Summer Agricultural Research Station, Kaghan. The 48 CMS and one Restorer line was planted on 5-06-2013 in 2:1 ratio with single row hand drill. At maturity, hybrid seed from each CMS as well as restorer was harvested and threshed separately. A total of 48 hybrid combinations obtained. These hybrid combinations were evaluated for seed yield potential during 2013-14 to identify best hybrids.

The data revealed that there were significant difference among hybrid combinations for seed yield and it ranged from 2048 to 2758 kg ha^{-1}. Seed yield of 11 hybrids was better than commercially grown hybrid "Hyola-401" (2563 kg ha^{-1}). The hybrid CRH-81 produced highest seed yield of 2758 kg ha^{-1} followed by CRH-260, CRH-32 and CRH-80 with respective seed yield of 2718, 2662, and 2652 kg ha^{-1}. Maximum heterosis (6.7% yield increase over Hyola-401) was recorded in the hybrid combination "CRH-81". The 10 other crosses also produced 0.2 to 6.0% higher seed yield than Hyola-401.

Eleven new hybrids were evaluated in Adaptability Yield Trial of Chinese Brassica Entries conducted at five different locations for seed yield potential and adaptability. These trials were carried out in randomized complete block design with 4 replications. Experiments were sown at best possible sowing time at each site with recommended seed rate. Data showed significant differences among entries for seed yield at all five locations. On an average of five locations, seed yield ranged from 1654 to 1766 kg ha^{-1}. The highest seed yield 1766 kg ha^{-1} was produced by CRH-388 followed by Hyola-401 with seed yield of 1650 kg $ha^{-1,}$ CRH-131 with seed yield of 1611 kg ha^{-1} and CRH-374 with seed yield of 1599 kg ha^{-1}.

Three Canola Rapeseed Hybrids "CRH-101, CRH-148 and CRH-119" were tested in National Uniform Rapeseed Yield Trial (NURYT) during 2013-14 for seed yield potential and adaptability. The NURYT trials were conducted at eleven different locations across Pakistan. The data revealed that there were significant differences among entries for seed yield at all locations. On an average of 11 locations, seed yield performance of CRH-119 was excellent and produced seed yield of 2129 kg ha^{-1}. Seed yield of CRH-148 was also encouraging and produced seed yield of 1943 kg ha^{-1}. Seed yield of CRH-148 was also encouraging and produced seed yield of 1943 kg ha^{-1}. The seed yield of check hybrid "Hyola0401" was 1832 kg ha^{-1} and OP variety Faisal Canola was 1943 kg ha^{-1}. The hybrid CRH-101 was low yielding and produced 1620 kg ha^{-1} The hybrid CRH-101 was low yielding and produced 1620 kg ha^{-1} seed.

Name of project: **Indigenous Hybrids Development in Vegetables**

Name of PI/Institute: **Taj Naseeb Khan**
PSO, HRI, NARC, Islamabad

Duration: 01.04.2012 to 31.03.2015

Financial Status: Total Cost: Rs.4.768 million
Funds Released: Rs.3.482 million-
Funds Utilized: Rs.3.383 million

Objectives:

- Two high yielding F_1 hybrids of each in determinate tomato, chili and bitter gourd will be developed/ finalized by the end of the project.
- Preliminary/secondary evaluation of developed hybrids of tomato, chilies and bitter gourd
- Characterization of hybrids and parental lines
- Seed multiplication/maintenance of parental/promising lines of determinate tomato, chilies and bitter gourd

Achievements:

Chilies: The off-type plants in the stable inbred on the basis of plant and fruit morphology were rouged out. Evaluation of 05 new indigenously developed chili hybrids (spring season, 2014) along with their parents and 02 local and 01 international checks (F_1) were in the phase of evaluation. Up till, June 2014; 03 green fruit pickings were made and further in progress. The characterization of the remaining 03 elite chili inbreds was in progress.

Bitter Gourd: Maintenance of eight bitter gourd inbred lines viz., I.B.L 01, I.B.L. 02, I.B.L 03, I.B.L 04, I.B.L 05, I.B.L 06, I.B.L 07 & I.B.L 08 and eight variety/strains (Faisalabad long, Vehari medium, KBG-2, Karela Jhalari, Kaleem, Ghutka Karela, TNC and Palee F_1) was in progress. Eight new lines in S_0 and one line in S_1 are in the phase of selfing. Primary evaluation of 04 new indigenously developed bitter gourd hybrids (spring season, 2014) along with 01 local and 05 international checks (F_1) was in the phase of evaluation.

Tomato: The off-type plants in 09 parental lines on the basis of plant and fruit morphology were rouged out and the pure seed stock was reserved. Primary evaluation of 18 new indigenously developed determinate tomato experimental hybrids (F_1) was completed in spring season, 2014 along with their 09 parents. The hybrid-6, hybrid-1, hybrid-7, hybrid-2, hybrid-14 and hybrid-5 gave maximum yield (t ha-$^{1)}$ i.e, 110.94, 106.15 106.02, 104, 102.03 and 101.69 respectively over all the 09 parents where the yield ranged from 42.58-87, 39 t ha-^{1}. The characterization of the remaining 01 line (17905) was also completed. However, the detail will be provided in the annual report (2014-15)

Name of Project: **Conservation and Sustainable Utilization of Aromatic and Medicinal Plants**

Name of PI/Institute: **Dr Ghulam Mustafa Sajid**
Director, IABGR, NARC

Duration: 01.04.2012 to 31.03.2015

Financial Status:
Total Cost: Rs.5.749 million
Funds Released: Rs.3.524 million
Funds Utilized: Rs.3.327 million

Objectives:

- Germplasm collection of aromatic and medicinal plants of commercial importance from diverse ecologies (AJK, Gilgit-Baltistan, Northern Khyber Pakhtunkhwa and Cholistan/ Thall areas of Punjab).
- Characterization and identification of promising lines of selected medicinal plants of economic significance.
- Seed multiplication and on-farm demonstration of elite lines of cultivated medicinal plants at farmer's field.
- Chemical (Phytochemical) analysis of cultivated medicinal plants for active ingredients.
- Training of local growers, researchers and students at graduate/postgraduate level in production technology and post-harvest processing of medicinal plants.

Achievements:

The project aimed at devising strategies for conservation and sustainable use of important medicinal and aromatic plants of the Pakistan so that local genetic resources can be efficiently utilized. A total of 169 accessions of indigenous germplasm of buckwheat, castor, guar, Ispaghol, Kalonji, linseed Taramira and Tukhme-balungoo were collected from diverse ecologies including Cholistan, Gilgit-Baltistan, Hazara, Potohar and Thall area during second year of the project. Efforts were also made to acquire varied germplasm of medicinal plants of economic significance from international sources. As a result 665 accessions of buckwheat, false linseed, Kalonji, linseed, safflower and Taramira germplasm were received from Austria, Sweden and USA.

A total of 141 accessions of guar were characterized under trials to assess variation for agro-morphological characters and other traits of economic significance. Germplasm diversity is reported based on numerical taxonomy for quantitative and qualitative traits along-with first cycle of simple selection and its impact on genetic improvement to predict selection criterion. High variance for pods/plant height, clusters/plant, branches/plant and seed yield recorded was exploited through visual simple selection. Overall mean performance of selected plants was reduced in half of the lines that were mainly attributed through annual climatic variation; hence selection procedure in guar needs revision, especially for development of high yielding

sable genotypes. However the plants selected from the genotypes (3538 & 23688) excelled even in the second year performance, hence are suggested to evaluate under wider range of environments to narrow down selection intensity. Nine components were able to reduce the selection parameters providing more than two-third variability in the germplasm. Positive correlations among economically important traits including plant height, seed weight, pod length, seeds/pod, seed yield, branches/plant, clusters/plant and pods/plant indicated the scope of selection for more yield components without losing desirable linkages. Cluster analysis did not symbolize conspicuous affinities geographic pattern, however the clusters were grouped on the basis of agronomic performance and selective parents from different cluster may likely produce better hybrids either for direct use or for developing stable cultivar based on effective selection methodology.

A collection of 109 fenugreek accessions acquired from USA was regenerated and evaluated under NARC field conditions. The accessions were highly variable for several traits, including qualitative and quantitative traits indicating the possibilities for genetic improvement of the crop through selection and cross breeding. The varying characters of the superior accessions have implications for further work. Thus, the variation for the different characters found in fenugreek accessions included in this study could be exploited and used in fenugreek breeding programmes. Similarly, to regenerate and assess variation for phenotypic characters, 109 accessions of Ispaghol and around 50 accessions of linseed are being characterized under glasshouse and field conditions, respectively.

Genetic diversity of safflower landraces was also studied at seed storage proteins level using sodium dodecy sulphate polyacrylamide gel electrophoresis (SDS-PAGE). Safflower (*Carthamus tinctorius L.*) germplasm, comprising of 116 accessions was characterized using SDS-PAGE of seed storage proteins. The germplasm was acquired from different countries of the world. Total seed proteins were separated through electrophoresis polyacrylamide gels using standard protocols. Eighteen (60%) of the protein bands detected were polymorphic, the rest being monomorphic. Eight bands (14, 17, 18, 19, 20, 23, 24 & 25) were more than 80% common in all accessions. Accessions 16327 and 26752 were the most divergent genotypes having maximum dissimilarity with all the other accessions used. The un-weighted pair group method with arithmetic averages (UPGMA) was used which is based on dissimilarity matrix. Dendrogram obtained separated all accessions into four main clusters (I, II, III and IV) and two independent individual genotypes. Four major clusters comprised of 23, 75, 8 accessions, respectively. This technique did not reveal genetic variability of significant value in safflower genotypes, hence advanced molecular and biochemical markers are recommended for further studies. This study will be helpful for the future breeding programmes of safflower accessions.

Seed of promising lines of cultivated medicinal crops of economic importance including fennel (on line), guar (4 lines), linseed (one line), Methi (one line), NARC-Kalonji' and Taramira one line) were multiplied for enhanced cultivation at farmers' field/using as seed source for next year crop season.

Phytochemical analysis of Kalonji seeds for active ingredients showed 112.9 mgGE/100g of total phenols, 98.056 mg CE/100g of flavonoids and 25.6% oil contents. Antioxidant activity of methanolic extract varied from 43.02 to 86.59% at various concentrations. Promising lines will be identified for future utilization in breeding programmes.

Three students at postgraduate level (M. Phil) from QAU, Islamabad and Haripur University and four research internees, two each from Swabi University and University of Agriculture Faisalabad are being trained in medicinal plants production, crop management and post-harvest technology, morphological characterization techniques using IPGRI descriptors, SDS-PAGE analysis of total seed storage proteins, data analysis and conservation techniques at PGRI gene-bank.

Name of Project: **Packaging Innovation for Quality and Shelf Life Sustainability of Dhakki Dates and the Development of Value Added Date-Products**

Name of PI/Institute: **Dr Shahzada Arshad Saleem**
Post Harvest Technologist, Food Technology Section ARI, Dera Ismail Khan

Duration: 01.04.2012 to 30.03.2015

Financial Status: Total Cost: Rs.3.694 million
Funds Released: Rs.2.999 million
Funds Utilized: Rs.2.998 million

Objectives:

- To devise techniques for shelf life extension and quality enhancement of Dhakki dates through packaging.
- Standardization and development of value added products from inferior grade dates.
- Studies on shelf life stability during storage under various packaging materials at different temperatures, environment & acceptability by end user.

Achievements:

Studies were conducted on the effect of different packaging films on physiochemical properties of dates during storage. Dates were packed at three different pouches such as polyethylene pouches, cellophane pouch and laminated pouches. The dates taken in the pouches were stored at two different temperatures (40^0 and 30^0C) for four months. The samples were periodically taken out after one month interval, and were subjected to analysis for moisture contents, browning, acidity, pH and total soluble solids. Organoleptic evaluations were also performed. Laminated pouches produced the least effect on moisture variations at different temperatures on account of having two types of insulating materials of lower permeability. The cellophane and polyethylene pouches have shown higher permeability to moisture as well as to oxygen at both the temperatures. The quality deterioration under these pouches continued at a rapid rate, whereas the changes were minimal under the laminated environment. Nevertheless all of packaging films reduced changes to a certain degree during storage for four month period. The laminated pouches proved to be superior barrier against contamination, moisture and atmospheric gases at both temp 30^o and 40^oC, and hence protected quality of the dates. The organoleptic quality study conducted at the end of storage of 4 months period showed that dates stored under laminated pouches retained maximum quality & received maximum scoring. Irrespective of the packaging material used changes in the quality continued during four months of the storage at 30^oC. The non-enzymic browning and acidity showed increasing trend while pH and total soluble solids with a decrease trend at both of the temperatures, however the changes took place with slower rate at 30^oC.

The value-added date products like Date syrup and Date paste were prepared from inferior grade dates. The products were evaluated for quality and storage stability. The date pulp were boiled in sufficient amount of water and blended. The slurry was filtered/centrifuged to have a clear juice. The clear extract was concentrated under vacuum to 76^{o} brix. The syrup was stored at room temperature for 4 months, analysed and evaluated organoleptically. Date syrup has dense colour, good taste & appealing flavour. It has high sugar contents full of energy & date nutrients. The product remained overall acceptable up to 4 months storage at room temperature.

Date paste is produced from clean pitted dates by blending/mincing with predetermined amounts of water. The optimum soaking time was 10 min at room temp (25 ^{o}C). The paste was strained for paste uniformity. Date paste contains high levels (75-80%) of invert sugar, dietary fibre & good source of trace elements. The paste was stored under plastic packs at room temperature for 4 months, analysed and evaluated organoleptically. Storage time causes a gradual & marked increase in the hardness of the paste. The texture (softness) of the product is mainly determined by moisture content. Viscosity and water activity are slightly affected by storage time. Sample did not show appreciable difference in colour, pH and total sugar content for 4 months at 25 ^{o}C. The date paste retained organoleptic qualities of an acceptable range for 4 months at 25 ^{0}C.

Two workshops were arranged for the Dates grower and Agriculture official of the Extension Deptt: about the processing & value addition of Dhakki Dates during reported period. Progressive growers were educated through lectures and practical demonstration in respect of harvesting, handling, grading, packing & storage techniques and preparation of different products from date's fruits. Some of the results were also presented in *"Fifth Symposium on Date Palm in Saudi Arabia"* at King Faisal University Al-Ahsa, Hofuf, Kingdom of Saudi Arabia from 3-5 November, 2013 and Fifth International Date Palm Conference at Abu Dhabi, UAE 16-18 March, 2014. PI received appreciation certificate and conference shield for significant effort and contribution in the Date processing from UAE conference organizers.

Name of Project: **Molecular Diagnostic Assay for the Assessment of Seed Health in Rice *(Oryza sativa)***

Name of PI/Institute: **Dr Riffat Tahira**
SSO, Institute of Agri - Biotechnology and Genetics Resources
PGRP, NARC, Islamabad

Duration: 01. 04. 2012 to 31.03.2015

Financial Status:
Total Cost: Rs.3.366 million
Funds Released: Rs.2.176 million
Funds Utilized: Rs.1.876 million

Objectives:

- Assessment of rice germplasm present in the gene bank and the seed available in the market against Bacterial leaf blight and Rice blast.
- Improving the health status of infected rice seed via various treatments and replacing the infected seeds in the gene bank with the healthy seed.
- Documentation of seed health status and dissemination of information.

Achievements:

Seeds of 700 rice accessions were acquired from gene bank while 32 samples were collected from Sheikhupura, Lahore, Sialkot, Narowal, Pasroor, Faisalabad and Hajira (AJK) for assessment against bacterial leaf blight and rice blast. DNA of all these samples was extracted through CTAB (using half seed) method. Extracted DNA was checked for quality and quantity through 0.8% agarose gel and Nanodrop spectrophotometer. Genomic DNA of *X. oryzae* and other bacterial strains i.e., *B. subtilis, B. thuringenesis, P. syringae* was also extracted to check the specificity of the primers. Diagnostic PCRs were conducted with *X, oryzae* specific primer *Xoo2*. Specificity of *P. oryzae* specific diagnostic primers was also confirmed by applying these primers on DNA of different fungal strains. MIF primer producing 300 bp bands only in *P. oryzae* was used in diagnostic PCRs for identification of infected rice seed samples. A total of 87 samples were found to be infected for Bacterial Leaf Blight and 95 for Rice Blast out of 700 rice accessions acquired from gene bank. Mint and basil essential oils were tested for their antimicrobial potential against *X. oryzae* and *P. oryzae*. Significant differences were recorded for antimicrobial activity among mint and basil essential oils. Hot water treatment also showed promising results for removal of infection from seeds at 53 ^{o}C for 30 minutes. Germination percentage was checked for hot water and essential oil treated seeds. Hot water treated seeds showed 100% germination rate while maximum germination percentage (86%) was recorded in 90 ppm essential oil applied seeds. After three months of storage at 10 ^{o}C, germination %age will be checked again and treatment showing higher germination percentage and seed vigor will be applied to infected rice seeds for removal of infection during storage.

Name of Project: **Development of Market Life Enhancement Technology to Persimmon and its Dissemination to Growers**

Name of PI/Institute: **Ms Nizakat Bibi**
Principal Scientist, Nuclear Institute for Food & Agriculture (NIFA) Peshawar

Duration: 01.07.2012 to 30.06.2015

Financial Status: Total Cost: Rs.4.738 million
Funds Released: Rs.2.478 million
Funds Utilized: Rs.1.737 million

Objectives:

- Establishment and optimization of pilot scale mobile facility for astringency removal and marketable life extension of persimmon fruit.
- Transfer of this technology to the farmers/ entrepreneurs through trainings and demonstration.

Achievements:

To achieve the objective "establishment and optimization of pilot scale facility for astringency, removal and marketable life extension of persimmon fruit" the design for ART facility has been finalized with HMC-3 engineer and fabrication of the facility completed. Some preliminary experiments on selection of picking time for persimmon growing areas; Charsadda, Swat and value addition of persimmon fruits were conducted on relatively larger scale by using already available autoclave and growth chamber as closed/ controlled atmosphere chamber.

From the data obtained from experiments/study conducted on "Selection of picking time for Charsadda and Swat persimmon fruits and value addition of persimmon fruits collected from Swat at picking time" some of the significant findings are as follows:

- Keeping in view both the important parameters, astringency and weight loss of Charsadda fruits, the storage period could be one week after treatment for fruits picked from the orchards by the end of September.
- Delayed (if possible) picking time from end of September to end of October would be more beneficial for longer storage period.
- Regarding the fruits collected from swat orchards, the storage period may be extended by storing the fruits in the same environment after treatment.
- For swat persimmon, although the modified atmosphere reduced the astringency significantly but fruits could not resist the change in temperature for longer storage period.

- This treatment is more useful for value addition of export quality fruit purchased from fruit mandi, Peshawar as modified atmosphere treatment can reduce astringency to some extent as well as extended marketable life of persimmon fruit.
- By comparison of total phenolic content of all the differently treated fruits, it was evident that modified atmosphere caused reduction in total phenol/ astringency. Improvement in the treated fruits was not up-to the mark probably because of the fact that the chamber used was not up-to totally air-tight. Although this part of work was not included in the project plan, however it is highly relevant from the stand-point of applicability of this technique on commercial scale. Such information will hopefully contribute more towards uplifting of persimmon trade.

Name of project: **Introduction/Evaluation and Demonstration of Exotic, Local Fruit Germplasm and Vegetable Varieties/ Hybrids for Enhancement of Farm Sustainability and Poverty Reduction of Khuzdar District (Component-I)**

Name of PI/Institute: **Muhammad Yaqoob**
SSO, Horticultural Research Institute (HRI), PARC, Khuzdar

Duration: 01-07-2012 to 30-06-2015

Financial Status: Total Cost: Rs**.**5.337 million
Funds Released**:** Rs.2.993 million
Funds Utilized: Rs.2.864 million

Objectives:

- To establish a disease free nursery of horticultural crops
- To develop a modern research laboratory/ Green houses for multiplication of indigenous and exotic germplasm
- To develop packages for fruits and vegetables cultivation by evaluating optimum crop productivity, including tunnel farming, trickle irrigation IPM and ICM

Achievements:

During the year under report research activities conducted in HRI and farmers' field at Khuzdar. The main focus of activities was the propagation of horticultural fruit crops. As per objective of the project nursery of different fruit plants raised and looked after throughout the year. The main areas of focus were timely irrigation, fertilization, weeding from the ridges of the nursery, multiplication of the different horticulture crops at HRI Khuzdar. Farmers of Olive, Pistachio, Fig, Grapes, and Pomegranate orchards at Khuzdar were trained regarding the timely irrigation and fertilization throughout year.

Vegetable varieties of Tomato, Chili, Okra, Carrot, Cabbage, Cauliflower were tested on the farmer's field for pesticide residues and fertilizer requirements and further farmers were trained to control the weeds in fields. Attention of the progressive farmers were diverted for growing Tomato, Cucumber, Sank Guard, Bitter Gourd in the Tunnels during the off-season by controlling the temperature in the tunnel.

Meeting with farmers organized during January, 2014 and demonstrate the olive oil extracting plant to farmers. Farmers of the Khuzdar have received the nursery plants of different horticulture crops, seedlings of vegetables and training about best use of pesticides. Seed collection of vegetables and their processing techniques, shared with the farmers on their field during the harvesting of the vegetable crops. The experiments results of the multiplication of the horticulture fruit varieties growing by cuttings shared with the farmers.

Name of project:	**Introduction/Evaluation and Demonstration of Exotic, Local Fruit Germplasm and Vegetable Varieties/ Hybrids for Enhancement of Farm Sustainability and Poverty Reduction of Khuzdar District (Component-II).**	
Name of PI/Institute:	**Syed Abdul Qaim Shah** Director, Agriculture Research Baghbana, Khuzdar	
Duration:	01-07-012 to 30-06-2015	
Financial Status:	Total Cost:	Rs.3.235 million
	Funds Released**:**	Rs.1.991 million
	Funds Utilized:	Rs.1.896 million

Objectives:

- To study and survey the existing horticulture crops production in the area and to identify the key areas for improvement.
- To demonstrate the good agricultural practices viz tunnel farming, trickle irrigation IPM and ICM to horticulture growers through farming system research.
- To impart training to the farmers and service providers for rapid dissemination of developed technologies.

Achievements:

To study the existing horticultural crop production, fruit orchards and vegetable varieties of *Wadh Wahre* were visited. The issues faced to the farmers were identified and discussed to resolve these issues. Survey of the Ferozabad and Nall farmers also carried out and diversification of crop grown identified.

Trickle irrigation, IPM and ICM controlled experiment conducted at Khuzdar. The trickle irrigation system was demonstrated to the farmers on research field.

Land approximately 2½ acres was prepared applying F.Y.M. and fertilizer for nursery establishment. Seeds of almond were sown in February, 2014. Cuttings of pomegranate and grapes were planted in February 2014. Rootstocks of apple were planted in nursery during the dormancy period 2014. Olive cuttings treated in chemical of rooting hormones were planted in shade house from February to April 2014. Pistachio seeds were also planted in shade house.

Farmers training were conducted in local language during field visits, on olive nursery raising by cuttings, olive nursery raising by seed, olive pruning, pomegranate growing by cutting, pomegranate orchards pruning, apple orchards pruning, pistchio nursery raising, tomato growing, lady finger growing, cabbage growing, cauliflower growing, maiz growing, cotton growing+ insect controlling, chili growing and drip irrigation efficient use of water.

Olives were planted on trickle irrigation system in Baghbana farm and demonstrated to the farmers. Majority of farmers shown interest in this system, but they desired to be installed as a demonstration plot from Government side. Almond nursery of 80 kg seed was sown. In December 2012, 1500 plants were raised and budded in July/August 2013 at Baghbana farm. These will be ready for plantation in February to March, 2015. Apricot nursery was raised; 2000 plants in December 2012, which were budded in Baghbana farm during July to August 2013 and will be ready for plantation in February to March, 2015.

Name of project:	**Introduction and Demonstration of Integrated Farming Systems (IFS) to Enhance Farm Sustainability and Poverty Alleviation in Lasbella District" (Component-I)**
Name of PI/Institute:	**Mr. Saeed Ahmad** Scientific Officer, Coastal Agriculture Research Institute (CARI), Bhawani, District Lasbella
Duration:	01-07-2012 to 30-06-2015
Financial Status:	Total Cost: Rs.4.780 million Funds Released**:** Rs.2.178 million Funds Utilized: Rs.2.163 million

Objectives:

- To study the suitability of different crop-livestock-aquaculture based IFS models for agro-ecological zone of Lasbella
- To investigate the macro-and micro-environments for IFS based multiple commodity models
- To study the effects of integrated farming approach on crop productivity, animal performance and total biomass (animal and fish) yield
- To study the economics of crop, livestock and fish productivity under model integrated farming system

Achievements:

Research activities carried out to study the suitability of the different crop-livestock - aquaculture bases IFS models for agro-ecological zone of the Lasbela. Survey of 07 tehsils and 22 UCs conducted in the Lasbela. It is observed that 310 farmers are engaged fully and partially in the integrated farming system at small and large scale.

Demonstration trials conducted on different crops sown on the farmers' field for demonstration of bi-tri commodity IFS model.

- Fodder trial sown on the CARI and farmer's field (*one acre each of Berseam, Sudan grass and Atfalfa).* Overall germination percentage was 90% successful and comparison of all three fodder crops done during the field activities.
- 3000 cuttings of cassava plant raised on the CARI station field. Germination was 95% successful.
- 2000 plants of Cassava distributed among the farmers for propagation purpose. Germination of the 2000 plant on the farmer's field is successful,
- 3000 Lemon seed were sown in the polyethylene bags. The results of the germination is 89%.

- 200 Ber varieties introduced among the farmers. The results of the germination are 90% successful.

Bi- Tri commodity integrated crop + livestock + poultry + fish IFS introduced on the CARI and Farmer's field (*10 sheep and fodder crop experiment designed under the IFS bi, tri-commodity sheep, poultry and fish*).

Demonstration trial on wheat (Advanced Wheat Yield Trial) sown in CARI using entries and data regarding germination and other factors recorded.

Established a fish pond and poultry shelter at CARI, in which 1200 fish Catla, 1300 Gulfam and 250 poultry layer respectively were managed. The result of IFS model - fish and poultry came successful. Seminar/ workshop conducted at CARI and trained the farmers on horticulture crop production and applying the IFS model. The workshop enhanced the knowledge of the farmers regarding IFS model.

Name of Project: **Introduction and Demonstration of Integrated Farming Systems (IFS) to Enhance Farm Sustainability and Poverty Reduction in Lasbella District (Lasbella University of Agri., Water & Marine Sciences (LUAWMS), Lasbella Comp. II)**

Name of PI/Institute: **Mr Abdul Hameed Baloch**
Assistant Professor, Faculty of Crop and Plant Sciences, Lasbela University of Agri., Water & Marine Sciences, Lasbella

Duration: 01.08.2012 to 31.07.2015

Financial Status: Total Cost: Rs.5.036 million
Funds Released: Rs.0.897 million
Funds Utilized: Rs.0.197 million

Objectives:

- To study the existing crop, livestock and aquaculture production system in the Lasbella district.
- To undertake the capacity building programmes to propagate sustainable crop livestock aquaculture based IFS models.
- To develop cost effective and viable packages for sustainable agriculture productivity.

Achievements:

Sowing of 11 Entries of Oat Fodder: In order to assess the potential of oat as fodder, plantation of 11 entries carried out at LUAWMS, in RCBD design with 03 replications. The seed was provided by NUFYT. All the entries performed well. The cultural practices were kept constant. Data regarding other yield collected at he time of harvesting and seed setting and analysis is still in process.

Sowing of 03 Entries of Lucerne: Plantation was carried out during October with RCBD design at LUAWMS with 03 replications. The seed was provided by NUFYT (NARC). All the entries performed well and data about crop stand, Plant height ,tiller/plant, leaf/tiller, green fodder yield, dry matter yield (t/ha) has been recorded as per given plan of NARC. Research data will be analysed to recommend ideal variety with better produce and yield.

Plantation of 55 Entries of Sugar beet at Tropical Zone: Sowing was carried out on 20 November 2012 of 08 different varieties on ridges and compared with flat bed system. The data regarding time of sowing, varietal performance, method of ploughing, fertilizer application, irrigation given through flood system and sugar content bricks has been recorded.

Name of Project: **Development and Evaluation of a In-bin Seed Drying, Aeration and Storage Technology**

Name of PI/Institute: **Mr. Liaqat Ali Shahid**
Principal Engineer/ PSO, Agricultural Biological Engineering Institute (ABEI), NARC, Islamabad

Duration: 01.10.2012 to 30.05.2015

Financial Status: Total Cost: Rs.5.030 million
Funds Released: Rs.3.293 million
Funds Utilized: Rs.3.158 million

Objectives:

- To develop and evaluate an In-bin seed drying, aeration and storage technology.
- To undertake cost analysis of this technology.
- To demonstrate this technology among the local agricultural machinery manufacturers and seed growers/traders.

Achievements:

The fabrication process of prototype unit was started at manufacturer's premises under the technical support and supervision. Process is narrated as under:

- The bin was fabricated and assembled in three separate parts; top cone assembly with exhaust outlet, bottom cone assembly with perforated hot air distribution pipe, and seed outlet for unloading, and main cylindrical bin assembly.
- The bin was assembled, reinforced with four square bar pillars with bottom steel bolted plates for coupling on the trolley. A two wheeled trolley with four mechanical jacks and a single point for hitching was fabricated and assembled. The bin assembly was bolted on the trolley at four points.
- A bucket type elevator assembly for bin loading, and screw type horizontal conveyor assembly for seed unloading were fabricated, assembled and installed on back side of trolley.
- The special attention was given to heating system design being a critical component of the dryer. As per design, heating system consisting of a centrifuge fan electric motor, automated LPG burner with two LPG large size cylinders, and temperature gauges was fabricated, assembled, and installed at the front side of bin system.
- A control panel for smooth operation of the system was designed, fabricated, assembled and installed.

The idle operation of the system as a whole unit as well as individual machine component assemblies was checked at the manufacturer's premises and after that delivered to ABEI on 16th June, 2014. The unit was unloaded and reassembled at ABEI premises by the manufacturer's team. It is now ready for field testing and performance evaluation during forthcoming paddy harvesting season.

Name of Project:	**Use of Alternative Energy Sources for Pumping Water in Agriculture (AZRI, D. I. Khan, Component-III)**
Name of PI/Institute:	**Engr. Noman Latif** Principal Scientific Officer, Aird Zone Research Institute - PARC, D. I. Khan
Duration:	01. 02. 2010 to 14. 03. 2014
Financial Status:	Total Cost: Rs.7.176 million Funds Released: Rs.4.891 million Funds Utilized: Rs.4.356 million

Objectives:

- Develop and adapt pumping systems for irrigation water using alternative energy sources (solar and biogas)
- Evaluate and improve efficiency of pumping systems run by alternative energy sources.
- Evaluate economics of pumping systems run through alternative energy sources.

Achievements:

About 77-78% decrease in diesel fuel was noted in case of engine operation with dual fuel for pumping system of irrigation water.

Visits were carried out to different locations where bio-gas digesters are constructed by FIDA (an NGO) with the assistance of USAID. Fifty (50) farmers/ people were given practical demonstration for use of gas and safety measures in use for domestic purposes.

An 1800 watts submersible pump is under operation from a depth of 120ft below ground level. The total panel installed has the capacity of 1960 watts (14 panels * 140 watt per panel). The discharge of the pump is measured as 2.25 litre / sec.

Three hundred and fifty (340) plants of guava, citrus, lemon and mango developed into a drip irrigated orchard on 02 acres of land with drip irrigation system operated with solar energy. It is also coupled with a 25ft high overhead tank of 1800 gallons capacity to store the water and apply to the field by gravity when required. Plant growth parameters such as height, girth and canopy measured at regular interval to develop the data about mortality rate. The winter vegetables i.e. spinach, garlic, turnip, fenugreek and reddish were grown well with solar pumped water.

Solar Pumps on the recommendation of ALP project, included by the Inter-Cooperation programme under Swiss assistance for FR D. I. Khan on Drinking Water Supply Schemes (DWSS). A 3000 watt solar system is installed in Raghaser area of FR.

The project also coordinated with SPO (a national NGO) for use of Solar energy in agricultural farms especially horticultural purposes in Chodwan area where energy availability is very critical issue. An effort was made between ALP project and FIDA (NGO) for technically evaluating their installed units. They have constructed 50 bio-gas plants in D. I. Khan for domestic purposes with the financial assistance of USAID. Gauges were suggested for pressure and temperature indication to facilitate the operation. Another local NGO naming VEER had developed a project for UNDP with the technical back stopping of ALP project to shift 100 diesel operated pump sets to dual fuel (bio-gas &diesel) for riparian region of D.I. Khan with shallow water table available.

Economic analysis of the project intervention was carried out as final project objective. Economic analysis shows the BCR as more than 1 and NPV greater than zero, resulting in viability of the intervention.

Drip irrigated Orchard developed with Solar pump & gravity flow irrigation at D. I. Khan

Name of Project: **Management of Rawal Watershed under Changing Landuse**

Name of PI/Institute: **Mr. Muhammad Saleem Pomee**
Scientific Officer, Climate Change, Alternative Energy and Water Resources Institute, (CAEWRI), NARC, Islamabad

Duration: 28. 09. 2010 to 27. 09. 2013

Financial Status:
Total Cost: Rs.21.722 million
Funds Released: Rs.17.338 million
Funds Utilized: Rs.16.791 million

Objectives:

- Organization of Rawal Watershed users through a process of social organization and social engineering at selected sub-watersheds.
- Participatory assessment of current state of Rawal watershed at selected sub-watershed in terms of changing landuse and infrastructural development.
- Develop integrated strategy for cost effective management of Rawal Watershed based on experimental interventions in selected sub-watershed for sustainable yield and livelihood.

Achievements:

The project activities were designed and implemented through participatory mod at representative Sub-watersheds at upper, middle and lower reaches of Rawal Catchment. The issues of unorganized communities, urban encroachments, suboptimal land and water productivities, increased erosions, poor locale capacities for innovative agro-based technologies and uncertainties in predicting hydrological behaviors of Rawal Catchments due to lacking of scientific information were considered as major constraints. To address these issues, different interventions/ scientific studies were executed at selected Sub-watersheds during project period and results have been compiled through final technical report.

Since issues of Watershed were of collective nature, therefore, sustainable interventions were only possible, if collective wisdom of inhabitants was trapped and utilized. This objective was achieved through social integration of communities with project activities since beginning through structured organizations. The issues of anthropogenic landuse change within Rawal Watershed on temporal scale were estimated by using GIS/RS applications. It was concluded that since 1994, about 53 % of land use has been changed and rate of change was higher in recent times. Urban encroachments were increased by 231%, while agriculture grew by 32 % meanwhile.

The implications of rapid urbanization in Rawal Catchment were also investigated in-terms of wastewater production and its untreated mixing into fresh water streams by monitoring largest urban setting of Barakaho. The study area was subdivided into five Sub-catchments and it was

found that Col. Kiani Road Sub-catchment was most pollutant. Moreover, detailed statistical analysis was carried out using One-Way ANOVA technique to conclude that temporal variability was more profound rather than spatial perspective in terms of selected pollutants. Seasonality was another key variable affecting quality and quantity of waste productions from study area.

Perennial spring waters managed at Aarokus to command over 12 acres of previously barren terraced land by developing innovative by low-tech Contour Based Surface Irrigation System (CBSIS). Once the water was made available, studies were planned to demonstrate improved water productivities for major cereal crops of the study area. Similarly, land and water productivities were also improved under purely rainfed farming systems of the Rawal Catchment. Rooftop rainwater harvesting systems were introduced to increase domestic water supplies and demonstrated efficient use of scare water for kitchen gardening activities to engage gender particularly at upper reaches. Innovative system was designed and demonstrated at Aarokus, where precious roof water was used through drip irrigation system without any external energy. Similarly, selected high efficiency irrigation systems were introduced in the study area to cover wider range agricultural applications. The concept of supplemental irrigation was induced in project areas to harvest more returns from given rainfed-farming system.

Different innovative and high rewarding agricultural practices (like tunnel farming, honey farming and fish farming) were introduced in project areas and necessary capacity buildings were accomplished for promoting adaptations on regular basis. Various available biological covers were evaluated for their potential of soil and water conservation under Watershed conditions through detailed statistical applications. Likewise the impacts of agricultural practice Vs uncultivated landscape were also investigated to estimate soil and water conservation aspects. Different low-cost soil and water conservation interventions were also designed and executed at critical locations to reduce erosions. Moreover, different types of monitoring systems were installed at study area to estimate key meteorological parameters at selected Sub-catchments, while rainfall-runoff interaction was also monitored to develop hydrological database. Based upon rainfall analysis, it was concluded that water harvesting were essential to support crop productivities though there was more rainfalls than ET needs due to rainfall distributional issues. Research infrastructure developed under project also helped in supporting thesis requirements of various postgraduate and graduate level students.

Name of Project: **Commercialization of Biofertilizer (inoculants) for Important Crops**

Name of PI/Institute: **Dr M. Ehsan Akhtar**
Principal Scientific Officer/PL, LRRI, NARC, Islamabad

Duration: 25. 10. 2010 to 24. 10. 2013

Financial Status:
Total Cost: Rs.10.818 million
Funds Released: Rs.4.466 million
Funds Utilized: Rs.4.474 million

Objectives:

- Commercialization of multipurpose synthesized biofertilzer through private sector.
- Technical backstop support to private sector: Build capacity of private sector for mass propagation of microbial inoculants, field testing, impact monitoring.
- Provide feedback to production team for improvement of the quality of Biofertilizer.
- Up-scaling of the existing pilot production facility.

Achievements:

Established a microbial gene bank and a bio-inoculants production unit at Innovative Technology Yard, National Agricultural Research Centre, Islamabad.

Field experiment/demonstration for rice and cotton were conducted during Kharif 2012 at different sites of Faisalabad, Pindi Bhatiyyan, Bahawalpur and Hafizabad with seed treated with Biozote and without biozote to compare effectiveness of product. Data for growth and yield parameter recorded and presented in report. Observations and farmer's response has shown an average increase of 7-15% in yield for both crops with 20% less use of chemical fertilizer.

Field experiment was conducted in collaboration with Jaffer Brothers for wheat crop in November 2012. Jaffer Brother has sent their product to be tested and in response to Biozote in NARC field conditions. Their product was urea and DAP coated with microbes to be applied directly with different treatments of chemical fertilizer. Biozote was applied in comparison, with 75% and 100% use of chemical fertilizer. Data showed that Biozote 100% NP has significantly higher yield with Biozote 75% NP and second lowest was observed in treatment D (U+DAP). Results showed that Biozote performed far better than Jaffer Brothers product.

Demonstrations were conducted in collaboration with sugar mills for sugarcane crop. Isolates were characterized, identified and screened after successful pot culture experiment for field trial. Collaborative demonstrations were conducted with Husain sugar mill and Kamalia sugar mill, Jaranwala Lahore. Fauji fertilizer sugarcane research and multiplication

farm, Sindh have also conducted demonstration of Sugarcane Biozote. Farmer field demonstration was also the part of R & D activities of bio-fertilizer. Detail is mentioned below.

- Mass production of Biozote was completed successfully for wheat crop, Rabi 2012-13 in collaboration with Private dealers, companies, farmers and researchers. Due to excellent response of Biozote to wheat crop last year, the production has to be increased to fulfill the demand of farmers and dealers. About 4000 packets of Biozote was produced and distributed for demonstration and commercialization purpose.

For Kharif, 2012-13 production of Biozote continued on large scale. Demand was received for cotton, rice, mungbean, groundnut, sugarcane, and guar. Packets were produced and distributed successfully. Detailed performance report is given under:

- Three cases of Bio-fertilizer products with commercial names Biozote-Max, Biozote-P and Biozote-N were submitted for registration with Department of Agriculture Punjab through Directorate of Soil Fertility & Research, Lahore. The cases have been considered by the committee and found fit for approval. However, final approval will be issued after inspection of Biozote production facility at NARC by Task Force, Agriculture Department Punjab,
- For up-scaling of biofertilizers (bio-inoculants) production unit at Innovative Technology Yard, NARC, two large scale fermenters of 60 litre capacity were installed there.

Name of Project: **Formulation and Quality Improvement of Biofertilizers (inoculants) for Crop Production**

Name of PI/Institute: **Dr Tariq Sultan**
Principal Scientific Officer, Soil Biology, LRRI, Islamabad

Duration: 27.10.2010 to 26.10.2013

Financial Status:
Total Cost: Rs.9.988 million
Funds Released: Rs.4.757 million
Funds Utilized: Rs.4.713 million

Objectives:

- Isolation and identification of beneficial bacteria from roots and rhizosphere soil of sugarcane and cotton.
- Selection of isolates showing high nitrogen fixing, phosphorous solubilizing activity and/or producing higher amounts of phytohormones.
- Evaluation and selection of the promising strains and their combinations showing beneficial effects on their respective host crop under lab. greenhouse as well as field conditions.

Achievements:

About 115 PGPR isolates of each, cotton, sugarcane, onion, potato, peas, rapeseed and maize crop have been acquired. These isolates have been characterized; colony morphology, cell morphology, gram staining (-ve & +ve) and few strains were identified at genetic levels and remaining are under process. These isolates have reasonable abilities to produce IAA growth hormone. 37 isolated PGPRs also have phosphate solubilizing ability. The strains tested on sugarcane & maize showed clear indication that microbes are crop specific. The best combinations of strains were evaluated and yield increased was 15-25%. The best combination PGPRs & PSB also saved about 25% NP fertilizers.

On the basis of above results and formulation combinations of three Biozote products (Biozote-N, Biozote-P and Biozote-Max) were developed and tested by the team of another ALP project "commercialization project NR-19" in field conditions.

Eight (08) students completed their M. Phil degree and Two (02) student got PhD degree by using data of this ALP project

Name of Project:	**Evaluation and Commercialization of Rhizogold - A Multi Strain Biofertilizer Developed in the ALP Project**
Name of PI/ Institute:	**Dr Zahir Ahmad Zahir** Professor, Institute of Soil & Environmental Sciences University of Agriculture, Faisalabad
Duration:	12.04.2012 to 11.04.2015
Financial Status:	Total Cost: Rs. 6.361 million Funds Released: Rs.5.120 million Funds Utilized: Rs.4.681 million

Objectives:

- Evaluation of different carrier materials to select most economical and efficient carrier material for the Rhizogold.
- Evaluation of shelf life of the product.
- Demonstration trials on farmer's fields in different regions for the awareness of the farmers.
- Farmer/field days in different areas for the awareness of the farmers.
- Extensive evaluation of Rhizogold at farmers' fields.

Achievements:

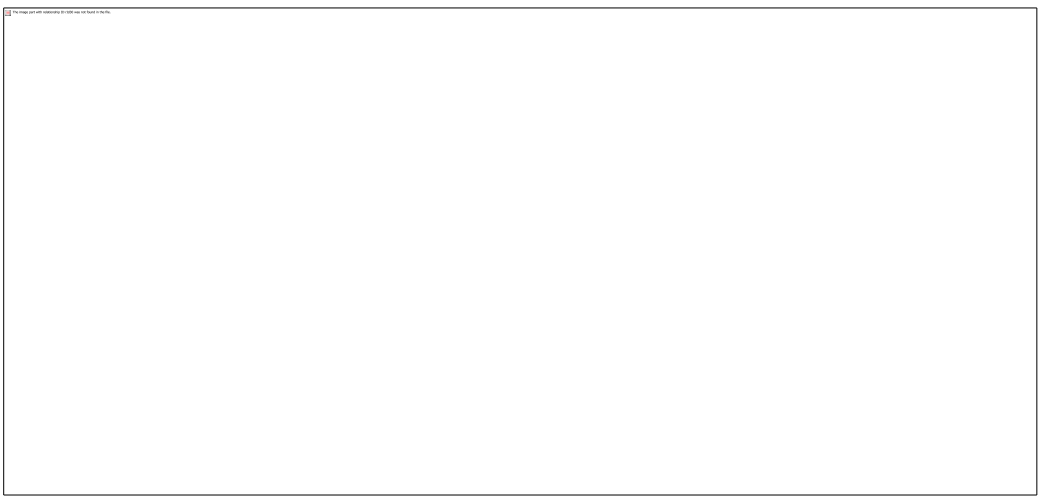
In a previous ALP-PARC project (ALP-268; 2008-2011) number of rhizobial strains and PGPR having ACC-deaminase activity were isolated from nodules and rhizosphere of mung bean, chickpea and lentil, respectively, from different areas of Pakistan. These isolates were tested alone as well as in combinations under axenic conditions, pots and field to screen and select effective multi-strain combinations for promoting the growth, nodulation and yield of respective legumes. The effective combinations were used to develop multi-strain biofertilizer "Rhizogold" for the sustainable production of chickpea, lentil and mung bean. The project focuses on evaluation of Rhizogold on farmer's field.

During second year of the project, locally available carrier materials i.e. peat, compost, press mud, biogas slurry, crushed corn cob, and sawdust were evaluated to improve the performance of Rhizogold in mung bean, chickpea, and lentil for enhancing the growth and yield under pot conditions. In the third year, carrier materials selected from pot trials were evaluated to improve the performance of Rhizogold-mung bean, Rhizogold-chickpea, and Rhizogold-lentil for enhancing the growth, nodulation and yield of respective grain legumes under field conditions. Survival efficiency of Rhizogold was also evaluated in these carrier materials. Extensive evaluation of Rhizogold on farmer field has also been started and tested in several trials (24/GB Jaranwala; Mongi bangalow; Gojra; Bhowana; Bahawalpur). Farmer days arranged at different areas to motivate the farmers for legumes production.

A summary of accomplishments and research findings during the third year of the project is given below.

- Field trials for the evaluation of selected carrier materials for Rhizogold
- Evaluation for the shelf life of Rhizogold in different carrier materials
- Introductory seminar of Rhizogold & inaugural ceremony of Biofertilizer Production Unit
- Three Farmers days/ Field days
- Extensive evaluation of Rhizogold on farmer field
- In the project 09 students are doing their research work of M. Phil.
- 14 research papers are published in different journals.

Biofertilizer Production Unit installed at UAF under ALP Funded Project (ALP NR-036)



Carrier based Rhizogold (RG) inoculation to improve the nodulation of mung bean under field conditions

Name of Project:	**Improving Productivity of Some Major Crops Through Integrated Plant Nutrient Management (IPNM) in FATA Kurram Agency.**
Name of PI/ Institute:	**Mr Iqrar Hussain** Research Officer, Soil & Water Testing Lab., Parachinar, Kurram Agency
Duration:	01.07.2012 to 30.06.2015
Financial Status:	Total Cost: Rs. 4.979 million Funds Released: Rs.4.194 million Funds Utilized: Rs.3.632 million

Objectives:

- To investigate the nature, extent and severity of nutrient disorder in Kurram Agency
- To improve and sustain soil fertility as well as crop productivity under wheat-rice cropping system of the area through integrated plant nutrient management
- To build capacity of laboratory staff, agricultural extension workers and farmers in plant nutrient management and create awareness among farming community by ensuring a steady flow of applied research results through field days, trainings/workshops and pamphlet/brochures

Achievements:

During the reporting period, eighty soil samples were collected from Upper, Lower and Central Kurram Agency. The samples were dried, ground, sieved and analysed for soil pH, electrical conductivity, organic matter content, calcium carbonate (lime), phosphorus, potash, zinc, copper, iron and manganese. Organic matter, phosphorus and potash were low in 44, 53 and 49 %, medium in 26, 36 and 44, high in 30, 11 and 7% soil samples respectively. Zinc, copper, iron and manganese were found low in 64, 5, 16 and 25%, medium in 20, 8, 35 and 0 % and high in 15, 87, 49 and 75 % soil samples respectively.

Experiments were conducted on the effect of IPNM on the yield and yield components of rice and wheat crops. The results showed that highest grain yield of rice and wheat (5546 and 5564 kg ha^{-1}) was recorded in the treatment receiving 75% nitrogen from urea and 25% nitrogen from FYM. TDM, straw yield and 1000 grain weight showed almost similar response as that grain yield of rice and wheat.

NPK application at the rate of 50:90:60 kg ha^{-1} along with green maturing showed highest rice yield of 5201 kg ha^{-1} followed by 3583 kg ha^{-1} in the treatment receiving 50:90:60 kg ha^{-1} NPK along-with crop residue incorporation

NPK application at the rate of 50:90:60 kg ha^{-1} along with green manuring produced highest wheat grain yield of 5054 kg ha^{-1} followed by 4439 kg ha^{-1} in the treatment receiving similar dose of NPK with crop residue incorporation in treatment 4.

Maximum uptake of N, P and K 90.78, 10.66 and 98.82 kg ha^{-1} was recorded in treatment receiving Nitrogen 75% from urea and 25% from FYM followed by 85.20, 10.66 and 93.82 kg ha^{-1} respectively in the treatment which received nitrogen from urea and FYM in 50:50 % age. Maximum up take of N, P and K 115.14, 12.25 and 102.70 kg ha^{-1} was recorded in treatment receiving Nitrogen 75% from urea and 25% from FYM followed by 108.80, 11.10 and 98.26 kg ha^{-1} respectively treatment which received nitrogen from urea and FYM in 50:50 ratio.

The data showed that value cost ratio of 3.71 with highest net return of Rs.115300 ha^{-1} by the application of 75% nitrogen from urea and 25% nitrogen from FYM ha^{-1} indicating economical significance for profitable rice yield.

Name of Project: **Production of Humic Substances Based Plant Nutrient Products for Improving Crop Productivity**

Name of PI/ Institute: **Dr M. Zameer Khan**
PSO, Land Resources Research Institute, NARC

Duration: 01.10.2012 to 30.09.2015

Financial Status:
Total Cost: Rs.14.149 million
Funds Released: Rs.8.573 million
Funds Utilized: Rs.5.133 million

Objectives:

- Improving extraction of humic acid from lignite coal, crop residues and low grade industrial wastes.
- Formulation and characterization of humic acid based fertilizer products.
- Testing of humic acid based products under laboratory, greenhouse and field conditions.
- Promotion of farm use of efficient humic acid based plant nutrient products.

Achievements:

Extraction and Characterization of Humic Substances: Humic substances (HSs) extracted from plant and coal material were characterized using UV-VIS spectroscopy, HPLC and FTIR analysis techniques. Results are summarized as below;

- The presence of spectra in UV-VIS area was detected. An inverse relation was found between absorption intensity and wavelength. CD HA showed less steepness while compared with PD (both sunflower and maize).
- HPLC analysis showed presence of hydrophobic end of HA at around tR = 14-16.5.This property of HA could be ascribed as the slow release character of Plant Derived (PD), Coal Derived (CD) and Humic Substances (HA).
- FTIR analysis showed presence of various functional groups such as carboxylic and alcoholic in PD, and CD HA.
- Characterization of HA/HSs helped to identify the structural composition of HA/HSs and identify active adsorption sites for plant nutrients.

Testing and Evaluation of Humic Substances: Series of pot and field experiments were carried out to evaluate the beneficial effect of HA on plant growth and yield.

- The experiment to compare the effectiveness of HA/HSs applied by two different methods such as soil and foliar under field conditions were conducted during reporting period. Results showed an increase of 11-14% in grain yield with application of PD and CD Humic substances in wheat over control where no HA was applied.

- Field experiment was conducted with aim to see the uptake of nutrients as affected by HA application along with micronutrients (MN). Results showed that HA application along with MN enhanced grain yield by around 10 to 30%.

Establishment of Prototype Humic Acid Production Unit: Equipment's were purchased during the reporting year for the installation of prototype of Humic Acid Production Unit at NARC and installation of prototype of Humic Acid Production Unit at NARC was accomplished.

Name of Project: **Farm Productivity Improvement through Management of Artesian Wells in Piedmont Plains of Suleiman Ranges of Dera Ismail Khan, Khyber Pakhtunkhwa**

Name of PI/Institute: **Engr. Noman Latif Sadozai**
PSO, Arid Zone Research Institute, D. I. Khan

Duration: 01. 12. 2012 to 30. 11. 2015

Financial Status:
Total Cost: Rs.5.938 million
Funds Released: Rs.2.281 million
Funds Utilized: Rs.2.279 million

Objectives:

- To quantify the water potential of artesian well in the piedmont plains of Suleiman ranges in D. I. Khan.
- To delineate the possible command area under each well for optimized cropping pattern.
- Introduce improved water management and application technaiques for efficeint utilization of precious water without any energy input.
- Anlayze feasibility of low-cost storage of slack period surplus water and carry over to peak water requirement periods.

Achievements:

Survey for wells locations with longitude, latitude & altitudes was accomplished. Fourteen (14) potential locations were identified with different discharges; however 4 were selected for intervention. Activities regarding measurements of well discharges, collection of rainfall data of the area and command area demarcation carried out. Constructed 550 ft pre cast parabolic segments lining of a water course.

Wheat and rapeseed were sown in demonstration plots under Artesian well at Daraban area of D. I. Khan. A fish pond having size of 2 kanal with plastic lining was constructed. Fish seed obtained from fisheries nursery Bhakkar added in the fish pond to improve the livelihood of farmers. Survey of new Artesian wells conducted in collaboration with a Swiss agency.

Tunnel farming at Artesian well site & Fish shifting in the developed pond
Water course lining, capping of artesian well and meeting with farmer of area.

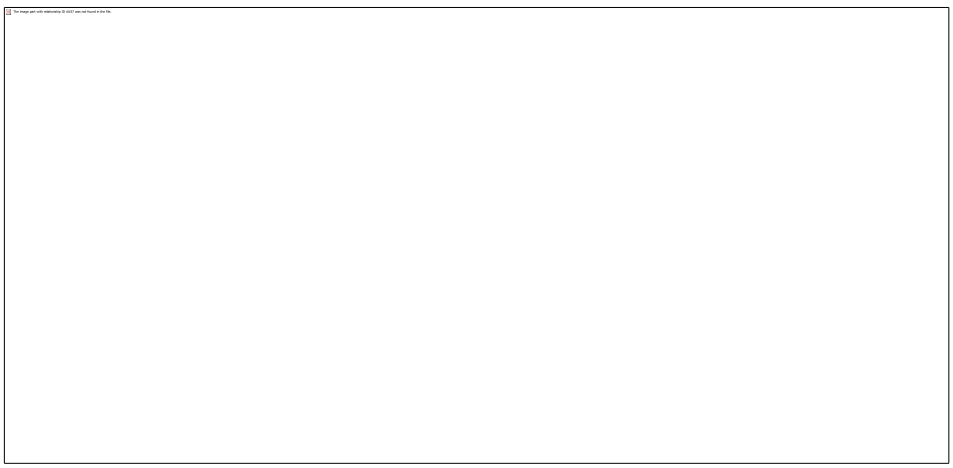
Name of Project:	**Synthesis and Production of Hybrid Silkworm Strains at Pakistan Forest Institute for Promoting Sericulture in Pakistan**
Name of PI/ Institute:	**Dr Ghulam Ali Bajwa** Coordinator Sericulture, Sericulture Division, Pakistan Forest Institute, Peshawar
Duration:	15.04.2013 to 14.04.2016
Financial Status:	Total Cost: Rs.6.938 million Funds Released: Rs.4.028 million Funds Utilized: Rs.2.853 million

Objectives:

- Synthesis/evolution of Bivoltine hybrid silkworm strains.
- Assessment of heterosis/hybrid vigour.
- Assessment of field performance of newly synthesized hybrid strains.
- Production of silk seed for different stakeholders.

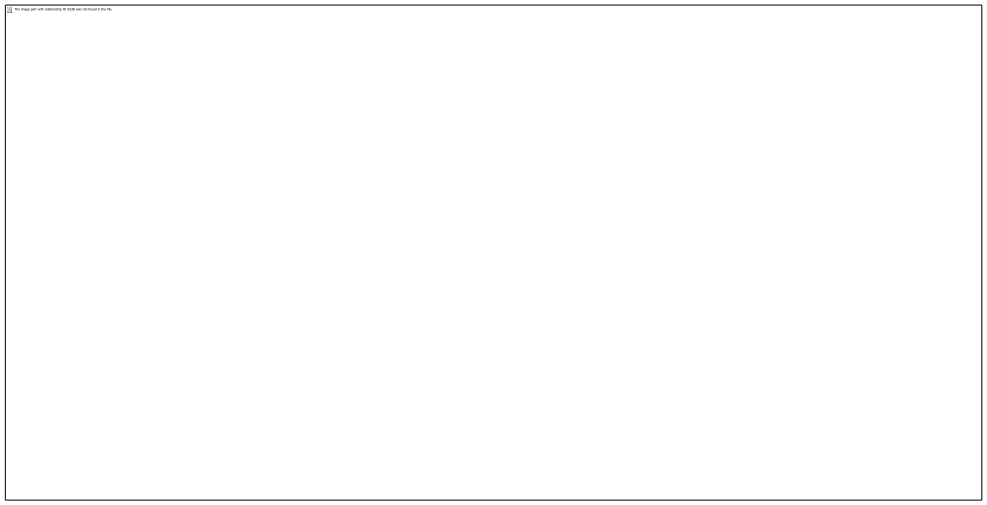
Achievements:

A mulberry nursery, both in tubes and beds was raised at Pakistan Forest Institute, Peshawar. Six mulberry varieties including exotic sources, two each from Japan and Korea, and one each from China and Pakistan were planted. A total of 4,200 saplings were prepared. Besides, a mulberry gene bank/research garden was established at PFI Field Station, Bhurban (Murree), 3246808 N latitude, 1088360 E longitude at 1832 m above sea level. More than 64% plantation survival was achieved in autumn plantation after first overwintering.



Mulberry Nursery established at PFI

Synthesis of Hybrid Silkworm Strains and Heterosis Assessment: Silkworm rearing was conducted for synthesizing hybrids, assessing heterosis effect, maintaining silkworm germplasm and producing silk seed. Silkworm rearing was conducted in Autumn Silkworm Rearing Season 2013 (ASRS 2013) and Spring Silkworm Rearing Season 2014 (SSRS 2014). Performance of hybrids was also assessed at field level during SSRS 2014 for which inbred lines as well as newly synthesized hybrids were reared at Afzalpur, Mirpur (AJK) in collaboration with Sericulture Department, Government of AJK. The eggs were incubated at 25±1°C and 80±5% relative humidity and obtained 85 to 97 percent egg hatching. The egg hatchability varied with silkworm strain, season and rearing location.



Hybrid 4th Instar larvae reared during SSRS 2014

Overall results showed that growth performance of silkworm strains was superior during SSRS 2014 compared to ASRS 2013. Fecundity and larval body weight was improved by 2.9% and 10.0% in hybrids. In addition to the highest egg hatchability of 97.4% of 205PO*J101, seven hybrids gave egg hatchability >95% during SSRS 2014. First time larval body weight of 6.06 g and cocoon weight of 3.1 g was obtained in C102 and 206PO*J101, respectively. Overall, hybrid cocoon shell weight and shell-cocoon ratio increased by 4.6% and 3.8%, respectively. The hybrid cocoon dimensions were improved by 2.1% in length and 2.7% in width.

Seven hybrids resulted in mean Multiple Evaluation Index >50. J101*205PO, 205PO*206MKD and C102*205MKD showed positive heterosis effects for nine quantitative traits. Cocoon weight, cocoon shell weight and cocoon yield was enhanced by 7.7%, 9.4% and 7.7%, respectively over Mid Parent performance, while larval body weight was improved by 8.2% over Mid Parent performance in J101*205PO. Larval body weight, cocoon weight, shell-cocoon ratio and cocoon yield was improved by 17.7%, 15.5%, 17.4% and 27.6%, respectively over Better Parent performance. The highest Cumulative SF was 7.5% for 205PO*J101. Based on mean Evaluation Index and Cumulative SF, C102*206MKD was ranked first during ASRS 2013 at PFI, as well as, during SSRS 2014 at

Afzalpur, while 206PO*J101 was ranked at first position during SSRS 2014 at PFI. Resistance against diseases and climatic conditions was improved in hybrids.

Outreach Activities: A survey was conducted using structured questionnaire at Changa Manga, Kasur to assess community perception about role of Sericulture in livelihood enhancement of rural communities. Overwhelming majority of respondents agreed that Sericulture was profitable cottage industry (98.1% positive response) which could enhance livelihood of rural communities (100% positive response). Occurrence of silkworm diseases was highlighted as a problem of paramount importance which was ruining Sericulture in the area.

Focused Group Discussion during Field Survey

Silk seeds were provided to the (i) Directorate of Non-Timber Forest Produce, Forest Department, Government of Khyber Pakhtunkhwa, (ii) Sericulture Wing, Forest Department, Govt. of the Punjab, and (iii) Department of Agri.-Entomology, University of Agriculture, Faisalabad. Also provided mulberry propagating materials to the Sericulture Department, Govt. of AJK.

Published a booklet titled *"Manual for Sericulture"* in Urdu for different stakeholders. One research paper has published in a National journal.

Name of Project:	**Nutrient Management for Cotton Productivity by Conjoint Use of Organic and Inorganic Fertilizers under Extended Cultivation Regimes (Component-I)**
Name of PI/ Institute:	**Dr Ejaz Rafique** Principal Scientific Officer, LRRI, NARC, Islamabad
Duration:	15.03.2013 to 14.03.2016
Financial Status:	Total Cost: Rs.7.500 million Funds Released: Rs.4.807 million Funds Utilized: Rs.3.727 million

Objectives:

- Determine/ appropriate nutrient requirement of Bt cotton as well as traditional non-Bt under extended cultivation regimes using organic and inorganic sources.
- Study soil nutrient balances/budgets [Inputs - (Removal + Losses) = Balance] as a consequence of manuring and cropping- *knowledge on farm in-gate nutrient balance sheets helps determine wise and economical fertilizer use strategies, with enhanced productivity.*

Achievements:

One 3-year (medium-term) permanent layout field experiment was initiated at 4 sites, i.e., Alwardi Khan, Harappa (2/10-L), Chak 6/11-L and Chak 142/9-L in Sahiwal division for determining appropriate nutrient requirement of Bt cotton as well as traditional non-Bt cotton under extended cultivation regimes using organic and inorganic sources with special emphasis on (i) crop productivity; (ii) nutrient uptake; (iii) yield trends; (iv) apparent soil nutrient balances; and (v) selected chemical properties. Summarized findings of the study are:

- Nutrient treatment effects on seed cotton yield, boll weight and boll bearing of both cultivars were significant across the sites during the year. Treatment effects as well as yield potential of Bt cotton were relatively higher as compared to traditional non-Bt cotton. Lowest seed cotton yield of both cultivars was obtained with farmers' fertilizer use practice (T_1). Application of recommended fertilizer dose (T_2) increased seed cotton yield ranging from 16 to 24% for Bt and 12 to 22% for non-Bt cultivars over T_1. Increase in seed cotton yield obtained with balanced nutrient management (T_3; 75% of T_2 + micronutrients) varied from 14-23% for Bt and 12-23% for non-Bt cotton. Highest seed cotton yield was observed consistently with integrated nutrient management (T_4; 75% of T_3 + farmyard manure, i.e, 75% N from fertilizer + 25% N from FYM) which varied from 17-25% for Bt and 14-23% for non-Bt cotton. There was considerable increase in seed cotton yield of both cultivars across the sites with T_5 (75% of T_3 + humic acid) and T_6 (75% of T_3 + biozote). However, extent of increase in seed cotton yield under T_5 and T_6 was lower compared with T_2-T_4.
- As the relationship between seed cotton yield and boll bearing/boll weight was highly significant, obviously this yield component was directly responsible for determining the quantum of seed cotton harvest

- Nutrient concentrations (N, P, K, Zn and B) in diagnostic leaves (4^{th} leaf from the top at flower initiation) of both cultivars varied as consequence of nutrient treatments without following any particular trend across the sites. Leaf nutrient concentrations in plant tissue receiving T_1 were significantly lesser than the nutrient concentrations exhibited with other treatments. Highest nutrient concentrations were observed with T_4 treatment in both cultivars.

- Nutrient uptake pattern by both cultivars tended to closely resemble those of yields. However, nutrient uptake by both cultivars was relatively higher at Chak 142/9-L because of greater yield potential and higher nutrient concentrations in diagnostic plant parts.

According to initial findings, application of INM (T_4 treatment, i.e., 225 kg N ha^{-1} (170 kg N from inorganic source & 56 kg N from FYM) + 80 kg P_2O_5 ha^{-1} +70 kg K_2O ha^{-1} + 5 kg Zn ha^{-1} + 1 kg B ha^{-1}) increased seed cotton yield by 17-25% for Bt and 14-23% for non-Bt cotton over T_1 (FFU). The increase in seed cotton yield with INM treatment (where substantial less fertilizers were used), was at par or even little higher compared with increase in yield recorded with recommended dose (as per Agri. Deptt., Govt. of Punjab), i.e., 400 kg N ha^{-1} + 150 kg P_2O_5 ha^{-1} + 125 kg K_2O ha^{-1} that varied from 16 to 24% for Bt and 12 to 22% for non-Bt cultivars. Inclusion of Biozote and Humic acid with chemical fertilizers also helped in increasing crop productivity and reducing the fertilizer use.

Thus, INM appears convincingly beneficial and can play a vital role in increasing farmer's income for better livelihood. Further, INM holds great promise in achieving not only a high level of soil fertility and crop productivity, but also against emergence of multiple nutrient deficiencies and deterioration of soil physical health and leads to sustainable cotton productivity.

Name of Project:	**Nutrient Management for Cotton Productivity by Conjoint Use of Organic and Inorganic Fertilizers under Extended Cultivation Regimes (Component-II)**
Name of PI/ Institute:	**Dr Fiaz Ahmad** Scientific Officer/PI, Physiology/Chemistry Section, CCRI, Multan
Duration:	15.03.2013 to 14.03.2016
Financial Status:	Total Cost: Rs.3.838 million Funds Released: Rs.1.012 million Funds Utilized: Rs.0.460 million

Objectives:

- Determine/ appropriate nutrient requirement of BT cotton as well as traditional non-Bt under extended cultivation regimes using organic and inorganic sources.
- Study soil nutrient balances/budgets [Inputs - (Removal + Losses) = Balance] as a consequence of manuring and cropping- *knowledge on farm in-gate nutrient balance sheets helps determine wise and economical fertilizer use strategies, with enhanced productivity.*

Achievements:

After field surveys, four sites were selected, three at farmers fields; and one at CCRI as per detailed below:

1. Naseer Pur, Shujabad
2. 6-MR at Vehari Road
3. Chak 5-Faiz at Lodhran Road
4. CCRI, Multan

Pre-sowing soil samples were collected from all sites for the determination of soil physical characteristics and indigenous nutrient status. Sowing of the trials was done in the months of April/May 2014 after applying the proposed fertilizer, manure and humic acid treatments. Cotton seed was also treated with Biozote for sowing in respective plots. Crop management and plant protection measures were carried out throughout the cropping season. Crop progress was monitored by recording data on vegetative and reproductive development.

Diagnostic leaf sampling for nutrient concentrations has been done from two experimental sites. Likewise first pick of seed cotton has been done from two sites (i.e. CCRI, Multan, Naseer Pur, Shujabad) for yield estimation.

Name of Project:	**Nutrient Management for Cotton Productivity by Conjoint Use of Organic and Inorganic Fertilizers under Extended Cultivation Regimes (Component-III)**
Name of PI/ Institute:	**Mr. Mukhtiar Ali Channa** Soil Fertility Officer, Soil Fertility Section, Agri. Research Institute, Tandojam
Duration:	15.03.2013 to 14.03.2016
Financial Status:	Total Cost: Rs.4.950 million Funds Released: Rs.1.407 million Funds Utilized: Rs.1.281 million

Objectives:

- Determine/ appropriate nutrient requirement of Bt cotton as well as traditional non-Bt under extended cultivation regimes using organic and inorganic sources.
- Study soil nutrient balances/budgets [Inputs - (Removal + Losses) = Balance] as a consequence of manuring and cropping- *knowledge on farm in-gate nutrient balance sheets helps determine wise and economical fertilizer use strategies, with enhanced productivity.*

Achievements:

Soil experimental sites were selected from the four districts (Sanghar, Mirpur Khas, Tando Allahyar and Hyderabad) of Sindh province and characterized for the permanent layout. Soil samples from the selected sites were taken and analysed for macro and micronutrients as well as for physico-chemical properties of selected sites.

Initiated medium term field experiment after seed bed preparation, fertilizer application and sowing of cotton crop in all four districts and all the basic yield parameter recorded. Application of fertilizer according to treatment plan will help to evaluate the response of nutrients in different soils and variety (BT cotton & Non BT-cotton).

Sampling and analysis of plant tissues from the crop is in process. This will help to evaluate the response of applied fertilizers, their uptake, losses, genotypically response and the effect on seed cotton.

Name of Project: **Investigation into Effectiveness of the Concept of Farmer's Field School (FFS) in Agricultural Development in Districts Malakand, Swat and Charsadda**

Name of PI/Institute: **Dr Khalid Nawab**
Professor, Department of Agriculture Extension, Education and Communication, The University of Agriculture, Peshawar

Duration: 01.12.2012 to 30.11.2014

Financial Status: Total Cost: Rs.1.654 million
Funds Released: Rs.0.801 million
Funds Utilized: Rs.0.756 million

Objectives:

- To study the impact of FFS on productivity of the major crops.
- To determine increase in per acre yield of the same crop.
- To find out reduction in per acre input cost.

Achievements:

To achieve the objectives of the project, studies were conducted to assess the role of FFS in increasing major crops including maize, bitter gourd and tomato in districts Malakand, Swat and Charsadda. During reporting year data collected was analysed and statist comparison of seed quantity and seed cost per acre of tomato in Swat before and after FFS, cost of fertilizer, cost of crop protection and cost of farm yard manure of tomato per acre before and after FFS in Swat and yield and income per acre before and after FFS in Swat carried out. The results are summarized as under:

- It was found that the mean seed quantity of tomato used in the study area before FFS was 290.50 gm per acre while after FFS it was 130.39 gm pr acre. The t value (24.12) shows a significant difference ($p<0.05$) between the mean seed quantity used before and after FFS in the study area as t_{cal} (24.12)>t_{tab} (1.98) at 5% level of significance.

- The mean seed cost incurred before FFS in the study area was Rs.3835.0 per acre while it was Rs.4316.8 per acre after FFS. The t-value (31.79) shows a significant difference ($p<0.05$) between the mean seed cost incurred before and after FFS in the study area as t_{cal} (31.79)> t_{tab} (1.98) at 5% level of significance.

- It was found that mean of cost of fertilizer incurred before FFS was Rs.13948.0 per acre while it was Rs.5080.0 per acre after FFS in the study area. Higher cost of fertilizer after FFS is due to inflation in the prices of fertilizers in the study area. The t-value (61.48)

shows a significant difference ($p<0.05$) between the mean cost of fertilizer incurred before and after FFS in the study area as the t_{cal} (61.48) > t_{tab} (1.98) at 5% level of significance.

- It was found that the mean cost of crop protection incurred before FFS was Rs.6462.50 per acre while it was Rs.829.25 per acre after FFS. The much higher cost of crop protection before FFS was mainly due to injudicious use of expensive chemicals by the farmers of the study area which was replaced by trichograma cards which is a biological measure of crop protection recommended at FFS that is much cheaper and eco-friendly. The t-value 54.75 shows a significant difference ($p<0.05$) between the mean cost of crop protection before and after FFS in the study area as the t_{cal} (54.75) > t_{tab} (1.98) at 5 % level of significance.

- The mean cost of farm yard manure before FFS was found to be Rs.7918.60 per acre while after FFS it was Rs.8398.8 per acre in the study area. The higher cost after FFS was mainly due to the inflation in cost of farm yard manure and transportation. The t-value (-15.52) shows a significant difference ($p<0.05$) between the mean cost of farm yard manure before and after FFS in the study area as the t_{cal} (-15.52) > t_{tab} (1.98) at 5% level of significance.

- The mean yield of tomato before FFS was 9508.80 kg per acre while it was 12735.00 kg per acre after FFS in the study area. The higher yield of tomato crop after FFS was mainly due to the adoption of modern farming activities by the farmers that were recommended at FFS in the study area. The t-value (2203) shows a significant difference ($p<0.05$) between the mean yield per acre before and after FFS in the study area as the t_{cal} (-22.03) > t_{tab} (1.98) at 5% level of significance.

- The mean income of tomato growers before FFS was Rs.201750.0 per acre while it was Rs.288880.0 per acre after FFS in the study area. The higher income of tomato growers after FFS was mainly due to the higher production per acre by adoption of modern farming activities recommended at FFS in the study area.

- The farmers of the study area were asked about the adoption of FFS approach in future that is whether they will adopt FFS approach or not. It was found that 74 respondents were willing to adopt FFS approach in future while the respondents not in the favour of adopting FFS approach in future were 6 in number.

Name of Project: **Economics of Using Alternative Energy Sources and Adoption of Energy Saving Practices by the Farmers under Current Energy Crisis in Pakistan**

Name of PI/Institute: **Mr. Nadeem Akmal**
Senior Scientific Officer, SSRI, NARC, Islamabad

Duration: 01.10.2012 to 30.06.2015

Financial Status:
Total Cost: Rs.3.596 million
Funds Released: Rs.1.827 million
Funds Utilized: Rs.1.543 million

Objectives:

- To study the economics of alternative energy sources currently used in the agriculture sector in selected ecologies of Pakistan.
- To study the adoption of energy saving practices by the farmers in different cropping systems.
- To carry out the comparative analysis of electric and diesel tube wells in different ecologies of Pakistan.
- To study the effects of switching from conventional to new energy sources at farm level.
- To suggest measures for rapid promotion of use of alternative energy sources.

Achievements:

Data collection tool/ comprehensively structured questionnaire for collecting required information from all stakeholders about alternative energy sources like solar water pumps, biogas and biodiesel being used in agriculture sector of Pakistan formulated. Primary data collected through interviews of 43 respondent farmers in Punjab province using electric/ diesel as energy source, information gathered from 17 respondents who were using Bio-gas as energy source, interview 9 farmers using solar energy and interview 38 farmers using raised bed plantation technique. The significant findings of the data collected are:

- Bio-gas and solar technology are found rare but emerging alternative energy sources at study sites. Based on farmers' information and preliminary analysis, the sophisticated bio-gas plant could be considered as the most feasible and economical alternative energy source of energy rather it is supplemented with diesel.
- Bio-slurry, a byproduct of bio-gas, is applied as an organic fertilizer through irrigation water. All the respondent farmers reported a substantial raise in crops yield (15-25 percent) and soil fertility with application of bio-slurry. It also has reduced the use of DAP and Urea.
- Another significant finding was the Raised Bed Plantation technique, which conserves energy through reducing irrigation time from 15-20 percent as well as increases yield (5-10 percent).

Name of Project: **Participatory Development of Tea Value Chain around Mansehra Areas**

Name of PI/Institute: **Mr. Qamar-ul- Zaman**
PSO, NTHRI, Shinkiari, Mansehra

Duration: 01.07.2012 to 30.06.2015

Financial Status: Total Cost: Rs.7.275 million
Funds Released: Rs.1.578 million
Funds Utilized: Rs. 0.650 million

Objectives:

- To analyse field situations for developing tea production clusters through interdisciplinary planning and implementation.
- To assess gender roles for targeting skill development in tea production and value chain activities.
- To conduct on-going evaluation during different phases of tea production and value chain development processes.
- To develop strategic plans for achieving national goals of progressive self-sufficiency in tea production.

Achievements:

Planted 10,000 tea sapling of variety Qi-men at Sum and 5,000 plants at Khaki (Mansehra) at farmer's field. Provided necessary support/ inputs for irrigation system. Establishment work of water tank, reservoir at sum and khaki is in progress (50 % work has been completed). Provided urea fertilizer @23 kg N/ acre at Sum and Battang (6 acre).

Name of Project: **Capacity Building on Writing Technical Proposals for Grants**

Name of PI/Institute: **Dr Muhammad Kamal Sheikh**
PSO, Planning & Development Division, PARC

Duration: 01.10.2012 to 30.09.2015

Financial Status:
Total Cost: Rs.14.420 million
Funds Released: Rs.3.425 million
Funds Utilized: Rs.2.656 million

Objectives:

- Scientists' capacity building in writing skills for technical proposals for competitive grants under ALP.
- Develop a culture of quality technical proposal writing.

Achievements:

Arranged four training workshop with the involvement of IFPRI for technical proposal writing as per detail below:

i. 1st training workshop arranged at Islamabad for trainers of scientists and educators from all over Pakistan. Twelve (12) scientists/educators participated for imparting further training.
ii. 2nd training/workshop arranged exclusively for scientists from Sindh was attended by 18 scientists from University and agriculture/livestock departments.
iii. 3rd training/workshop was held in Islamabad for enhancing the capability of scientists from Balochistan in proposal writing. Eighteen (18) scientists participated in the workshop
iv. Fourth workshop was arranged at Faisalabad whereby 24 scientists and educators from Agriculture University, Faisalabad and agriculture/livestock department get training in proposal writing

Due to the involvement of PSSP-IFPRI in jointly holding workshop, collaboration developed with PSSP-IFPRI, USAID, SAU, UAF, UAP and other Agri. R & D and educational organizations. Prepared and adopt training modules for workshops for technical proposal writing.

Name of Project:	**Agricultural Productivity in Relation to Farmer's Nutritional Status of Mardan**
Name of PI/Institute:	**Dr Zia ud Din** Assistant Professor, Department of Human Nutrition, The Uni. of Agri., Peshawar
Duration:	01.05.2013 to 30.04.2016
Financial Status:	Total Cost: Rs.4.676 million Funds Released: Rs.0.998 million Funds Utilized: Rs.0.950 million

Objectives:

- To get updated information about study population in term of geographical distribution, farmer's population and agricultural area.
- To identify primary sample units (clusters i.e. union councils) and secondary sample units (i.e. farmers).
- To develop questionnaires/pre-test questionnaires for collection of primary data regarding health and nutrition status of farmers
- To recruit team for implementation of the project
- To carry the administrative procedure for purchase of equipments
- To screen farmers through collecting primary data regarding their health and nutrition status
- To computerize, clean and edit the collected data on health and nutrition status of the respondents
- To carry preliminary analysis of the collected data
- To identify farmers for implementation of project interventions

Achievements:

The study aims to find out the interaction of various factors (demographic, socioeconomic and nutritional) that influence food and dietary intake, nutritional status of farmers and farm income. In the first step, Population Census organization local office in District Mardan was requested to provide updated information on geographical and administrative divisions and population distribution of the district. This information was needed to identify the primary Sampling Units (PSUs). Primary sample units (PSU) i.e. Union Councils (UC) were identified and randomly selected to represent District Mardan. The selected UCs were visited to select Secondary Sampling Units (SSU) i.e. farmers. The team was properly trained about the procedures for getting relevant data through accurate measurements.

Questionnaires to gather data on farm income & expenditure, Socio-economic status and nutritional status of the farmers were developed. All questionnaires were standardized and pre-tested during a survey conducted in the rural areas of district Peshawar.

District Mardan is comprised of two tehsils, Takht Bhai & Mardan and 60 UCs located in the rural areas; 20 UCs were randomly selected. Sixty farmers (tenants and / or owners who were physically involved in farming) from each UC were randomly selected initially for screening of nutritional status. Nutritional status of the farmers were assessed taking their anthropometry (body weight, height, mid upper arm circumference (MUAC) & triceps skinfold measurement (TSF), biochemical measurements (random blood glucose level and hemoglobin) and blood pressure.

Intervention materials were developed including materials on nutritional/dietary guidelines and preservation techniques of fruits and vegetables at household level. Nutritional & dietary guidelines' according to WHO/UNICEF recommendations were developed. A total of 600 farmers were screened during March- May 2014. The team computerized the collected data for statistical analysis.

Descriptive analysis was carried out to look for data errors and ensure that all respondents fulfilled *selection criteria*. Mean ($\pm$ Standard Deviation, SD) age of the farmers was 43 ± 8.1 year (range: 20 - 64), free from any chronic disease and all were physically involved in farming activities either as tenant or owner. Other statistical techniques like histograms were used to check distribution of the scale variable i.e. whether their distributions were normal or skewed.

Based on the recommended cut-off values of BMI, blood hemoglobin level and blood pressure, 5%, 14% and 26% of the farmers were underweight, anemic and likely to be hypertensive, respectively. Farmers' work performance in farms' was assessed by taking data on 'regularity to work', 'number of working days per week' and 'usual number of working hours per day', Results of correlation analysis showed a significant association between farmers' work performance and their current nutritional status ($p<0.05$). Findings on 'regularity to work' showed that on average overweight/obese farmers were significantly more likely than their normal weight counterparts to report no regularity to work. Farmer's working days per week' were found in negative relation to their age i.e. senior aged farmers in comparison to young farmers were likely to work in their farms for lesser days per week. Other important findings include association of 'working hours per day' with anthropometric and biochemical measurements of the farmers. Overall, farmers' working hours per day was mildly associated with their age, (r-value; 0.1328, $P<0.05$) and TSF (r-value: 0.1758, $p<0.05$). This association was moderate with farmers' BMI and MUAC (r – values: 0.2101 and 0.2104 respectively, $p<0.001$). However, a strong association between farmers' working hours per day' and blood Hb level was evident (r –value: 0.6471, $p=0.0000$) indicating that blood hemoglobin level has a strong impact on working performance of the farmers in term of their daily productive time.

Based on nutritional status, farmers were grouped as interventional, non- interventional and control group. Using BMI and blood Hb level, total of 88 farmers were identified at the risk of malnutrition. These farmers were randomly dichotomized in intervention and non-intervention groups; an equal 44 healthy farmers were also randomly selected as control. These groups will be followed accordingly in year III as planned in the proposal.