EXECUTIVE SUMMARY

1. Introduction

PARC being the apex coordinating body of agricultural research in the country has supported all segments of the national agricultural research system (NARS) in their quest for improved research and development efforts.

PARC has supported through development projects funded under public sector development program (PSDP), building of labs, research farms, supplied equipment, computers and vehicles. In human resource development PARC has trained scientists abroad from NARS in degree programs i.e. M. Sc. and Ph.D., sent persons on short-term training abroad and has trained persons locally in short-term courses including researchers, teachers, extension workers, NGOs, para-professional staff and farmers.

Initially research schemes were funded through current budget of PARC. However, after the financial constraints, this funding mode was discontinued. Funding of research projects was then started from Agricultural Research Endowment Fund, established by the Government of Pakistan in 1999 for Rs.1.3 billion for Agricultural Linkages Program (ALP). The objectives of ALP is to promote and support agricultural research and development activities in accordance with the Pakistan's long term development goals and to promote long term scientific cooperation between Pakistan and the United States in agriculture sector.

2. Progress

This program is fully functional since 2000 and successfully launched four batches of projects. The research projects are being implemented in federal and provincial agricultural research centre, institutes, stations and universities etc. During the year 2009-10, two meetings (16th and 17th) of Technical Advisory Committee (TAC) of Board of Directors (BOD) and 10th meeting of BOD of ALP were organized and approved 22 projects for funding. Two meetings of in-house review were arranged for assessment of the progress of 09 projects of crop sciences and 08 of natural resources sector. Onsite review and field evaluation of 05 projects falling in animal sciences and 10 of crops sciences sector was also carried out during the report year 2009-10.

The ALP projects covers plant sciences, natural resources, animal sciences and social sciences sectors. In total 255 projects have been completed by June 30, 2010, whereas 49 were in operation as on July 1, 2010. Twenty two (22) projects of 4th batch of ALP has been started on signing the project implementation agreement between PARC and host institutes during January to March, 2010. These projects focus on irrigation system for enhancing water productivity, use of alternate energy sources for pumping water in agriculture, enhancement of phosphorus from rock phosphate, seed production of multi-purpose trees and forage species and poverty reduction through involvement of women. The 5th batch was announced in March 2010. Six projects of 5th batch have been approved in 11th BOD meeting on 23.10.2010 which will focus on development of bio-fertilizers from bones, mechanized multipurpose nursery raising technology, organization

of Rawal watershed through process of social organizations, commercialization of multipurpose synthesized bio-fertilizers (inoculant), formulation of bio-fertilizers for crop production and establish cooperative milk marketing facilities at Fateh Jang. On signing project implementation agreement, these projects have also been started. In total 55 ongoing projects are being implemented at various research institutes and universities as on January1, 2011.

The sector wise numbers of projects completed by December 31, 2010 in various research institutes and universities are as follows:

Completed Projects by December 31, 2010

S.No	***Name of Institutions***	***No of Projects***				***Total***
		Animal Sciences	***Crop Sciences***	***Natural Resources***	***Social Sciences***	
Federal						
1	PARC/NARC, Islamabad	13	33	12	04	62
2	AZRC-PARC, Quetta	1	-	04	-	05
3	PCRWR, Islamabad	-	-	02	-	02
4	NIAB, Faisalabad	-	05	01	-	06
5	NIBGE, Faisalabad	02	06	01	-	09
6	NIFA, Peshawar	-	05	-	-	05
7	NIA, Tandojam	-	05	-	-	05
8	SARC-PARC, Karachi	02	05	-	-	07
9	PFI, Peshawar	-	-	01	-	01
10	TTI-PARC, Peshawar	-	-	-	01	01
11	TTI-PARC, Tandojam	-	-	-	03	03
12	TTI-PARC, Faisalabad	-	-	-	01	01
13	TTI-PARC, Quetta	-	-	-	01	01
14	TTI-PARC, Muzaffarabad, AJ&K	-	-	-	01	01
15	TTI-PARC, Gilgit	-	-	-	01	01
16	MARC-PARC, Juglot, Gilgat	01	-	-	-	01
17	CABI Bio Sciences, Rawalpindi	-	03	-	-	03
18	PARC-IPM, Sub station, Multan	-	01	-	-	01
19	FATA Kurram Agency, Parachinar	-	01	-	-	01
	Total	***19***	***64***	***21***	***12***	***116***
Punjab						
20	University of Agriculture, Faisalabad	17	11	08	07	43
21	PMAS Arid Agri. Uni., Rawalpindi	-	06	02	01	09
22	UV&AS, Lahore	07	-	-	-	07
23	AARI, Faisalabad	-	06	01	-	07
24	RRI, Kala Shah Kaku	-	01	-	-	01
25	BARI, Chakwal	-	03	-	-	03
26	SSRI, Pindi Bhattain	-	-	01	-	01
27	LPRI, Bahadurnagar, Okara	01	-	-	-	01
28	Fisheries Hatchery, Govt. of Punjab, Rawal Town, Islamabad	01	-	-	-	01
29	University of Punjab, Lahore	-	-	-	01	01
30	B.Z.U., Multan	-	01	-	-	01

31	Green Bio Tech., Lahore	-	-	-	01	01
	Total	***26***	***28***	***12***	***10***	***76***
Sindh						
32	Shah Abdul Latif Uni., Khairpur	-	-	01	-	01
33	University of Karachi, Karachi	03	05	-	-	08
34	Sindh Agri. University, Tandojam	01	-	-	02	03
35	ARI, Tandojam	-	04	-	-	04
36	Kundi Buffalos Farm, Rohri	01	-	-	-	01
37	Indus Dev. Resource Centre, Sehwan Sharif, Sindh	01	-	-	-	01
38	University of Sindh, Jamshoro	01	-	-	01	02
39	HRI, Mirpur Khas	-	01	-	-	01
	Total	***07***	***10***	***01***	***03***	***21***
NWFP						
40	KPK Agri. University, Peshawar	03	09	07	01	20
41	Gomal University, D. I. Khan	-	01	01	-	02
42	ARI, Tarnab, Peshawar	-	02	01	-	03
43	ARS, Mangora, Swat	-	01	-	-	01
44	CCRI, Pirsabak	-	01	-	-	01
45	VRI, Peshawar	02	-	-	-	02
46	ARI, D. I. Khan	-	02	-	-	02
47	BARS, Jarma, Kohat	-	01	-	-	01
	Total	***05***	***17***	***09***	***01***	***32***
Balochistan						
48	University of Balochistan, Quetta	02	01	-	01	04
49	ARI, Sariab, Quetta	-	03	02	-	05
	Total	***02***	***04***	***02***	***01***	***09***
Azad Jumma & Kashmir						
50	Agri. Department, Muzaffarabad	-	-	01	-	01
	Total	***-***	***-***	***01***	***-***	***01***
	Grand Total	**59**	**123**	**46**	**27**	**255**

The list of completed projects showing the title, name of PI/institute, total cost, releases and expenditure is given in Annexure-I.

The ongoing research projects are in operational stage and research is being continued as per objectives and plan of work. The province and institute wise detail of the ongoing projects is as follows.

On-Going Projects as on January 1, 2011

S. No	***Name of Institutions***	***No of Projects***				***Total***
		Animal Sciences	***Crop Sciences***	***Natural Resources***	***Social Sciences***	
Federal						
1	PARC/NARC, Islamabad	01	05	09	2	17
2	AZRC-PARC, Quetta	-	-	02	-	02
3	AZRC-PARC, Bahawalpur	-	-	03	-	03
4	AZRI-PARC, D. I. Khan	-	-	03	-	03

5	AZRI-PARC, Umerkot	-	-	02	-	02
6	WRRI Field Station, PARC, Thana Bola Khan	-	-	01	-	01
7	SARC-PARC, Karachi	-	01	-	-	01
8	NSCRI-PARC, Thatta	-	01	-	-	01
8	MARC-PARC, Gilgit	-	-	01	-	01
9	NIAB, Faisalabad	-	-	01	-	01
10	NIFA, Peshawar	-	01	02	-	03
11	Livestock Development Foundation, Islamabad	01	-	-	-	01
12	Idara-e-Kissan, Lahore	-	-	-	01	01
	Total	***02***	***08***	***24***	***03***	***37***
Punjab						
13	Uni. of Agriculture, Faisalabad	-	01	02	-	03
14	PMAS Arid Agriculture University, Rawalpindi	-	01	-	-	01
15	University of Vet. & Animal Sciences, Lahore	02	-	-	-	02
16	AARI, Faisalabad	-	01	-	-	01
17	Shakar Ganj Sugar Res. Inst., Jhang	-	01	-	-	01
	Total	***02***	***04***	***02***	***-***	***08***
Sindh						
18	University of Sindh, Jamshoro	-	01	-	-	01
19	ARI, Tandojam	-	-	01	-	01
	Total	***-***	***01***	***01***	***-***	***02***
NWFP						
20	KPK Agricultural University, Peshawar	-	-	01	-	01
21	ARI, Tarnab, Peshawar	-	01	01	-	02
22	ARI, D. I. Khan	-	01	-	-	01
23	ARS, Karak	-	-	01	-	01
24	Sugar Crop Res. Inst. Mardan	-	01	-	-	01
25	Al-Moiz Indus. D. I. Khan	-	01	-	-	01
	Total	***-***	***04***	***03***	***-***	***07***
Balochistan						
26	ARI, Sariab, Quetta	-	-	01	-	01
	Total	***-***	***-***	***01***	***-***	***01***
	Grand Total	**04**	**17**	**31**	**03**	**55**

The list of ongoing projects which remain in operation as on January 1, 2011 in various research institutes and universities is given at Annexure-II.

Research was conducted during the reporting year (2009-10) under ongoing ALP research projects in Animal Sciences Sector on breeding and seed production of Channel catfish; studies on reproductive physiology of one humped camel; synchronization of estrus in buffaloes to enhance fertility; feeding management for growth and first lactation performance in Sahiwal cattle; production of thermostable Newcastle disease vaccine for rural poultry; induced breeding and fry rearing techniques of indigenous catfish, *Rira rita*; reproductive performance of Seengharee *Aorichthys aor;* phenotypic and genetic characterization of indigenous breeds of

caprine and ovine species in Punjab; identification of molecular markers of fecundity in goat breeds of Pakistan; and production of genetically superior breeding bulls of Kundhi buffaloes breeds in Sindh.

The research and studies in projects of Plant Sciences focused on evaluation and screening of sugarcane germplasm for frost tolerance; evaluation of commercial potential of sugar beet genotypes for their adoptability in different ecologies of Pakistan; use of spectral reflectance to estimate growth, biomass and yield of different wheat cultivars under moisture stress conditions; determination of the optimum maturity indices of various mango varieties; survey of midges and their natural enemies associated with mango and develop non pesticides measures for their control; investigation on viral diseases of sugarcane; management of date palm insect pests in Sindh; development of high yielding and powdery mildew resistant varieties in peas; identification and evaluation of *Gossypium arboretum* genes for cotton leaf curl virus resistance; development of wheat heat tolerant breeding material; investigation on pesticides residues in fruits and vegetables in KPK; enhancement of quality and storage stability of Dhakki Dates; development of salt tolerance sugarcane through genetic engineering; drying and storage of exportable chilies to control aflatoxins contamination; and phenotypic plasticity of safflower in response to environment and integrated nutrient management.

In Natural Resources work conducted under ALP projects on the studies on IPM with reduced chemical beekeeping approach to avoid related treatment resistance of parasitic mites, honeybee diseases and pests; soil salinity monitoring under various resource conservation technologies adopted in various ecologies; management and improvement potential of rangelands of Balochistan; evaluation of nitrification inhibitors for reducing nitrogen loss under irrigated cotton-wheat system; enhancing stone fruit productivity through integrated nutrient management; assessment of toxic metals in agriculture products; microbial ACC-deaminase biotechnology for sustainable production of legumes; carbon sequestration through tillage, organic matter and mulch managing soil quality for sustainable crop production; effect of different irrigation and mulching materials on growth, yield and quality of onion; centre pivot irrigation system for enhancing water productivity; use of alternate energy system for pumping water; solubility enhancement of phosphorus from rock phosphate; improve palatability and nutritive value of comparatively low palatable forage species; seed production of multi-purpose trees; management of Rawal watershed; commercialization of bio-fertilizer; and quality improvement of bio-fertilizer.

Research and studies carried out in Social Sciences sector include economic analysis of intercropping in sugarcane in Sindh; model women network of livestock farmers for poverty reduction and angora rabbit farming as high value livelihood source for Pakistani women.

Useful research information has been generated through research studies conducted under these projects. The projects contributed in form of new knowledge and training of research students in universities for their thesis research work for award of master and Ph. D degrees.

3. *Salient Scientific Achievements of Completed Projects*

Animal Sciences

- Prepared and standardized 4 different *Staphylococcus* vaccines viz; (i) Dextran sulphate adjuvanted bacterin, (ii) plain bacterin, (iii) live attenuated vaccine, and (iv) oil adjuvanted becterin with 100% protection in rabbits by all except 80% protection by live attenuated vaccine for immunological control of Staphylococcus aureus mastitis in buffaloes. (University of Agriculture, Faisalabad)
- Developed methodology for farming mud crab in the coastal earthen ponds in saline conditions. This will help in promoting crab aquaculture on scientific line in coastal belt of Pakistan for both domestic and export market. (University of Karachi)
- Urea molasses block technology has been improved and the refine version has given better results which offer an easy and economical method of supplementing buffalo calves under low quality roughages feeding system. This has resulted in better growth rate and net benefit. (ASI, NARC)
- Two thousands fingerlings of channel catfish were imported and cultured in polyculture system with major Chinese carps without affecting the growth of carps. (Aquaculture & Fisheries Program, NARC)
- An income of Rs.1.723 million generated on account of sale of breeding buffalo bulls to the private breeders (Livestock Production Research Institute, Bahadarnagar, Okara)
- Five medicines namely Ivomec, Endectin, Dectomax, Euvectin and Promectin were found 100% effective in controlling warble fly disease. Administration of these indictable during the 1st to 3rd week of September was safe and did not cause any side effects to the treated animals. (ASI, NARC)
- The Infectious Bronchitis Virus (IBV) vaccine has been prepared for control of disease in Chicken (ASI, NARC)
- Milk Starter Bank has been developed for fermentation of milk products (Dairy Technology, NARC)
- Percentage ingredients composition of early weaning diet for calf feeding and milk replacer has been identified after the nutritional comparison of whole milk, milk replacer and early weaning diet (ASI, NARC)
- The national list of animal genetic resource for sheep is extended, and one of the unique resources has been added on the nation's account. The breed is exclusively the property of Pakistan and only found in Chitral. No breed similar in morph metric or performance traits was found in neighboring regions of Pakistan and Afghanistan (KPK Agricultural University, Peshawar)
- High energy protein and low energy protein rations computed. (Sindh Agricultural University, Tandojam)
- An open nucleus breeding scheme accompanied with higher selection intensity for improvement of Red Sindhi cattle herd has been introduced at Livestock Experiment Station, Karachi

- Ultrasonography technique for monitoring of reproductive functions in dairy animals was established at NARC Islamabad.
- Trivalent foot mouth disease (FMD) vaccine was prepared and is being evaluated in farm animals which gave satisfactory result. (UV&AS, Lahore)
- Information on Epedemiology of Helminthiasis in sheep has been generated at UV&AS, Lahore
- Database on mineral profile of feedstuffs, their availability and strategic supplementation of mineral block to dairy animals has been developed
- Brood stock of Channel Catfish was developed from imported channel catfish stock. Hundred channel catfish yearling with an average weight of 1650g were stocked in 0.1 ha earthen pond @1000 fish/ha. The Channel Catfish fingerling and brooders were successfully transferred to different fish farmers.

Crop Sciences

- One hundred and fifty five grape species accessions collected and maintained at field gene bank at PGRP and HRI, NARC. 354 genotypes of *Pisum sativum* characterized for qualitative and quantitative traits. (PGRP, NARC)
- Out of 177 genotypes of *Pisum sativum* screened against powdery mildew, 13 found resistant are available to breeders. (PGRP, NARC)
- After screening of drought tolerant genotypes of wheat, identified 29 genotypes /lines for wheat breeders to cope with the emerging challenge of acute water shortage by evolving drought tolerant varieties. (NIA, Tandojam)
- Four lines of wheat found heat tolerant at grain formation stage under high temperature conditions in plastic sheet tunnel, were used to develop new crosses with commercial varieties. One of the wheat advance lines, Shafaq-06 found heat tolerant was released for general cultivation. (AARI, Faisalabad)
- Crossed durum wheat with one of the salt tolerant accession *Aegilops geneculata* and produced "Durugen" which combines salt and water deficiency tolerance. Durugen is a natural allopolyploid with 4 genomes: $AABBU^{o}U^{o}M^{o}M^{o}$ (NIAB, Faisalabad)
- Useful genetic variability (*Brassica juncea L.)* in important agronomic and quality characters was created with gamma rays induced mutations and classical breeding techniques. (NIFA, Peshawar)
- Canola Hybrid development: Fourteen stable CMS lines (A-lines) along with their maintainers (B-lines) have been developed. Stable fertility restorer lines of canola such as R-26 developed and maintained and four crosses of canola (BLN-877 x R-26, CON-I x R-26, CON-II x R-26, Rainbow x R-26 and Sponsor x R-26) better in yield performance identified. (Oilseed Program, NARC)
- Twenty nine superior lines having resistance towards mustard aphid and better in yield and oil content have been developed through inter and intra-specific crosses of *Brassica juncea, Brassica campestris* & *Brassica carinta*. (KPK Agricultural University, Peshawar)
- Seven blight resistant chickpea genotypes with high yielding potential were identified from exotic material through molecular breeding of Kabuli Chickpea. (Pulses Program, NARC)

- Identification of resistant lines (major pulses crops) to viral diseases has been carried out and is being used by local breeders to develop virus resistant high yielding cultivars of legume crops. (Pulses Program, NARC)
- Five high yielding & flower shedding tolerant mutants/recombinants of Mungbean has been developed (NIFA, Peshawar)
- Lines of Moth bean resistant to yellow mosaic virus (YMC) identified. Two lines; Dera Moth and Green Moth (Fodder) approved by the KPK Provincial Seed Council were released for cultivation in southern district of KPK.
- Studies on malformation of mango have lead to identification of causal organism of the disease as *Fusarium. magniferae*. Strategy of consecutive clipping and chemical spray has proved successful in minimizing the malady. (AARI, Faisalabad)
- Standardized protocols for invitro shoot proliferation and rooting (peach rootstock GF-677); and field nursery of greenhouse acclimatized plants developed. (Fruits Program, NARC)
- Protocol established for germplasm conservation & cryo-preservation of grapes, peaches, pear and potato. (PGRP, NARC)
- Seedless trait in Kinnow was cloned and plants produced by sprout/shoot apex and embryo grafts. Unique seedless Kinnow plants obtained from nucleolus callus embryogenesis. (NIAB, Faisalabad)
- Throw-in Type (Axial Flow) Rice Thresher developed and successfully demonstrated to farmers and 500 units were brought in operation. (FMI, NARC)
- Multi-crop Mobile Seed Dryer Unit developed and successfully field tested on wheat, paddy, gram and mung crops. It can clean and grade grains of cereals, oilseeds and round seeded vegetables. (FMI, NARC)
- Developed a mobile flat-bed dryer for sunflower and canola at FMI, NARC and tested for sunflower drying trial at Faisalabad in November-December, 2005 and for canola at Mongiwali, Attock. The cost of drying of sunflower was Rs.1.25/kg.
- IPM model for management of fruit flies in mango demonstrated on 450 acres in Multan and 550 acres in Kabirwala; application of MAT, BAT, Neem seed powder extract and sanitation were the major components of IPM model against the indiscriminate use of pesticides. (IPEP, NARC/CABI, Rawalpindi)
- IPM strategy for management of aphids in canola demonstrated at Multan and Bahawalpur. Strategy was based on host plant resistance, cultural, chemical and biological control methods. (Agriculture College, BZU, Multan)
- One hundred and eighty five (185) new cross combination of wheat were developed through hybridization involving the diverse parental material from national and international research institutes to incorporate the desirable traits like drought resistance (especially the stem rust race Ug 99, another threat at the doorsteps of the country) quality and yield components for the development of improved wheat germplasm for the rainfed area of Pakistan (Wheat Programme, NARC)
- Pesticides residue contamination found in fruits and vegetables at alarming levels; maximum residue levels (MRL's) violation (35%) is in fruits and vegetables. The most common pesticides found were Endosulfan, Methamidophos, Imidacloprid, Deltamethrin, Bifenthrein, Cyhalothrin, Prophenophos, Thiophnate – Methyl and Fosety Aluminum. (SARC, Karachi)

Natural Resources

- Composted organic material; enriched with 25 % of full dose of N fertilizer increased significantly yield of maize and wheat at University of Agriculture, Faisalabad
- Potential organic waste (crop residue, fruit & vegetable), manure and municipal waste successfully converted to compost at NWFP Agricultural University, Peshawar applied on wheat and maize significantly improved the crop and yield
- Application of Humic Acid (HA) significantly increased growth and yields of wheat, sugar beet, maize, cotton and groundnut in project area at Kohat and Karak, NWFP. Indigenously developed humic acid extraction plant has been installed at KPK Agricultural University, Peshawar is working efficiently.
- Arbuscular Mycorrhizal (AM) fungi have the capability and increased shoot dry matter and grain yield of wheat in salt affected and shoot and roots dry matter yield of maize crop in eroded soils under investigation due to the improved mycorrhizal roots infection rates, soil spores density and plants accumulation of N, P, Fe, Cu, Zn and Mn. (KPK Agricultural University, Peshawar)
- Groundnut *Rhizobium* inoculant for more than 5500 acres of land were locally prepared and distributed among the farmer during 2006-07 by ARI, Tarnab, Peshawar.
- Prepared a generalized geomorphic soil map, generalized agricultural development potential map and generalized soil erosion map of Pothwar. Found widespread deficiency of major plant nutrient in soil of Fatehjang and Gojar Khan area. (WRRI, NARC)
- Bacterial inoculant for sugarcane produced and about 3000 bags of biofertilizer (Biopower) have been provided to farmers for further field testing by NIBGE, Faisalabad.
- Twelve Plant Growth Promoting Rhizobacteria (PGPR) isolates of wheat and rice acquired and added in the existing microbial gene bank at NARC.
- Recovered 250 endophytic diazotrophic isolates from wheat roots and characterized for their cultural and microscopic characters. (INRES, NARC)
- Various exotic range grasses and shrubs were evaluated at various sites in Balochistan. *Acacia victoriae* showed survival and production potential under drought condition (AZRC, Quetta)

Social Sciences

In the projects of Social Sciences sector important studies were conducted addressing issues related to Pakistan's agriculture and papers/reports were generated for consideration. These studies mainly focused on WTO trade liberalization move: implication for Pakistan; performance of marketing system; identification and analysis of technology transfer for sustained growth; poverty alleviation through enhancing agricultural productivity; comparative advantage and competitiveness of major crops; impact of domestic support to Punjab's agriculture under WTO regime; socio-economic, institutional and policy issues constraining the productivity of livestock in the deserts of Pakistan; socio-economic and health implication of female unpaid workers in agriculture and livestock sector; and human resource development in changing environment of globalization. Beside study papers/reports, students were awarded Ph. D and Master degrees

conducted their research studies under the projects. Field days and workshops/seminars were also arranged for researchers and other relevant stakeholders to share their knowledge and benefits from their experience.

4. Other Contribution of ALP Projects

The ALP projects besides research and development have also contributed and assisted research centre/institutes/stations and universities through following;

- Provided research and lab. equipments, machinery and computers etc.,
- provided operational funds and made functional to some extent,
- new knowledge and information has been generated in forms of progress reports, research papers, brochures etc. and shared with scientists through circulation, field days and seminars, workshops etc.,
- assisted students especially in agricultural universities in conducting research for their degree program,
- provided job and better training facilities to the graduate students on recruitment in projects as Research Assistants/Fellows/Associates,
- being the competitive grant in field of agricultural research, enhanced the capabilities and skills of scientists to develop and win research proposals for funding, and
- established national and international linkages and coordination among various research scientists and institutes.

The tables showing human resource development, knowledge generated and transferred in forms of research papers, seminars and workshops etc. as in March 2009 has been compiled from various reports of the ALP projects is as follows:

Human Resource Development:

	AS	***CS***	***NR***	***SS***	***Total***
Ph. D.	25	35	17	05	***82***
M/ Phil	19	16	08	00	***43***
M. Sc.	36	113	92	12	***253***
B. Sc.	00	14	19	00	***33***

Research Papers/Publications:

	AS	***CS***	***NR***	***SS***	***Total***
Published	59	118	55	11	***243***
Presented in Workshops/ Seminar	31	38	37	05	***111***
Papers approved for publications	16	48	18	00	***82***
In Process of Publications	03	10	10	00	***23***

Seminars/Workshop/Field Days:

	AS	***CS***	***NR***	***SS***	***Total***
Workshops	01	14	03	00	***18***
Seminars	05	09	01	05	***20***
Trainings	01	65	00	37	***103***
Field Days	01	11	06	107	***125***

The progress and achievements of the projects which remain in operation during the period July 2009 to June 2010 under ALP, extracted from the annual and final technical progress reports alongwith financial status is reported in the coming section.

Name of Project:	**Studies on Breeding and Seed Production of Channel Catfish (*Ictalurus punctatus*) in Pakistan**
Name of PI/ Institute:	**Dr. Abdul Rab,** Principal Scientific Officer (Fisheries), Aquaculture and Fisheries Program, NARC, Islamabad.
Duration:	19. 07. 2007 to 30. 06. 2010
Financial Status:	Total Cost: Rs.3.704 million Funds Released: Rs.2740600/- Funds Utilized: Rs.2691527/-

Objectives:

- To study the breeding biology of channel catfish under the local environmental conditions.
- To develop sustainable technology for channel catfish breeding, larval rearing (on both natural and artificial diets) and seed production for promotion of channel catfish farming in the country.

Achievements:

Broodstock development from imported and locally bred Channel Catfish: Brood stock of channel catfish (*Ictalurus puctatus*) was developed from imported channel catfish stock. Hundred channel catfish yearling with an average weight of 1650g were stocked in 0.1 ha earthen pond @ 1000 fish/ha, fed on artificial diet containing 30% Crude Protein (CP) prepared from locally available feed ingredients. In first year of the project thirty pairs of channel catfish with an average weight of 2.3 kg were selected on the basis of physical appearance and stocked in the reservoir for natural breeding during the month of April 2008. The Gonado-Somatic Index was calculated and was found to be 6.16% with the approach of breeding season. To observe the fecundity, the eggs in mature gonads were counted and fecundity was recorded as 11430 eggs/kg.

For the development of brood stock, locally bred channel catfish fingerling with an average weight of 636 g were stocked in earthen ponds @ 3000 fish/ha during August 2008. The gonads were found mature in some fishes when dissected in April 2009. The channel catfish attained sexual maturity within two years of age in local environmental conditions. During third year of the project the same stock was reared for the development of brood fish. The channel catfish attained an average weight of 3460 g in one year from April 2009 to March 2010 as compared to initial stocking weight of 1376 g with a 100% survival. The total weight gain recorded was 2088 g with daily weight gain 5.72 g/day. The gonads were fully mature in third year.

Designing of spawning containers for the natural breeding of Channel Catfish: Channel catfish is cavity spawner, therefore different spawning nests were designed from different material like tin, plastic and wood. Out of these containers, tin containers were found to be suitable for natural breeding of channel catfish as more spawning take place in these containers.

Breeding of Channel Catfish: The breeding of channel catfish started from first week of May when water temperature rises to 26°C and ended up to first week of June when temperature was 30°C. During 1st year, eight pairs of channel catfish were spawned. Out of eight pairs, five spawned in tin containers, two in wooden container and one in the plastic container. However, hatching was recorded only in four pairs. This might be due to non-availability of male as 50% mortality was recorded in brood stock during the month of January, 2008; when the water temperature fell down to 6°C due to extreme cold weather.

In the 2nd year, only two pairs of channel catfish successfully bred naturally in the spawning containers. In the current (3rd) year five pairs of channel catfish bred so far (up to June, 2010) in the modified nests and breeding is under way. Approximately 20,000 channel catfish larvae are expected this year.

Early larval rearing: Catfish larvae obtained from channel catfish during the study were shifted to indoor fiberglass circular tanks and outdoor concrete raceways for rearing. After absorption of yolk sac these larvae were fed on imported floating feed (37% CP). A survival of 87% was recorded among channel catfish larvae during the first fifteen days. Fry of the channel catfish achieved an average weight of 3.52 g compared to their initial weight of 0.034 g in 45 days.

In order to replace imported floating feed the larvae were reared on different experimental diets out of which a 35% CP diets having 8% fish meal was found better on the basis of good growth and survival (84%). The larvae attained a weight of 3.52 gm in just 45 days compared to their initial weight of 0.034 g indoor circular tanks. The survival of 84% was recorded during study.

In order to study the effect of different feeding ratios to body weight and effect of enzyme supplementation in diet on growth of channel catfish fry, two feeding experiments were conducted. No significant ($P>0.05$) effect on growth was recorded when channel catfish fry were fed to different body ratios of 3%, 4.5% and ad-libitum, however fish fed @3% of body weight showed comparatively better growth.

The same diet was supplemented with different concentrations of protease and laccase enzymes @ 1 ml, 2 ml and 3 ml/kg and offered to channel catfish fry @3% of their body weight. The channel catfish fry shows a significantly ($P<0.05$) higher growth when fed a diet supplemented with 3 ml/kg protease enzyme, compared to other concentrations of protease and laccase enzymes.

Culture of fingerlings at different stocking density in earthen ponds: Channel catfish fingerlings were cultured in earthen ponds at different stocking density to observe their growth rate. The fish grew better when stocked in earthen ponds @ 3000 fish/ha as compared to a

stocking densities of 2000 and 4000 fish/h. Further at this stocking ratio, fish attained a maximum weight of 53.21g from initial weight of 2.41g within five months August to December 2009.

Technology Transfer: The channel catfish fingerling and brooders were successfully transferred to the different fish farmers; four in Punjab, three in Sindh, one in Khyber Pakhtoon Khwa and two programs at NARC and four pairs of brooders were transported live to the private fish farmer at Thatta, Sindh with a 100% survival.

Live Transportation of Catfish: The fish was transported live to different parts of the country. The fish were packed in polythene bag in 10 liters of water and sedated with mild anesthesia using MS 222 @ 40 mg/l.

Two papers have been published in Pakistan Journal of Zoology during 2008 and 2010 from the research and studies conducted under the project. Four M. Sc Zoology students of Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi conducted their research for report writing from the project. Two M. Sc Zoology students of Azad Jammu Kashmir University also conducted research for their M. Sc thesis from the project.

Name of Project:	**Studies on the Reproductive Physiology of One-Humped Camel (*Camelus dromedarius)* in the Natural Ecology of Pakistan**
Name of PI/ Institute:	**Dr. Anas Sarwar,** Chairman/Associate Professor, Department of Veterinary Anatomy, University of Agriculture, Faisalabad
Duration:	21. 10. 2005 to 20. 10. 2009
Financial Status :	Total Cost: Rs.5.000 million Funds Released: Rs.3350456/- Funds Utilized: Rs.3350456/-

Objectives:

- To promote an efficient, ecologically sound, economically viable camel production system in Pakistan.
- To describe the reproductive physiology of camels kept in traditional management system.
- To study the reproductive events of camel in traditional management system and delineate those are amenable to intervention.
- To describe the natural ecology and the pattern of traditional herding of Pakistani camels.
- To make recommendations on improved methods of production based on manipulations of reproductive physiology.

Achievements:

Ecological baseline survey was carried out at three experimental sites; Faisalabad, Attock and Bhakkar and analyzed the ecological monitoring data. Also carried out a questionnaire survey to study the traditional system of camel husbandry. Completed histological studies on reproductive system of males and females based on slaughter house material. Ultrasonic studies were performed on the reproductive activities and also an observational study on the manifestation of estrus cycle was conducted.

Six trials conducted during 2008-09 on male and female dromedaries during four different seasons of the year in three different ecological zones viz., irrigated plains (Faisalabad district), Thal desert (Bhakkar district) and Pothwar (Attock) showed that female dromedaries manifest optimal behavioral and physical signs of estrus during winter and spring seasons. However, these signs gradually diminish on commencement of summer and remain inactive till the end of autumn. These trials showed that the reproductive activity might be augmented

in female dromedaries by the administration of pregnant mare serum gonadotropin (PMSG Folligon) in off-season which resulted in variable number of ovarian follicles within five days following treatment and moderate estrus signs commenced to appear along with the secretion of sex steroids. By and large similar findings were recorded in autumn. When follicles matured (15-20 mm in diameter) in response to PMSG injection, ovulation was induced with the help of 20 µg GnRH analogue, buserlin, for experimental purpose which resulted both in ovulation and formation of corpora lutea along with rise in progesterone secretion. These results indicated that dromedaries are seasonally induced ovulator, however, sexual activity and ovulations may be induced/augmented in dromedaries during off-season by the hormonal intervention along with the proper climatic and nutritional management. Structural response of the gonads will further help to understand the ovarian kinetic mechanism responsible for this ovarian response.

Among males, serum testosterone profiles at three different experimental sites clearly indicated that testosterone levels mainly depend upon the ecological conditions. Contrary to female dromedaries, trials on males proved that the rutting by the exogenous administration of testosterone hormone can not be attained. It indicates that probably the relationship between hormone pattern and climatic factors among males is more stringent. Moreover, morphological changes in testes (Ultrasonographic, caliper and water displacement methods, histological examination) are positively correlated to the climatic changes.

The project has been completed in October 2009, the final technical progress report has not been provided so far.

Name of Project: **Synchronization of Estrus in Buffaloes to Enhance Herd Fertility Using Various Protocols**

Name of PI/Institute: **Dr. Nasim Ahmed,**
Professor/Chairman,
Department of Theriogenology, University of Veterinary & Animal Sciences, Lahore

Duration: 23. 07. 2007 to 30. 06. 2010

Financial Status: Total Cost: Rs.4.938 million
Funds Released: Rs.4771400/-
Funds Utilized: Rs.4137062/- (up to 31. 12. 2009)

Objectives:

- To determine the effect of various synchronization protocols during breeding & non-breeding season on ovarian dynamics (Follicle and CL) hormone profiles (Estradiol and progesterone), interval to estrus, ovulation, estrus behavior, fertility, pregnancy wastage and farm economics
- To enhance the reproductive efficiency by 20-25 %, milk production potential by 10-20% and farmer income by 10% in the buffalo herd where synchronization protocols are used

Achievements:

Reproductive efficiency is the primary factor affecting productivity in buffalo, but is greatly hindered by weak estrus symptoms, long postpartum anoestrus and subsequent calving interval. In recent years, with the increase knowledge of buffalo estrus cycle and with the advent of ultrasonography, new methods of manipulating ovarian functions have become available. The use of controlled internal drug releasing device (CIDR) devices has provided the opportunity of fixed-time artificial insemination with optimal pregnancy rates in buffaloes. Several studies were conducted under the project during the three years period of project implementation.

The objective of the first study was to determine the effect of GnRH and estradiol benzoate (EB) on follicular wave emergence, estrus, ovulation and pregnancy rate in CIDR treated buffaloes. Buffaloes were randomly selected into three treatment groups which received either GnRH, (n = 9) or EB (3 mg plus 50 mg progesterone; Duoton Fort; T.P Drug, Lab., Thailand; 2 ml; i.m.); (n = 6) along with insertion of CIDR (day 0) while buffaloes (n = 10) with CIDR alone served as control (CON). The results showed that the follicular wave emergence did not differ due to treatment ($P>0.05$), however, it was earlier in buffaloes given GnRH and E.B (2.8±0.5 day) than control (4.0±0.5 day). Similarly, the proportion of buffaloes showing

estrus did not differ (P > 0.05) among the groups. The interval from $PGF_{2\alpha}$ administration to estrus (45.3±5.4 h) did not vary due to treatments but was greater in buffaloes given GnRH. The interval to ovulation after estrus (38.6±7.9 h) did not change because of treatment. There was no significant difference in size (9.9±0.5 mm) of the ovulatory follicle among the groups. Likewise, pregnancy rate (6/19, 30%) remained the same across the treatments. In conclusion, this preliminary data indicate that administration of GnRH and EB result in emergence of follicular wave, estrus and ovulation and similar pregnancy rate in CIDR treated buffaloes.

The objective of the second study was to determine the effect of once used CIDR and FSH on estrus expression and Pregnancy Rate (PR) during low breeding season in Nili-Ravi buffaloes. Two experiments were conducted during June-August, 2008. In experiment 1, buffaloes received either a used CIDR (UCIDR, n = 35) or a new CIDR (NCIDR, n = 36) for 7 d and PGF2α on d 6. Estrus expression was similar (P>0.05) between UCIDR (88.5%) and NCIDR (96.6%) buffaloes. The mean interval to estrus from PGF2α in UCIDR was 64.5 h compared to 68 h in NCIDR (P>0.05). The pregnancy rate did not differ (P>0.05) due to treatment (13/35 in UCIDR vs. 11/30 in NCIDR). In experiment 2, buffaloes at unknown stages of estrous cycle received CIDRs on d 0 and PGF2α on d 6. Animals were either treated with two injections of FSH (12 hr interval; n = 9) starting at CIDR removal on d 7 or remain untreated (Control, *n* = 10). Estrus detection, insemination and pregnancy diagnosis was similar as in experiment 1. FSH treatment did not affect the proportion of buffaloes expressing estrus, mean interval from CIDR removal to estrus and ovulation, size of ovulatory follicle or pregnancy rate (P>0.05), overall estrus expression rate (16/19), interval to estrus from PGF2α (62.8 h) and interval to ovulation from estrus (35 h), ovulatory follicle size (10.55 mm), pregnancy rate (5/19). In conclusion, a) compared to NCIDR devices, previously UCIDR devices are equally effective to induce estrus and ovulation synchronization with comparable pregnancy rate in buffaloes during low breeding season and b) low dose FSH treatment CIDR removal did not improve estrus expression or pregnancy rate.

The objective of the third study was to determine the effect of CIDR on pregnancy rate in anestrous buffaloes during breeding and low breeding season. Anestrous buffaloes (*n* = 105) were treated with Controlled Internal Drug Releasing Device (CIDR) on day 0 (day of CIDR insertion) during breeding (*n* = 46) and low breeding season (*n* = 59). The results showed that pregnancy rate at day 40, during breeding season, were higher (P< 0.05) (23/46; 50%) than that of during low breeding season (18/59; 30%). Pregnancy rate at day 60, were higher than those observed at day 40 in both the seasons. However, they were similar (P > 0.05) at day 60 between breeding season (29/46; 63%) and low breeding season (40/59; 67%). It is concluded that CIDR is a good reproductive management tool to enhance the fertility in anestrous buffaloes.

The objective fourth study was to determine the effect of estradiol benzoate and GnRH on ovulation and pregnancy rate in CIDR treated postpartum buffaloes during breeding season. Fifty buffaloes received CIDR device for 7 days. Each buffalo was administered PGF2α, on day 6. CIDR devices were removed on day 7. On day 8, twenty buffaloes received Estradiol Benzoate and on day 9, twenty buffaloes received GnRH. The results showed that ovulation

rate was higher in EB buffaloes (90%) than GnRH group (80%) and control group (70%). The pregnancy rate of both EB group (66%) and GnRH group (50%) are significantly higher than control (30%). It is concluded that the administration of Estradiol Benzoate after 48 hours of PGF2α results in tighter synchrony (less variability) and better pregnancy rate in buffaloes.

On the research side several experiments were designed and conducted both at the experimental and at commercial dairy farms. Overall through this project comprehensive information on physiology of estrous synchronization in buffaloes has been generated which has enhanced the fertility and productivity of dairy buffaloes. These findings have strong and direct implication on commercial dairy farm of the country.

An economic analysis for three years (2007, 2008 and 2009) as a case study to critically evaluate the productive performance, assess the economic viability, examine the major constraints and opportunities was performed at a commercial dairy farm where improved reproductive management practices were introduced. The improved feeding and reproductive management of dairy herd proved helpful in enhancing the production and economics of the farms.

One day training workshop was arranged to promote awareness and provide hands on practical training in area of dairy reproduction, nutrition and health with emphasis on new techniques of estrus in synchronization, use of improved estrus detection methods, better quality of semen and detecting early pregnancy by using ultrasonography and balance nutrition in dairy animals.. The workshop was attended by more than eighty farmers, breeders, practitioners, government officials and post graduate students.

Name of Project:	**Feeding Management for Optimum Growth, Early Maturity and First Lactation Performance in Sahiwal Cattle**
Name of PI/ Institute:	**Dr. Muhammad Abdullah**, Professor, Department of Livestock Production, University of Veterinary & Animal Sciences, Lahore
Duration:	23. 07. 2007 to 30. 06. 2010
Financial Status:	Total Cost: Rs.6.382 million Funds Released: Rs.5078200/- Funds Utilized: Rs.5035116/-

Objectives:

- To evaluate the capacity of whole milk replacer feeding for economical / optimum growth in Sahiwal calves.
- To compare different level of starter and concentrate mix for the growth and sexual maturity of Sahiwal heifers.
- To suggest a feeding system for decreasing age at puberty and age at first calving.
- To demonstrate a short term feeding management system for increase milk production from the existing dairy cattle and resources.

Achievements:

Whole Milk and Replacer Feeding: The calves fed on whole milk and milk replacer diets alongwith starter ration @ 0.2% of body weight showed significantly ($P<0.05$) higher weight gain, better body condition score and reduced medication cost. It was also noted that the calves on milk replacer diets produced comparable growth to whole milk feeding. Mean total serum protein and albumin contents were higher ($P<0.05$) in calves on whole milk and lower on milk replacer diets. Mean hemoglobin contents were higher in calves on whole milk + calf starter diet (11.62±2.789 g/dl) followed by milk replacer, whole milk+milk replacer feeding. Feeding cost was 40% lower in milk replacer diets as compared to whole milk (Rs.5602±104 vs. 9340±211).

Feeding green fodder and starter ration in Sahiwal: Sahiwal calves fed on green fodder with starter ration 1% of body weight showed significantly improved dry matter intake (DMI), weight gain, body condition score and feed efficiency. Mean red blood cells (RBCs) count and hemoglobin contents was significantly ($P<0.05$) higher in calves on 1% supplemented diet as compared to control. Total serum protein, albumin and triglyceride value was significantly ($P<0.05$) different in calves on supplemented diet. It was also recorded that the calves fed on green fodder with starter ration showed 73.33% more weight and improved

health status as compared with the green fodder.

Feeding green fodder and concentrate upto maturity of Sahiwal Heifers: The Sahiwal heifers in treatment III (fed 1% concentrate ration with green fodder) gain more live weight, DMI, feed efficiency, body condition score, physiological norms and better growth rate were significantly improved. In phase II the heifers were fed upto maturity. The dry matter intake, weight gain, feed efficiency and body measurements were significantly higher on treatment III. The animals of treatment III gain maturity weight (275) at 2 years ±1 month of age earlier than treatment II & I. Blood constituents were also significantly ($P<0.05$) higher in treatment III fed concentrate ration @ 1% of concentrate ration. Total variable cost in Sahiwal heifers during the experimental period was Rs.6307±42, 7951±232 and 9682±444 on treatment I, II and III, respectively.

Feeding green fodder and concentrate ration up to 6 months of Pregnancy: The pregnant heifers in treatment III (fed green fodder with concentrate 1%) gain 57.24% more weight. The average dry matter intake and feed efficiency was significantly different among different treatments. The total cost of the experiment in Sahiwal heifers on treatment I, II and III was 7682±179, 10683±237 and 13375±611, Rs./Animal, respectively.

The studies have concluded that Sahiwal calves can be economically raised on milk replacer alongwith feeding of calf starter during milk feeding phase. It is suggested that the calves and heifers be supplemented with concentrate @ 1% body weight to attain early maturity and pregnant animals be fed supplements @ 2% of body weight to achieve better conditions score and good fetal growth. Supplementation of concentrates in the daily diet of lactating Sahiwal calves results into increased quality milk yield.

Feeding green fodder with concentrate ration of six month Pregnant heifer upto calving: The pregnant heifer in treatment III fed green fodder with concentrate ration @ 2% of body weight gains 125.45±10.25 as compared to treatment 1 fed concentrate 1% of the body weight 80.75±3.35. Weight gain and feed intake was higher during the last trimester of pregnancy, feed efficiency and body measurement of animals was significantly different among different treatments. The total cost of the Sahiwal heifers on treatment, I, II, III were 11580±237, 14920±611 and 17470 Rs/animal.

Animals Performance after calving: The dry matter and weight gain was initially decreased and gradually improved significantly. The milk production improved from 6.25 to 10.34. Quality and production of milk was significantly improved by milking machine.

The studies conclude that Sahiwal calves can be economically raised on milk replacer alongwith feeding of calf starter during milk feeding phase. It is suggested that the calves heifers be supplemented with concentrate @ 1% of body weight to attain early maturity and pregnant animals be fed supplemented @ 2% of body weight to achieve better conditions score and good fetal growth. Supplementation of concentrates in the daily diet of lactating Sahiwal calves results into increased quality with yield.

Name of Project:	**Production of Thermo-Stable Newcastle Disease (ND) Vaccine for Rural Poultry**
Name of PI/ Institute:	**Dr. Shakeel Babar,** Associate Professor, Centre for Advanced Studies in Vaccinology and Biotechnology (CASVAB), University of Balochistan, Quetta
Duration:	11. 09. 2006 to 30. 09. 2009
Financial Status:	Total Cost: Rs.3.459 million Funds Released: Rs.2923900/- Funds Utilized: Rs.1685467/- (up to 30.06.2009)

Objectives:

- Availability of thermo-stable vaccine for rural poultry/ backyard chicken rearing villagers.
- Trials to adopt the thermo-stable strains of ND on permanent cell line like vero and others.
- To develop an easy, more convenient way of administration of vaccine.
- Development of ND control booklet in national and local languages.

Achievements:

The New Castle Disease is very common rather enzootic in Balochistan. It is a serious problem of poultry in Balochistan. The conventional freeze-dried, live vaccine does not suffice the need of common villagers. Lot of primary work has been done by different groups in the world but the ACIAR and Queensland University at Brisbane (Australia) have done significant work in developing the thermostable vaccine for rural poultry. Efforts are being made in finding the easy administration of thermostable vaccine. This type of vaccination protected 60% of the rural chicken and no outbreak of ND was reported during two years of field trials. Similarly variants of thermostable V4 (ND Virus) sprayed on food of chicken, again between 3-6 weeks. These chickens showed the protection levels of antibodies (HI) and withstand the challenge of virulent ND virus satisfactorily. The analysis of the serum levels of broiler chickens vaccinated by thermostable live vaccine in drinking water and by other routes showed that more than 89% birds were found protected four weeks post vaccination. The workers claimed that the V4 strain of ND virus could satisfactorily protect broiler chickens. The same group measured the serum antibodies in layers and found that about 81% of the birds showed protection. Trials and comparison of the V4 vaccine Thailand by using different rules of administration proved that the group of birds having no maternal antibodies withstood the challenge of virulent field strain while the birds having maternal antibodies didn't showed protection. It was conclude that thermo-stable strain, when given as edible vaccine can protect village chickens against NDV. Overall the Thermostable Newcastle Disease Virus has been successfully propagated in cell culture system and ready to be used for vaccine production.

Name of Project: **Induced Breeding and Fry Rearing Techniques of Indigenous Catfish, *Rita rita* (Hamilton) in Cemented Cistern**

Name of PI/Institute: **Dr. Naeem Tariq Narejo**,
Professor,
Department of Fresh Water Biology & Fisheries, University of Sindh, Jamshoro

Duration: 23. 07. 2007 to 30. 06. 2010

Financial Status: Total Cost: Rs.1.124 million
Funds Released: Rs.905000/-
Funds Utilized: Rs.905500/-

Objectives:

- To study the breeding biology of commercially important catfish.
- To study the reproductive potential.
- To develop artificial propagation and culture of *R. rita* in cemented cisterns.
- To develop induced breeding and fry rearing techniques of *R. rita*.
- To study the effect of water quality parameters on growth and survival rate of experimental fishes.

Achievements:

To study the breeding biology of indigenous catfish, *Rita rita* (Hamilton), month-wise sampling of 10 fish of both the sexes (5 each) of different sizes were collected from local fish market Hyderabad and from Indus River near Jamshoro during July 2007 to June 2008. The study was initiated in terms of sex dimorphism, gonadosomatic index (GSI), ova diameter and fecundity. It indicated that the fish *R. rita* breeds once in a year in the month of July. The fecundity data were plotted against their respective length, weight and gonad weight. The fecundity-gonad weight relationships showed better relationship as compared to fecundity-total length and fecundity-body weight relationship. Best fertilization rate (90±2%) was obtained at 175 and 200 mg/kg body weight and best hatching rate (90±2, 90±5, 90±5%) was revealed at 150, 175 and 200 mg/kg body weight of ovaprim application. Fertilization and hatching rate were 90 and 80% respectively, in case of the experiment where only females were injected. Ovulation occurred after 10 to 14 hours of injection and the eggs hatched out after 18 to 20 hours fertilization. The larvae started feeding after 56 hours of hatching and best survival rate (16%) was achieved by supplying zooplankton as food.

The indigenous catfish *Rita rita* could be successfully reared in cemented cisterns with plastic container as suitable shelter under semi natural breeding conditions. To study the effect of

different food items there were five different treatments to test best food item for better growth and survival. It was noted that the fish *R. rita* grows significantly well fed with dead small fish (treatment II), followed by chopped small fish, live small fish (treatments III and IV respectively) while significantly lower growth and survival was recorded from pellet feed (treatment V).

The various physico-chemical parameters of water like temperature, pH, dissolved oxygen, alkalinity, ammonia and nitrite were monitored fortnightly. The values of these parameters were found within the suitable ranges of fish culture. Finally it was concluded that indigenous catfish *Rita rita* could be cultured artificially under semi natural condition with dead small fish and 20 fish per meter^2 as suitable feed and stocking density respectively.

It is concluded from the findings that the indigenous catfish, *Rita rita* (Hamilton) breeds once in year during the months of May to July with peak in July. A full grown specimens about 1 kg weight could produce about 0.2 million eggs during the breeding season. This fish *(Rita rita*) could breed in captivity with ovaprim-C 150 mg/kg body weight, zooplankton as starter feed, dead small fish of non commercial values as suitable feed and 20 fish/m^2 density for the better growth and survival rate in cemented cisterns.

Name of Project: **Growth Response of Broilers to Ideal Amino Acids Ratio**

Name of PI/Institute: **Dr. M. Aslam Mirza,**
Associate Professor,
Dept. of Animal Nutrition, University of Agriculture, Faisalabad

Duration: 11. 10. 2007 to 30. 06. 2010

Financial Status: Total Cost: Rs.1.595 million
Funds Released: Rs.434500/-
Funds Utilized: Not reported

Objectives:

- To establish an ideal set up of indispensable amino acid for improved nutrient utilization and protein accretion in broilers.
- To determine indispensable amino acids level for optimizing feed conversion/improve feed efficiency or to decrease feeding cost per kilogram of gain.
- Hot environment management in broilers through nutrient manipulation and dietary amino acid supplementation.

Achievements:

Since the project has been started in October 2007, the PI of the project has not reported progress of the project. Financial and technical progress reports have not been provided. The PI also did not attend review meeting in March 2009 and failed to highlight his achievements.

Name of Project: **Pond Culture and Reproductive Performance of Seengharee, *Aorichthys aor* (Hamilton, 1822)**

Name of PI/Institute: **Mr. Muhammad Ramzan Ali,**
Scientific Officer,
Aquaculture & Fisheries, NARC, Islamabad.

Duration: 22. 08. 2008 to 30. 06. 2011

Financial Status: Total Cost: Rs.5.628 million
Funds Released: Rs.3318700/-
Funds Utilized: Rs.3334598/-

Objectives:

- To study performance of Seenghare, *Aorichthys aor* in pond culture system.
- To study reproductive cycles and breeding performance of Seenghare, *Aorichthys aor*.

Achievements:

Conducted an experiment on "Effect of different diets having crude protein (CP) level 25%, 30%, 35% and 40% on the growth performance of Seengharee" was conducted. The results of experiment concluded that a feed of 30% CP is best for the optimum growth of Seengharee.

To determine the animal and plant protein ratio in feed of catfish, an experiment "Comparison of growth performance of Seengharee, fed on diets containing different ratio of animal and plant proteins" has been conducted. Another experiment "effect of feeding frequency on the growth performance of seengharee in cemented raceways" was also conducted. There was a non significant effect of feeding frequency on the growth of Seengharee.

To evaluate the growth performance in ponds, an experiment "Comparison of growth performance of Seengharee in cemented raceways and ponds" was started. According to sampling, fish showed better growth (0.2 g per day) in ponds compared to cemented raceways (0.06 g per day) and no mortality observed during the experiment. Water quality parameters were also within the normal range. The hematological parameters i.e. hemoglobin percentage (HB %), red blood corpuscles (RCBs) count, white blood corpuscles (WBCs) count, platelet count, differential WBCs count, packed cell volume (PCV) or hematocrit value, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) studied. All parameters showed significant variation through different seasons.

During December/January few fishes showed the signs of Pop eye disease and were treated by applying a Chinese medicine 'DBO' where 5 ml was used in 100 ml of water once daily for a week time.

Name of Project: **Identification of Molecular Markers for Fecundity in Goat Breeds of Pakistan**

Name of PI/Institute: **Dr. Masroor Ellahi Babar,**
Professor,
Department of Livestock Production, University of Veterinary and Animal Sciences, Lahore

Duration: 24. 07. 2008 to 30. 06. 2011

Financial Status: Total Cost: Rs.7.080 million
Funds Released: Rs.5347900/-
Funds Utilized: Rs.5288900/-

Objectives:

- To find Single Nucleotide Polymorphisms (SNPs) in BMPRIB gene.
- To test the SNPs in BMPRIB gene as markers for fecundity in local goat breeds.
- Screening of goat populations available at Govt. livestock farms to identify more prolific animals.

Achievements:

The project aim was identification of molecular markers for fecundity in goat breeds and screening of goat population available at Govt. livestock farms to identify more prolific animals. Plan of work for first year was selection of high and low prolific animals in different breeds of goat by checking the performance records available at all the government farms and by observing the performance of selected animals and extraction of DNA from blood. Work was started with blood sampling of different goat breeds throughout Pakistan. The breeds of goat were selected initially for the blood sampling from various locations in Punjab, KPK and Balochistan provinces. Special emphasis was given on the purity of the breed and non relationship of the sampled individuals. Pedigree information was also collected, wherever, it was possible. Ten ml blood was collected aseptically from the Jugular vein of each selected animal into vaccontainer tubes containing anticoagulant i.e. Ethylendiamine tetra-acetic (0.5 M EDTA). Proper record was prepared containing the information regarding the breed, animal ID, age, sex and location of animal. Field blood samples were placed on ice immediately after their collection and brought to the Molecular Cytogenetics and Genomics Laboratory, UVAS, Lahore and stored temporarily in freezer at -20^{o} C. Seventeen pairs of primers were designed. PCR optimization conditions have successfully been completed.

The work plan for the second year was Genotyping and Sequencing of the selected individuals of the goat breeds. To detect Single Nucleotide Polymorphism in fecundity genes the sequencing of true representative samples of different goat breeds done. During this year a

set of 29 primers was designed and synthesized for BMP15 gene. The SNPs in BMP15 gene were detected. Restriction enzymes were also identified for further screening of animals at different livestock farms. Another set of primers for BMPRIB gene was also designed and synthesized. Optimization of this primer was done on samples of goat breeds. The sequencing results of the samples of goat breeds from the Centre of Excellence in Molecular Biology (CEMB) are still awaited for identification of SNPs in this gene.

Two research fellows, one enrolled for M. Phil and one engaged in Ph. D study are working in the project.

Name of Project: **Phenotypic and Genetic Characterization of Indigenous Breeds of Caprine and Ovine Species in Punjab**

Name of PI/Institute: **Dr. Khalid Javed,**
Associate Professor,
Department of Livestock Production, University of Veterinary and Animal Sciences, Lahore

Duration: 28. 07. 2008 to 30. 06. 2011

Financial Status: Total Cost: Rs.5.061 million
Funds Released: Rs.3560200/-
Funds Utilized: Rs.3371285/-

Objectives:

- Phenotypic characterization of the goat and sheep breeds of the Punjab province.
- Genetic characterization of the goat and sheep breeds of the Punjab province.
- Estimate genetic and phenotypic correlation between various productive traits.
- Phylo-genetic relationships among different breeds and development of breed specific molecular genetic markers for identification of different breeds from various populations in different areas in the Punjab province.

Achievements:

Survey and Phenotypic Characterization of different breeds of both species: Survey of two farms; Livestock Experiment Station, Khizarabad, district Sargodha and Livestock Experiment Station, Jugaitper, district Bhawalpur was conducted. Body measurements of 1200 Kajli sheep and 470 Buchi sheep have been recorded and punched into the computer. It would help in Phenotypic characterization of our goats and sheep breeds. Measurements on 1200 Kajli sheep and 470 Buchi sheep have been recorded. Analysis of the pooled data will be performed for inferring some meaningful results.

Blood sampling of Phenotypically selected individuals from both species and DNA extraction: Blood sampling of the phenotypically selected animals; Beetal, Teddy, Nachi, Dera Din Panah, Kajli, Lohi, Buchi and Thalli was done. Their DNA was extracted using inorganic methods. The quantification of all DNA samples was done using gel electrophoresis. It would help in genotypic characterization of our goat and sheep breeds.

For Genetic Characterization, blood samples of different sheep and goat breeds maintained on different Livestock Farms and private owners were collected. 10 ml blood was collected aseptically from Jugular vein in EDTA added falcon tubes and stored in ice before it was brought to Molecular Biology and Genomics Lab in University of Veterinary and Animal

Sciences, Lahore. The samples were stored temporarily in -20^{0}C freezer before DNA extraction. DNA was extracted using inorganic method. The quantification of all DNA samples was done using gel electrophoresis. All the samples were brought at same concentration of 50 mg/uL by adjusting volumes of working DNA.

Micro satellites are class of marker that has become the preferred technique for population genetic studies, useful for a variety of purposes as genome mapping, parentage determination, disease research and genetic diversity/diversion. So they are highly effective in evaluating differences within a breed and determining population substructure. For Characterization of breeds the five microsatellite marker (Forward primers were fluorescently labeled at 5' end which enabled to detect and analyze the final PCR product in genotyping) were selected from the International Society for Animal Genetics (ISAG)/FAO recommended lists of microsatellite markers to examine the genetic differentiation and relationship within and between the sheep and goat breeds.

A set of five micro satellites were initially selected and synthesized from Gene Link USA (www.genelink.com). The Forward primers were labeled with recommended Fluorescent Dyes.

All the Micro satellites were optimized for amplification by Polymerase Chain reaction by using Thermal Cycler (BioRad). PCR reactions was carried out in a total volume of 25 µl Touchdown PCR temperature profile used for amplification, including initial denaturation at 94º C for 5 min followed by 10 cycles of denaturation at 94º C for 30 sec, annealing at 65º C-55º C (decrease in temperature was set 1º C/cycle) for 45 sec and extension at 72º C for 45 sec. Following these 10 cycles with annealing temperatures, 25 cycles with constant annealing temperature of 54º C were performed and reaction was ended with a step of final extension at 72º C for 10 min.

Interpretation of these results will be done after the complete analysis and will be reported in final report.

Name of Project: **Production of Genetically Superior Breeding Bulls of Kundhi Buffalo Breed in Sindh Province**

Name of PI/Institute: **Mr. Mashooq Ali Bhutto,**
President,
Livestock Development Foundation, Shahzad Town, Islamabad.

Duration: 27. 01. 2010 to 26. 01. 2013

Financial Status: Total Cost: Rs.9.414 million
Funds Released: Rs.1551000/-
Funds Utilized: Rs.1244000/-

Objectives:

- To bring potential farmers in agreement with Livestock Development Foundation (LDF) as Stakeholder of this project.
- To select male calves on proper laid down criteria and Genomic tests.
- To provide animal health coverage to Bull mothers for two lactations and all male calves up to 28-30 months of age.
- To observe periodic culling of calves after first and second Genomic tests.
- Compensate the farmers with feed/fodder in addition to Animal Health coverage.
- To improve the production potential of Kundi Buffalo breed in Sindh Province.

Achievements:

Discussion and meetings were held with farmers and registered 186 potential farmers in Tando Allahyar, Sindh. The farmers have registered 203 male calves. Initially 2240 buffaloes and cows in the herd of registered farmers have been provided animal health care services with vaccination, devorming and spray of ectoparasiticides in 13 villages.

Stipend paid regularly to the 140 registered farmers for calves feed and fodder. Registered calves were vaccinated along with their bull mothers with HSV, VQV, ASV and Foot and Mouth Disease vaccine.

Monthly farmers meeting held at LDF, Tando Allahyar office. Five meetings held in field office. Weekly villagers meeting held in 13 villages; Jan Muhammad Bhutto villages, Fazal Muhammad Talpur village, Dera Ali Nawaz Deeshak, Chamber road villages, Dingano Bozdar, Dera Ch. Muhammad Anwar Ghuman, Dad Jarwar and three villages of Ghulam Hussain Leghari on chamber road including UC Khokhar and Tando Adam Road villages.

First orientation seminar arranged in April 2010 on animal health and production in kundi buffaloes attended by all concerned. A pamphlet in Sindhi language printed and distributed among farmers.

Name of Project: **Evaluation of Commercial Potential of Sugar Beet Genotypes for their Adaptability in Different Ecologies of Pakistan (Coordinating Unit NARC, Islamabad, Component)**

Name of PI/ Institute: **Dr. Muhammad Zubair,**
Coordinator (Sugar Crops),
Sugar Crops Research Program, CSI, NARC, Islamabad.

Duration: 01. 07. 2008 to 30. 06. 2011

Financial Status:

Total Cost:	Rs.0.924 million
Funds Released:	Rs.262700/-
Funds Utilized:	Rs.310840/-

Objective:

- Testing of adaptability of different sugar beet genotypes and their agronomic management in NWFP, Punjab and Sindh.
- Studies on pest and disease management practices in sugar beet.
- Increase water-use efficiency through intercropping of sugarcane crop with sugar beet.
- Study salt-tolerance in sugar beet genotypes.

Achievements:

The coordinated research project on sugar beet constitutes three components (sub projects) i.e. NARC, Islamabad; Al-Moiz Sugar Mills, D. I. Khan and NSCRI, Thatta. Meeting of the PIs of all the three sub projects was held at NARC during 2nd week of September 2010 to review the progress and plan next year's activities/experiments. Experiments to be conducted during Rabi 2009-10 and their locations were finalized. Seed of sugar beet hybrid varieties was arranged from two seed companies (Strube Sat, Germany and KWS, Germany). Sugar beet varietals adaptation trial comprising 10 hybrid varieties, was conducted at 18 locations including 10 at Punjab (in district of Bhakkar, Mianwali, Layyah, Kot Addu, Gujranwala and Jhang), 4 of Khyber Pakhtunkhwa (KPK) (district D. I. Khan) and 4 of Sindh (in districts of Thatta, Badin and Matyari). Six agronomic trials conducted during 2008-09 were also repeated during 2009-10 at Al-Moiz Sugar Mills, Research Farm, D. I. Khan for confirmation of the results to determine best agronomic management practices in the region. During crop growth period the trials were visited to monitor their performance. General performance of all the trials was found satisfactory except the one at Badin in Sindh which performed poorly due to irrigation water shortage. Sugar beet crop in Al-Moiz Sugar Mills area (D. I. Khan, Bhakkar, Mianwali and Layyah) was also visited during April 2010 to record observations on general crop condition. Crop condition on farmers' field was excellent. Mostly the crop was sown during October which is the appropriate month of sugar beet planting in the region. The coordinated sugar beet project of PARC had great impact in Al-Moiz Sugar Mills (the only sugar mill in Southern KPK having beet processing unit) region consisting D. I. Khan, Bhakkar, Layyah and Mianwali districts. The

sugar beet variety trials conducted during 2008-09 have proved their worth in selecting high sugar varieties for the region. Considering high sugar yields of the varieties, SD-Pak 09-07 and SD-Pak 03-06, Al-Moiz Organization imported 1400 kg seed of these varieties to distribute among farmers. Out of total 1800 acres, these two varieties were planted on 1000 acres in the region. A total of 317 farmers planted sugar beet during 2009-10 in Al-Moiz Sugar Mills region, out of which 200 farmers achieved beet yields between 500-950 kg/acre. The sugar beet recovery % of the AL-Moiz Sugar Mills during 2009-10 season was 10.66 against cane recovery % of 8.75 from cane. The project has also developed mechanized beet planter that plants 10 acres beet per day against sowing of one acre by 10 labors in one day.

Name of Project: **Evaluation of Sugar Beet Genotypes for their Adaptability in Different Soil and Environmental Conditions of Punjab; A Component of the Coordinated Project "Evaluation of Commercial Potential of Sugar beet Genotypes for their Adaptability in Different Ecologies of Pakistan" (NARC, Islamabad, Component-I)**

Name of PI/ Institute: **Dr. Sagheer Ahmad,**
Senior Scientific Officer,
Sugar Crops Research Program, CSI, NARC, Islamabad.

Duration: 01. 07. 2008 to 30. 06. 2011

Financial Status:

Total Cost:	Rs.2.426 million
Funds Released:	Rs.2835700/-
Funds Utilized:	Rs.2747232/-

Objective:

- Test adaptability of different sugar beet genotypes and their agronomic management in Punjab.
- Study salt-tolerance in sugar beet genotypes.
- Study pest and disease management in sugar beet.

Achievements:

Trials on sugar beet adoptability comprising SD-PAK04/06, SD-12970, SD-PAK09/07, SD-PAK03/06, SD-PAK01/07, SD-PAK01/07, SD-PAK07/07, California, Magnolia, Ernestina, and Sandrina varieties were conducted at Gujranwala, Jhang, Layyah and Muzaffargarh areas of Punjab and NARC, Islamabad.

Sugar beet germination was maximum for the varieties, SD-PAK01/07 (99.2%) at Adaptive Research Farm, Gujranwala, SD-PAK04/06 and Ernestina (85.5%) at Chak # 99 TDA Kror, district Layyah, SD-PAK 07/07 (100%) at Fatima Sugar Mills Farm, Sanawan, Kot Addu, district Muzaffargarh, Ernestina (96.9%) at Shorkot, district Jhang and SD-PAK03/06 (82.6%) at NARC, Islamabad.

Sugar beet yield was maximum for the varieties, SD-PAK03/06 (61.8 t ha^{-1}) at Adaptive Research Farm, Gujranwala, SD-PAK01/07 (85.4 t ha^{-1}) at Chak # 99, TDA Kror, district Layyah, SD12970 (54.3 t ha^{-1}) at Fatima Sugar Mills Farm, Sanawan, Kot Addu, district Muzaffargarh, SD-PAK04/06 (93.9 t ha^{-1}) at Shorkot, district Jhang and SD-PAK01/07 (53.3 t ha^{-1}) at NARC, Islamabad.

Sugar recovery was maximum for the varieties, SD-PAK 04/06 and SD-PAK07/07 (16.4%) at Adaptive Research Farm, Gujranwala, SD-PAK07/07 (15.1%) at Chak # 99 TDA Kror, district

Layyah, SD-PAK 04/06 (17.4%) at Fatima Sugar Mills Farm, Sanawan, Kot Addu, district Muzafargarh and SD-PAK 04/06 (16.2%) at Shorkot, district Jhang and SD-PAK07/07 (16.7%) at NARC, Islamabad.

Sugar yield was maximum for the varieties, SD-PAK03/06 (9.46 t ha^{-1}) at Adaptive Research Farm, Gujranwala, SD-PAK01/07 (11.79 t ha^{-1}) at Chak # 99 TDA Kror, district Layyah, SD-12970 (8.04 t ha^{-1}) at Fatima Sugar Mills Farm, Sanawan, Kot Addu, district Muzafargarh, SD-PAK04/06 (15.21 t ha^{-1}) at Shorkot, district Jhang and SD-PAK01/07 (7.57 t ha^{-1}) at NARC, Islamabad.

On overall basis, sugar beet performed best at district Jhang followed by Layyah and Gujranwala. Further, sugar beet varieties SD-PAK01/07, SD-PAK03/06, SD-PAK07/07 and SD-PAK-04/06 remained best for beet yield, sugar recovery and sugar yield.

A replicated trial was conducted at Jhang to study the importance of intercropping of sugar beet in sugar cane using same delta of water as required by sugarcane. October planted sugar beet - sugarcane remained the best with respect to yield (145.2 t ha^{-1}) and net income to the farmers of Rupees 243,783 per hectare.

A lab. experiment was also conducted to evaluate 12 sugar beet genotypes for salt tolerance. The varieties SD-Pak-0310 and SD-PK-0110 were found tolerant to NaCl salinity of 30 dS m^{1}.

Name of Project: **Testing of Adaptability of Different Sugar Beet Genotypes and their Agronomic Management in KPK; A Component of the Coordinated Project "Evaluation of Commercial Potential of Sugar beet Genotypes for their Adaptability in Different Ecologies of Pakistan" (Al-Moiz Industries, D. I. Khan-Component-II)**

Name of PI/ Institute: **Mr. Karim Bakhsh Malik,**
Advisor R & D,
Al-Moiz Industries, Chashma Road, D. I. Khan

Duration: 01. 07. 2008 to 30. 06. 2011

Financial Status:

Total Cost:	Rs.2.962 million
Funds Released:	Rs.1319900/-
Funds Utilized:	Rs.1498788/-

Objective:

- To evaluate different sugar beet varieties for their yield and quality performance and studies on various agronomic aspects to solve various beet production problems in the region

Achievements:

Screening sugar beet varieties adaptive in the region: Eleven (11) varieties of two seed supply group namely 'KWS' and 'Strube Diekmann' were planted at nine different sites in D. I. Khan and Bhakkar region. The beet yield data reveal that SD 09/07 gave the highest yield of 64.85 t ha^{-1} and yield is statistically at par with Sandrina and SD 03/06. Sandrina has shown the highest sugar recovery of 11.57%, and is closely followed by Antek (11.54%). For sugar yield Sandrina has excelled in yield (7.25 t ha^{-1}), while SD 09/07, SD 03/06 and Ernestina are statistically at par. The prevailing commercial variety California has given lower yield of beet and sugar.

Method of planting trial: Dual row and single row planting were compared for ridges and flat planting. Beet root yield data show non-significant differences in the means of different treatments. However, single row top seeding has shown the trends of higher yield which could be due to higher plant population.

Ascertaining method of planting and plant population in sugar beet: Comparison of single row and dual row planting at 75 cm row distance, show that beet root yield increased with corresponding increase in beet root population. Dual row planting gave higher yield than single row planting. Plant density of 100,000 plants per hectare gave the highest yield and was at par with 112,500 plants.

Ascertaining optimum time of planting and harvesting sugar beet: Five planting dates (1st Oct, 15th Oct, 1st Nov and 1st Dec.) and five harvesting dates (1st April, 15th April, 1st May, 15th May and 1st June), were compared in split plot design. The October planting with harvesting in mid May gave significantly higher yield than rest of the treatment periods. Harvesting on 1st May has given the highest sugar recovery (11.11%), while the lowest sugar recovery (9.0%) was recorded from April harvesting.

Intercropping: Sugarcane was planted as intercrop in sugar beet along with sugar beet – mung rotation. Beet yield data show non-significant differences in treatments means. Cane and beet crops raised from 2008-09 season trial show that intercropping had depressing effect on the yield of either beet or cane. Beet + cane intercropping was economically very remunerative but posed problems in mechanized harvesting. Recovery of beet roots was significantly reduced, from autumn Cane + Beet intercrop during 2009-10.

Post harvest staling losses: Sugar beet roots were stored for 5 days after harvest on 1 April, 15 April, 1 May and 15 May. The crop showed post harvest staling loss by 10-18% in weight of beet roots and 5 to 8% loss in sugar recovery. Losses were low in early harvest period and the post harvest losses increased with advance in harvesting time during hot summer days. Losses were considerably reduced by keeping the roots under some cover. Such huge losses in yield and recovery call for the necessity to slice beet root within 24 hrs of harvesting.

Name of Project: **Introduction of Sugarbeet as a Sugar Crop in Lower Sindh; A Component of the Coordinated Project "Evaluation of Commercial Potential of Sugarbeet Genotypes for their Adaptability in Different Ecologies of Pakistan" (NSCRI, Thatta, Component-III)**

Name of PI/ Institute: **Mr. Ghulam Moheyuddin Kaloi,**
Scientific Officer,
National Sugar Crops Research Institute- PARC, Makli, Thatta

Duration: 01. 07. 2008 to 30. 06. 2011

Financial Status:

Total Cost:	Rs.2.454 million
Funds Released:	Rs.1671900/-
Funds Utilized:	Rs.1635000/-

Objective:

- Introduction of sugar beet on farmer's field as a major sugar crop.
- Testing for adaptability of different sugar beet genotypes and its agronomic management
- Increase per acre sugar yield through intercropping of sugar beet with sugarcane.

Achievements:

During 2009-10 (2nd year) ten exotic sugar beet varieties were tested on four locations (NSCRI, PARC Experimental Farm, Thatta, Ramesh Agricultural Farm near Chohar Jamali, district Thatta, Noor Ahmad Agricultural Farm, district Badin and Hussaini Agricultural Farm, district Matyari) under agro-climatic conditions of Lower Sindh. The sugar beet varieties under study were Antek, California, Ernestina, Esteban, Sandrina, SD-12970, SD-PAK03/06, SD-PAK04/ 06, SD-PAK 07/07 and SD-PAK09/07.

It was observed that yield and quality performance of sugar beet varieties on different location was dissimilar. Overall, the performance of all sugar beet varieties was better and satisfactory. The location wise performance of varieties is summarized as i.e. NSCRI, Experimental Farm Thatta (SD-12970, SD-PAK09/07 and Sandrina were better in beet yield and Antek, SD-PAK 07/07, SD-PAK 04/06 varieties were better in sugar recovery), Ramesh Agricultural Farm near Chohar Jamali, district Thatta (same varieties of SD-12970, SD-PAK09/07 and Sandrina were better in beet yield and Antek, Esteban and SD-PAK 09/07 varieties were better in sugar recovery), Hussaini Agricultural Farm, district Matyari (Sandrina, SD-PAK09/07 and SD-PAK 03/06 were better in beet yield and SD-PAK 07/07, SD-PAK 09/07 and SD-PAK 04/06 were better in sugar recovery) and Noor Ahmed Agricultural Farm, district Badin (SD-PAK 09/07, SD-PAK 07/07 and SD-12970 were better in beet yield and SD-PAK 07/07, SD-PAK 09/07 and Antek varieties were better in sugar recovery).

The minor attack of insect was observed but was controllable. The results of the intercropping study showed that autumn intercropping system is better and economical because sugarcane and sugar beet both can be sown with same inputs like fertilizer and irrigation. However, the brackish water in Lower Sindh may be utilized and a better crop of sugar beet could be achieved with 2-3 applications of canal water and 5-6 applications of brackish water.

The results of two years studies showed that sugar beet can successfully be grown as a supplement crop with sugarcane in lower Sindh, if Sugar beet processing plant is established at Sugar Mills of the Thatta and Badin areas.

Name of Project:	**Evaluation of Sugarcane Gemrplasm for Frost Tolerance; A Component of the Coordinated Project "Screening of Sugarcane Germplasm and use of Induced Mutation/Callus Culture for Frost Tolerance, High Cane and Sugar Yield" (NARC, Islamabad, Component-I)**
Name of PI/ Institute:	**Dr. Muhammad Zubair,** Coordinator, Sugar Crops Sugar Crops Research Program, CSI, NARC, Islamabad.
Duration:	01. 07. 2008 to 30. 06. 2011
Financial Status:	Total Cost: Rs.3.528 million Funds Released: Rs.1649865/- Funds Utilized: Rs.1648840/-

Objective:

- Identify the nature, extent and severity of frost damage to commercial cane varieties.
- Screening of sugarcane germplasm for frost tolerance under natural conditions.

Achievements:

Two hundred and forty eight (248) sugarcane germplasm lines including 28 commercial varieties were planted during September 2008 at NARC, Islamabad to test for frost tolerance. The data up to December 2009 were recorded on germination, tillers per plant, Brix %, Pol %, Purity %, CCS % (commercial cane sugar), Recovery %, Cane weight and Juice pH. The Brix %, Pol %, Purity %, CCS %, Recovery%, Cane weight and pH ranged from 13.1-23.7, 12.51-21.84, 71.58-98.89, 8.59-17.01, 3.5-17 and 5.23-6.07 respectively. Weather data for the months of December, January and February have also been recorded that revealed non-occurrence of frost. Plant damage due to frost and parameters regarding juice quality deterioration was to be recorded after occurrence of frost from December to February (2009-10), could not be recorded due to frost free winter. Frost damage survey to sugarcane growing areas of Khyber Pakhtunkhwa (KPK) and Punjab to record sugarcane plant damage and sampling for juice quality analyses could also not be undertaken as the winter of 2009-10 was frost free. Although sugarcane germplasm could not be screened for frost tolerance due to non-occurrence of frosting temperatures during the winter of 2009-10, yet a number of high yielding and high sugar content lines have been identified to be utilized for development of new promising sugarcane varieties.

Name of Project:	**Screening of Sugarcane (*Saccharum officinarum*) Germplasm and Use of Induced Mutations/Callus Culture for Frost Tolerance, High Cane and Sugar Yield; A Component of the Coordinated Project "Screening of Sugarcane Germplasm and Use of Induced Mutation/Callus Culture for Frost Tolerance, High Cane and Sugar Yield (NIFA, Peshawar Component-II)**
Name of PI/ Institute:	**Mr. Roshan Zamir,** Principal Scientist, Nuclear Institute for Food & Agriculture, Peshawar
Duration:	01. 07. 2008 to 30. 06. 2011
Financial Status:	Total Cost: Rs.2.853 millions Funds Released: Rs.2115700/- Funds Utilized: Rs.2071777/-

Objectives:

- Culture media optimization for callus, shoot and root induction
- Creation of genetic variability through induced mutation and tissue culture
- Testing of the developed sugarcane genotypes in the frost prone areas.

Achievements:

Screening of Sugarcane Genotypes for Frost Tolerance, High Cane and Sugar Yield: Research work for identification and selection of frost tolerant sugarcane genotypes remain in progress and fifty four (54) promising sugarcane genotypes were evaluated. The data collected on various parameters is summarized as below:

i. Agronomic Evaluation:

Stool/stock: The data on stool/stock was significantly different from each other in all the germplasm. The highest stool/stock (6.43) were observed in line HOSG-1145 followed by line CPSG-1607 where 5.83 stool/stock were obtained.

Cane thickness: The data on cane thickness is also significantly different from each other at 0.05 level of significance. The maximum cane thickness (29.5 mm) was recorded in line CPSG-1004 followed by line CPSG-85 with cane thickness of 28.07 mm.

Number of nodes/plant: Data on number of nodes/plant was significantly different from each other. The highest number of nodes (18.97) was recorded in line HOSG-155, CPSG-85 and CPSG-437 followed by line CPSG-1607 with 18.63 nodes.

Plant height: The highest plant height (279.4 cm) was recorded in line HOSG-1021 followed by line CSSG-2402 with height of 256.3 cm.

ii. Chemical Analysis:

Sugar Recovery: According to the data, the highest sugar recovery of 12.18 was recorded in line CPSG-159 followed by line HOSG-1145 with recovery of 11.67. The recovery data of all the germplasm is not significantly different from each other.

Commercial Cane Sugar (CCS%): The data on the commercial cane sugar (CCS) of all the germplasm under screening shows that the highest commercial cane sugar (13.61%) was recorded in line CPSG-159 followed by line HOSG-1145 with 13.02%CCS.

Name of Project: **Screening of Sugarcane *(Saccharum officinarum L.)* Germplasm for Frost Tolerance, High Cane & Sugar Yield; A Component of the Coordinated Project "Screening of Sugarcane Germplasm and Use of Induced Mutation/Callus Culture for Frost Tolerance, High Cane and Sugar Yield" (SCRI, Mardan Component-III)**

Name of PI/ **Mr. Sartaj Ali,**
Research Officer,
Institute: Sugar Crops Research Institute, Mardan.

Duration: 01 .07. 2008 to 30. 06. 2011

Financial Status:

Total Cost:	Rs.2.539 million
Funds Released:	Rs.1764400/-
Funds Utilized:	Rs.1030553/-

Objective:

- Screening of Commercial Sugarcane Varieties and Exotic Germplasm under natural frost conditions of NWFP.
- Creation of genetic variability through hybridization.

Achievements:

During the year 2007-08 about 70-75% of sugarcane in Peshawar valley was severely damaged by frost. The exposure of sugarcane to damaging frosts occurs in approximately 25% of sugarcane producing countries. For the last couple of years 50% area of sugarcane in Punjab and KPK was affected which increased losses in both quality and quantity.

For screening of sugarcane germplasm, selection of 42 varieties have been made out of 52 germplasm received last year from various sources, on the basis of germination %age, tillering, growth, resistance to insect pest attack and resistant to frost. These 42 varieties were sown in October, 2009, both at Sugar Crops Research Institute, Mardan and Seed Multiplication Farm, Harichand. Each variety was sown in 3 lines. The middle row was sown with 150 buds. Data on all parameters from germination to harvesting specially on frost tolerance during December-February recorded on central row. During 2009-10, ten (10) more varieties/germplasm were received from Sugarcane Research Institute, Faisalabad and Sugar Crops Research Institute, Shakarganj, Jhang, and sown at Sugar Crops Research Institute, Mardan. Each variety was sown in two lines each (10 m long) during November, 2009. All cultural, mechanical and manual practices kept standard. Data on all parameters i.e. germination to harvesting recorded and reported.

The data collected revealed that at location No.1 (SCRI, Mardan), 10-40% bud damage occurred in some of the varieties by frost occurred from 15th December 2009 to 13th January 2010,

however, a single bud was not affected in varieties QSG-17, CPSG-3481, HOSG-795, HOSG-449, LPSG-1515, HOSG-315, HOSG-439, HOSG-149, CSSG-2402 and HOSG-1325. All these varieties were lush green up to the end of January 2010. At location No.2 (Seed Multiplication Farm, Harichand) intensity of frost was very low and in only few varieties, 10-17% buds were affected by frost while there was no significant effect of frost on remaining varieties. Mild pyrilla attack was observed in varieties S 2001-CPSG-3453, S 2003-CPSG-244 and S 2003-CPSG-375 during August, 2009 at both locations. Kuracron were applied for the control of pyrilla immediately. Smut attack was observed in variety CSSG-2402.

Name of Project: **Enhance the Cane Yield, Sucrose Contents and Frost Tolerance of Genotypes Using Callus Culture; A Component of the Coordinated Project "Screening of Sugarcane Germplasm and Use of Induced Mutation/Callus Culture for Frost Tolerance, High Cane and Sugar Yield" (SSRI, Jhang, Component-IV)**

Name of PI/ Institute: **Dr. Shahid Afghan,**
Director,
Shakarganj Sugar Research Institute, Jhang

Duration: 01. 07. 2008 to 30. 06. 2011

Financial Status:

Total Cost:	Rs.0.785 million
Funds Released:	Rs.415000/-
Funds Utilized:	Rs.375404/-

Objective:

- Evolution of frost tolerant genotypes using selection-breeding techniques.
- Creation of useful genetic variability through induced mutation using callus culture for frost tolerance, high cane and sugar yield.

Achievements:

To develop the frost tolerance sugarcane clones, selected varieties (CSSG-676, CSSG-668, HOSG-529, HOSG-795 from SSRI, Jhang, HSF-240, CPF-237 from Faisalabad and CP72-2086, CP-77-400 from Mardan) were cultured on callus media. After four weeks callus regeneration had been started. In addition to that, about 54 promising clones at SSRI developed and included in the screening against frost tolerance were given to the collaborating institute viz; NARC, Islamabad, Nuclear Institute for Food and Agriculture, Peshawar and SCRI, Mardan. Regenerated callus was shifted to growth media for plant formation. After 4-5 weeks plant formation had been started, then its multiplication was done on growth media. The stuff was shifted to rooting media for root development.

Contamination was a major problem in sugarcane tissue culture. Serious bacterial contamination problem was noticed in varieties HOSG-795, CP-77-400, CPF-237 and CP-72-2086. Bacterial contamination and slow multiplication problem was also faced by HOSG-529. About three thousand plants of selected frost tolerant varieties have been developed through callus culture that was shifted to green house during Sept to Oct, 2009.

Three sugarcane varieties modified through callus culture have shown good promise for tolerance against post freeze deterioration. Therefore, maximum (2100) plants were multiplied of the three sugarcane varieties viz; CSSG-668, CSSG-676 and HSF-240. These were 2100 till June 2010.

Name of Project: **Development of Salt Tolerance in Sugarcane through Genetic Engineering**

Name of PI/ Institute: **Mr. Ikram-ul-Haq,**
Lecturer,
Institute of Biotechnology and Genetic Engineering (IBGE), University of Sindh, Jamshoro.

Duration: 01. 07. 2008 to 30. 06. 2011

Financial Status:

Total Cost:	Rs.2.707 million
Funds Released:	Rs.2024100/-
Funds Utilized:	Rs.1866291/-

Objective:

- Establishment of an efficient plant regeneration system that may regenerate maximum sugarcane cultivars.
- To establish mutagenesis in the proliferating embryogenic calli through chemicals or UV treatment.

Achievements:

During the period 2009-10, root induction in the regenerated plantlets of different sugar cane cultivars (Thatta-10, CPF-237 and SPHS-19) was optimized. Best rooting was observed in the cultures MS basal medium supplemented with 1 mg/L^{-1} NAA as well as combination of 1 mg/L^{-1} IBA + 1 mg/L^{-1} NAA. The cultures supplemented with only 1 mg/L^{-1} NAA was considered best for rooting because a combination of hormones causes mutation in the genome.

Almost, seven week old callus culture of each genotype was subjected to MS basal culture with chemical mutagen (NaN_3) for 6 days and than cultured on NaCl stressed callusing MS nutrient medium. Best callus proliferation was observed in Thatta-10 and CPF-237 on the culture with 25mM, 50mM NaCl stress. After 4 weeks of callus proliferation medium (MS+3.0mg L^{-1} 2, 4-D) cultured on somatic embryogenesis medium (MS+ kinetin (0.2 mg L^{-1}), BAP (0.3mg L^{-1}) and 0.3% (w/v) casein hydrolysate) for 4 weeks under dark conditions. When culture was sub-cultured on plant regeneration medium [MS+ kinetin (0.2 mg L^{-1}), BAP (0.3 mg L^{-1})] and transferred to light conditions, no plant regeneration was observed.

Well micro-propagating plantlets of Thatta-10 and CPF-237 were also cultured on 5 different NaCl stressed MS cultures. Continuous culturing of growing plantlets under stressed condition may develop resistance in them against that specific applied stress. Both varieties have shown good response up to 100mM NaCl stressed level.

The genomic DNA was isolated from 51 genotypes of sugarcane and freezed at 20^0C for future use.

Name of Project: **Phenotypic Plasticity of Safflower (*Carthamus tinctorius* L.) in Response to Environment and Integrated Nutrient Management**

Name of PI/ Institute: **Dr. Fayyaz-ul-Hassan,**
Professor,
Department of Agronomy, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi.

Duration: 01. 07. 2008 to 30. 06. 2011

Financial Status:

Total Cost:	Rs.1.913 million
Funds Released:	Rs.1191000/-
Funds Utilized:	Rs.1176226/-

Objective:

- To generate information related to the potential of safflower cultivation in Pothwar
- To document the effect of environment on quantity and quality of safflower
- To sort out the most appropriate integrated nutrient management technique for safflower under rainfed conditions.
- To impart practical training to students relevant to safflower cultivation
- To transfer the generated technology to the end users.

Achievements:

Safflower is an oilseed crop which is grown throughout the semi arid region of the temperate climates in many parts of the world for use as vegetable and industrial oils, spices, and birdfeed. Safflower has been under cultivation in Pothwar since ages as fodder and minor oilseed crop. However, due to different socioeconomic and technical difficulties farmers have abandoned sowing of safflower. Among these difficulties are; lack of high yielding varieties, spiny nature of the varieties that interfere manual harvesting and threshing, competition with other major winter crops, long duration of crop maturity and germination of seeds inside the head if rain occurs at the mature crop.

Keeping in view the difficulties being faced by the farmers to cultivate safflower, the present studies were initiated to explore the potential and identify the most promising cultivars from newly developed local and exotic cultivars under varying environmental conditions. Eight cultivars (four local and four exotic) were planted at three locations (Rawalpindi, Chakwal & Talagang) during November, 2009. At the same time a separate study was conducted on integrated nutrient management using six different treatments of NPK, FYM & Poultry Litter for safflower. The experiment was also sown during November, 2009. All the experiments were harvested during June, 2010. Results from present studies revealed statistically significant differences among cultivars under study for different parameters. The exotic cultivar TN-79-683

out yielded rest of the cultivars in almost all the parameters recorded during the course of study, while amongst local cultivars, Thori-78 proved to be better than rest of the cultivars.

From the integrated nutrient management experiment, it become clear that neither alone application of NPK nor FYM is a good practice, rather combination of both at appropriate rate is the best option.

It became clear from the interaction with farmers and survey of different areas of Pothwar that farmers are looking for some early maturing and less spiny safflower cultivars, those are high yielding in terms of seed as well as fodder. Based on results, exotic cultivar TN-79-683 has the potential to be adapted under Pothwar conditions. However, local check Thori-78 may be alternate. One Ph. D student enrolled in the University is working in the project on Safflower research.

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Name of Project: **Enhancement of Quality & Storage Stability of Dhakki Dates Using Advanced Technology**

Name of PI/ Institute: **Dr. Shahzada Arshad Saleem,**
Post Harvest Technologist,
Agricultural Research Institute, D. I. Khan

Duration: 01. 07. 2007 to 30. 06. 2011

Financial Status:

Total Cost:	Rs.4.099 million
Funds Released:	Rs.3732100/-
Funds Utilized:	Rs.3730624/-

Objective:

- Characterization of various developmental stages, maturity indexing.
- Artificial ripening by various ripening stimulators.
- Probing of shelf life extension.
- Storage studies at different temperature and water activity levels.

Achievements:

Dates were employed for drying to enhance shelf life using different drying methods viz. Solar drying, Cabinet drying and Oven drying. The dates were graded according to standard ranking (A, B, C) for quality in terms of colour, flavour, size, taste, and general acceptability. A fine quality product of Grad "A" was achieved under solar drying conditions.

Storage trials were conducted to extend shelf life of the product and identify various water activity levels at 40º C temperatures. The water activity of Dhakki dates was determined by storing the date samples over selected water activity levels in the range of 0.12 to 0.97 a_w at 40º C. Sorption isotherm is constructed by relating equilibrium moisture content with water activity. The water activity of the Dhakki dates dried over following solar drier technique was found to have 0.62a_w. The stability of the date was measured by keeping the samples over selected water activity levels of 0.44, 0.52, 0.58 and 0.75 a_w at 40º C for 6 months, and quality evaluated by follow-up changes in moisture content, NEB, pH, titratable acidity and soluble solid content. On the basis of results, it is recommended that the fruit may be stored at around its own water activity 0.62 a_w, indicated the most promising one of the extended storage.

Two workshops on harvesting, handling, packing & storage techniques and preparations of different products from date's were arranged attended by Dates growers and official of Agri. Extension. Some results were presented in "Two days Dates Seminar & Exhibition at Khairpur", Sindh on 28-29 July, 2009 and Fourth International Date Palm Conference at Abu Dhabi, UAE on 15-17 March, 2010. Due to project contribution, the PI received Khalifa International Date Palm award and appreciation certificate. One student registered for his Ph. D degree program in the Gomal University, D. I. Khan is working in the project.

Name of Project: **Investigations on Pesticide Residues in Fruits and Vegetables Grown under Agro Climatic Conditions of KPK**

Name of PI/ Institute: **Dr. Barkat Ali Khan,**
Research Officer,
Agricultural Research Institute, Tarnab Peshawar.

Duration: 01. 07. 2008 to 30. 06. 2011

Financial Status:

Total Cost:	Rs.5.441million
Funds Released:	Rs.4382400/-
Funds Utilized:	Rs.3403545/-

Objective:

- Determine the residue levels of various insecticides on fruits and vegetables through surveys by collecting samples from farmers' fields in major growing areas of NWFP.
- Determine withholding periods of commonly used insecticides fruits (peach, apple, sweet orange and guava) and vegetables (Okra, tomato, peas and cauliflower) in field supervised trials under agro climatic conditions of NWFP.
- Impart trainings to farmers on the judicious use of pesticides and create awareness among them about the harmful effects of the persistent pesticide residues.

Achievements:

During the reporting period, 370 samples of eight vegetables (Okra, tomato, eggplant, cucumber, onion, cabbage green peas and cauliflower) and 95 samples of four fruits (guava, apple, apricot and peach) were collected from farmers' fields/orchards in various districts of KPK (Swat, Mardan, Charsadda, Malakand and Dir) during 2009-10. The samples of these crops were analyzed for assessment of any contamination level with residue levels of the pesticides reported by the growers. The most commonly detected residues were chlorpyrifos (6.1%) of 370 samples, λ-cyhalothrin (5.5%), cypermethrin (4.12%) and imidacloprid (3.5%), thiamethoxam (2.7%) and indoxacarb (2.1%), metalaxyl (1%). The sample were extracted with ethyl acetate, cleaned up and analyzed using HPTLC and HPLC techniques. The results indicated that 138 out of 370 samples contained detectable residues representing 37% rate of contamination while 10% contained residues that exceeded MRLs. Results from the residue analyses corroborate the pesticide use history reported by the growers.

Trials conducted on two vegetable (cauliflower and tomato) and two fruits (apple and peaches) to study the residue dissipation rates of four insecticides as foliar applications to these crops and determine their withholding periods. The trial on peaches (Cv. 6-A) was conducted on farmers' field at Urmar, Peshawar and on apple "Golden Delicious" was conducted in a farmer's orchard at Sherpalam, district Swat. The trials on tomato and cauliflower were conducted at the farm of Agricultural Research Institute Tarnab, Peshawar.

Based on residual dissipation of the selected insecticides from trials, it can be recommended to local growers to elapse 3, 7, 14 and 7 days as the safe waiting periods for picking tomatoes, cauliflower, peach and apple respectively treated with indoxacarb, cypermethrin, trichlorfon and chlorpyrifos. The results of analytical survey support the view that pesticides are used excessively by some local farmers.

Three training workshops "Use of pesticides and their residues in crops" were conducted in districts of Bannu, Mansehra and Charsadda where farmers, extension workers were educated about the problem of residues in crops and the possible solution. Efforts were made to create awareness in farming community to ensure safe application of pesticides resulting in no residues/below the established or proposed MRL values.

Name of Project:	**Survey of Midges and their Natural Enemies Associated with Mango and Develop Non Pesticides Measures for their Control in Pakistan (CABI-Rawalpindi, Component-I)**
Name of PI/ Institute:	**Mr. Riaz Mahmood,** Senior Scientific Officer, Regional Biosciences Centre, CABI, Rawalpindi.
Duration:	01. 07. 2007 to 30. 06. 2010
Financial Status:	Total Cost: Rs.4.715 million Funds Released: Rs.3575500/- Funds Utilized: Rs.3335659/-

Objectives:

- Identification of midges and their natural enemies associated with mango in Pakistan
- Study biology and ecology of important midges pest and their natural enemies.
- Assessment of yield losses incurred by midges to mango
- Development of biological control based IPM with integration of bio-pesticides as short term and long term strategies for management of midges.

Achievements:

More than 20 species of midges are known worldwide associated with various parts of mango plant including bark, shoots, leaves, pre and post flowering shoot buds, inflorescence buds, axillaries, flowers, newly formed fruit and twigs. In Pakistan first time under this project investigations were made on this group of the insects, which due to their multifarious mode of feeding have become serious pests of mango.

A temporary laboratory at Rahim Yar Khan, was established for studies on midges and their natural enemies. The midges and parasitoids reared during the report period were sent to Natural History Museum, U.K, for identification. Other studies initiated on midges and their parasitoids included their vertical distribution on a tree, distribution on different parts of a branch, biology, phenology, population trends and losses incurred by the midges. For management of midges, studies were made on midges' adults attraction to mango leaves extracts and different colors sticky bands. Light traps were also tested if the midges become attracted to light at night. Experiments were also initiated on cultural control, conservation biological control and integration of biopesticides with other measures for controlling midges.

Nine species of midges were recorded attacking mango. Six of these {*Procontarinia* possibly *mangiferae, Procontarinia matteiana?* and *Procontarinia spp* (3) and an unidentified sp} were restricted to leaves and the remaining two *(Dasineura amaramanjarae* and *Procontarinia sp*

(?Erosomyia indica) were associated with inflorescences only and an unidentified species on twigs.

Eight species of parasitoids including *Synopeas mangiferae, S. procon* on *P. mangiferae; S. temporale, Closterocerus pulcherrimus, Trichacoides indicus; Inostemma oculare* on *P. matteiana* and *Aprostocetus* sp on unknown midge and an unidentified species on *Erosomyia indica* were recorded.

During the studies it was found that more than 38% newly set fruit were lost by feeding of larvae of midges. In-field mass rearing techniques of parasitoids of midges was developed. At Rahim Yar Khan, cultures of parasitoids of midges were maintained on more than 7000 mango seedlings. Studies were made on impact of different management tools. Hoeing of the soil had marked impact on populations of the midges that pupate in soil.

By stopping pesticides sprays and with integration of conservation of parasitoids, parasitism increased and populations of the midges decreased in the study orchard. Studies made on attraction for midges to mango extracts, colored sticky bands, light traps also indicated their usefulness and can be considered to integrate with other control measures.

The studies conducted under the project had led to the conclusion that for the first time in Pakistan nine species of midges attacking mango in Punjab has been discovered. Of these *Procontarinia mangiferae*, and *Procontarinia matteiana*, on leaves and *Dasineura amaramanjarae* and *Erosomyia indica* on flowers were important pests. It was found that more than 38% newly set fruit were lost by feeding of midges larvae. Midges have good natural enemy complexes and the need is to encourage them through application of techniques of conservation biological control in combination with other measures for sustainable management of midges. Conservation of parasitoids played major role in regulating midges population on mango. Of different types of traps tested for attraction of mango midges the light traps were found comparatively more attractive to them.

One Ph. D students registered in Bahauddin Zakaryia University, Multan worked in the project. Two student completed internship, trained in all the research activities conducted in Mango Lab. in Rahim Yar Khan.

Name of Project:	**Survey of Midges and their Natural Enemies Associated with Mango to Develop Non Pesticides Measures for their Control in Pakistan (NARC Component-II)**
Name of PI/ Institute:	**Dr. Ghulam Jilani,** Sr. Director, Insect Pest Management Program, Institute of Plant Environmental Protection, NARC, Islamabad.
Duration:	01. 07. 2007 to 30. 04. 2010
Financial Status:	Total Cost: Rs.2.547 millions Funds Released: Rs.1725300/- Funds Utilized: Rs.1306260/-

Objectives:

- Assessment of role of bio-pesticides and integration of bio-pesticides in short and long term strategies for management of midges and effect on their parasitoids.
- Development of IPM models and implementation in collaboration with coordinating units.

Achievements:

Currently 2-3 sprays of insecticides are being applied to mango inflorescences for control of mango midges. This increased application has given rise to new major pests through development of resistance and elimination of natural enemies of minor pests. During last two years, three species of midges and four species of parasitoids have been identified and studied their biology and phenology by CABI, Biosciences Unit, Rawalpindi. However, effective rearing techniques have not been standardized so far because of concealed life in the galls for major part of life except at few in the inflorescence.

Neem seed water extract affected pupation and adult emergence of both the species of mango midges viz. *Dasineura amararamanjari* and the unidentified species. Plant oils such as neem, sesame and caster oils also inhibited pupation of mango midges even when applied at 0.1, 0.05 or 0.025 percent concentration in soil as against 4.00, 2.00, 1.00 or 0.5 percent. Leaf extracts of six mango varieties were evaluated for their repellent or attractant effect. Leaf extract of Chaunsa had no repellent or attractant affect on mango midges. All other varieties viz. Tota Pari, Fajri, Anwar Ratol, Sindhri and Dosehri had some affect during the active period of mango midges from January to April. To develop Integrated Pest Management of Mango midges out of five treatments such as application of 2% neem extract to mango plant alone or in combination with soil hoeing under the canopy; applying neem seed extract to soil with or without hoeing etc. were

applied. Application of 2% neem seed extract to the mango plant at 12 days interval and soil hoeing under the plant canopy gave maximum control of mango midges.

The results of the study revealed that application of neem seed extract at 2 percent concentration to mango plant at 12 days interval alongwith soil hoeing under the plant canopy in the month of March provided more than 80 percent control of mango midges. Plant oils such as neem oil, sesame oil and caster oil applied to soil at 0.10 percent concentration significantly inhibited midges pupation.

A student enrolled in BZU, Multan for Ph. D in Entomology worked for his thesis research "Integrated Pest Management of Mango Midges" under the project.

Name of Project: **Survey of Midges and their Natural Enemies Associated with Mango to Develop Non Pesticides Measures for their Control in Pakistan (ARI, Tandojam, Sindh Component-III)**

Name of PI/ Institute: **Dr. Abdul Sattar Buriro,**
Entomologist,
Agricultural Research Institute, Tandojam, Sindh.

Duration: 01 .07. 2007 to 30. 06. 2010

Financial Status:

Total Cost:	Rs.2.632 million
Funds Released:	Rs.2415600/-
Funds Utilized:	Rs.2355577/-

Objectives:

- Identification of midges and their natural enemies associated with mango in Pakistan
- Study biology and ecology of important midges' pests and their natural enemies.
- Assessment of yield losses incurred by midges to mango.
- Testing of bio-control agents and bio-pesticides to develop short term and long term strategies for management of midges and develop capabilities in farmer communities.

Achievements:

Information about mango midges is not much known from Pakistan level. At world level more than twenty species of Cessidomyiid midges on mango have been reported, eleven of these are from India. Important of these gall midges are *Dasineura amaramanjarae, Procontarinia metteriana, Erosomyia magnifera (indica), E. magnicola* and *Procystiphora magnifera* (Mani, 1939, 1952; Dasa, 1980). Midges (Diptera: Ceccidomyidae) is considered a serious insect pest causing direct and indirect loss of flower and fruits by laying eggs.

Midges attacked were surveyed from managed and un-managed garden of District Mirpurkhas and noted infestation of leaf gall midges attack, where %age was found high on top leaves of the tree followed by middle and bottom.

The population distribution of mango midges was recorded high in district Hyderabad followed by district Mirpurkhas and Tando Allahyar. The fruit losses percentage in spray garden was 11.31 and in un-spray garden was 44.19. Work was carried out on phenology, monitoring of midges through sticky bands and light traps. Effect of neem tree extract of different concentration on control of leaf gall midges and inflorescences midges and role of attraction of mango leaves extracts were also studied. Of different color light traps used, only yellow light traps, zero bulb traps and without bulb trap gave response to caught of adult midges. Similarly the sticky traps of different colors used to catch the midges, the yellow sticky traps attract maximum midges while the sticky traps without color attract minimum midges. Different

concentrations of neem tree extract were used to observe repellent behavior on leaf gall midges. The neem tree extract was found useful in controlling the midges.

Two species namely *Procontanaria matteiana* on leaves, *Dasineura amaramanjarae* and one parasitoid have been identified at species level with the collaboration of CABI Bioscieces, Rawalpindi. A student registered for hid Ph. D study carried out research work for his thesis writing in the project.

Name of Project:	**Investigations on Viral Diseases of Sugarcane in Pakistan with Special Emphasis on Sugarcane Mosaic Virus (SCMV): Characterization and Identification of Resistant Sources**
Name of PI/ Institute:	**Dr. Tahira Yasmin,** Scientific Officer, National IPM Program, Institute of Plant and Environmental Protection, NARC
Duration:	01. 07. 2007 to 30. 06. 2010
Financial Status:	Total Cost: Rs.5.436 million Funds Released: Rs.3038000/- Funds Utilized: Rs.2997424/-

Objectives:

- To conduct surveys of major sugarcane growing areas of Punjab and NWFP to know the occurrence, distribution and prevalence of viral diseases.
- Indexing of survey collected samples against major viruses infecting sugarcane through ELISA.
- Characterization of SCMV on the basis of serological and biological properties.
- Screening of available sugarcane germplasm against SCMV for identification of resistance.
- Development of management strategies for SCMV.

Achievements:

To investigate occurrence, distribution and prevalence of major virus infecting sugarcane crop, field surveys of four (Mardan, Peshawar, Charsadda and Dargai) major sugarcane growing districts of Khyber Pakhtunkhwa (KPK) and ten (Mandi Bahauddin, Sargodha, Faislabad, Jhang, Toba Tek Singh, Okara, Rahim Yar Khan, Bahawalpur) districts of Punjab were conducted during 2008, 2009 and 2010. The samples collected from farmer's field were tested through enzyme linked immuno-sorbent assay (ELISA) against four major viruses viz. Sugarcane Mosaic Virus (SCMV), Maize Streak Virus (MSV), Maize Dwarf Mosaic Virus (MDMV) and Sugarcane Bacilliform Virus (SCBV). Overall in KPK (Mardan, Peshawar, Charsadda and Dargai), incidences in random samples were 15, 22.5, 26.5 & 16.5 % respectively while in non-random samples, the incidences were 40, 13.75, 18.75 & 15 % respectively. Among viruses, the highest incidence (in random samples) was found for MDMV (60%) in Mardan district. The relative incidences of SCMV, MSV, MDMV & SCBV in random samples of Punjab (Mandi Bahauddin, Sargodha, Faisalabad, Jhang, Toba Tek Singh, Okara, Rahim Yar Khan, Bahawalpur) were 35.26, 68.12, 39.37 & 63.75% respectively while in non-random samples 36.875, 75, 42.5 & 36.87% respectively. In Punjab, Sargodha and Toba Tek Singh districts

seemed apparently free of SCMV infection while the highest incidence among viruses in random samples was found of SCBV (95%) in Toba Tek Singh district. Among the weed flora, seventeen weeds were collected from sugarcane fields, nine were found to be infected with SCMV infection.

The representative isolates of SCMV obtained from survey samples from each province were maintained on sugarcane plants under field conditions as well as preserved for experiment use. However among wheat (Barani-73, Wafaq 2001, GA-2002), Sorghum (JS-62, mixture sweet sorghum), Millet (MS-5, MS-2, Super-1, S-2000, Johar 1, Johar & Y-84), Maize (EV 1097, SWL-2002, GS-5392, Islamabad Gold, Soan 3, SP-4482-1, SP-4482-2, SP-4487-3), Oat (BROOKS, Worvin, Glinder, PD_2LV_{65}) and Barley (Soorab-96), only MB-87 (Millet), Islamabad Gold (Maize), and Sorghum (JS-62) were found ELISA positive and were used for SCMV propagation under glasshouse conditions.

For biological studies, host range and transmission were investigated. Among wheat (Chakwal-97, NARC No.1542 & Barani-73), Sorghum (JS-62), Millet (MB-87, Super-1 & Acc. No. 8808), Oats (PD_2LV_{65}), Maize (EU-5098, Rakaposhi, Islamabad Gold & Islamabad White) & Barley (Soorab-96) tested through mechanical inoculation under glasshouse conditions, only crop varieties MB-87, Super-1, Acc. No. 8808 (Millet) & EU-5098, Rakaposhi, Islamabad Gold & Islamabad White (Maize) were found positive for SCMV through ELISA. SCMV was successfully transmitted by mechanical inoculation as well as through two aphid species *(Sitobion sp.* and *Macrosiphum euphorbiae)* under glass house conditions.

A total of 106 sugarcane germplasm cultivars/lines were evaluated under glass house conditions at NARC. On the basis of symptom expression and ELISA results, four commercial sugarcane cultivars (COJ-84, SPSG-26, PR-1000, L-116) with moderately resistance and five (Triton, CP-77-400, IM-61, L-357, L-62-96) with moderately susceptible to SCMV were identified. The rest of commercial cultivars tested were found resistant to SCMV. Similarly, ten advance lines were found moderately resistant, fifteen lines were found moderately susceptible, ten lines were found susceptible and only three lines were found highly susceptible to SCMV.

For management of SCMV, thermotherapy or hot water treatment (50-65^{0}C for one min each) approach was used for reducing the virus infection in sugarcane setts. None of the treated cultivars (CPS-150, CP-75-1030 & AEC-81-8415) showed SCMV symptoms within 2-3 months period after germination, hence the given temperatures seem suitable to reduce the virus affect.

Six (one/year/province) farmer field days/awareness seminars were organized on *"Viral diseases of sugarcane crop and their management"* in Punjab and NWFP during three years period in collaboration with various provincial agriculture extension and research institutes including theoretical and practical demonstration of sugarcane crop and its various disease and insect problems, discussion about problems and probable solutions by farmers and researchers.

A paper has been prepared from project work and submitted to Pakistan Journal for Phytopathology for acceptance. A brochure in Urdu "Sugarcane Viral Diseases & their

Management" has been published and distributed among farmers and researchers. A student of PMAS, AAU Rawalpindi worked in the project, published his master thesis under the project.

It has been concluded from research conducted under the project that sugarcane crop in major growing areas of Punjab and KPK has been found infested with four viruses viz; SCMV, MDMV, MSV and SCBV with varying incidences. Overall the incidences of viruses have been found more in KPK during three years period. Highest incidence of MSV was recorded in Punjab province whereas lowest incidence of SCBV was recorded in KPK during the three years period. In KPK the continuous use of same and own germplasm, prevalence of insect pests as well as poor management practices are major factors in viral disease development while in Punjab, non availability of resistant varieties, poor field conditions, insect pests etc. are the major factors. Thermotherapy is an effective method to reduce SCMV in sugarcane setts. Among 30 commercial varieties cultivated in Punjab, KPK and Sindh, 21 were found resistant while none of the advanced line was resistant against SCMV. For controlling sugarcane diseases, use of certified healthy seed or of disease resistant varieties, proper phyto-sanitary measures and hot water treatment are best measures.

Name of Project: **Management of Date Palm Insect Pests in Sindh**

Name of PI/ Institute: **Mr. Muhammad Usman Shar,**
Entomologist,
Agriculture Research Institute, Tandojam, Sindh.

Duration: 01. 07. 2007 to 30. 06. 2010

Financial Status:

Total Cost:	Rs.3.616 millions
Funds Released:	Rs.3291700/-
Funds Utilized:	Rs.3261327/-

Objectives:

- To conduct studies on life table of major insect pests i.e., Red-palm weevil and Fruit borer of date palm.
- To study the effect of ecological factors, natural enemies and alternate host plants on date palm pests.
- Field observations on date palm varieties for comparative resistance to pests' i.e. Red palm weevil and fruit borer and extent of damage.
- Screening of environmentally safe pesticides against major insect pests.
- Development and dissemination of IPM techniques on the basis of results to the date palm growers.

Achievements:

During 2007-08 and 2008-09 survey of date orchards was carried out for red palm weevil (RPW) insect pest in four different locations/talukas viz; Kotdiji, Kingri, Rohri and Pano Akil. Observations regarding different stages (egg, larva, pupa and adult) of the pest were recorded at fortnight level. The maximum percent infestation (11.8%) of RPW was recorded at Pano Akil and lowest (8.6%) at Kingri. The monthly mean temperature ranged between 26.93 ^{0}C to 30.5 ^{0}C seems favored the pest attack. The mean attack (10.25±6.66%) remained higher due to removal of suckers. During survey and lab studies, still no natural enemies of RPW and lesser date moth were found. In life table study more mortality (27.39%) from egg to pupae was recorded in RPW in laboratory conditions and survival (78.50). However, in 2nd generation more survival (71.5) from egg to pupae and more mortality (39.86) recorded. Karbalian variety was more susceptible (15.25). During the application of pesticides more recovery percent of trees were recorded in Pano Akil. In study on evaluation of pheromones trap more (60-70%) was recorded at Ghulam Shabbir Sheikh's orchard. During survey of date orchards of different talukas all orchards were infested with fruit borer. The maximum mean infestation (13.4-17.65%) was recorded in the months of May and June in the immature fruits and maximum temperature favored the pest attack. In life table study mortality (56.0%) and survival (44.0) from egg to pupae was recorded in LDM laboratory conditions. The Aseel variety was proved as most susceptible (13.50), among

other varieties. In April, more trapping (45.6±3.01) and in May (25.8±1.78) was recorded by light trap and sweep net.

Different coloured traps (Mercury, Energy saver, Florescent and Milky bulb) were installed for mass trapping of lesser date moth (LDM) adults at different date palm varieties. The maximum number of (145.3±15.45) mass trapping of lesser date moth was recorded from Aseel variety and the minimum number (64.8±3.17) mass trapping of LDM was recorded in Muzawati variety. Regular monitoring of red palm weevil and fruit borer (lesser date moth) is required. Phytosanitation followed by irrigation is important for control of date palm pests. Young date trees (7-12 years) needs proper attention. Varieties i.e. Muzawati, Pathri, Thothar, Khar, Shakri, Edan Shah, Fasli and Dadhi are more comparatively resistant to RPW while varieties Edan Shah, Muzawati, Khar, Karbalian, Pathri, Thothar, Fasli and Shakri are comparatively resistant to lesser date moth. Controlling of LDM, the light traps are recommended at the rate of 4 traps/acre.

Under this project two Ph. D scholars were registered at Department of Plant Protection, S.A.U. Tandojam. A publication in local language title *"Red Palm Weevil & its remedies"* has also been made from the project.

Name of Project: **Development of High Yielding and Powdery Mildew Resistant Varieties in Peas**

Name of PI/ Institute:	**Mr. Khalid Mahmood,** Scientific Officer, Vegetable Research Institute, AARI, Faisalabad	
Duration:	01. 07. 2007 to 30. 06. 2010	
Financial Status:	Total Cost:	Rs.1.474 million
	Funds Released:	Rs.1360425/-
	Funds Utilized:	Rs.1360350/-

Objectives:

- To develop varieties in peas having high yield and powdery mildew resistance.

Achievements:

During the year 2009-10, four new crosses were made to create variability for selection of high yielding and powdery mildew resistant lines. Seed of four crosses harvested last year was evaluated for its hybrid plants and seed of F1 plants collected for further evaluation. Seeds of 1150 single plants from three crosses in F2 were planted in plant to families and fifty better performing and disease resistant single plants were selected for further evaluation. Seeds of 850 single plants from three crosses in F3 were planted in plant to families and 145 better performing and disease resistant single plants were selected for further evaluation. Seeds of 200 single plants from one cross in F4 were planted in plant to families and 67 better performing and disease resistant single plants were selected for further evaluation. Seeds of 650 single plants from two crosses in F5 were planted in plant to families and 113 better performing and disease resistant single plants were selected for further evaluation. Plant traits like pod length & width, numbers of pods per plant, pod filling, grain size and days to maturity were kept in view during selection in different filial generations for further evaluation following pedigree method. Five new genotypes were collected and evaluated for further use to improve peas genotypes to meat the future requirements of the peas growers.

The project has also provided assistance partially in the development of high yielding and powdery mildew resistant pea variety (Pea-2009). This variety has been approved by Punjab Seed Council in its meeting held on 23. 10. 2010 for general cultivation in Punjab.

A paper has been published in International Journal of Vegetable Science and one has been accepted for publishing in Journal of Horticulture Sciences. Two brochures/leaflets, one in English (*Pea Cultivation in Punjab, 2008*) and one in Urdu (*Punjab Mein Matar Ki Kasht, 2010*) were printed and distributed among farmers.

Name of Project: **Identification and Evaluation of *Gossypium arboreum* Genes for Cotton Leaf Curl Virus Resistance**

Name of PI/ Institute: **Dr. Aftab Bashir**
Principle Scientist,
Plant Bio Technology Division, NIBGE, Faisalabad.

Duration: 01 .07. 2007 to 30. 06. 2010

Financial Status:

Total Cost:	Rs.4.273 millions
Funds Released:	Rs.3518200/-
Funds Utilized:	Rs.2921964/- (up to Dec. 2009)

Objectives:

- Construction of leaf cDNA libraries from CLCuV resistant and susceptible cotton lines
- Identification of differentially expressed genes
- Evaluation of isolated genes for CLCuV resistance in a model plant system
- Establishment of gene pool resource for development of transgenic CLCuV resistant cotton lines

Achievements:

Cotton Leaf Curl disease (CLCuD) is a major problem in Pakistan since 1992. *G. arboreum* is a diploid (AA genome) and only cotton species that is resistant to this disease, while all the tetraploid species *G. hirsutum* AADD genome, are susceptible. The natural mechanism of CLCuD resistance has not been explored in *G. arboreum*. The project aim is to look into the genes differentially expressed between *G. arboreum* and *G. hirsutum* and evaluating them for their role, if any, against CLCuD resistance.

Two of the genes differentially expressed among *G. arboreum* and *G. hirsutum* were cloned and the plant expression cassettes were constructed. These genes have been transformed in tobacco. The plantlets developed and shifted to jars for developing complete plants. Both of the transgenic lines have the oxygenases isolated from *G. arboreum*. Oxygenases have been reported to confer host defense mechanism. The transgenic tobacco plants will be tested for conferring resistance to CLCuV resistance at maturity through vacuum infiltration/bombardment of the leaves with infectious clone.

The transgenic tobacco plants bearing two of the candidate genes i) Cytochrome P450 and Lipo-Oxygenase have been developed. These plants will be subjected to cotton leaf curl virus infection for determining their potential capability to resist virus infection.

The project has been completed on 30 June, 2010, the final technical report has, however, not yet provided.

Name of Project: **Insecticide Resistance Management of key Pests of Vegetable**

Name of PI/ Institute: **Dr. Mushtaq Ahmad,**
Dy. Chief Scientist,
Plant Protection Division, NIAB, Faisalabad

Duration: 01. 07. 2007 to 30. 06. 2010

Financial Status:

Total Cost:	Rs.2.293 millions
Funds Released:	Rs.1690000/-
Funds Utilized:	Rs.1591113/-

Objectives:

- Monitor the level of resistance in field strains of various vegetable pests compared with the laboratory-reared susceptible strains.
- Determine cross-resistance spectra as to what chemicals can be substituted in the wake of resistance development
- Find out mechanisms responsible for the resistance in question
- Evaluate if the existing pesticide mixtures are potentiating, additive or antagonistic, and if some mixtures can be used in counteracting resistance.
- Devise appropriate insecticide resistance management strategies to combat resistance.

Achievements:

With the increased use of pesticides in Pakistan, there has been a progressive development of genetically-acquired resistance of vegetable pests to insecticides. This is resulting in control failures of vegetable pests and the problem is aggravating day to day. Mealybug *(Phenacoccus solenopsis)* resistance was low to chlorpyrifos, methidathion, carbosulfan, lambdcyhalothrin, acetamiprid, thiamethoxam and thiocycalm in the year 2007, which quickly increased to high levels along with other insecticides by the year 2009. Synergism studies by enzyme inhibitors PBO and DEF showed that metabolic detoxification by cytochrome P450 mono oxygenases and esterases had a limited role in imparting resistance to pyrethroids, methomyl and imidacloprid. Other mechanisms such as decreased cuticular penetration and target site insensitivity may be more important mechanisms of resistance in *P. solenopsis* from Pakistan. Mixtures of pyrethroids plus organophosphates (OPs) were mostly found antagonistic in *P. solenopsis.* Whitefly *(Bemisia tabaci)* resistance was low to carbodiimide and neonicotinoids in 2007, which rose to high levels like other conventional insecticides by the year 2009. Jassid *(Amrasca devastans)* resistance was moderate to high to OPs, pyrethroids, neonicotinoids, spinosyns; however, it was still low to endosulfan, indoxacarb, chlorfenapyr, emamectin benzoate, carbodiimide and nitenpyram. Among aphids, potato aphid *(Myzus persicae)* showed resistance to all the insecticides tested. Cowpea aphid *(Aphis craccivora)* was resistant to chlorpyrifos, pyrethroids and neonicotinoids but susceptible to carbamates, deltamethrin and thiamethoxam. Cabbage aphid *(Brevicoryne brassicae)* was susceptible to several insecticides in 2008 but became resistant to all the tested insecticides (except endosulfan and chlorphyrifos) by the year

2010. The commonly-used insecticides for insect pests proved highly toxic to predatory coccinellids *Menochilus sexmaculatus* and *Hippodamia variegate.* However, a few insecticides were found safe against a parasitoid *Trichogramma chilonis* and a predator *Chrysoperla carnes.* On the basis of findings in the present project, an insecticide resistance management strategy has been proposed to mitigate resistance problem in vegetable pests in Pakistan.

The research has found the existence of insecticide resistance in the Pakistani populations of vegetable pests such as mealybug *(Phenacoccus solenopsis),* whitefly *(Bemisia tabaci),* jassid *(Amrasca devastans),* potato aphid *(Myzus persicae),* cowpea aphid *(Aphis craccivora)* and cabbage aphid *(Brevicoryne brassicae),* However, there are insecticides to which resistance is still low, particularly in jassid, cowpea aphid and cabbage aphid. Such insecticides can be applied in rotation to control the particular insect pests. The insecticides found to be safer for a parasitoid or predator can be used to control target pests without much harm to that parasitoid/predator. The proposed insecticide resistance management strategy can be very helpful in counteracting insecticide resistance in the future.

Name of Project: **Development of Wheat Heat Tolerant Breeding Material During Grain Fill Period**

Name of PI/ Institute: **Mr. Muhammad Ashraf Mian,**
Assistant Botanist,
Barani Agricultural Research Institute, Chakwal

Duration: 01. 07. 2007 to 30. 06. 2010

Financial Status:

Total Cost:	Rs.1.557 millions
Funds Released:	Rs.1490600/-
Funds Utilized:	Rs.1490430/-

Objectives:

- Extensive screening of germplasm resources for heat tolerance during grain filling period.
- Incorporation of heat tolerance into otherwise desirable genotypes.
- Development of wheat germplasm that can tolerate high temperature during grain filling period
- Multi-location screening/testing of breeding material developed.

Achievements:

Twenty wheat lines identified during 2007-08 as tolerant to rising temperature during grain fill period were included in crossing block to incorporate heat tolerance in varieties having desirable characters like high yielding, drought and disease tolerant. During 2008-09, seventy (70) crosses were attempted at Barani Agricultural Research Institute (BARI), Chakwal and Barani Agricultural Research Station, Fateh Jang, Attock and out of which 66 crosses were found successful. The seed of these crosses having heat tolerance and other desirable characters i.e. disease tolerance, drought tolerance and high yielding with low inputs was collected for further evaluation.

During 2009-10 seed of 66 crosses along with parents was sown at BARI,, Chakwal (both in heated and normal conditions) and at Cotton Research Station, Multan and seed of these crosses has collected for further study.

Sixty six (66) successful F1 generations developed for heat tolerance will be helpful for the development of high yielding and heat tolerant breeding material of wheat/varieties. By the development of heat tolerant varieties, we shall overcome the problem of yield reduction in wheat due to sudden rise in the temperature.

Thirty four (34) new crosses were developed to incorporate the heat tolerance in to otherwise desirable characters. 100 new combinations of wheat having heat tolerance are available.

Name of Project: **Sustainable Control Measures for Rose-ringed Parakeet (*Psittacula krameri)* on Maize, Citrus, Guava, Sunflower and Mango in Some Selected Agro-ecosystems in Central Punjab**

Name of PI/ Institute: **Dr. Hammad Ahmad Khan,**
Assistant Professor,
Department of Zoology and Fisheries, University of Agriculture, Faisalabad

Duration: 01. 07. 2007 to 30. 06. 2010

Financial Status:

Total Cost:	Rs.1.629 millions
Funds Released:	Rs.1059800/-
Funds Utilized:	Rs.1068417/-

Objectives:

- To carry out a detailed survey of the agricultural crops in the selected agro-ecological systems throughout Central Punjab to assess the potential parakeet roosts and nests, likely to cause the depredations on food croplands.
- To make an assessment regarding the foraging, feeding, roosting and nesting rhythms (activities) of the rose-ringed parakeets, in particular to calculate their numbers in different roosts. This will provide an approximation of the standing parakeet population throughout Central Punjab.
- To evaluate the level of damage caused by the rose-ringed parakeet on maize, sunflower, citrus, mango and guava in the proposed studies in varying seasons.
- To employ various mechanical/biological control devices viz, repellents, bird nets, chemo-sterilants along with some others for sustainable management of rose-ringed parakeet populations in various habitats in Central Punjab, and to present a strategic package to the farmers, the end users, the proposed methodology in a simplified way.

Achievements:

Survey of the potential roosting sites of the rose-ringed parakeets in the region of Central Punjab was conducted. The amplified parakeet populations existed in the cultivations of the University Campus, Canal rest houses and the abandoned habitats. All the roosts possessed sufficient number of parakeets in the cropped areas, particularly in the presence of multiple cropping systems in Punjab.

The roosts were assessed and quantified in terms of the preferred trees for the parakeets. A few control measures such as the reflecting ribbons, multi-mirror reflectors and sound players were installed in the fields to visualize their management effects.

The reflecting ribbons proved to be highly effective in managing the parakeet attacks on the cropped areas. Following the ribbons, the mirror reflectors also were sufficiently efficient in preventing the damage to the crops.

The research study conducted under the project led to the conclusion that rose-ringed parakeets exist in amplified populations of farm crops and fruit orchards in Central Punjab. Mostly the roosts are located in the light timbered vegetations, where there is, sufficient moisture available. The roosts are mainly confined on some specific trees such as the *Salmalia malabarica, Delbergia sissoo, Terminalia arjuna, Cedrella toona and Ficus bengalensis.*

The damage in the unprotected situations can be vicious, resulting in abundant economic losses. The management devices specifically designed for the present research, proved to be fairly successful in inhibiting the parakeet depredations. The reflecting ribbons were the best in controlling the parakeets' damage. Additionally, the ribbons being quite accessible to the farmers, were also best in cost effectiveness. Certainly, the other devices viz. the multi-mirror reflectors, gas exploders, acetylene exploders, distress sound players and bird scaring models were also fairly effective in deterring the bird depredations.

Three papers have been submitted for approval and publication while one is under preparation. Four students of M. Sc and two of M. Phil. have completed their thesis from project work. One Ph. D students has also submitted and defended his thesis at University.

Name of Project: **Integrated Control of Root Rot of Pepper in Peshawar and Malakand Divisions**

Name of PI/ Institute: **Dr. Shoukat Hussain,**
Associate Professor,
Department of Plant Pathology, KPK Agricultural University, Peshawar.

Duration: 01. 01. 2007 to 31. 12. 2009

Financial Status:

Total Cost:	Rs.2.622 million
Funds Released:	Rs.2066500/-
Funds Utilized:	Rs.1953284/-

Objectives:

- To characterize the isolates of *Phytopthora capsici* both *in vitro* and *in vivo* on commercial pepper varieties used by the farmers of the area.
- To determine pathogenicity and loss assessment of the collected isolates.
- To test effective strains of the biocontrol agents *Trichoderma* against isolates of the pathogen under *in vitro* and *in vivo* conditions.
- Evaluation of integrated control of *P. capsici in vitro.*

Achievements:

Pepper is one of the most important market vegetables, its yield and quality is frequently limited by Phytophthora blight caused by oomycete pathogen *phytophthora capsici*. Surveys conducted during 2007 in Peshawar and Malakand divisions showed that the intensity of root rot varied at different sites. A total of 16 isolates of *Phytophthora capsici*, collected during surveys, were tested for pathogenicity and characterized both in vitro and in vivo to determine population diversity of the pathogen in the region. The phenotypic markers including growth on selective media, metalaxyl sensitivity and lesion size were used to characterize the isolates. Pathotyping of representative isolates was also carried out on commercial pepper cultivars.

Phathogenicity tests confirmed that the symptoms produced post inoculation were similar to those observed on pepper plants in the field. In pathotyping studies, a high degree of virulence was found among all the isolates tested.

Screening of *Trichoderma harzianum* revealed that isolates clustered in different groups with respect to checking the growth of the pathogen. The lowest growth of the pathogen (2.05cm) was recorded when challenged with *T. harzianum* isolate Th.2.Mat. In the preliminary in vitro experiment on integrated control of *P. capsici*, both ridomil and curzate yielded promising results in combination with isolates Th.1Jah and Th.2.Mul which were used for further testing in the field. In *planta* studies, a combination of ridomil plus *Trichoderma harzianum* (Isolate

Th1Jah) and organic amendment (zameendost) yielded promising results both in screenhouse and field trials thereby showing that potential for control of root rot exists. However, mass cultivation of the biocontrol agent and its effective delivery system needs to be optimized.

The studies conducted revealed that disease was present at varying degrees of intensity in Peshawar and Malakand divisions. Pathogenicity tests conducted during the course of the study confirmed the identity of the pathogen. Based on three phenotypic markers, it was concluded that variation does exist in the population structure of *Phytophtohra capsici,* which is suggestive of sexual recombination. Most of the isolates proved metalaxyl resistant which is indicative of indiscriminate use of fungicides by the growers. A high degree of virulence amongst the isolates suggests co-evolution of the pathogen with the host under the influence of selection pressure. A disease management toolkit comprising of ridomil, zameendost and *Trichoderma harzianum* has been developed with promising results.

One student worked as research fellow in the project registered for Ph. D. accomplished research for his thesis title "Biology and management of root rot of pepper in Peshawar and Malakand divisions of NWFP".

Name of Project: **To Determine Optimum Maturity Indices of Various Mango Varieties (Langra, Dusehri and Samar Bahist) to Enhance Export and Minimizing Post Harvest Losses**

Name of PI/ Institute: **Abdul Rahim Khan**
Assistant Research Officer,
Post Harvest Research Centre, Ayub Agricultural Research Institute, Faisalabad.

Duration: 01. 07. 2008 to 30. 06. 2011

Financial Status:

Total Cost:	Rs.3.947 millions
Funds Released:	Rs.2928900/-
Funds Utilized:	Rs.2926503/-

Objectives:

- To determine/identify the maturity indices of promising mango varieties
- To introduce the maturity indices among the mango growers
- To study the interdependence of the different physical and chemical changes which occur during the maturing and ripening of mangoes
- To develop storage parameters for mature green mango on variety bases.

Achievements:

Shelf life extension in mango is the main aim of research activities, to control quality of mangoes by avoiding physiological disorders during ripening. Fungicide spray at the time of fruit setting reduces the chances of Anthracnose and stem end rot during ripening. Sap washing, pre-cooling and control ripening process can better improve freshness of mangoes and extend market span.

In mango orchards flower commencement started during the month of February-March. In order to select orchards for study, various orchards were visited. The orchards selected were tagged in and data was collected. Maturity indices study of promising mango varieties were carried out during maturation period of each variety at Faisalabad, Multan, Khnewal, Bahawalpur and Rahin Yar Khan. Fruit was harvested at specific level of Brix and pH. Harvested fruits were stored at different storage temperatures. Observations and data on various parameters recorded.

The flowering initiated in Dusehri in the 4th week of February while in Langra and Samar Bahist flowering started in the 3rd week of March. Data for "Total Degree Days" was recorded right from fruit setting up to harvesting.

Sap washing of harvested mangoes was done with calcium chloride and potassium aluminum sulphate solution to improve fruit outlook. After harvesting total sugar, reducing sugar, non-reducing sugar and ascorbic acid (Vitamin C) were analyzed along with TSS, firmness and pH.

One-day seminar on “Impact of maturity indices of mango quality attribute and shelf life” was arranged at AARI, Faisalabad on 11. 06. 2010 attended by scientists and farmers.

It has been concluded from research study that sap washing and pre-cooling expand shelf life and maintain freshness by reducing fungal attack and improving cosmetic value. Uniform ripening of mangoes was achieved with application of ethylene gas. Total sugar reducing and non-reducing sugar of ripe mangoes showed significant data for future study. Dusehri with 15.38% total sugar, 12.48% non-reducing sugar and 2.90% reducing sugar, Langra with 13.39% total sugar, 8.73% non-reducing sugar and 4.66% reducing sugar and Samar Bahist with 13.19% total sugar, 11.84% non-reducing sugar and 1.35% reducing sugar content were recorded. Vitamin C content of all three varieties differs slightly from 25.26mg/100mL, 22.49 and 27.98 for Langra, Samar Bahist and Dusehri respectively. One stakeholder of the project is going to establish modernized post harvest management facilities at his farm and exporting mangoes as well.

Name of Project: **Use of Spectral Reflectance to Estimate Growth, Biomass and Yield of Different Wheat Cultivars, under Moisture Stress Conditions**

Name of PI/ Institute: **Dr. Ashfaq Ahmed**
Associate Professor,
Department of Agronomy, University of Agriculture, Faisalabad

Duration: 01. 07. 2008 to 30. 06. 2011

Financial Status:

Total Cost:	Rs.3.713millions
Funds Released:	Rs.1740900/-
Funds Utilized:	Rs.1593628/-

Objectives:

- To determine vegetative indices such as spectral ratio (NIR/Red) and normalized difference vegetation index (NDVI) of different wheat cultivars at different growth stages during the season.
- To investigate the relationship between canopy structure and plant composition (LAI, biomass, light interception & yield), and vegetative indices.
- To prepare recommendations for suitable cultivars by estimating in-season biomass and grain yield.
- To improve the quality of teaching and research at post-graduate levels by providing new knowledge related to spectro radio-metery.

Achievements:

Recently, crop growth research has been focused on measurements of light interception and its utilization efficiency in field crops for assessing productivity. Total Dry Matter (TDM) production is measured as the difference between successive harvests and the analysis of radiation use efficiency (RUE) by this technique refers to periods of at least a week. For these reasons measurements of radiation interception are integrated over a day, or several days, to eliminate any diurnal variation. Such measurements make the technique too expensive and labour consuming for its use in large scale agronomic experiments. Over the past decade, an increased use of irrigation and nitrogen application increased environmental degradation and contamination. This sense of concern has brought an awareness of efficiently utilizing our resources and decreasing the negative environmental impacts of fertilizers leaching and runoff. To avoid or at least to reduce this laborious, time consuming techniques, an easy, rapid and inexpensive methods of measurements are needed. Therefore, it would be beneficial to use modern techniques like spectral reflectance or remote sensing to help agronomist, farm managers/farmers determine when and where a water/nutrient stress exists.

To achieve the above mentioned objectives a field experiment “Use of spectral reflectance to estimate growth, biomass and yield of different wheat cultivars, under moisture stress conditions” was conducted at University of Agriculture, Faisalabad during the year 2008-09. The

experiment was laid out in randomized complete block design (RCBD) split arrangement with four replications.

Data on growth, development, light interception and yield were taken from the experiment. Measurement of spectral reflectance was made using a Green Seeker, above the canopy at different growth stages during the season. Each plot was divided into 2 x 5 m long sub plots. One of them was used for destructive biomass and leaf area sampling, whereas the other remained intact for reflectance measurements and grain yield determination. Total dry matter and spectral reflectance measurement was made at tillering, booting, heading, anthesis and grain growth stages. All the data were analyzed statistically by using the analysis of variance technique by M-STAT package with the help of computer. Differences among treatments means were calculated using Duncan's Multiple Range Test at 5% probability.

Results revealed that irrigation throughout the season from stem elongation to booting stages proved to be the best traits in producing more fertile tillers, grains per spike, grain weight and finally grain yield. Among cultivars Shafaq-2006, Mirag-2008 and Sahar-2006 performed well in terms of yield and yield components.

Two Ph. D and one M. Sc (Hons) students are working and doing research in the project.

Name of Project: **Establishment of a System Based on HACCP Guidelines for Drying and Storage of Exportable Chilies to Control Aflatoxin Contamination. (SARC, Karachi, Component-I)**

Name of PI/ Institute:	**Mr. Mubarik Ahmad,** Director/Principal Scientific Officer, Grain Storage Research Institute, SARC-PARC, Karachi	
Duration:	01. 07. 2008 to 30. 06. 2011	
Financial Status:	Total Cost:	Rs.6.429 million
	Funds Released:	Rs.3199700/-
	Funds Utilized:	Rs.2395380/- (up to Dec., 2009)

Objectives:

- To identify the causes of aflatoxins production in chilies grown in Sindh.
- To prevent and control the aflatoxins in chilies.
- To develop the system based on the guidelines of HACCP for the drying and storage of chilies to prevent aflatoxins contamination.

Achievements:

The problem of aflatoxins contamination in chilies (*Capsicum aestivum* L.) is highly emerging. It is known to be mutagenic, teratogenic, carcinogenic and immunosuppressive etc. Aflatoxins are the secondary metabolites mainly produced by *Aspergillus flavus* and *Aspergillus parasiticus*. The key factors in its production are favorable temperature and relative humidity. It was found to be the prime hazard in Pakistani chili.

During study to determine the extent of aflatoxins contamination in chilies as well as to evaluate the critical stage that favors the production of aflatoxins, improper drying was found to be the most critical stage of chili production and need to be optimized for the production of safe chilies.

In order to prevent and control aflatoxins in chilies, various mean for drying including solar, mechanical were evaluated in terms of quality, cost, time etc. The results are in process of compilation and shall be reported in the final progress report.

The 2nd year (2009-10) report has not been provided so far by the PI.

Name of Project: **Establishment of a System Based on HACCP Guidelines for Drying and Storage of Exportable Chilies to Control Aflatoxin Contamination (SHRI, Mir Pur Khas, Component-II)**

Name of PI/ Institute: **Syed Mukhtar Ahmed Jaffery**
Director,
Sindh Horticulture Research Institute, Mir Pur Khas

Duration: 25. 08. 2008 to 29. 01. 2010

Financial Status:

Total Cost:	Rs.2.382 million
Funds Released:	Rs.505000/-
Funds Utilized:	Rs.497000/-

Objectives:

- To identify the causes of aflatoxins production in chilies grown in Sindh.
- To prevent and control the aflatoxins in chilies.
- To develop the system based on the guidelines of HACCP for the drying and storage of chilies to prevent aflatoxins contamination.

Achievements:

Conducted survey of farmer's field of chilies located in Districts of Umarkot and Mirpurkhas. Thirty three (33) samples of different varieties of chilies were collected from field and market/stores in different locations and tested for presence of aflatoxins. Aflatoxins test of these samples was carried out at Grain Storage Research Institute, PARC, Karachi.

Seed of newly developed chilies variety Nagina was distributed among 500 growers. Training programs were arranged from time to time to educate chilies farmers/growers regarding cultivation and post harvest technique to prevent the crop from aflotoxin contamination. The modern packages of storage and packing has been adopted and introduced in the grower community. In addition meetings were also held with commission agents to maintain the proper export quality.

Name of Project:	**Fabrication and Commercialization of a Gasifier (Operated with Crop Residue) for Sustainable Agriculture**
Name of PI/ Institute:	**Dr. Manzoor Ahmad,** Associate Professor, Department of Farm Machinery and Power, University of Agriculture, Faisalabad
Duration:	01. 07. 2008 to 30. 06. 2010
Financial Status:	Total Cost: Rs.2.119 million Funds Released: Rs.1250700/- Funds Utilized: Rs.822277/- (up to June, 2009)

Objectives:

- Gather the data and calculate the cost of biomass per unit.
- Cost and availability of other fuel like charcoal, coal, wood etc.
- To design, develop and fabricate a gasifier with all accessories.
- Evaluate the performance of gasifier.
- To operate a single cylinder engine with producer gas by different sources.
- Compare the cost of operation with diesel engine.

Achievements:

During 1st year of the project data relating to the mass of crop residue available for gasification was estimated/gathered. The biomass available from major crops like cotton, sugarcane, sunflower, wheat and rice need to be processed before it can be used for gasification.

The gasifier was designed for 12 KW engine and tested with charcoal, coal and corn cobs. The functioning of gasifier was found excellent with all the three fuel used. The analysis of producer gas carried out using gas analyzer and observed that gas produced by three fuels was of good quality. The results of first year study revealed that alternative source of energy in form of biomass are available at low cost at farm level and cheaper than petrol and diesel. A student completed research for his master thesis under the project.

The project has been completed in June, 2010 but the PI has not reported the final financial and technical progress of the project.

Name of Project:	**Studies on IPM with Reduced Chemical Beekeeping Approach to Avoid Related Treatment Resistance of Parasitic Mites, Honeybee Diseases and Pests**
Name of PI/ Institute:	**Dr. Elizabeth Stephen Waghchoure,** Senior Scientific Officer Honey Bee Research Program, INRES, NARC, Islamabad
Duration:	07. 11. 2006 to 06. 11. 2009
Financial Status:	Total Cost: Rs.3.517 million Funds Released: Rs.2818000/- Funds Utilized: Rs.2747882/-

Objectives:

- Identification of parasitic mite distribution and behavior.
- To develop reduced Chemical Beekeeping (RCB) management system.
- Breeding of resistance honeybee colonies.
- Assess the combination of Integrated Pest Management (IPM) control methods.
- Train beekeepers / workers for the management of honeybee colonies with modern techniques to obtain maximum yield by exploiting the mite resistant vigor in the colonies.
- Using the results of the above to devise an Integrated Pest Management Strategy for brood mite control. This information could be produced as a leaflet for distribution for beekeepers.

Achievements:

Two surveys were conducted on mites and disease incidence in beekeepers apiaries in Chakwal, Dhudial (December 2006 to January 2007), Peshawar, Swat and Attock areas (May-June, 2007). Produced 42 quality queens for resistance against mites and diseases. Increased the number of colonies from 24 to 42.

Evaluated chemical and non-chemical control measures against honeybees' parasitic mites. Introduced integrated use of quality queen with *Varroa* screens, formic acid and thymol for effective management of parasitic mites. Established laboratory for mite, pests and disease identification. Identified two haplotypes of mites, *Varroa destructor* (Korean type) in *Apis mellifera* and *Varroa destructor* (Pakistani type) in *Apis cerana.* There are many genotypes of *Varroa* mites natural parasites of the Asian honeybee *Apis cerana*, only two genotypes can breed on European, Korean and Japanese bees. The genotype of the *Varroa* mite which arrived in Pakistan in 2002 was identified to be Korean genotype.

Organized a national workshop in first year for progressive bee-keepers in IPM techniques for mite and disease control. 21 progressive farmers participated in the workshop. A 4 days Second National Training Workshop on "IPM of Parasitic Mites & Disease of Honeybees for Sustainable Beekeeping" during April 15-18, 2008 attended by 23 participants was also organized.

The PI participated in International APIMONDIA Congress in Melbourne, Australia from September 9-14, 2007 and presented a seminar on "Status of beekeeping in Pakistan" described the occurrence, effect and control of *Tropilaelaps mite* and *Varroa destructor* in Pakistan at the CISRO world lead honeybee research laboratory in Canberra, Australia.

The PI has not provided the final technical progress report, though the project has been completed in November 2009.

Name of Project: **Determination of Soil Moisture Movement and Salinity Buildup Patterns Under Different Sizes of Bed Furrow Irrigation Systems; Component-1 of Umbrella Project "Soil Salinity Monitoring Under Various Resource Conservation Technologies (RCTs) Adopted in Various Agro-ecologies"**

Name of PI/ Institute: **Dr. Muhammad Munir Ahmad**
Principal Scientific Officer,
Water Resources Research Institute, NARC, Islamabad

Duration: 20. 07. 2007 to 30. 06. 2010

Financial Status:
Total Cost: Rs.3.049 million
Funds Released: Rs.1966400/-
Funds Utilized: Rs.1901812/-

Objectives:

- Determine optimum size of bed furrow irrigation system for wheat-maize cropping system.
- Adopt suitable computer model for moisture distribution and salinity buildup pattern in the bed furrow.
- Develop management guidelines for sustained operation and management of bed furrow irrigation system.

Achievements:

The short availability of water poses great threat in increasing per acre yield and bringing more area under cultivation. There is need to improve management of irrigation system and application efficiency at the farm level. Research studies were carried out under maize-wheat cropping system at Mardan in Khyber Pakhtoonkhwa (KPK). Three furrow-bed of 65 cm (small), 90 cm (medium) and 120 cm (large) were selected and compared with basin in the saline environment of Mardan.

Soil moisture content variation was similar under basin and furrow-bed system during crop season. The moisture content trend was higher at the edge of the large furrow-bed as compared to centre but no significant difference was there among the treatments. This indicates that irrigation may apply frequently in large furrow bed as compared to basin. Electrical conductivity (EC) and pH increased from sowing to harvest and these values have no significant difference within treatments. Thus no salinity and pH build up danger is there in the area when adopting furrow-bed system. The average maize grain yield was 8.9 ton/ha under basin and it was 9.44 under small furrow-bed and similar grain yield was obtained under other furrow-bed treatments. The average maize grain yield was 3-6% higher under

furrow bed. The average grain yield of wheat was 4.42 ton/ha under conventional basin. It was 5.05 ton/ha under small furrow-bed which is 14% high than conventional basin. The increasing trend in grain yield was observed in furrow bed system. The straw yield was 8 to 11% higher under furrow bed as compared to basin. Water saving was 24% higher under small furrow-bed and it was double under large furrow-bed in maize-wheat farming system. The saved water can be used to increase cultivated area. Water productivity increased about 14% under small and medium furrow-bed and 24% under large furrow-bed as compared to conventional basin for wheat crop.

The studies led to the conclusion that the furrow-bed irrigation system can save water and address the scarcity of water. There is no fear of salinity build up in adopting furrow-bed system. Results indicate that along saving the irrigation water the more crops per drop can be achieved through large furrow-bed system without environmental degradation.

Name of Project:	**Studies on Rice-Wheat Cropping System in Sheikhupura and Maize-Potato in Okara District; Component-II of Umbrella Project "Soil Salinity Monitoring Under Various Resource Conservation Technologies (RCTs) Adopted in Various Agro-Ecologies"**
Name of PI/ Institute:	**Dr. Arshad Ali,** Principal Scientific Officer, Land Resources Research Institute, NARC, Islamabad
Duration:	20. 07. 2007 to 30. 06. 2010
Financial Status:	Total Cost: Rs.4.605 million Funds Released: Rs.4111700/- Funds Utilized: Rs.4015951/-

Objectives:

- Study the impact of resources conservation technologies (RCT) on salt build up in various soils under rice-wheat cropping system in Punjab province.
- Devise strategies for appropriate soil salinity management under such practices to ensure sustainable production

Achievements:

A survey conducted to assess the salt build up and loss in production due to zero tillage (ZT) exhibited 81% farmers as adopters. Majority of the farmers in Sialkot (57%) and Sheikhupura (71%) were of the view that there is increase in yield if wheat is planted with ZT. Good placement of both seed and fertilizers was the main reason for the higher yield followed by less oxygen stress by rains if planted by ZT. The cost at ZT field was low at all soil types mainly due to saving from land preparation. Salt build up was noticed in fine textured soil where ZT was practiced while non-significant salt build was noticed in coarse to medium textured soils. Thus there is need to enhance the accessibility to ZT knowledge, its purpose of timely plantation of wheat and cost saving needs to be highlighted. ZT drill can be safely used in coarse and medium textured soil. However, care and proper monitoring of salt is needed in fine textured soils.

Foliar application @ 4% K_2SO_4 at 30 and 45 DAT enhanced the paddy yield significantly as compared to soil K application. Similar trend of yield increase was observed in wheat productivity. K_2SO_4 can be safely used as compared to KNO_3 application.

Crop residue incorporation enhanced both wheat and rice productivity by contributing significant amount of N, P, K, Ca and micro-nutrients to plants. The presence of more K and

Ca availability improve the crop productivity in saline sodic soils helping plants to cope with the Na presence in soil solution. Significant high amount of K was observed in paddy and wheat grain and straw. Raised bed plantation after the incorporation of paddy straw proved to be the better planting method under saline sodic soils. From the studies conducted during project, it can be concluded that residue incorporation is future fertilizer. It is precious natural resource rather than wastage. Its burning is mere wastage and be discouraged. Farmers education is must in this regard.

Maize-potato rotation is being practiced since long time in Okara district. Both crops are being grown on ridges requiring heavy inputs like fertilizer, irrigation, pesticides etc. Heavy and frequent irrigations are made to fulfill the crop requirement. Since 65-70% tube wells are pumping brackish water and in case of ridges net water movement is upward. Soil salinity monitoring exhibited more salt buildup to top of the furrow as compared to bottom of the furrow. To correct this situation, alternate application of canal and tubewell water, 10% addition tubewell water application and heavy application of canal water after harvest of maize and potato crops was recommended to leach down soluble salts.

Name of Project:	**Management and Improvement Potential of Rangelands of Balochistan with Community Participation**
Name of PI/ Institute:	**Dr. Sarfraz Ahmad,** Principal Scientific Officer, Arid Zone Research Centre, PARC, Quetta
Duration:	23. 07. 2007 to 30. 06. 2010
Financial Status:	Total Cost: Rs.5.303 million Funds Released Rs.3523000/- Funds Utilized: Rs.3538201/-

Objectives:

- To document the existing traditional range management practices and productivity of rangelands.
- To test the range improvement potential by protection, grazing range fertilization, and integrated rainfed crop-livestock management with community participation
- To test the establishment of suitable grasses/shrubs species in potential range areas with community participation
- Assessment of rangeland dynamics with particular scenario of changing species composition of grasslands and declining of shrub lands.

Achievements:

Project activities were carried out in three districts (Mastung, Ziarat, Loralai) of Balochistan. Different range management and improvement trials were conducted at various sites. Trial on grazing response of perennial bunchgrasses (*Cymbopogon jwarancusa* & *Chrysopogon aucheri)* indicates that grasslands can heavily be grazed during winter months and during active growth period (March-May) rest is essential for recovery of vegetation. Grazing of improved rangelands is possible from April to September and with supplemental feeding during winter months. Ewes grazed on grassland and supplemental feeding (250 g/day/ewe) showed better results for live weight and reproductive performance. Forage production and crude protein content of less preferred grass species *Saccharum grifithii* was improved by winter season burning. Fresh and dry forage production of burned treatment was 2316 and 1548 kg/ha respectively of un-burned treatment. Defoliation response of perennial grasses (*Cymbopogon jwarancusa, Chrysopogon aucheri)* and shrub *(Seriphidium quettense)* indicate that heavy utilization during winter season have no determinable affect on growth and production.

Increased forage production of *Antriplex canescens* as a result of winter season defoliation from 205 to 367 g/plant. Community degraded rangelands (total 347 ha) were improved either

by restoration of natural vegetation or rehabilitation by planting suitable fodder shrub species. Seedlings of Atriplex species (*Atriplex canescens, Atriplex lentiformis)* and *Salsola vermiculata* were planted on degraded community rangeland. This plantation resulted increase in forage production from 1141 to 8576 kg at various sites in addition to the increase of forage production from natural vegetation as a result of protection from grazing. Increase in forage production as a result of protection ranged from 240 to 864 kg/ha as compared to initial forage production of 60-184 kg/ha. Increased fodder production as a result by provision seed of sorghum, millet and mash in the Sailaba farming communities at Loralai. Fresh sorghum and millet production ranged from 1953 kg/ha to 17383 kg/ha and 1363 to 13773 kg/ha, respectively. Various exotic range grasses and shrubs were evaluated at various sites. *Acacia victoriae* showed survival and production potential under drought conditions.

Two students of M. Sc have completed their research under the project for thesis writing.

Name of Project:	**Microbial ACC-deaminase Biotechnology for Sustainable Production of Legumes**
Name of PI/ Institute:	**Dr. Zahir Ahmad Zahir,** Associate Professor, Institute of Soil & Environmental Sciences, University of Agriculture, Faisalabad
Duration:	22. 08. 2008 to 30. 06. 2011
Financial Status:	Total Cost: Rs.4.289 million Funds Released: Rs.2911500/- Funds Utilized: Rs.2889478/-

Objectives:

- Isolation and screening of rhizobacterial cultures carrying ACC-deaminase enzyme.
- Isolation and screening of effective rhizobial cultures for different legumes.
- Evaluation of the growth promoting and nodulation potential of the rhizobacterial/ rhizobial cultures.
- Evaluation of the co-inoculation of rhizobia and rhizobacteria for improving growth and yield of legumes.

Achievements:

Ethylene is a plant hormone involved in the regulation of many physiological responses. Besides its physiological roles in different developmental stages, ethylene was originally regarded as a "stress hormone" because its synthesis in plants is increased by a number of biotic and abiotic stresses. Some PGPR contain an enzyme 1-aminocyclopropane-1-carboxylate (ACC-deaminase) which hydrolyses the ACC, the precursor of ethylene, into ammonia and α-keto butyrate thus reducing the inhibitory effect of ethylene on plant growth.

During second year (2009-10) a series of jar experiments were conducted in the growth room to evaluate the effectiveness of co-inoculation of PGPR containing ACC-deaminase and rhizobia on growth of legumes (mung bean, chickpea and lentil). The plant growth promoting rhizobacteria and rhizobia that showed best performance in 1st year study and also highest ACC-deaminase activity were used for co-inoculation. Mung bean, chickpea and lentil seeds were co-inoculated with their respective inoculum. The experiments were conducted using completely randomized design with three replicates. These were harvested after 50 days to check growth and nodulation. Data regarding shoot length, root length, root weight, shoot weight and number of nodules per plant, nodule fresh and dry weight were recorded and analyzed statistically with following results:

- The ability of rhizobacterial isolates to utilize ACC as a sole N source was authenticated by determining their optical densities (OD) via ACC-deaminase test. All the bacteria isolated from the rhizosphere soil were capable of utilizing ACC as sole source of nitrogen but with variable growth rates.

- The rhizobacterial and rhizobia selected during 1st year under axenic conditions were tested in all possible combinations under axenic conditions to screen effective co-inoculant strains for the improvement of growth and nodulation of legumes. Three best combinations of mung bean, [(F2 x MN6), (F6 x KH6) and (F6 x MG6)], chickpea [(J1 x BK4), (J1 x JH4) and (B5 x BK2)] and lentil [(LCR1 x LC4), (LBR2 x LC3) and (LLR3 x LB5)] were selected on the basis of maximum nodulation and growth of seedlings.

- Classical "triple" response bioassay was carried out to check the effect of different concentrations of ACC on etiolated mung bean, chickpea and lentil seedlings. Results indicated that exogenous application of ACC had concentration dependent effect on creating classical "triple" response in etiolated legumes (mung bean, chickpea and lentil) and seedlings.

- In the presence of ACC, inoculation with PGPR containing ACC-deaminase diluted the negative effect of ACC on shoot/root length and swelling of hypocotyls compared to un-inoculated control.

- Classical "triple" response trial was also carried out to check the effect of co-inoculation with PGPR containing ACC-deaminase the rhizobium on etiolated legumes (mung bean, chickpea and lentil) seedlings. Co-inoculation with PGPR containing ACC-deaminase and rhizobium improved the growth of legumes (mung bean, chickpea and lentil) and diluted the classical "triple" response. The results also showed that PGPR containing ACC-deaminase performed better than rhizobium.

- The effect of co-inoculation with PGPR containing ACC-deaminase and rhizobium on etiolated legume seedlings was also compared with Co^{2+} i.e. chemical inhibitor of ethylene. Co-inoculation with PGPR containing ACC-deaminase and rhizobium, and application of Co^{2+} had positive effects on legume seedlings and decreased the negative impact of ACC. Separate application of PGPR containing ACC-deaminase and rhizobium performed better than CO^{2+} and un-inoculated control. However, co-inoculation with PGPR containing ACC-deaminase and rhizobia performed better than PGPR, rhizobium, cobalt and diluted the classical triple response.

It was observed from the analysis of ACC-deaminase activity of all PGPR, that the strains that had shown marked increase in root/shoot length, fresh and dry weight during 1st year were highly positive for ACC-deaminase activity. Results revealed that co-inoculatin increased root/shoot growth and nodulation in mung bean and chickpea respectively, with reference to un-inoculated control.

Results have also shown that ACC had concentration dependent effect on creating classical "triple" response in etiolated legumes (mung bean, chickpea and lentil) seedlings. By increasing ACC concentration "triple" response increased but inoculation diluted the negative effect of ACC on shoot/root length and swelling hypocotyls compared to un-inoculated control.

These studies suggest that plant growth could be modified in a desired direction by changing the ethylene synthesis endogenously and in the close vicinity of root through co-inoculation with PGPR containing ACC-deaminase and Rhizobium.

Name of Project: **Carbon Sequestration through Tillage, Organic Matter and Mulch: Managing the Soil Quality for Sustainable Crop Production**

Name of PI/ Institution: **Dr. Anwar-ul-Hassan,**
Professor,
Institute of Soil & Environmental Sciences, University of Agriculture, Faisalabad

Duration: 28. 07. 2008 to 30. 06. 2011

Financial Status:
Total Cost: Rs.4.881 million
Funds Release: Rs.2179000/-
Funds Utilized: Rs.2012456/-

Objectives:

- To assess the potential of soil carbon sequestration in Pakistan with different farm manure and mulch rates and tillage methods.
- To determine the effects of tillage systems, farm manure and mulch for enhancing soil quality to meet the food demands of the country.
- To determine the effect of deficit irrigation on growth and yield of crops.

Achievements:

Experiments were carried out under field conditions for achieving the objectives. Two trials were conducted on maize-wheat crop rotation, keeping tillage methods i.e. deep, conventional and minimum tillage while manures was applied at their respective rates. Plant height, total plant biomass and grain yield of maize and wheat were recorded at crop maturity. A significant increase in soil organic carbon was observed with the application of dairy manure and the residual soil organic fertility after crop harvest was proportional to the level of dairy manure used. The results of maize crop indicated that integrated application of manure with inorganic fertilizer and deep tillage yielded the maximum plant height (243.22 cm), total plant biomass (20.9 Mg ha^{-1}) and grain yield (9.01 Mg ha^{-1}) of maize crop while increased soil organic contents of soil was its additional benefits. Residual effect of manure application showed that the treatment combination MT x DM_{45res} gave maximum plant height, total plant biomass and grain yield of wheat crop i.e. 100 cm, 15.60 Mg ha^{-1} and 5.68 Mg ha^{-1} respectively. Integrated application of deep tillage (DT) with manure @45 Mg ha^{-1} showed the maximum hydraulic conductivity and infiltration rate at maize harvest i.e. 47.02 and 27.97 mm hr^{-1}. Minimum tillage statistically increased the soil organic carbon contents of the soil near the surface (0-10 cm depth) compared to conventional tillage and deep tillage. Deficit irrigation had a significant negative effect on growth and yield of maize and wheat crop. There was a significant decrease in plant height, total plant biomass and grain yield of maize and wheat crop with reducing irrigation depth, but with application of mulch this reduction was minimized, so the use of mulch was

efficient in decreasing the negative effect of deficit irrigation. Soil organic carbon concentration was significantly increased with the application of mulch. Application of mulch significantly increased the water use efficiency of maize and succeeding wheat crop.

Regarding the research findings, there was decrease in yield and yield contributing parameters with decreasing irrigation depth (deficit irrigation) but negative effect on yield was minimized by applying mulch. Mulch also increased water use efficiency (WAU) of wheat and maize. With minimum tillage, yield obtained was comparative to conventional but increased soil organic contents at 0-10 cm were its additional benefit. Integrated application of dairy manure along with mineral fertilizer not only increased the maize yield but also it increased the organic matter of the soil and improved soil physico-chemical properties. So its residual effect was found significant on succeeding wheat crop. Economic analysis shows that deep tillage alongwith dairy manure was best due to low input and maximum return.

Name of Project: **Assessment of Toxic Metals in Agriculture Products and their Relation with Nutritional Status in NWFP- Pakistan**

Name of PI/ Institution:	**Dr. Ihsanullah** Dy. Chief Scientist, Food Sciences Division, Nuclear Institute for Food and Agriculture, Tarnab, Peshawar
Duration:	28. 07. 2008 to 30. 06. 2011
Financial Status:	Total Cost: Rs.2.926 million Funds Release: Rs.1919800/- Funds Utilized: Rs.1862277/-

Objectives:

- To assess the levels of toxic heavy metals in agricultural foods in various locations around Peshawar consumed in the region and to determine circulatory level of toxic elements from selected site in Peshawar.
- To measure the nutritional status of population using anthropometric (BMI) procedures and to collect data for various parameters through food frequency questionnaire.
- To develop relationship between toxic metals and nutritional status of the population and to create awareness in the social sector through training workshops.

Achievements:

Sector-wise sampling of drinking and sewage irrigation water, soil and the selected vegetable from various location of Peshawar, Nowshera and Manshera district was carried out. Heavy metals content of dietary components like vegetables and drinking water samples were analyzed for the quantification of essential and toxic trace elements (Pb, Cd, Cu, Ni, Cr etc.) using Atomic Absorption Spectrophotometer (AAS) to find out the antagonistic and synergistic effect of heavy metals in soil and vegetables. Data was statistically analyzed using SPSS package by applying one-way ANOVA. For checking the mean difference, T-test of this package was performed. From the data it is clear that Mn, Pb, Cd, Ni and Cu were found to be the most abundant elements in the various media. The principal component analysis revealed that these effluents are causing the contamination of the adjacent soil and corresponding water. By comparison between the metal levels with the background area and the control area, it is evident that the effluents cause a potential health risk to the inhabitants in the surrounding area. This study provides substantial information to the government agencies to implement strict regulatory procedures for the safer discharge of effluents from these industries and devise procedure for the safe recycling of effluent to ensure reclamation and quality loss of ground water. The environmental contamination of the adjoining areas by the effluents stream needs to be constantly monitored.

Name of Project: **Enhancing Stone Fruits (Peach, Plum and Apricot) Orchards Productivity through Integrated Nutrients (NPK) Management; A Component of the Coordinated Project "Stone**

Fruits Productivity Enhancement through Appropriate Nutrient Management" (NIFA, Peshawar, Component – II)

Name of PI/ Institution: **Dr. Syed Mahmood Shah,**
Dy. Chief Scientist/Head,
Soil Science Division, Nuclear Institute for Food and Agriculture, Tarnab, Peshawar

Duration: 28. 07. 2008 to 30. 06. 2011

Financial Status:
Total Cost: Rs.4.743 million
Funds Release: Rs.2766700/-
Funds Utilized: Rs.2677320/-

Objectives:

- To improve the yield and quality of stone fruits (peach, plum and apricot) through balance nutrition.
- To sustain orchards fertility and fertilizer use efficiency through integrated use of mineral and organic manures.

Achievements:

Six orchards two each of plum, peaches and apricot of different farming communities are under trial at Peshawar and Nowshera districts (KPK Province). NPK and Farm Yard Manure (FYM) were applied in different combination alongwith control. Half nitrogen and all the phosphorus and potassium fertilizers were applied 0.5 meter away from tree trunk and between the drip lines after fruit picking in mid summer 2009 while the FYM was applied in dormant season. There were eight treatments NPK (T_1 0-0-0, T_2 0.75-0.5-0, T_3 1.0-0.5-0, T_4 0.5-0.5-0.5, T_5 0.75-0.75-0.5, T_6 1.0-0.75-0.5, T_7 0.75-0.5-0.5+FYM, T_8 1.0-0.5-0.5+FYM) with three replications and two trees per treatment. In this way in each orchard 48 trees of uniform size, age and vigour were selected (Total 144 trees in three orchards). Leaf samples were collected in these orchards from each tree in mid summer (2009) from mid portion of current year extension growth. These samples were dried, ground and were analyzed for NPK. Soil samples (two depth 0-15, 15-30 cm) were collected from all these orchards after fruit picking in mid summer. These samples were dried, ground and were analyzed for NPK organic matter and various parameters etc.

In **peach** orchard the nitrogen concentrations in leaves ranged from 2.1 to 2.93%, and maximum concentrations of 2.93% were recorded in the treatment received NPK+ Farm Yard Manure (1.0 kg N+ 0.50 kg P_2O_5 + 0.5 kg K_2O $tree^{-1}$). In this treatment nitrogen was applied from 75% mineral source and 25% FYM. A maximum phosphorus and potassium concentration of 0.23% and 2.5% was recorded in the same treatment. In all the treatments, the N contents in the leaves were improved compared to control. The soil analysis revealed that total soil nitrogen, AB-DTPA extractable P and K were 0.10%, 16.85 mg kg^{-1} and 188.9 kg^{-1} were found in the same

treatments received NPK + FYM. Soil organic matter in peach orchard ranged from 0.90-1.78% with mean values of 1.28 ± 0.30. FYM also improved soil organic matter in the soil profile.

In the **Plum** fruit orchard's leaves the higher NPK content of 2.17, 0.21 and 2.13% respectively was found in treatments received NPK alongwith FYM. In Plum orchards the total soil nitrogen ranged from 0.056 to 0.12%. Higher N values were found in the top soil compared to lower depth. All the nitrogen treatments improved soil nitrogen in the soil. The nitrogen content was higher in the treatment to which one kg tree^{-1} nitrogen was applied. The soil phosphorus content in the soil profile ranged from 3.1 to 13.5 mg kg^{-1}. Similar to nitrogen, phosphorus was also higher in the surface soil compared to the lower depth. A maximum of 100 mg kg^{-1} potash was found in the treatment to which NPK and FYM was added.

In **apricot** orchards nitrogen in the soil ranged from 0.06 to 0.09 %, phosphorus ranged from 3.6 to 16.3 mg kg^{-1} and potassium content ranged from 46.6 to 100 mg kg^{-1}. Similarly maximum NPK content of 2.3, 0.28 and 1.75% respectively were found in the leaves. In all the above orchards fruits analysis showed similar trend.

Fruit picking in peach and apricot orchards was started from April 27, 2010 and completed in the 3rd weak of May 2010 respectively while picking of plum orchards was started in the 2nd week of June 2010 and completed in 3rd week of June. Results on fruit yield indicated that in case of peach the highest yield of 143.07 kg tree^{-1} in Shakarpura and 100.83 kg tree^{-1} in Daman Afghani with mean value of 121.95kg tree^{-1} was given by treatment received NPK + Farm Yard Manure (1.0 kg N + 0.50 kg P_2O_5 + 0.5 kg K_2O tree^{-1}). In apricot orchard the maximum mean yield of 82.1 kg tree^{-1} with 76% increase over control were obtained in the same treatment. In case of plum maximum fruit yield of 77.6 and 75.6 kg tree^{-1} was obtained in T_6 and T_7 respectively. Fruits analysis for NPK and leaf and soil samples collected after fruit picking are in progress. In conclusion in all the above orchards (peach plum and apricot) NPK content in the soil were improved. FMY manure along with NPK improved the organic matter contents in the soil profile. The FMY manure along with NPK also improved the nutritional status of fruit trees and yield. Final conclusion will be drawn after completion of the project.

Name of Project:	**Micronutrients Studies on Stone Fruit Orchards in Peshawar Valley; A Component of Coordinated Project "Stone Fruit Productivity Enhancement through Appropriate Nutrient Management" (ARI, Tarnab, Peshawar, Component-I)**
Name of PI/ Institution:	**Mr. Mir Abbas Khattak,** Agricultural Chemist, Agricultural Research Institute, Tarnab, Peshawar
Duration:	29. 01. 2009 to 28. 01. 2012
Financial Status:	Total Cost: Rs.3.166 million Funds Release: Rs.1876300/- Funds Utilized: Rs.1865032/-

Objectives:

- To study the existing level of macro and micronutrients in the soils and leaves of stone fruit orchards.
- To improve the yield and quality of stone fruits (peach, plum and apricot) through balance nutrition.
- To recommend proper doses of macro and micronutrients based on soil test values, leaf analysis and field trials.
- To sustain orchard fertility through integrated use of mineral and organic manures.

Achievements:

Three surveys were conducted to assess the micronutrients (Zn, Cu, Fe, Mn and B) deficiency and soil fertility status of peach, plum and apricot orchards in Peshawar valley of Khyber Pukhtoon Khwa during July 2009-2010. For each crop about 50 orchards were surveyed. In each survey general observations on orchards were recorded. Relevant information from the concerned farmers was also collected. Soil and leaf samples were collected from each orchard and analyzed for micro nutrients. Soil samples were also analyzed for fertility and other soil characteristics. The analysis of peach leaves showed that 60% were low, 30% adequate and 10% high in Zinc. Copper was low in 18%, adequate in 62% and high in 20% samples. None of the 50 orchards was deficient in Fe. Manganese was low in 40%, adequate in 56% and high in 4%. Boron was low in 22%, adequate in 72% and high in 6%. The soil analysis revealed that none of the 50 orchards was deficient in Cu and Mn. Fe was deficient in the surface soil 0-15 cm of only 16 orchards. Zinc was deficient in both surface and sub surface soils in large number of orchards. The soils at lower depths (15-45 cm) were more deficient in zinc than the surface 0-15 cm soil. No orchard was low in organic matter in the surface 0-15 cm soil but 44% orchards were low in the 15-45 cm soil. Moreover, 4% orchards were low in P in the 0-15 cm and 42% were low in the 15-30 cm soil. Similarly 16% and 44% orchards were low in K in the 0-15 cm and in 15-45 cm

respectively. The soil pH of majority of peach orchards was between 7.5 and 8.5 and EC was below 4.0 dS m^{-1}.

From the survey and soil & leaf samples analysis it could be concluded that, peach, apricot and plum orchards in Peshawar valley were deficient in varying level of micronutrients. Zn was deficient in 60%, Cu in 18%, Mn in 40% and boron in 22% peach orchards. In apricot, Zinc was found deficient in 54%, Cu in 0%, Mn in 14%, and Boron in 24% orchards. In plum, Zinc was deficient in 52%, Cu in 0%, Mn in 0%, and Boron in 46% orchards.

Organic matter contents were generally sufficient in the surface but deficient in the lower soil depths of all peach, plum and apricot orchards. Soil pH of almost all stone fruit orchards was normal to alkaline (7.5-8.5). Alkaline pH hinders the availability of Zn, Cu, Fe and Mn. Low organic matter contents in the lower depth together with wide spread deficiency of extractable P and K were likely responsible for unavailability of micronutrients of peach, plum and apricot plants. The alkaline pH in stone fruit orchards further aggravates micronutrients availability to plants.

Name of Project:	**Micronutrients Studies on Stone Fruit Orchards in Balochistan; A Component of the Coordinated Project "Stone Fruits Productivity Enhancement through Appropriate Nutrient Management" (ARI, Sariab, Quetta, Component-III)**
Name of PI/ Institution:	**Mr. Muhammad Nasim,** Horticulturist, Agricultural Research Institute, Sariab, Quetta
Duration:	24. 07. 2008 to 30. 06. 2011
Financial Status:	Total Cost: Rs.2.126 million Funds Release: Rs.1305000/- Funds Utilized: Rs.1304103/-

Objectives:

- To create awareness in farming community about the use of NPK and micronutrients in the stone fruit orchards.
- To find out the best optimal dose of NPK and micronutrients for the benefit of growers to enhance the productivity of apricot.

Achievements:

A detailed survey was conducted in the targeted areas (Khuzdar, Pishin, Khanozai and Loralai) and sites were selected for field experiments. The apricot fruit orchards were selected in districts, Loralai, Pishin, Mastung and Kalat. Soil and water samples were collected and analyzed.

The data revealed that the apricot fruit orchards in different districts of Balochistan are low in essential nutrients and needs chemical fertilizer application at appropriate rate. Soils are high in salt and require balancing agent and frequent irrigation to leach down the salts.

Leaf and soil samples were collected during the growing season and analyzed in the Soil & Water Testing Lab., Directorate of Agriculture Research, ARI, Sariab, Quetta to see the results of applied micronutrients on tree & fruit. On the basis of soil analysis, it was observed that the apricot fruit trees were deficient in micronutrients and medium in macronutrients. By applying different levels of micronutrient alongwith constant dose of macronutrients, the orchard improved its production and also improved vegitatively.

The PI has not provided 2nd year (2009-10) progress report. He has provided only the soil sample analysis results.

Name of Project: **Diagnosis and Control of Leaf Reddening in Cotton**

Name of PI/ Institution: **Dr. Jawed Akhtar Memon,**
Soil Fertility Officer,
Agricultural Research Institute, Tandojam, Sindh

Duration: 24. 07. 2008 to 30. 06. 2011

Financial Status:
Total Cost: Rs.3.643 million
Funds Release: Rs.1508000/-
Funds Utilized: Rs.1466091/-

Objectives:

- Survey and identify the areas and the possible causes of growth stunting, wilting of the plants and reddening of cotton leaves.
- To develop a package of technology to overcome the problem of reddening in cotton leaves.
- Effective and efficient transfer technologies for controlling cotton leaf reddening disseminated to the cotton growers.

Achievements:

Survey of the affected areas of leaf reddening in cotton conducted in Sanghar, Mirpurkhas and Tando Allah Yar districts. Soil and leaf samples collected and analyzed for physico-chemical properties. To see the specific nutrient affecting leaf reddening, pot experiment was conducted at ARI, Tandojam. Field trials were conducted at farmers' field to investigate the effect of macro and micronutrients on leaf reddening of cotton in districts Umerkot, Matiari and Hyderabad.

The results of the experiments revealed that application of Mg via soil and foliage neither increase the yield of seed cotton nor control leaf reddening. The addition of K, however, increased seed cotton and control leaf reddening. The treatment without fertilizer caused 42% leaf reddening with poor yield. In application of N alone, 12% leaf reddening occurred

It was observed that cotton sown in early March to mid April was stressed by irrigation water that caused leaf reddening and growth stunting in early stage. To overcome the stunting problem, 0.1% Zinc and 0.1% Boron via foliage at the interval of seven days gave good results and accelerated the growth.

The symptoms of Potash deficiency observed in all BT varieties resulted in leaf reddening. Partially reddening was controlled by 10 mM KNO_3 or K_2SO_4, when applied 3-6 times via foliage at the intervals of seven days. However, severe attack of leaf reddening could not control through foliar application of K. Nitrogen deficiency resulted small leaves improved with foliar application of 2-3% urea applied three times.

Name of Project: **Effect of Different Irrigation Intervals and Mulching Materials on the Growth, Yield and Quality of Onion under Agro Climatic Conditions of Southern Regions (KPK)**

Name of PI/ Institution: **Mr. Muhammad Suleman,**
Assistant Vegetable Botanist,
Agricultural Research Station, Ahmad Wala, Karak, KPK

Duration: 28. 07. 2008 to 30. 06. 2011

Financial Status:
Total Cost: Rs.3.554 million
Funds Release: Rs.1199000/-
Funds Utilized: Rs.1194618/-

Objectives:

- To study the effect of different irrigation intervals and mulching material on the yield of onion.
- To demonstrate the use of mulching materials to the farmers.
- To come up with solid recommendation on various mulching materials, moisture conservation and culture practices for onion crop.

Achievements:

In order to see the effect of irrigation intervals and mulching materials on growth and yield of onion, two experiments were conducted each at ARS, Ahmad Wala, Karak and ARS, Serai Naurang, Bannu. Ten numbers of adaptive plots were also laid out at farmer's field. It was observed that irrigation at interval of 5 days was the most suitable interval for high production of onion at the Research Stations, as well as at farmer's field. Gram straw mulching material gave encouraging result at all the locations and prolonged the availability of moisture for onion growth. Combination of gram straw and 5 days irrigation interval supercede all the treatments and gave high production. The gram straw was easily fermented in the soil after application and improved the soil structure. Ten numbers of farmers were trained on application of mulching material and irrigation of onion in the vicinity of each plot. Two field days were also arranged for this purpose.

The results of the studies conducted indicate that mulching material (gram straw) is most suitable for maximum production of onion bulb with irrigation intervals of 5 days. Mulching material (gram straw) reduces cost of production and improved soil structure.

Name of Project: **Evaluation of Nitrogen Inhibitors for Reducing Nitrogen Loss under Irrigated Cotton - Wheat System using ^{15}N-Balance Technique**

Name of PI/Institute: **Dr. Tariq Mahmood,**
Principal Scientist,
Soil Biology & Plant Nutrition Division, NIAB, Faisalabad

Duration: 28. 07. 2008 to 30. 06. 2011

Financial Status: Total Cost: Rs. 5.557 million
Funds Released: Rs. 3839300/-
Funds Utilized: Rs. 3757480/-

Objectives:

- To identify technically and economically effective nitrification inhibitors for agricultural application under environmental conditions prevailing during the cotton and wheat growing seasons in Pakistan.
- To investigate (using ^{15}N-tracer Technique) under greenhouse conditions the performance of selected nitrification inhibitors for improving fertilizer-N recovery, crop yields and fertilizer-N use efficiency under cotton and wheat.
- To identify through field experiments appropriate fertilize-N management practices for cotton and wheat production taking into account the possibility of improving crop yields and reducing fertilizer-N loss, and conserving environment.

Achievements:

During 1st year of the project, out of 15 compounds tested, 4-Amino-1, 2, 4-triazole (ATC) and N-(n-butyl) thiophosphoric triamide (NBPT) were identified as effective nitrification and urease inhibitors, respectively. During the 2nd year of the project (2009-2010), detailed experiments conducted on these two compounds are as under:

- Laboratory experiments to work out effective concentrations of ATC and NBPT to blend with urea for application under winter soil temperature (16°C), have been completed.
- Laboratory experiments on fine tuning of effective concentrations of ATC and NBPT (either applied alone or in combination) at stimulated summer (35°C) and winter (16°C) soil temperatures have been completed; 15N analysis is in progress.
- Greenhouse experiments with cotton and wheat to study the fate of ^{15}N-labelled urea applied by three methods, each with/without nitrification inhibitor and/or urease

inhibitors (ATC and NBPT) along with different methods of urea-N application (NIAB site) has been completed and plant sample analysis in progress.

- Establishing field experiments with cotton at Khanewal and NIAB sites for testing the performance of selected nitrification and /or urease inhibitors (ATC and NBPT) are in progress.

Following conclusion can be drawn from the experiment conducted:

- Laboratory experiments on the nitrification inhibitor (ATC)-blended urea revealed that effective application rate of ATC is equivalent to 2% of urea-N for summer season crops and 0.25% of urea-N for winter season crops. Therefore, for cotton crop receiving urea-N at 150 kg ha^{-1}, 3 kg ha^{-1} of ATC will be required to effectively inhibit nitrification, whereas for wheat crop receiving urea-N at 100 kg ha^{-1}, this amount could be reduced to 250 g ha^{-1}
- Laboratory experiments on urea inhibitor (NBPT)-blended urea revealed that NBPT applied at 1% of urea-N effectively delays urea hydrolysis both under summer and winter soil temperatures. Therefore, for cotton crop receiving urea-N at 150 kg ha^{-1}, 1.5 kg ha^{-1} of NBPT, and for wheat crop receiving urea-N at 100 kg ha^{-1}, 1 kg ha^{-1} of NBPT will be required to effectively inhibit urease activity.
- Detailed greenhouse and field experiments are in progress to evaluate (i) the role of ATC and NBPT in reducing fertilizer-nitrogen loss (^{15}N-Balance), (ii) their effects on crop yields, and (iii) cost economics regarding the use of nitrification/urease inhibitors in Pakistan agriculture.

Name of Project: **Centre Pivot Irrigation System for Enhancing Water Productivity of Seed Multiplication System and Crop Production Systems (WRRI, NARC, Islamabad Component-I)**

Name of PI/Institute: **Mr. Asaf Ali Bhatti,**
Principal Scientific Officer,
Water Resources Research Institute, NARC, Islamabad

Duration: 01. 03. 2010 to 28. 02. 2013

Financial Status: Total Cost: Rs.8.386 million
Funds Released: Rs.1463000/-
Funds Utilized: Rs.219193/-

Objectives:

- To develop Center-pivot sprinkler irrigation facilities for seed multiplication and crop production at NARC and other ecologies of Pakistan.
- To conduct research at various ecologies for crop production under center pivot irrigation systems.
- Devise packages of technology for optimum water productivity for seed and crop production.
- Demonstrate and disseminate state of the art irrigation technologies to farmers, extensionists, researchers and planners.

Achievements:

The project has been started recently i.e. in March 2010 on releases of funds. Initial work has been started. Sites selected for centre pivot installation and activities. Carried out discharge measurement of tubewell nearby the site. Tender floated for installation of centre pivot system.

Name of Project: **Centre Pivot Irrigation System for Enhancing Water Productivity of Seed Multiplication System and Crop Production Systems (FO&S, NARC, Islamabad Component-II)**

Name of PI/Institute: **Mr. Talat Farid Ahmed**
Sr. Engineer,
Farm Operation & Services, NARC, Islamabad

Duration: 01. 03. 2010 to 28. 02. 2013

Financial Status: Total Cost: Rs.21.231 million
Funds Released: Rs.391000/-
Funds Utilized: Rs.29993/-

Objectives:

- To develop Center-pivot sprinkler irrigation facilities for seed multiplication and crop production at NARC and other ecologies of Pakistan.
- To conduct research at various ecologies for crop production under center pivot irrigation systems.
- Devise packages of technology for optimum water productivity for seed and crop production.
- Demonstrate and disseminate state of the art irrigation technologies to farmers, extensionists, researchers and planners.

Achievements:

The project started in March, 2010 on release of 1st installment of funds. As project is just started, site selection, lay out and designing of centre pivot irrigation system has been done.

Name of Project: **Centre Pivot Irrigation System for Enhancing Water Productivity of Seed Multiplication System and Crop Production Systems (AZRI, Bahawalpur Component-III)**

Name of PI/Institute: **Dr. Rukhsana Anjum,**
Director/Principal Scientific Officer,
Arid Zone Research Institute - PARC, Bahawalpur

Duration: 01. 03. 2010 to 28. 02. 2013

Financial Status: Total Cost: Rs.8.639 million
Funds Released: Rs.302000/-
Funds Utilized: -

Objectives:

- To develop Center-pivot sprinkler irrigation facilities for seed multiplication and crop production at NARC and other ecologies of Pakistan.
- To conduct research at various ecologies for crop production under center pivot irrigation systems.
- Devise packages of technology for optimum water productivity for seed and crop production.
- Demonstrate and disseminate state of the art irrigation technologies to farmers, extensions, researchers and planners.

Achievements:

The 1st installment of funds has been released to the project in March, 2010. Appropriate site has been selected at AZRI, Bahawalpur for installation of centre pivot irrigation system. Formalities to float tender for procurement of the system completed.

Name of Project: **Centre Pivot Irrigation System for Enhancing Water Productivity of Seed Multiplication System and Crop Production Systems (WRRI Field Station, Thana Bula Khan, Hyderabad, Sindh Component-IV)**

Name of PI/Institute: **Mr. Abdul Ghani Soomro**
Scientific Officer,
Water Resources Research Institute, Field Station, PARC Thana Boula Khan, Hyderabad

Duration: 01. 03. 2010 to 28. 02. 2013

Financial Status:
Total Cost: Rs.18.884 million
Funds Released: Rs.414000/-
Funds Utilized: Rs.325701/-

Objectives:

- To develop Center-pivot sprinkler irrigation facilities for seed multiplication and crop production at NARC and other ecologies of Pakistan.
- To conduct research at various ecologies for crop production under center pivot irrigation systems.
- Devise packages of technology for optimum water productivity for seed and crop production.

Achievements:

Survey of three sites, two at A. Majeed Nizamani Farm 9 kms away in east of Tando Muhammad Khan main city at the link road of Soomro, Mirjat and one at A. Majeed Nizamani Farm, Tehsil Matli conducted with the collaboration of Sindh Aabadgar Board for selection of site for installation of centre pivot irrigation system. On the basis of survey, a site of 96 acres area with main crops sugarcane, sunflower, wheat, rice, cucumber and vegetable (Okra) at Abdul Majeed Nizamani Farm, tehsil Matli opposite Ansari Sugar Mills, village Allahdad Nizamani Deh Jarki was selected. The status of soil texture, soil salinity, sodicity and fertility has also been carried out.

Lay out plan of the site for 96 acres land located in centre of four small villages; Sultan Leghari, Ganji Kolhi, Allahdad Nizamani and Harsand Kolhi have been developed.

Name of Project: **Centre Pivot Irrigation System for Enhancing Water Productivity of Seed Multiplication System and Crop Production Systems (AZRC, Quetta Component-V)**

Name of PI/Institute: **Dr. Basharat Hussain,**
Senior Scientific Officer,
Arid Zone Research Centre - PARC, Quetta

Duration: 01. 03. 2010 to 28. 02. 2013

Financial Status: Total Cost: Rs.8.432 million
Funds Released: Rs.340000/-
Funds Utilized: Rs.278000/-

Objectives:

- To develop center-pivot sprinkler irrigation facilities for crop production in Balochistan province ecologies of Pakistan.
- To conduct research for crop production under center pivot irrigation systems.
- Devise packages of technology for optimum water productivity for seed and crop production.
- Demonstrate and disseminate state of the art irrigation technologies to farmers, extension workers, researchers and planners.

Achievements:

Work has just been initiated on 1st release of funds in March 2010. To start the project activities, 8-10 acres of land identified and selected at AZRC, Quetta for installation of the centre pivot irrigation system. As the site was quite un even, leveling was carried out.

Name of Project: **Centre Pivot Irrigation System for Enhancing Water Productivity of Seed Multiplication System and Crop Production Systems (AZRI, D. I. Khan, Component-VI)**

Name of PI/Institute: **Mr. Noman Latif,**
Senior Scientific Officer,
Arid Zone Research Institute- PARC, Ratta Kulachi, D. I. Khan

Duration: 01. 03. 2010 to 28. 02. 2013

Financial Status: Total Cost: Rs.8.689 million
Funds Released: Rs.346000/-
Funds Utilized: Rs.244893/-

Objectives:

- To develop center-pivot sprinkler irrigation facilities for seed multiplication and crop production at NARC and other ecologies of Pakistan.
- To conduct research at various ecologies for crop production under center pivot irrigation systems.
- Devise packages of technology for optimum water productivity for seed and crop production.
- Demonstrate and disseminate state of the art irrigation technologies to farmers, extension workers, researchers and planners.

Achievements:

Various locations were visited at AZRI, Farm to finalize area for installation of the centre pivot irrigation system. A plain area of approximately 34 acres close to D. I. Khan bypass road with no tree, electric pole or obstruction as per requirement has been identified. Soil and water analysis of the proposed location has been carried out:

Water Analysis

Location	EC* 10^6	PH	Ca + Mg	CO_3	HCO_3	Cl	TSS	Na	SAR	Class
AZRI Farm Canal Water	350	8.0	4.5	Nil	11.26	4.86	0.022	6.0	2.76	C_2S_1
Tube well	600	8.0	14.0	Nil	12.52	25.25	0.038	8.0	3.03	C_2S_1

Soil Analysis

Location	EC* 10^6	PH	Ca + Mg	CO_3	HCO_3	Cl	O.M	N%	Texture
AZRI Farm (0-15cm)	450	7.86	6.1	Nil	3.68	10.2	0.75	0.038	Clay
15-30 cm	350	7.81	5.7	Nil	3.96	7.6	0.76	0.035	Clay loam

Topographic survey was accomplished to find the area and dimension of the proposed field which come as 33.35 acres.

Name of Project: **Use of Alternate Energy Sources for Pumping Water in Agriculture (NARC, Islamabad Component-I)**

Name of PI/Institute: **Mr. Abdul Wahab Siyal,**
Asstt. Agri. Engineer,
Water Resources Research Institute, NARC, Islamabad

Duration: 01. 03. 2010 to 28. 02. 2013

Financial Status: Total Cost: Rs.10.414 million
Funds Released: Rs.2608000/-
Funds Utilized: Rs.1631520/-

Objectives:

- Develop and adapt pumping systems for irrigation water using alternative energy sources (solar, wind 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:

Since the start of the project in March 2010, following activities has been performed.

- Tender was floated for procurement of equipment for installation of biogas systems at NARC and D. I. Khan, while for Bahawalpur and Umerkot the same is in process.
- Carried out detailed review for pumps, engines and other accessories required for alternative energy sources to run the pumping systems for irrigation water.
- Collected information about potential of livestock and availability of dung per day at NARC and matched with our required need and system capacity as per project objectives.
- Coordinated with the other project components and provide technical as well as financial and administrative backstopping from time to time.

Name of Project: **Use of Alternate Energy Sources for Pumping Water in Agriculture (AZRI, Bahawalpur Component-II)**

Name of PI/Institute: **Dr. Rukhsana Anjum,**
Director,
Arid Zone Research Institute - PARC, Bahawalpur

Duration: 01. 02. 2010 to 28. 02. 2013

Financial Status: Total Cost: Rs.6.912 million
Funds Released: Rs.1257000/-
Funds Utilized: Rs. -

Objectives:

- Develop and adapt pumping systems for irrigation water using alternative energy sources (solar, wind, 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:

The project was started in March, 2010 on release of first installment of funds. The formalities to start the project have been completed. Appropriate site selected for construction of the Biogas Unit at AZRI, Farm of Bahawalpur.

Name of Project: **Use of Alternate Energy Sources for Pumping Water in Agriculture (AZRI, D. I. Khan, Component-III)**

Name of PI/Institute: **Mr. Noman Latif,**
Senior Scientific Officer,
Aird Zone Research Institute - PARC, D. I. Khan

Duration: 01. 02. 2010 to 28. 02. 2013

Financial Status: Total Cost: Rs.7.176 million
Funds Released: Rs.1257000/-
Funds Utilized: Rs.569596/-

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:

Ten agricultural farms with fruit orchards and livestock were visited during the reconnaissance survey. Economic profiling was also made to develop the base line. All baseline information collected and profarmae were filled-in to record the data.

Abdul Rehman farm was selected with more than 25 acres agricultural land with mango orchard and above 50 livestock heads for installation of Bio-gas. Another farm owned by Mr. Amanul Haq with 20 acres of agricultural land was selected for installation of solar panels. The farm has mango, date palm and citrus orchard along with a fish pond. The farmers were also willing to carry out the research activities and help in running the experiments on these alternate energy projects.

On finalization of procurement process, the bio-gas digester is being completed; however, the solar system will be procured and installed.

Name of Project: **Use of Alternate Energy Sources for Pumping Water in Agriculture (AZRI, Umerkot, Component-IV)**

Name of PI/Institute: **Mr. Hamaz Ali Samoon,**
Asstt. Engineer,
Arid Zone Research Institute - PARC, Umerkot

Duration: 01. 02. 2010 to 28. 02. 2013

Financial Status: Total Cost: Rs.4.980 million
Funds Released: Rs.1661000/-
Funds Utilized: Rs.202596/-

Objectives:

- Develop and adapt pumping systems for irrigation water using alternative energy sources (solar, wind, 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:

Since the start of the project in March, 2010 on release of funds, activities were initiated and carried out.

The sites were visited in the desert and adjoining irrigated belt for review of developing pumping systems. In the area wind mills are installed for pumping water and biogas plants but are used for the purpose of domestic use.

A site was selected at Arid Zone Research Institute, PARC, Umerkot for conducting research on solar and biogas pumping system to be used for irrigation. Relevant data was also collected from metrological, livestock department, NGOs and local survey carried out in the surrounding of Umerkot to develop alternate energy pumping system.

Solar system installed with 2" delivery at Tebhri Bhambhro village near Chore on farmer's field growing lemons and vegetable. The farmers are satisfied from the system. Annual wind velocity data was observed at Umerkot in Thar which is 21-30 kph for 600 hrs, 12-20 kph for 1900 hrs, 8-11 kph for 1400 hrs. Solar energy potential of the area is 10-11 hrs sun shines in Umkerkot with high temperature (Max: 45ºC)

Different sites have also been surveyed where the farmers are utilizing animal dung as biogas for cooking purpose. Large quantity of animals is available in the desert and 4-6 animals can provide 48kg/day of dung for running 8 m^3gas per plant.

Name of Project: **Solubility Enhancement of Phosphorus from Rock Phosphate (NARC, Islamabad Component-I)**

Name of PI/Institute: **Mr. Matiullah Khan,**
Senior Scientific Officer,
Water Resources Research Institute, NARC, Islamabad

Duration: 08. 01. 2010 to 07. 01. 2013

Financial Status: Total Cost: Rs.5.749 million
Funds Released: Rs.1729000/-
Funds Utilized: Rs. 906652/-

Objectives:

- Enhance the solubility of rock phosphate by biological means and formulate Biological Phosphate Rich Organic Matter (Bio-PROM) for better crop production.
- Explore other options for effective use of rock phosphate for better crop production.
- Collect information and categorize the indigenous resources of rock phosphate on the basis of phosphorus content.

Achievements:

Phosphorus (P) is considered as second essential macronutrient for plant growth. The deficient of this nutrient is wide spread in Pakistani soil. To combat the deficiency of P nutrient, Pakistan imports 566 thousand N tons against its requirement of 759. During the last couple of year a continuous price hike was observed in P fertilizers. The price increase in P fertilizers was 230% during the year 2008-09 over the year 2003-04. Simultaneously the price of DAP hiked to Rs.5000 from Rs.1800 in open market during the years.

Pakistan has large reserves of rock phosphate (RP) in Hazara area of Kyber Pakhtunkhwa province which is sufficient for 30 years of country requirement. Rock phosphate is the only raw material for preparation of phospatic fertilizers. Besides, RP composting with organic material and treatment with microbes can produce phosphate rich organic manure. Keeping in view the above mentioned face it became necessary to explore new cheaper ways and means to utilize these indigenous RP reserves for agricultural purposes. In order to overcome the problem, activities have been conducted in the project.

50 bags of Single Super Phosphate Fertilizer were prepared from indigenous rock phosphate of Hazara area. The RP stones colleted from Abbottabad area were grinded at 160 mesh level and analyzed for P_2O_5 content. The analysis showed 26% P_2O_5 content in the RP. A quantity of 250 kg (one treatment) was spread in a stainless steel and specified amount & dilution of sulphuric acid was applied through stain less steel spray pumps. After

incubation, the SSP was tested in laboratory for P_2O_5 content. The highest P_2O_5 content of 19.24% was recorded in the treatment where 3:3 (acid : water) was applied, while commercial SSP (as check) showed 16% P_2O_5 content. The economic analysis showed that expenditure per beg was Rs.460 (including labour and bagging charges) which was almost half of the prevailing rates of SSP in open market. The price can be further lowered by mechanization of the process and input purchases in bulk.

Name of Project: **Solubility Enhancement of Phosphorus from Rock Phosphate (KPK Agricultural University, Peshawar Component-II)**

Name of PI/Institute: **Dr. Muhammad Sharif**
Professor,
Department of Soil and Environmental Sciences, KPK Agricultural University, Peshawar

Duration: 08. 01. 2010 to 07. 01. 2013

Financial Status:
Total Cost: Rs.3.867 million
Funds Released: Rs.1227000/-
Funds Utilized: Rs.1114580/-

Objectives:

- Enhance the solubility of rock phosphate by biological means and formulate Biological Phosphate Rich Organic Matter (Bio-PROM).
- Determine the effect of Bio-PROM technology on increasing crops production.
- Explore other options for effective utilization of rock phosphate for better crop production.

Achievements:

Initiated the processes of composting of different organic materials with rock phosphate. During the report period, the composting process of organic wastes and RP feeded farm yard manure with rock phosphate remain is in progress. The compost so produced will be applied to maize crop.

Methods to be used for various laboratory analyses of project studies were standardized. Composting products were analyzed with interval of fifteen days for moisture content, nitrogen, phosphorus, organic carbon and pH.

A preliminary field experiment was conducted to determine the impact of direct application of RP alone and in combination with various organic materials on yield and P uptake of wheat crop. The crop was harvested; field data recorded while analysis in the laboratory is in progress. Field experiment has also been planned to determine the effect of produced compost on the yield and P uptake of maize plants.

Name of Project: **To Improve the Palatability and Nutritive Value of Comparatively Low Palatable Forage Species**

Name of PI/Institute: **Dr. Imtiaz Ahmad Qamar,**
Senior Scientific Officer,
Rangeland Research Institute, NARC, Islamabad

Duration: 18. 01. 2010 to 17. 01. 2013

Financial Status: Total Cost: Rs.7.140 million
Funds Released: Rs.1410000/-
Funds Utilized: Rs. 938865/-

Objectives:

- To evaluate nutritive value of low palatable grasses at different stages of their phonological development
- To add value to less palatable grasses by mixing with waste materials left over from fruits, vegetables, green fodders, and leaves of multipurpose tree species etc.
- To conduct feeding and digestion trials of value added less palatable grasses with the livestock.
- To survey Pothwar, Balochistan and Northern Areas rangeland to assess biomass production of relatively low palatable grass species.
- To conduct economic analysis through calculation of cost/benefit ratio of the new intervention.

Achievements:

Fresh and dry matter yield of palatable and low palatable grasses were recorded. Among palatable grasses, five ecotypes of *Panicum antidotale,* four ecotypes of *Cenchrus ciliaris, Pennisetum purpureum, Pennisetum, orientale. Chloris gayana* and *Selaria anceps* along with low palatable grasses viz. *Sorghum halepense, Imperata cylidrica* and *Heteropogon contortus* were clipped at stubble height of 15 cm from various location of NARC at pre-flowering, full flowering and maturity growth stages. Fresh and dry matter yield were recorded. All the samples were then ground and were subjected to proximate analysis including crude protein, mineral content and crude fat. Data generated will be helpful in understanding yield and nutritive value of the palatable and low palatable grasses.

Excellent silage was produced from vegetable (waste of cauliflower, radish and turnip leaves) waste and unpalatable grass of Dab *(Desmostachya bipinnata)* in about 8 weeks. This proved a great intervention that waste product from vegetables and low palatable grass produced an excellent feed for livestock. Addition of molasses decreased crude fibre percentage from 32 to 27% and application of effective microorganism increased crude

protein from 6.5 to 7.2%. The most important aspect of this study is that once the silage is ready in January-February, it will be preserved for a longer duration and will be available to the livestock during the months of fodder scarcity period of May and June when almost no green fodder is available to the livestock.

Name of Project: **Seed Production of Multi-purpose Trees and Forage Species (RRI -NARC, Islamabad Component-I)**

Name of PI/Institute: **Dr. Javed Afzal,**
Senior Scientific Officer,
Rangeland Research Institute, NARC, Islamabad

Duration: 02. 02. 2010 to 01. 02. 2013

Financial Status: Total Cost: Rs.3.242 million
Funds Released: Rs.761000/-
Funds Utilized: Rs.640314/-

Objectives:

- To ensure supply of quality seed of multipurpose trees and forage species of foothills and moist temperate zone of Murree for research and development activities.
- To generate baseline data regarding tree phenology, seed viability, and germination percentage of different plant species.

Achievements:

A list comprising of 85 trees, 38 shrubs, 54 herbs, and 30 grass species of Pakistan was developed. The list included information on scientific name, local name, distribution and economic value of the plants. It will help prioritize plant species for seed collection. Data on flowering and seed harvest time of 28 plant species were collected and compiled.

Almost one ton seed of 32 multi-purpose trees and forage species was collected from Islamabad, Thal, and Motorway-2 area for raising plant nurseries to undertake aforestation activities. Gift packs each comprising seed of 16 different multi purpose trees and shrubs were distributed among the participants of trilateral commission during their visit. Another consignment of 30 packs of seed worth Rs.3,000/- was sold to Lok Sanjh Foundation, Islamabad. Seed of different plant species was supplied to RRI team for developing plant nursery at the Malakand University, Ckadara, Khyber Pukhtunkhwa.

About thirty thousand seedlings of 11 different plant species were raised in the nursery. Tuft planting of six promising grass species of Potohar plateau was done over an area of one ha at RRI field, NARC.

Name of Project: **Seed Production of Multi-purpose Trees and Forage Species (MARC, PARC, Gilgit Component-II)**

Name of PI/Institute: **Mr. Munir Hussain,**
Senior Scientific Officer
Mountain Agricultural Research Centre (MARC), PARC, Gilgit

Duration: 02. 02. 2010 to 01. 02. 2013

Financial Status: Total Cost: Rs.1.320 million
Funds Released: Rs. 213000/-
Funds Utilized: Rs. 206560/-

Objectives:

- To ensure supply of quality seed of multi-purposes trees and forage species of dry temperate zone of Gilgit-Biltistan for research and development activities.
- To generate base line date recording trees phonology, seed viability and germination percentage of different plant species.

Achievements:

The seeds of forest species have been collected from different ecological zones of Gilgit-Baltistan mountains in different timings. The quantities of seed collected is; Kikar *(Acacia nilotica):* 50 kg, Junipar (*Juniperus excelsa*): 60 kg, Parkin sonia (*Parkinsoni aculeate*): 60 kg, Seabuckthorn (*Hyppopheae rhamnoids*): 40 kg, Mulberry (*Morus alba*): 100 kg and Shisham (*Dalbergia sissoo*): 10 kg for further research and development activities.

Name of Project: **Seed Production of Multi-purpose Trees and Forage Species (AZRC - Quetta Component-III)**

Name of PI/Institute: **Mr. Muhammad Afzal,**
Senior Scientific Officer,
Arid Zone Research Centre - PARC, Quetta

Duration: 02. 02. 2010 to 01. 02. 2013

Financial Status: Total Cost: Rs.1.320 million
Funds Released: Rs.213000/-
Funds Utilized: Rs.185535/-

Objectives:

- To collect quality seed of important multipurpose trees, shrubs and grasses from different ecological zones of Balochistan.
- To generate baseline data regarding tree phenology, seed viability, and germination percentage of different plant species.

Achievements:

Quality seed/pods of more than 1.5 tonnes of various trees, shrubs and grasses has been collected; Chyla/Bakyn *(Melia azadarach)*: 312 kg, Toot *(Mulberry sp.)*: 160 kg, Toot - Black *(Mulberry sp.)*: 23 kg, Chank (Jangli Cherry): 100 kg, Sanober (*Juniperus excelsa*): 20 kg, Jangli Badam (*Amygdalus brahuica*): 40 kg, Makhai/Haji pet (*Caragana ambigua*): 32 kg, Zarch (*Berberris balochistanica*): 60 kg, Hawe (*Cymbopogon jawarancusa*): 110 kg, Quetta pine (*Pinus aldarica*): 300 kg, Saro (*Cupressus sempervireus*): 160 kg seed & 100 kg pods, Saltbush (*Atriplex lentiformus*): 12 kg, Chanar (*Platinus oreintalis*): 10 kg and Wild Ash (*Fraxinus oxycarpa*): 7 kg.

Wild bulbs & ornamental flowers were collected in March-April, 2010 from Karkhasa Forest, Hazargangi Forest, Marwar, and Ziarat areas;

i. Tulip lehmanniana (Red and Yellow colour): 200 each from Karkhasa Forest & Ziarat
ii. Ferula species: 300 from Marwar
iii. Eremurus persicus: 200 from Ziarat Road
iv. Iris songarica: 100 from Karkhasa & Hazargangi
v. Iris loczyi: 100 from Karkhsa & Hazargangi
vi. Salvia bucharcia: 100 from Karkhsa & Hazargangi
vii. Muscari neglectum: 100 from Karkhsa & Hazargangi
viii. Ixiolirion tataricum: 100 from Karkhsa & Hazargangi
ix. Gentiauodes olivieri: 100 from Karkhsa & Hazargangi
x. Erumurus stenophllus: 100 from Karkhsa & Hazargangi

Name of Project: **Seed Production of Multi-purpose Trees and Forage Species (AZRI, Bahawalpur Component-IV)**

Name of PI/Institute: **Malik Muhammad Yousaf**
Senior Scientific Officer,
Arid Zone Research Institute - PARC, Bahawalpur

Duration: 02. 02. 2010 to 01. 02. 2013

Financial Status:
Total Cost: Rs.9.8418 million
Funds Released: Rs.213000/-
Funds Utilized: Rs.70000/-

Objectives:

- To ensure supply of quality seed multipurpose trees and forage species of Cholistan desert of Bahawalpur for research and development activities.
- To generate baseline data regarding tree phenology, seed viability, and germination percentage of different plant species.

Achievements:

A check list comprising of 08 desert trees, 06 shrubs and 10 grass species of Cholistan desert of Bahawalpur have been developed. The list included information on scientific name, local name, distribution, and economic value of the plant, which will help in prioritizing the plant species for seed collection.

The different ecological zones of various strata of different desert plant species have been identified in lesser Cholistan desert of Bahawalpur for future seed collection and other activities of the project. Data on flowering and seed harvest time of more than 24 species was collected and compiled.

Seed of desert shrubs and trees; *Prosopis cineraria* (Jand): 40 kg, *Salvadora oleoides* (Jal): 10 kg, *Acacia nilotica* (Kiker): 100 kg, *Ziziphus moritiana* (Ber): 100 kg, *Haloxylon salicornicum* (Lana): 100 kg, *Capparis deciduas* (Karir): 20 kg, *Leptadenia pyrotechnica* (Khip): 20 kg, *Zizyhus nummularia* (Mulah ber): 10 kg, *Pakansonia aculeate:* 30 kg and desert grasses; *Lasiurus sindicus* (Gorkha): 100 kg, *Panicum antidotale* (Murrat): 05 kg, *Symbopogon jawarancusa* (Khavi): 50 kg, *Cenchrus ciliaris* (Local dhaman): 10 kg, *Chloris gayana* (Rhodes grass): 05 kg, *Cenchrus ciliaris* (Biloela): 04 kg, *Panicum maximum* (Genia grass): 05 kg and *Cenchrus ciliaris* (US Buffel): 10 kg collected from localities of Cholistan desert.

Twenty five hundred stubbles/buds of eight different economic geophytes were collected

from different areas of Cholistan desert and have been propagated at Cholistan farm of AZRI, Bahawalpur for multiplication.

After harvesting, germination % of *Acacia nilotica, Acacia ampliceps, Acacia stenophylla, Acacia jacquomonti, Prosopis cineraria, Salvadora oleoides, Ziziphus moritiana, Zizyphus nummulaia* and *Lasiurus sindicus* was tested under agro-climatic conditions of Bahawalpur.

Name of Project: **Seed Production of Multi-purpose Trees and Forage Species (AZRI, D. I. Khan Component-V)**

Name of PI/Institute: **Mr. Aman Ullah Khan**
Senior Scientific Officer,
Arid Zone Research Institute - PARC, D. I. Khan

Duration: 02. 02. 2010 to 01. 02. 2013

Financial Status: Total Cost: Rs.1.320 million
Funds Released: Rs.213000/-
Funds Utilized: Rs.187898/-

Objectives:

- To ensure supply of quality seed of multipurpose trees and forage species of arid zone of D. I. Khan for research and development activities.
- To generate base line data regarding tree phenology, seed viability, and germination percentage of different plant species.

Achievements:

Prepare list of multipurpose trees species of D. I. Khan; *Acacia nilotica* (Babul, Kikar), *Albizia lebbek* (Siris), *Azadirachta indica* (Neem), *Dalbergia sissoo* (Shisham), *Eucalyptus camaldulensis* (Safeda), *Leucaena leucocephala* (IPLE-IPLE), *Mangifera indica* (Bakain), *Prosopis cineraria* (Jand), *Sesbania sesban* (Jantar) and *Zizyphus mauritiana* (Ber).

Collected base line data regarding tree phenology of different plant species, *Albizia lebbek* (Siris), *Dalbergia sissoo* (Shisham), *Acacia farnesiana* (Sweet Acacia), *Melia azedarach* (Bakain), *Acacia nilotica* (Kikar), *Acacia albida* (Kikar), *Leucaena leucocephala* (IPLE-IPLE), *Prosopis cineraria* (Jandi) and *Zizyphus mauritiana* (Ber).

Collected quality seed/pods of different multipurpose trees: *Albizia lebbek* (Siris): 68kg, *Leucaena leucocephala* (IPLE-IPLE): 40 kg, *Mangifera indica* (Bakain): 47 kg, *Zizyphus mauritiana* (Ber): 50 kg, *Dalbergia sissoo* (Shisham): 40 kg, *Acacia albeda* (Acacia): 50 kg, *Prosopis juliflora* (Perasu): 20 bags, *Acacia farmesiana* (Sweet Acacia): 08 kg,, *Acacia nilotica* (Kikar): 50 kg (30 bags) and *Prosopis cineraria* (Jandi): 30 kg (9 bags).

Name of Project: **Seed Production of Multi-purpose Trees and Forage Species (AZRI, Umerkot, Sindh Component-VI)**

Name of PI/Institute: **Mr. Ghulam Shabbir Bohio,**
Principal Scientific Officer,
Arid Zone Research Centre - PARC, Umerkot.

Duration: 02. 02. 2010 to 01. 02. 2013

Financial Status: Total Cost: Rs.1.320 million
Funds Released: Rs.213000/-
Funds Utilized: Rs. 97370/-

Objectives:

- To generate base line data regarding tree phenology, seed viability, and germination percentage of different plant species.

Achievements:

Prepared check list of 10 multi purpose trees and forage species in different sites of Thar desert i.e. Districts Umerkot & Mithi. Identified the potential area i.e. AZRI, Umerkot herbarium, Chachro, Kantio, Mithi, Chelar, Islamkot to collect lot of seed germplasm.

In total 407 kg of desert seed collected from selected sites of desert area; Caster Bean: 240 kg, *Acacia ampliceps*: 66 kg, *Acacia parkinsonia*: 20 kg, *Tecomma undulate*: 18 kg, *Acacia stenophylla*: 15 kg, *Prosopis cineraria*: 13 kg, *Leucoecphalla*: 10 kg, *Acacia jaquomonti*: 09 kg, *Lasiurus scindus*: 04 kg, *Penicum antidotale*: 04 kg, *Acacia senegal khumbat*: 2.5 kg, *Cenchrus biflorus*: 02 kg, *Albiza lebbek*: 02 kg, *Scindicum*: 01 kg & *Cyperus rotundus*: 05 kg. All the collected seed species of trees, shrubs and grasses were cleaned and packed in the plastic and clothes bags of 10 kg to avoid decay due to out side moisture. During the process of seed collection, information on phonology such as flowering and maturity of plants was recorded.

After harvesting, six species; *Acacia senegal, Acacia ampliceps, Acacia stenophylla, Tecomma, undulate, Acacia jaquomonti* and *Penicum targidum* were tasted at AZRI Umerkot. Due to high temperature, only 25% trees and 10% grasses germinated.

Name of Project: **Economic Analysis of Intercropping in Sugarcane in Sindh: Implications for Research and Extension**

Name of PI/ Institute: **Dr. Ali Muhammad Khushk,**
Director,
Technology Transfer Institute, PARC, Tandojam, Sindh

Duration: 25. 08. 2008 to 24. 08. 2010

Financial Status: Total Cost: Rs.1.953 million
Funds Released: Rs.1898000/-
Funds Utilized: Rs.1897378/-

Objectives:

- To ascertain extent of adoption of major intercropping practices followed by the growers in sugarcane production.
- To undertake economic analysis of major intercropping practices in sugarcane.
- To determine the cost structure, gross margin of major intercropping practices in sugarcane.
- To identify the improved farmers practices for obtaining high yield of sugarcane is Sindh.
- To recommend policy measures and program initiatives for sustainable development of sugarcane production.

Achievements:

Study was carried out to examine the current status of intercropping in sugarcane in selected districts of Sindh. The primary data on farm size, cropping pattern, input use, labour cost, input cost, yield of sugarcane and intercropped, transportation, marketing cost to estimate the economics of major intercropping in sugarcane in Sindh was collected during 2008-09 from the sugarcane growers who intercropped in sugarcane.

The study conducted during 2008-09 regarding information collected from the sugarcane growers who intercropped in sugarcane concluded that majority 94 percent of growers adopted single intercropping and remaining 6 percent adopted double intercropping in sugarcane. Sugarcane sole crop was analysed and found that net return of sugarcane sole crop was Rs.106947/- per ha and gross margin of Rs.123429/- per ha. The input-output benefit cost ratio was Rs.1:2.08 and Rs.1:1.08 on their investment respectively. Results indicate that farmers received low profit from sugarcane sole crop than the intercropping. The study findings revealed that sugarcane + wheat was dominant practice and adopted by 47 percent growers, followed by sugarcane + onion intercropping adopted by 27 percent growers. Other intercropping were also practiced like sugarcane + rapeseed mustard, sugarcane + tomato, sugarcane + sunflower. Very small proportion (6 percent) growers adopted double intercropping in sugarcane. The major double intercropping

was sugarcane + onion + wheat followed by sugarcane + tomato + wheat and sugarcane + cauliflower + wheat respectively.

The study concluded that sugarcane + wheat intercropping was the major single intercropping followed by sugarcane + onion intercropping. Majority (47 percent) growers adopted sugarcane + wheat intercropping due to profitable combination and meet the dietary need of the household. This intercropping was found in all sugarcane growing districts and growers obtained a benefit cost ratio of Rs.1:1.22 on their investment. The second important intercropping was sugarcane + onion intercropping. Farmers obtained a benefit cost ratio of Rs.1:1.62 on their investment.

The analysis indicates that sugarcane varieties: SPSG-26, Thatta 10 and CPF-234 had performed very well in the intercropping with other crops. It is suggested that extension department should promote these varieties and educate farmers to enhance the sugarcane productivity of the growers. The other input factors identified for obtaining maximum yield of sugarcane show that growers should apply 9 ploughing for land preparation, Nitrogen 448 kg/ha, Phosphorus 83 kg/ha, seed rate 214 mds/ha, and irrigations 26 for obtaining optimum yield of sugarcane.

At present, the growers are operating without formal and informal training. For rapid expansion of the technologies, the cost effectiveness and yield advantages of these technologies also need to be publicized through electronic media for its rapid adoption. The growers did not apply recommended dose of nitrogen and phosphorus to obtain optimum yield of intercropped sugarcane. It is recommended that research experiments are to be conducted on various input levels of FYM, organic fertilizer, compost bio pesticide for sustainable and eco-friendly agriculture development.

The wide fluctuation of input prices, increasing household expenditure, and non availability of credit facility, the small farmers are unable to adopt the intercropping technology. There is need to establish community based support structure to provide technical training for different intercropping practices in sugarcane to maximize the yield of both crops.

Name of Project: **Model Women Network of Livestock Farmers for Poverty Reduction**

Name of PI/Institute: **Hamida Masood Shah**
Director, Gender & Social Development, PARC, Islamabad

Duration: 18. 01. 2010 to 17. 01. 2013

Financial Status: Total Cost: Rs.7.933 million
Funds Released: Rs.2347000/-
Funds Utilized: Rs.450424/-

Objectives:

- Capacity Development of Livestock Farmers (men & women)
- Strengthening Public Private partnership
- Facilitating Livestock
- Research and Development
- Formation of Women Livestock Farmers Groups

Achievements:

Two trainings have been offered on livestock management and animal health, behavior change and social mobilization to livestock farmers of Sanghar and Nawabshah. As a result majority of the trained women have started to handle minor livestock issues at village level. A baseline questionnaire was developed to obtain baseline information regarding livestock and their management. A village profile proforma was also designed to collect the general information of villages. Two talukas of Sanghar (Sanghar and Sanjhoro) and Nawabshah (Nawabshah and Sakrand) districts were selected for baseline survey. The baseline survey comprising interview of 136 farmers in 31 villages of both the districts have been completed. The data analysis is in progress.

Community meetings have been conducted with women livestock farmers, district livestock departments, NGOs in Sanghar and Nawabshah district. The salient points of meeting were; selection of baseline survey areas, discussion of the work plan and selection of criteria of livestock farmers and livestock farmers group in social mobilization.

Registration of livestock farmers for the livestock farmer's network in Sanghar and Nawabshah districts remain in progress. More than 50 livestock facilitators have been selected.

Name of Project: **Angora Rabbit Farming as High Value Livelihood Source for Pakistani Women**

Name of PI/Institute: **Nustrat Batool,**
Director,
Benazir Bhutto Directorate of Cottage Industry & Livelihood, PARC, Islamabad

Duration: 18. 01. 2010 to 17. 01. 2013

Financial Status: Total Cost: Rs.4.567 million
Funds Released: Rs.896000/-
Funds Utilized: Rs.350000/-

Objectives:

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

Achievements:

To study the performance of Angora rabbit under Pakistani conditions, imported 25 Angora rabbits (21 female + 04 males) from Nepal in collaboration of the International Centre for Integrated Mountain Department (ICIMOD).

Designed two types of cages (Metal and Bamboo wire) and experimental cages for Angora rabbits were prepared with the collaboration of Agriculture and Biological Engineering Institute (A&BEI), NARC and Works Department of PARC. The first model Angora rabbitry is established at NARC with total 25 Angora rabbits of following breeds:

a) German Angora
b) French Angora
c) Himalayan Angora

The animals would serve as a foundation stock for further Angora rabbit production.

Conducted three days training workshop of PARC staff on Angora rabbit handling and management on the rabbitry. Total of 10 persons were trained in Angora rabbit farming. Five master trainers are also available to impart field training to rural women.

A book in English on "*Angora rabbit forming"* has been published while Urdu version is under preparation.

Annexure-I

List of ALP Projects Completed as on December 31, 2010:

(Rs.)

S. No	Name of Project	PI/Institute	Duration	Total Cost (million)	Release	Expenditure
Animal Sciences:						
1	Protection of Buffaloes Against Brucellosis	Dr. Rukhshanda Munir, Sr. Scientific Officer, Animal Sciences Institute (ASI), NARC, Islamabad	09.05.2002 to 08.05.2005	2.458	2438000/-	2185536/-
2	Ovarian Follicular Dynamics and Endocrine Activity in Postpartum Anoestrus Buffaloes	Dr. Nemat Ullah, Principal Scientific Officer, ASI, NARC, Islamabad	08.05.2002 to 07.05.2005	2.985	2985000/-	2929000/-
3	Studies on the Prospect of Introducing American Channel Cat fish (*Ictalurus puncutatus*) in Pond fish Culture System of Pakistan	Mr. Abdul Rab, Sr. Scientific Officer, AFRI, NARC, Islamabad.	10.05.2002 to 09.05.2005	3.035	3062000/-	2886000/-
4	Molecular Characterization of Pakistani Infectious Bronchitis Virus Variants and Development Recombinant Vaccine	Dr. Khalid Naeem, Sr. Scientific Officer, ASI, NARC, Islamabad	03.04.2002 to 02.04.2005	2.967	2967000/-	2084095/-
5	Development of Local Starter Culture Technology for Preparation of Fermented Milk Products.	Dr. Tariq Aziz, Sr. Scientific Officer, ASI, NARC, Islamabad.	14.04.2004 to 13.04.2007	3.750	3329100/-	3302081/-
6	Genetic Improvement of Buffaloes in Pakistan (GIBP)	Dr. Muhammad Anwar, Sr. Scientific Officer, ASI, NARC, Islamabad.	12.11.2004 to 11.11.2008	2.287	1447200/-	1362482/-
7	Effect of Civic Pollution on Fish and Fisheries in the Reverine System	Mr. Muhammad Afzal, Sr. Scientific Officer, Fisheries, NARC, Islamabad	21.05.2004 to 20.05.2007	1.996	1993100/-	1913538/-
8	Studies on Biology & Mapping of Warble Fly Infested Areas.	Dr. M. Qasim Khan, Sr. Scientific Officer, ASI, NARC, Islamabad	21.05.2004 to 30.06.2008	6.072	3400500/-	3383295/-
9	Development of Milk Replacer and Early Weaning Diets for Sustainable Calf Rearing.	Dr. Attiya Azim , Sr. Scientific Officer, ASI, , NARC, Islamabad	24.08.2004 to 23.08.2007	6.076	4978400/-	4794890/-

10	Development of Database on Minerals Profile of Feedstuffs, their Availability and Strategic supplementation of Minerals Block to Dairy Animals.	Dr. Attiya Azim, Sr. Scientific Officer, ASI, , NARC, Islamabad	17.09.2005 to 16.09.2008	2.513	2141400/-	2085712/-
11	Refinement of Multi-Nutrient Urea-Molasses Blocks Technology through Research and Development	Dr. Imdad Hussain Mirza, Pr. Scientific Officer (Animal Nutrition), ASI, NARC, Islamabad	10.08.2002 to 09.08.2005	0.952	711000/-	702000/-
12	Studies on Epidemiology of Peste des Petites Ruminant (PPR) in Pakistan	Dr. Aamer Bin Zahur Sr. Scientific Officer ASI, NARC, Islamabad	17.09.2005 to 28.02.2009	5.969	4245000/-	4252722/-
13	Development of Health, Nutrition and Breeding Management Packages for Increased Output from Range - Sheep/ Goats Production in Balochistan	Mr. Abdul Razzaq Scientific Officer, Arid Zone Research Centre, (PARC), Quetta	27.04.2006 to 26.04.2009	3.867	2808200/-	2647534/-
14	Role of Steroid Hormone in Regulation of Ovarian Follicular Development in *Tor Putitora*	Mr. Zaffarullah Bhatti, Dy. Director (Fisheries) Fish Hatchery & Res. Center, Rawal Town, Islamabad	27.09.2005 to 26.09.2008	8.500	6482400/-	6411383/-
15	Immunobiology and Immunoprophylaxis of Coccidiosis in Chickens	Dr. Masood Akhtar, Asstt. Prof., Deptt. of Parasitology, Uni. of Agri., Faisalabad	03.04.2002 to 02.03.2005	1.463	797800/-	786429/-
16	Studies on Tilapia Culture through Controlled Breeding in Saline Areas	Dr. Iftikhar Ahmed, Asso. Prof., Fisheries Res. Farms, Dept. of Zoology and Fisheries, Uni. of Agriculture, Faisalabad	03.04.2002 to 02.04.2005	0.898	688100/-	688100/-
17	Characterization of Tannins in Feeds and Forages of Pakistan and their Evaluation for Anthelmintic Activity	Dr. Zafar Iqbal, Asso. Prof., Uni. of Agriculture, Faisalabad	13.08.2002 to 12.08.2004	0.968	872850/-	871232/-
18	A Comparison of Concentrate and Fodder Based Finishing Diets on the Performance, Carcass Composition and Meat Quality of Lohi and Sipli Lambs.	Dr. Muhammad Iqbal Mustafa, Asstt. Prof., Department of Livestock Mgt., University of Agriculture, Faisalabad	08.09.2004 to 07.09.2006	1.779	1464550/-	1428562/-
19	Genetic Characterization of Native Cattle and	Dr. Safdar Ali, Astt. Prof., Uni. of	22.05.2004 to	4.628	3651800/-	3633292/-

	Buffaloes Breeds of Pakistan.	Agriculture, Faisalabad	21.05.2007			
20	Influence of Altering Dietary Cation Anion Difference on Productive and Reproductive Efficiency of Buffaloes.	Dr. Muhammad Sarwar, Associate Prof., Department of Animal Nutrition, University of Agri., Faisalabad.	28.05.2004 to 27.05.2007	5.058	4837200/-	4794375/-
21	Development of Milk Recording and Genetic Evaluation Models in Sahiwal Cattle.	Dr. Muhammad Sajjad Khan, Asso. Prof., Dept. of Animal Breeding & Genetics, Uni of Agri., Faisalabad.	22.05.2004 to 21.05.2007	3.695	2811800/-	2736692/-
22	Evaluation of Indigenous Medicinal Plants for the Isolation of Steroid Hormonal Activities for Veterinary Usage	Dr. Nazir Ahmad, Prof./Chairman, Department Animal Reproduction, University of Agriculture. Faisalabad	08.09.2005 to 07.09.2008	5.046	3361000/-	3287896/-
23	Mott Grass as a Potential Source of Dietary Forage for Lactating Sahiwal Cows	Dr. Muhammad Qamar Bilal, Assistant Prof., Dept. of Livestock Mgt., University of Agriculture, Faisalabad	14.09.2005 to 13.09.2008	1.660	1559100/-	1477169/-
24	Development of Supplementary Feed Based on Apparent Nutrient Digestibility of Different Feed Ingredients for *Labeo Rohita* Fingerlings	Dr. Muhammad Salim, Assistant Prof., Department of Zoology & Fisheries, University of Agriculture, Faisalabad	14.09.2005 to 13.09.2008	2.137	1439000/-	1408459/-
25	Pharmacokinetics and Dosage of Flouroquinolones in Animals	Dr. Faqir Hussain Khan, Asso. Prof., Dept. of Physiology and Pharmacology, University of Agriculture, Faisalabad	11.02.2006 to 10.02.2008	3.100	2623300/-	2480802/-
26	Preliminary Studies on the Efficiency of Locally Prepared *Staphylococcus Aureus* Vaccine in the Control of Mastitis in Dairy Buffaloes	Dr. Ghulam Muhammad, Asso. Prof. & Chairman, Dept. of Clinical Medicine and Surgery, Faculty of Vet. Sci., Uni. of Agri. Faisalabad	25.04.2002 to 24.04.2004	0.754	452000/-	446556/-
27	Inter-relationship of Mycotoxins Levels in Feed Organs/Tissues and Health of Poultry and Livestock.	Mr. Muhammad Zargham Khan, Chairman/ Asso. Prof., Dept. of Veterinary Pathology, University of Agri., Faisalabad.	25.07.2006 to 30.06.2009	9.345	9106900/-	9105853/-
28	Application of PCR	Dr. Sajjad-ur-Rahman,	22.02.2006	2.939	2734000/-	2546292/-

	Technology for the Detection of Avian Mycoplasma in Poultry Birds and Farm Environment.	Asso. Prof., Dept. of Vet. Microbiology, University of Agri., Faisalabad	to 21.02.2009			

29.	Clinical and Biochemical Studies on Genital Prolapse in the Buffaloes	Dr. Laeeq Akbar Lodhi, Prof./ Chairman, Dept. of Clinical Medicine & Surgery, Uni. of Agriculture, Faisalabad	25.08.2005 to 24.06.2009	4.794	3139500/-	3007454/-
30.	Molecular Characterization and Pathogencity of Avian Adeno-Viruses Causing HPS	Dr. Mansur-ud-Din Ahmad, Asso. Prof., Dept. of Microbiology, University of Vet. & Animal Sciences (UVAS), Lahore.	02.04.2003 to 30.03.2006	2.746	2474600/-	2348538/-
31.	Immuno-Prophylaxis of Foot and Mouth Disease (FMD) in Bovines	Dr. Khushi Muhammad, Chairman, Department of Microbiology, UVAS, Lahore	22.07.2003 to 21.07.2006	5.945	4549700/-	4480068/-
32.	Effect of Long Term use of Bovine Somatotropin (bST) Hormone on Milk Production, Reproduction, Health and Various Physiological Parameters in Nili- Ravi Buffaloes	Dr. Makhdoom Abdul Jabbar, Associate Prof., Department of Animal Nutrition, UVAS, Lahore.	17.07.2004 to 16.07.2007	3.464	3113200/-	3098669/-
33.	Epidemiology of Helminthiasis in Sheep	Dr. Haji Ahmad Hashmi, Associate Pro./Chairman, UVAS, Lahore	21.09.2005 to 20.09.2007	0.547	432100/-	396401/-
34.	Studies on Mineral Imbalances in the Livestock of Canal Irrigated Districts of the Punjab	Dr. Talat Naseer Pasha, Prof., Dept. of Animal Nutrition, Uni. of Vet. & Animal Sciences, Lahore	21.09.2005 to 20.09.2008	8.596	6665800/-	6413538/-
35.	Hyper-Secretion of Xylanase &/or *Cellulase Thermophile* for its Application in Poultry Feed Industry	Dr. Farooq Latif, Principal Scientist, National Institute for Biotechnology and Genetic Engineering (NIBGE), Faisalabad	09.08.2002 to 08.08.2005	1.743	1573080/-	1575000/-
36.	Application of Molecular Techniques for Differential Diagnosis of Rinderpest and Related Diseases	Dr. Qaiser Mahmood Khan, Principal Scientist, NIBGE, Faisalabad	19.07.2004 to 18.07.2007	2.760	2529975/-	2353032/-
37	Production of Breeding Bulls to Improve Milk Production of Nili Ravi Buffaloes in Rural Area	Dr. Muhammad Rafique, Research Officer, LPRI, Bahadar Nagar, Okara	20.12.2004 to 19.12.2007	3.764	3731000/-	3698113/-
38	The Status of Shrimp's Fisheries in Sonmiani	Dr. Naureen Aziz Qureshi, Asstt. Prof.,	28.07.2004 to	4.471	3682300/-	3405819/-

	Bay Lagoon, Balochistan Pakistan	Centre of Excellence in Marine Biology, Uni. of Karachi, Karachi.	27.07.2007			
39	Aquaculture of Fin Fishes (Snappers and Groupers) in Ponds Along Hub River Estuary/ Gharo Creek	Syed Makhdoom Hussain, Prof., Centre of Excellence in Marine Biology, Karachi University, Karachi,	17.04.2004 to 30.06.2008	4.679	4090700/-	4083909/-
40	Farming of Mud Crab (*Scylla serrata*) in the Coastal Earthen-Ponds	Prof. Dr. Javed Mustaquim, Prof., Center of Excellence in Marine Biology, Uni. of Karachi	06.05.2002 to 05.05.2005	2.386	1984300/-	1961587/-
41	Strategic Breeding of Red Sindhi Cattle (SBRSC)	Dr. U. N. Khan, DG., Southern Zone Agri. Research Center (SARC) - PARC, Karachi	23.04.2002 to 22.04.2005	2.785	2740000/-	2656118/-
42	Polyculture of Freshwater Prawn, *Macrobrachiuii Malcolmsonu* with Indian Major and Chinese Carps at Farmers Ponds in Pakistan.	Dr. Rafia Rehana Ghazi, Director (VPCI), SARC, Karachi,	22.04.2002 to 21.04.2005	1.984	1983000/-	1982734/-
43	Studies on the Effect of Bovine Somatotropins (rbST) on Productive and Reproductive Parameters of Kundhi Buffaloes in Sindh	Dr. Saghir Ahmed Sheikh, Associate Prof., Sindh Agriculture University, Tandojam-Sindh	26.08.2004 to 31.09.2007	2.975	2898500/-	2893674/-
44	Promotion of Animal Balanced Feed in Farmer Community.	Mr. Abdul Rehman Soomro, Technical Coordinator, Indus Resource Center Haji Allam Channa Colony, Sehwan, District Dadu, Sindh	29.05.2004 to 28.05.2006	2.376	2344685/-	2263090/-
45	Enhancing Milk Yield of Kindhi Buffaloes through Production of Performance Tested Bulls	Dr. Alam Solangi, Breed Improvement and Development Centre (SPU) Kundhi Buffalo Farm Rohri, Sindh.	14.09.2005 to 13.09.2008	3.556	2367744/-	2367744/-
46	Implementation of NIR Technique for the Evaluation of Animal Feeds.	Dr. M. Mohsin Siddiqui, Asso. Prof., Dept. of Livestock Mgt., NWFP Agri. University, Peshawar	27.04.2002 to 26.04.2005	1.946	1555000/-	1542711/-
47	Efficient Utilization of Local Feed Recourses	Dr. Ghulam Habib, Asso. Prof., (Animal	13.08.2002 to	1.854	1700000/-	1698861/-

	for Sustainable Increase in Livestock Production.	Nutrition), NWFP Agri. Uni. Peshawar	12.08.2005			
48	Maintaining Genetic Diversity of "Kari" Sheep Breed, for Sustained Development of Chitrali Patti Cottage	Mr. Sohail Ahmed, Lecturer, Veterinary Sciences, NWFP Agri. University, Peshawar	24.08.2004 to 23.08.2006	3.15	2849500/-	2789132/-
49	Taxonomical Studies of the Prevalent Ticks Species on Different Livestock Hosts throughout NWFP	Dr. Raheem Ullah Shah, Research Officer, Veterinary Research Institute, NWFP, Peshawar	25.04.2006 to 30.06.2008	2.629	2217500/-	2135023/-
50	Epidemiological Survey of Mastitis and Evaluation of Economic Losses due to Clinical & Subclinical Mastitis in NWFP	Dr. Mirza Ali Khan, Research Officer, Veterinary Research Institute, Peshawar.	08.09.2005 to 18.10.2008	3.248	2833100/-	2709996/-
51	Trout Farming in the Mountains of Northern Areas. A Research Project at TRMC Juglote.	Mr. Faridullah Khan, Scientific Officer, Karakuram Agril. Res. Institute for Northern Areas, (PARC), Juglote, Gilgit	19.10.2005 to 18.09.2008	5.713	3972100/-	3972100/-
52	Microbiological Studies on Caprine Mycoplasma in Balochistan.	Dr. Mohammad Arif Awan, Asstt. Prof., Centre for Advanced Studies in Vaccinology & Biotechnology, Uni. of Balochistan, Quetta,	11.03.2006 to 10.03.2009	4.800	3069600/-	3069119/-
53	Studies on the Reproductive Physiology of One-Humped Camel (C*amelus romedaries)* in the Natural Ecology of Pakistan.	Dr. Anas Sarwar Chairman/Associate Professor, Dept. of Veterinary Anatomy, University of Agriculture, Faisalabad	21.10.2005 to 20.10.2009	5.000	3350456/-	3350456/-
54	Production of Thermo-Stable Newcastle Disease (ND) Vaccine, for Rural Poultry	Dr. Shakeel Babar, Project Director, Center for Advanced Studies in Vaccinology and Biotechnology (CASVAB), University of Balochistan, Quetta.	11.09.2006 to 10.09.2009	3.459	2923900/-	1685467/- (Upto June 2009)
55	Studies on Breeding and Seed Production of Channel Catfish (*lctalurus punctuates*) in Pakistan	Dr. Abdul Rab Sr. Scientific Officer, Aquaculture and Fisheries, NARC, Islamabad.	19.07.2007 to 30.06.2010	3.704	2740600/-	2691527/-
56	Growth Response of Broiler to Ideal Amino Acid Ratio	Dr. Muhammad Aslam Mirza, Asso. Professor, Animal Nutrition, University of	11.10.2007 to 10.10.2010	1.595	434500/-	-

		Agriculture Faisalabad				
57	Feeding Management for Optimum Growth, Early Maturity and Fish Lactation Performance in Sahiwal Cattle	Dr. Muhammad Abdullah, Professor, Dept. of Livestock Production, University of Vet. and Animal Sciences, Lahore.	23.07.2007 to 22.07.2010	6.382	5078200/-	5035116/-
58	Synchronization of Estrus in Buffalos to Enhance Herd Fertility Using Various Protocols.	Dr. Nasim Ahmad, Professor, Department of Theriogenology, University of Vet. and Animal Sciences, Lahore	23.07.2007 to 22.07.2010	4.938	4771400/-	4137062/- (Upto June 2009)
59	Induced Breeding and Fry Rearing Techniques of Indigenous Catfish, *Rita rita* (Hamilton) in Cemented Cistern	Dr. Naeem Tariq Narejo, Professor, Dept. of Fresh Water Biology and Fisheries, University of Sindh, Jamshoro, Sindh	23.07.2007 to 22.07.2010	1.124	905000/-	905500/-
Crop Sciences:						
1	Development of High Yielding and Well Adaptive Indigenous Canola Hybrids.	Dr. Naazar Ali, Chief Scientific Officer, Oilseed Res. Program, NARC, Islamabad	18.07.2002 to 17.07.2005	1.869	1575000/-	1485687/-
2	Integrated Management of Fruit Flies in Pakistan, NARC, (Component-I)	Dr. Ghulam Jilani, Senior Director, IPEP, NARC, Islamabad	21.03.2002 to 31.12.2005	3.675	2972400/-	2513114/-
3	Mass Scale Production of Disease Free True-to-Type Peach Rootstock (GF-677) Plantlets through Tissue Culture for Productivity Enhancement/ Economic Self reliance.	Dr. Hafeez Ur Rahman, Sr. Scientific Officer, HRI, NARC, Islamabad	21.03.2002 to 30.06.2005	2.129	1511000/-	1346156/-
4	Adaptation and Commercialization of Throw-In-Type Rice Thresher	Mr. Abdul Waheed Zafar, Pr. Engineer, FMI, NARC, Islamabad	29.03.2002 to 30.06.2005	2.332	2291000/-	2261066/-
5	Development and Commercialization of Mobile Seed Processing Unit.	Dr. Tanveer Ahmed, Pr. Engineer, FMI, NARC, Islamabad	29.03.2002 to 30.06.2006	2.679	2154400/-	2076000/-
6	Development of Energy Efficient Wheat Thresher	Mr. M. Tahir Anwar, Sr. Engineer, FMI, NARC, Islamabad	29.03.2002 to 30.06.2005	2.558	1644000/-	761774/-
7	Studies on Viral Diseases of Major Pulse Crops and Identification of Resistant Sources.	Dr. Muhammad Bashir, Pr. Scientific Officer, CSI, NARC, Islamabad	22.03.2002 to 30.06.2005	2.701	2527000/-	2408079/-
8	Collection, Conservation,	Mr. Muhammad Afzal, Sr. Scientific Officer,	18.07.2002 to	3.000	2266010/-	2112691/-

	Evaluation and Documentation of Horticultural Crops Germplasm and its Wild Relatives.	ABGRI, NARC, Islamabad	30.06.2006			
9	In Vitro Conservation and Crypreservation of Plant Germplasm of Vegetativly Propagated Crops.	Dr. G. Mustafa Sajid, Sr. Scientific Officer, PGRI, NARC, Islamabad	15.05.2002 to 30.06.2005	2.100	1608000/-	1509973/-
10	Acquisition, Screening and Utilization of Peas Germplasm for Development of Superior Cultivars.	Dr. Abdul Ghafoor, Sr. Scientific Officer, PGRI, NARC, Islamabad	15.05.2002 to 30.06.2005	2.100	1665000/-	1576556/-
11	Study on Genetic Variation in X*anthomonas campestris* pv. Oryzae in Relation to Resistance in Rice.	Dr. M. Afzal Akhtar, Pr. Scientific Officer, CDRI, NARC, Islamabad	21.03.2002 to 30.06.2005	4.821	2680500/-	2369057/-
12	Molecular Breeding of Kabuli Chickpea for Ascochyta blight Resistance and High Yield Potential.	Dr. Ahmad Bakhsh Maher, Sr. Scientific Officer, Pulses, NARC, Islamabad	22.03.2002 to 21.03.2006	2.701	1374773/-	1374773/-
13	Studies on the Physiological Race Analysis of Fusarium monilifome Inciting Bakanae/Foot Rot in Rice	Dr. M. Afzal Akhar, Sr. Scientific Officer, CDRI, NARC, Islamabad	01.07.2005 to 31.03.2007	3.543	1387100/-	1206944/-
14	Development of Botanical Pesticides from Traditionally used Plant Derivatives Against Stored Grain Pests	Dr. Ghulam Jilani Sr. Director, IPEP NARC, Islamabad	01.07.2005 to 31.12.2008	3.385	2208000/-	2167646/-
15	Propagation of Sparsely Seeded/Seedless Kinnow Mandarin Using Cell and Tissue Culture Techniques.	Dr. Mrs. Nafees Altaf, Principal Scientist, NIAB, Faisalabad.	04.04.2002 to 30.06.2005	1.328	919000/-	861798/-
16	Integrated Management of Fruit Flies in Pakistan (NIA, Tandojam, Component – V)	Mr. Nazir Ahmed, Principal Scientist, NIA, Tandojam.	26.04.2002 to 30.06.2005	2.012	1225500/-	1219540/-
17	To develop drought resistant wheat (Triticum aestivum L.) genotypes under water stress condition.	Shaikh Muhammad Mujtaba, Principal Scientist, NIA, Tandojam.	26.04.2002 to 30.06.2005	1.070	784000/-	683644/-
18	Development of Canola	Syed Anwar Shah,	22.03.2002	1.350	1262000/-	1262000/-

	Quality Mustard (*Brassica juncae L.)* Genotypes.	Principal Scientist, NIFA, Peshawar.	to 21.03.2005			
19	Integrated Management of Fruit Flies in Pakistan (NIFA, Peshawar, Component - III)	Dr. Sana Ullah Khan Khattak, Head/ Principal Scientist, NIFA, Peshawar.	22.03.2002 to 30.06.2005	2.368	2079200/-	2074250/-
20	Integrated Management of Fruit Flies in Pakistan (CABI -Biosciences Component – II)	Dr. M. Ashraf Poswal, Director, CABI, Rawalpindi.	22.03.2002 to 30.06.2006	4.254	4235500/-	4255377/-
21	Morphological and Biochemical Variability of the Genus Trichogramma (Hymenoptera: trichogrammatidae) in Pakistan.	Mr. Riaz Mehmood, Sr. Scientific Officer, CABI, Rawalpindi	21.03.2002 to 30.06.2005	4.166	3114000/-	3039370/-
22	Some Physiological Studies on Vegetative Growth Pattern and its Impact on Productivity and Malformation of Mango *(Mangifera indica* L.)	Dr. F. M. Tahir, Prof., Dept. of Horticulture, Univ. of Agriculture, Faisalabad.	22.03.2002 to 21.03.2005	1.384	1027000/-	962482/-
23	Exploitation of forage legume diversity endemic to salt range in the Punjab.	Mr. Farrukh Javed, Asstt. Prof., University of Agriculture, Faisalabad.	06.04.2002 to 30.06.2005	1.095	510048/-	493160/-
24	Genetic improvement of brassica oilseed by integrative use of conventional and molecular biological approaches.	Dr. Zahoor Ahmed Swati, Prof., Inst. of Biotech. & Genetic Eng., NWFP Agri. University, Peshawar.	22.03.2002 to 21.03.2005	1.919	1291000/-	1280474/-
25	Management of parasitic weeds in rapeseed, onion and legume crops in NWFP.	Dr. Khan Bahadar Marwat Prof., Dept. of Weed Sci., NWFP Agri. University, Peshawar.	22.03.2002 to 30.06.2005	1.753	1730531/-	1726651/-
26	Investigation of mechanism for weed seed dormancy in rice based cropping system.	Dr. Gul Hassan Prof., Dept. of Weed Sci., NWFP Agri. University, Peshawar	22.03.2002 to 21.03.2005	0.400	405000/-	402921/-
27	Investigation of role of germin-like proteins (GLPS) during germination/early development by construction of rice plants engineered for sense and anti-sense expression of rice GLP.	Dr. Saqlain Naqvi, Prof., Dept. of Bio Sciences, University of Arid Agriculture, Rawalpindi.	22.03.2002 to 30.06.2005	2.473	2103000/-	2099530/-

28	Resource conservation technology for rice-wheat system in CRBC command areas.	Dr. Inayatullah Awan, Faculty of Agri., Gomal University, D. I. Khan.	04.04.2002 to 31.12.2003	2.750	1157000/-	1068085/-
29	Iron fortification of wheat flour in Pakistan: a step that needs critical evaluation.	Dr. M. Masoom Yasinzai, Prof., Dept. of Biochemistry, University of Balochistan, Quetta.	26.04.2002 to 30.06.2005	1.100	420500/-	405659/-

30	Integrated Pest Management of aphids in Canola.	Dr. Muhammad Aslam, Asso. Prof., University College of Agriculture, BZU, Multan.	01.07.2002 to 30.06.2005	1.346	899000/-	614856/-
31	Studies on malformation of mango	Dr. Ahmed Saleem Akhtar, Dir., Plant Protection Inst., AARI, Faisalabad.	29.03.2002 to 28.03.2005	2.241	1544000/-	1526160/-
32	Increasing production of Kabuli chickpea for its import substitution.	Dr. Muhammad Afzal, Dir., Pulses Res. Inst., AARI, Faisalabad.	06.04.2002 to 28.02.2006	1.328	898500/-	848056/-
33	Post harvest research on perishable fruits (guava, peach) and vegetables (tomatoes) in NWFP.	Mrs. Manzoor Nazli, Food Technologist, ARI, Tarnab, Peshawar.	22.03.2002 to 30.06.2005	1.637	1477000/-	1476742/-
34	Integrated management of fruit flies in Pakistan (ARI, D.I Khan, Component – IV)	Dr. Abdul Latif, Entomologist, ARI, D. I. Khan.	22.03.2002 to 30.06.2006	2.063	2060500/-	1958241/-
35	Survey and integrated pest management of cotton insect pests in Balochistan.	Mr. Muhammad Karim Shawani, Entomologist, ARI, Sariab, Quetta.	01.03.2003 to 28.02.2006	1.200	1077775/-	939795/-
36	Integrated management of fruit flies in Pakistan, (ARI, Sariab, Component – VI)	Mr. Muhammad Karim Shahwani, Entomologist, ARI, Sariab, Quetta.	01.03.2003 to 28.02.2006	2.031	1674900/-	1543412/-
37	Utilization of Genetic Variation in Yield Response to Drought Stress for the Development of Improved Wheat Germplasm	Dr. Muhammad Yaqoob Mujahid, PSO, Wheat Program, NARC, Islamabad	08.09.2005 to 07.09.2008	3.861	3211900/-	3109820/-
38	Investigation of Citrus Decline and Preliminary Management Studies in Punjab	Ms. Khurshid Burney, Sr. Scientific Officer, IPEP, NARC, Islamabad	01.07.2005 to 30.06.2008	2.801	2501600/-	2430477/-
39	Biochemical and Molecular Approaches to Study the Effect of Pesticide on Nitrogen Fixing Bacteria in Legumes	Mr. Sohail Hameed, PSO, Plant Microbiology Division, NIBGE, Faisalabad	01.07.2005 to 30.06.2008	1.650	1204000/-	1182373/-
40	Selection of Zinc Efficient Wheat Genotypes for a Balance Human nutrition	Dr. Muhammad Imtiaz, Principal Scientist, Dept. of Soil Science, NIA, Tandojam	01.07.2005 to 30.06.2008	1.705	997600/-	997071/-
41	Adaptation and Promotion of Ultra Low Volume (ULV) Pesticide Sprayer	Dr. Abdul Rehman Tahir, Asso. Prof., Univ. of Agriculture, Faisalabad.	01.10.2005 to 30.09.2008	2.387	1009000/-	1008617/-

42	Utilization of Allelopathic Properties of Sorghum, Sunflower and Brassica for Weed Management in Some Field Crops	Dr. Zahid Ata, Prof./Dir., Weed Sciences Lab., Univ. of Agriculture, Faisalabad.	20.08.2005 to 19.08.2008	3.117	1119600/-	1117342/-
43	Mass Production of Biocontrol Agents for Field Application	Dr. Saleem Shahzad, Asstt. Prof., Dept. of Agriculture, University of Karachi	01.07.2005 to 30.06.2008	1.145	683400/-	683500/-
44	Development of High Yielding, Disease Resistant Varieties of Groundnut through Hybridization and Mutation Breeding along with Nodulation Studies for N_2 Fixation under Rainfed Conditions	Mr. Naeem-ud-Din, Groundnut Botanist, Barani Agricultural Research Institute, Chakwal	01.07.2005 to 30.06.2008	3.221	2949600/-	2949540/-
45	Production of Double Haploids of Wheat by Using Wheat X Maize Crosses Technique	Dr. Abid Mahmood, Dir., Barani Agri. Res. Institute, Chakwal	01.07.2005 to 30.06.2008	3.817	3657400/-	3585974/-
46	Hybrid Seed Production of Rice	Dr. Muhammad Akhtar, Rice Botanist, RRI., Kala Shah Kaku	01.07.2005 to 30.06.2008	1.483	1466300/-	1452931/-
47	Investigation on Disease Control of Die Back/Citrus Decline in NWFP	Dr. Mahmood Khan, Plant Pathologist, ARI, Tarnab, Peshawar	01.07.2005 to 30.06.2008	2.838	2806600/-	2764681/-
48	In-Situ Evaluation of Indigenous Walnut Germplasm in Malakand Division, NWFP	Mr. Jamshaid Khan, Director, ARS, Mingora, Swat	01.07.2005 to 30.06.2008	0.784	673200/-	670607/-
49	Integrated Nematode Disease Management (INDM) in some cereals, fruits and vegetables of Pakistan.	Dr. Shahina Fayyaz, Director, NNRC, University of Karachi	01.05.2003 to 30.04.2006	3.435	3327000/-	3306610/-
50	Developmental Biology, Feeding Pattern and Management Strategy against Indian Crested Porcupine *(Hystrix Indica)* in Sindh and Balochistan Provinces. (C-IV)	Mr. Amjad Pervez Sr. Scientific Officer, VPCI, SARC, Karachi University, Karachi	01.07.2003 to 30.06.2006	1.962	1582300/-	1706691/-
51	Quantification of Maize Yield Losses from Leaf Blights and Improving Maize Populations for Grain Yield and Leaf	Dr. Hidayat-ur-Rehman, Prof., (PBG), NWFP Agricultural University, Peshawar.	01.07.2003 to 30.06.2006	2.173	1520000/-	1215037/-

	Blight Resistance					
52	Production of Doubled Haploids Wheat with Longer Coleoptile.	Dr. Fida Muhammad, Associate Prof., (PBG), NWFP Agricultural University, Peshawar.	01.08.2003 to 30.06.2006	1.859	1408700/-	1398904/-
53	Component 2: Investigations on Indian Crested Porcupine, Hystrix indica, Damage to Forest Flora and Development of Prevention Practices in Tarbela-Mangla Watershed Areas.	Mr. Rafiq Massih, Sr. Scientific Officer, VPCL, NARC, Islamabad.	01.07.2003 to 30.06.2006	2.866	2254600/-	2083056/-
54	Component 3: Biology and Management of Porcupine, Hytrix indica in Centeral Punjab.	Prof. Dr. Afsar Mian, Dean, Sciences, University of Arid Agriculture, Rawalpindi.	01.07.2003 to 30.06.2006	2.094	1916500/-	1870106/-
55	Umbrella Project Component 1: Pathobiology of Foliar Spots of Wheat and their Integrated Management.	Mrs. Shamim Iftikhar, Sr. Scientific Officer, IPEP, NARC, Islamabad	01.07.2003 to 30.06.2006	4.069	2761700/-	2756739/-
56	Component 2: Investigation on barley yellow dwarf virus (BYDV) in wheat crop in Pakistan.	Dr. Shahid Hameed, Sr. Scientific Officer, CDRI, NARC, Islamabad.	01.01.2004 to 30.09.2007	3.892	3377000/-	2526396/-
57	Component 3: Evaluation and incorporation of new genetic diversity in Pakistani wheats for stripe (yellow) rust resistance.	Dr. Iftikhar Ahmad, Dy. Director General, IPEP, NARC, Islamabad.	01.07.2003 to 30.06.2006	3.000	2092800/-	1744728/-
58	Component 4: Identification of sources of resistance to Karnal bunt disease of wheat.	Mr. Javed Iqbal Mirza, Sr. Scientific Officer, CDRP, NARC, Islamabad	01.07.2003 to 31.07.2007	2.540	2059000/-	1956941/-
59	Studies on Mycotoxins in Corn.	Dr. Yasmin Ahmad, PSO, IPEP, NARC, Islamabad	01.08.2003 to 30.06.2006	2.500	1720800/-	1579139/-
60	Introduction of Soft Fruit (strawberry, black berry, rasp berry, black currant) in the Potential Areas of Pakistan for Economic Returns.	Mr. Sudheer Tariq, Sr. Scientific Officer, IFHC, NARC, Islamabad.	01.07.2003 to 30.06.2006	4.000	3674200/-	3494648/-
61	Development of Heat Tolerant Wheat Varieties.	Dr. Muhammad Aqil, Director, Wheat Research Institute,	01.10.2003 to 30.09.2006	2.955	2157000/-	2063019/-

		AARI, Faisalabad.				
62	Development and Promotion of Improved Technology for Sorghum and Millet Production through Participatory Research in Dryland Areas of Pakistan and AJK.	Dr. Javed Fateh, SO, Maize, Sorghum & Millet, NARC, Islamabad	28.04.2004 to 30.04.2007	2.121	1380100/-	1380095/-
63	Development of Low Cost Plant Protection Technologies Through Integrated Pest Management Approaches and Use of Sacrificial Crop/ Plants in Sindh.	Dr. Abdul Sattar Buriro, Entomologist, ARI, Tandojam, Sindh	29.04.2004 to 28.04.2007	2.822	2505000/-	2490773/-
64	Utilization of Seaweeds in the Control of Soilborne Pathogens and Growth of Crop Plants	Dr. Viqar Sultana, Professor, Biogeochemistry University of Karachi.	01.01.2005 to 31.12.2007	1.780	1220150/-	1224410/-
65	Transgenic Tomato with Resistance to Bacterial Wilt	Dr. Zubaida Ch., SO, ABP, NARC, Islamabad	25.10.2004 to 24.10.2007	4.085	3724533/-	3616723/-
66	Studies on Monitoring of Contaminants in Exportable Food Commodities	Dr. Zahida Perveen, Sr. Scientific Officer SARC, Karachi.	01.01.2005 to 31.12.2007	4.997	3969900/-	3872645/-
67	Bread Wheat (T. aestivum L.) Improvement for Late Planting/Tterminal Stress and High Yield Potential.	Mr. Tila Muhammad PSO, NIFA, Tarnab, Peshawar	01.07.2004 to 30.06.2007	1.868	1690200/-	1575010/-
68	Increasing Oil Content in Sunflower Germplasm.	Mr. Makhdoom Hussain, Director, Oilseed Research Inst., AARI, Faisalabad	01.07.2005 to 30.06.2008	0.768	301500/-	301461/-
69	Developing Forage-Plus-Grain Winter Wheat Production System for the Northern Areas.	Dr. Iftikhar Hussain Khalil, Associate Professor, Dept. of PBG, NWFP Agri. University, Peshawar.	26.08.2004 to 30.09.2007	1.458	1192600/-	1192609/-
70	Enhancement and Evolution of Germplasm for Stressed Environment through the Use of Agro-biodiversity.	Dr. Shafqat Farooq Pr. Scientist, NIAB, Faisalabad	01.04.2004 to 30.04.2007	4.468	4334150/-	4308614/-
71	Development of High Yielding, Long Grain Varieties of Rice for Par Boiling Purpose.	Mr. Akbar Ali Cheema Deputy Chief Scientist NIAB, Faisalabad.	11.05.2004 to 30.04.2007	1.696	1647900/-	1639688/-

72	Management of Spider Mites on Apple	Dr. Inamullah Khan, Asstt. Prof., Dept. of Plant Protection, NWFP Agricultural University, Peshawar	30.08.2004 to 30.08.2007	1.408	1150800/-	1140427/-
73	Identification of Superior Soybean Cultivars for Different Agro-ecologies of Pakistan	Dr. Muhammad Ashraf, Sr. Scientific Officer, Oilseed Program, NARC, Islamabad	30.08.2004 to 30.06.2007	2.796	2772600/-	2716800/-
74	Management of Weeds in Wheat-Maize Cropping System in Barani Areas of Potohar (Component-I)	Dr. Tahira Z. Mahmood, Pr. Scientific Officer, IPEP, NARC, Islamabad	01.04.2004 to 30.06.2007	4.036	2777200/-	2744854/-
75	Integrated Weed Control for Major Crops (Wheat & Rapeseed) and Fallow Land in Pothwar (Component-II)	Prof. Dr. M. Azim Malik, Department of Agronomy, Pir Mehr Ali Shah Arid Agri. Uni., Rawalpindi	09.07.2004 to 30.06.2007	2.236	1708350/-	1543556/-
76	Integrated Weed Management in Wheat, Cotton, Rice and Pulses in Punjab (Comp.-III)	Mr. M. Sarfraz Iqbal, Director, Agronomic Research Institute, AARI, Faisalabad	30.08.2004 to 31.12.2007	2.120	1989300/-	1988648/-
77	Integrated Weed Control in Cereals (Wheat and Maize),(Component-IV)	Dr. Nasirudin, Director Crops Research Institute, Pirsabak, Nowshera	17.08.2004 to 30.06.2007	2.154	1133000/-	980131/-
78	Weed Management Studies of Wheat and Cotton Crops in Sindh (Component-V)	Mr. Allah Ditta Jarwar, Plant Physiologist, Agriculture Research Institute, Tandojam, Sindh.	13.05.2004 to 30.06.2007	2.154	1957546/-	1955794/-
79	Integrated Weed Management in Wheat and Vegetables (Onion & Tomato) (Component-VI)	Mr. Qazi Bashir Ahmed, Director, Agricultural Research Institute, Sariab, Quetta	28.07.2004 to 30.06.2007	2.154	1807745/-	1807316/-
80	Screening of Drought Tolerant Wheat Genotypes and Estimation of Genetic Basis	Dr. M. Munir, Prof., Department of PBG, Pir Mehr Ali Shah Arid Agri. Uni., Rawalpindi	01.07.2004 to 30.06.2007	1.967	1861000/-	1858605/-
81	Nematodes of Fruit and Vegetable Crops and Their Management in Karachi and Hyderabad Districts Using Plant Extracts	Dr. Aly Khan, CDRI, SARC, PARC, Karachi	01.01.2005 to 31.12.2007	2.641	2254500/-	2177530/-
82	Sustainable Cropping Patterns for Pothowar Plateau	Dr. Shahbaz Ahmad, Prof. of Agronomy, Pir Mehr Shah Arid Agri., Uni., Rawalpindi.	04.06.2003 to 03.06.2006	3.036	1957800/-	1892571/-

83	Assessment of Suitable Sealant Material (s) for Increasing the Gas-Tightness of Public Sector Warehouses and Tarpaulins used for Covering the Open-Stacks (Ganjees)	Syed Asim Rehan Kazami, Sr. Scientific Officer, GSRI, Southern Zone Agriculture Research Center (SARC), PARC, Karachi	17.05.2003 to 16.05.2006	5.258	1523000/-	1296289/-
84	Control of Phytopathogenic Microorganisms by Bacteriocins from Indigenous Strains	Dr. Sheikh Ijaz Rasool Senior Professor, Dep. of Microbiology, Uni. of Karachi, Karachi	29.07.2003 to 28.07.2006	2.133	2024500/-	2019623/-
85	Conservation and Sustainable Utilization of Agro-biodiversity of Under-utilized Crops	Dr. Zahoor Ahmad, Principal Scientific Officer, Plant Genetic Resources Institute (PGRI), NARC, Islamabad	17.03.2003 to 16.03.2006	1.896	1697698/-	1628248/-
86	Mutation breeding for High Grain Yield, Improved Quality and Earliness in Non-Aromatic Rice (*Oryza sativa L.*)	Abdul Wahid Baloch, Deputy Chief Scientist, NIA, Tandojam,	17.10.2003 to 16.10.2006	1.112	846000/-	846000/-
87	DNA-based Genetic Characterization of Cotton Germplasm. (Component-I)	Dr. Yusuf Zafar, Head, Plant Biotechnology Div., NIBGE, Fisalabad	02.12.2004 to 01.12.2007	4.384	2931442/-	2931442/-
88	Molecular Characterization of Available Germplasm of Wheat in Pakistan (Component-II)	Dr. Iftikhar Ahmad Khan, Prof./ Chairman, Dept. of Plant Breeding & Genetics, University of Agri., Faisalabad	02.12.2004 to 01.12.2007	5.230	4129373/-	3952031/-
89	Molecular Characterization of Rice Germplasm using RAPD Analysis (Comp. - III)	Dr. M. Ashiq Rabbani, Sr. Scientific Officer, PGRP, IABGR, NARC, Islamabad.	29.10.2004 to 28.10.2007	6.561	4188967/-	4188550/-
90	DNA Marker for Wilt (*Fusarium oxysporum*) Resistant Genes in Chickpea	Dr. Mohammad Saleem Asso. Prof., Plant Breeding and Genetics, Uni. of. Agriculture, Faisalabad	28.07.2004 to 27.07.2007	2.893	2838300/-	2821794/-
91	Introduction and Yield Improvement of Under-Exploited Pulses in NWFP	Mr. Mansoor Ahmad, Scientific Officer, Pulses, PARC, ARI, D. I. Khan	29.05.2004 to 28.05.2007	1.030	1023140/-	1024268/-
92	Mapping of Bacterial Diversity in Sindh Agricultural Fields and Deserts – A Molecular Level	Prof. Dr. Nuzhat Ahmad, Director, Center for Molecular Genetics, University of Karachi,	03.03.2005 to 02.03.2008	3.274	2382500/-	2549081/-

93	Better Utilization of Food for Healthy and Productive Life in Agriculture Sector	Dr. Alam Khan, Prof., Department of Human Nutrition, NWFP Agri. University, Peshawar	28.08.2004 to 27.08.2007	2.278	2277500/-	2276368/-
94	Studies on Resistance Monitoring and Insecticide Effects on Chrysopid Predators (Neuroptera)	Mr. Attaullah khan Pathan, Senior Scientific Officer/ Incharge, PARC-IPM Sub-Station, Multan	29.07.2004 to 28.07.2008	1.986	1891100/-	1868143/-
95	Characterization of Pakistani Isolates of Chili Veinal Mottle Potyvirus (ChiVMV) and Cucumber Mosaic Cucumovirus (CMV) Infecting Chili Crop	Mr. Hussain Shah, Scientific Officer, IPEP, NARC, Islamabad	27.09.2004 to 26.09.2007	2.933	1627500/-	1367747/-
96	Quality Characterization of Oilseed Crops Through NIRS	Mr. Iftikhar Ali, Principal Scientist, Nuclear Institute for Food & Agri. (NIFA), Tarnab, Peshawar	28.07.2004 to 27.07.2007	2.013	1762500/-	1746157/-
97	Use of RNA Interference for Genetically-Engineered Male Sterile Tomato Plants for Production of Hybrid Tomato	Dr. Shahid Mansoor, Pr. Scientist, Plant Biotechnology Division, (NIBGE), Faisalabad	28.01.2005 to 27.01.2008	3.223	1427000/-	1920649/-
98	Application of DNA Finger Printing for Drought Tolerance in Wheat	Dr. Mehboob-ur-Rehman, Sr. Scientist, Plant Biotechnology Division, NIBGE, Faisalabad	20.12.2004 to 19.12.2007	4.073	2275742/-	2275742/-
99	Evolution of Wheat Varieties for Low Water Requirements Using Conventional and Mutation Breeding Techniques	Mr. Mahboob Ali Sial, Principal Scientist, Nuclear Institute of Agriculture (NIA), Tandojam,	27.08.2004 to 26.08.2007	1.944	1479140/-	1314173/-
100	Development of Heat Tolerant, Early Maturing and High Yielding Mungbean (Vigna Radiata (L.) Wilczek) Genotypes	Dr. Gul Sanat Shah, Senior Scientists, Nuclear Institute for Food & Agriculture (NIFA), Peshawar	28.07.2004 to 27.07.2007	1.674	1494200/-	1482629/-
101	Development and Evaluation of a Mobile Flat-Bed Dryer for Sunflower and Canola	Dr. Munir Ahmad, PSO, Farm Machinery Institute (FMI), NARC, Islamabad	27.07.2004 to 26.07.2007	2.550	2330800/-	2166478/-
102	Studies on Breeding Biology and Post-Natal Development and Control Trails against	Syed Muzaffar Ahmed, Sr. Scientific Officer, Vertebrate Pest Control Research Institute ,	07.03.2005 to 06.03.2008	3.102	2621100/-	2520649/-

	Rodent Damaging Date-Palm Orchards of Tehsil Nok Kundi Distt: Chagai-Balochistan	SARC, PARC, Karachi				
103	Development of Integrated Pest Management of Subterranean Termits in Agro-Ecosystem	Dr. Sohail Ahmed, Asso. Prof., Dept. of Agri. Entomology, University of Agriculture, Faisalabad	27.07.2004 to 26.07.2007	2.431	1619000/-	1572131/-
104	Molecular Marker Facilitated Pyramiding of Bacterial Blight Resistance Genes in Super Basmati Rice	Dr. Muhammad Arif, Principal Scientist, Plant Biology Division, NIBGE, Faisalabad	16.08.2005 to 31.12.2008	3.458	3206600/-	2950501/-
105	Development and Testing of a Resource Conservation Tillage implement	Dr. Jehangir Khan Sial, Prof., Faculty of Agri. Engineering & Technology, Uni. of Agriculture, Faisalabad	30.10.2004 to 30.12.2007	1.910	1083825/-	801367/- (up to Dec. 2006)
106	Evaluation of Chickpea Germplasm Against Aggressive Isolates of *Ascochyta Rabiei* Identified by Biological And DNA Molecular Marker Techniques and Disease Management through Induced Systemic Resistance (ISR).	Dr. Nighat Sarwar, Principal Scientist, Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad.	25.07.2006 to 30.06.2009	3.909	2624200/-	2649842/-
107	Screening of Citrus Cultivars Grown in Pakistan Against Citrus Canker and its Management.	Dr. Shahbaz Talib Sahi, Associate Professor, Uni. of Agriculture, Faisalabad.	01.07.2006 to 30.06.2009	2.952	1577600/-	1053886/-
108	Characterization to Determine the Adaptive Role of Dehydrins under Drought Stress in Wheat *(Tritium aestivum)*	Dr. Rehana Asghar, Professor, PMAS Arid Agriculture University, Rawalpindi.	30.04.2006 to 29.04.2009	3.044	1987000/-	1916984/-
109	Sustainable Approaches Toward Adaptation of Sorghum and Millet Improved Varieties for Grain and Fodder Purpose in Rain Fed Areas of Kohat Division	Mr. Mirza Hassan, Research Officer, Barani Agricultural Research Station, Jarma, Kohat.	10.04.2006 to 31.03.2009	1.476	1251400/-	1214918/-
110	Integrated Control of Root Rot of Pepper in Peshawar and Malakand Divisions.	Dr Shaukat Hussain, Asso. Prof., Dept. of Plant Pathology, NWFP Agricultural University, Peshawar.	01.01.2007 to 31.12.2009	2.622	2066500/-	1953284/-
111	Genetic Biodiversity	Dr. Syed Asghar,	11.09.2007	1.495	233500/-	221850/-

	Improvement of Nuts (Almond and Walnut) in Fata	SRO (Horticulture), Agr. Research (FATA), Parachinar, Kurram Agency	to 30.06.2010			
112	Establishment of a System Based on HACCP Guidelines for Drying and Storage of Exportable Chilies to Control Aflatoxin Contamination (HRI, Mirpur Khas Component-II	Syed Mukhtar Ahmad Jafferi, Horticulture Research Institute, Mirpurkhas, Sindh.	14.07.2008 to 29.01.2010	2.382	505000/-	497000/-
113	Fabrication and Commercialization of a Gasifier (Operated with Crop Residues) for Sustainable Agriculture.	Dr. Manzoor Ahmad, Asso. Prof., Dept. of Farm Machinery and Power University of Agriculture, Faisalabad	01.07.2008 to 30.06.2010	2.119	1250700/-	822277/- (Upto June 2009)
114	Identification and Evaluation of *Gossypium arboreum* genes for Cotton Leaf Curl Virus Resistance	Dr. Aftab Bashir, Principle Scientist, Plant Bio Technology Div., NIBGE, Faisalabad.	01.07.2007 to 30.06.2010	4.273	3518200/-	3523285/-
115	Insecticide Resistance Management of Key Pests of Vegetable.	Dr. Mushtaq Ahmad Dy. Chief Scientist, Plant Protection Div., NIAB, Faisalabad.	01.07.2007 to 30.06.2010	2.293	1690000/-	1591113/-
116	Development of High Yielding and Powdery Mildew Resistant Varieties in Peas	Dr. Khalid Mahmood, Sc. Officer, Vegetable Res. Inst., AARI, Faisalabad.	01.07.2007 to 30.06.2010	1.474	1360000/-	1360425/-
117	Investigation of Viral Diseases of Sugarcane in Pakistan with Special Emphasis on Sugarcane Mosaic Virus (SCMV) Characterization and Identification of Resistant Sources.	Dr. Tahira Yasmin, Scentific Officer, CDRP, IPEP, NARC	01.07.2007 to 30.06.2010	5.436	3038000/-	2997424/-
118	Management of Date Palm Insect Pests in Sindh	Mr.Muhammad Usman Shar, Entomologist ARI, Tandojam	01.07.2007 to 30.06.2010	3.616	3291700/-	3261327/-
119	Survey of Midges and their Natural Enemies Associated with Mango to Develop Non-Pesticides Measures for their Control in Pakistan (ARI, Tandojam, Component-III)	Dr. Abdul Sattar Buriro, Entomologist, ARI, Tandojam, Sindh.	08.06.2007 to 30.06.2010	2.632	2415600/-	2355577/-

120	Survey of Midges and their Natural Enemies Associated with Mango and to Develop Non - Pesticides Measures for their Control in Pakistan (NARC, Islamabad, Component-II)	Dr. Ghulam Jilani Senior Director, IPEP NARC, Islamabad.	08.06.2007 to 30.06.2010	2.547	1725300/-	1306260/-
121	Survey of Midges and their Natural Enemies Associated with Mango and to Develop Non-Pesticides Measures for their Control in Pakistan (CABI, Rawalpindi, Component-I)	Mr. Riaz Mahmood Sr. Sc. Officer, CABI, Regional Biosciences Centre, Rawalpindi.	19.07.2007 to 30.07.2010	4.715	3575500/-	3335659/-
122	Development of Wheat Heat Tolerant Breeding Material During Grain Fill Period	Mr. Muhammad Ashraf Mian, Asst. Botanist, Barani Agri. Research Institute, Chakwal.	01.07.2007 to 30.06.2010	1.557	1490600/-	1490430/-
123	Sustainable Control Measures for Rose-Ringed Parakeet-*Psittacula krameri* on Maize, Citrus, Guava, Sunflower and Mango in Some Selected Agro-Ecosystems in Central Punjab	Dr. Hammad Ahmad Khan, Asstt. Professor, Department of Zoology and Fisheries, Uni. of Agri., Faisalabad.	01.07.2007 to 30.05.2010	1.629	1059800/-	1068417/-
Natural Resources:						
1	Soil Fertility Monitoring and Management in Cotton-Wheat System Productivity (NARC, Component-I)	Dr. A. Rashid, DG, NARC, Islamabad	24.04.2002 to 30.06.2006	2.700	2396400/-	2322664/-
2	Soil Fertility Monitoring and Management in Rice-Wheat System (NARC, Component-IV)	Dr. Fayyaz Hussain, Sr. Scientific Officer, LRRP, INRES, NARC, Islamabad	27.04.2002 to 30.06.2006	2.000	1911000/-	1886583/-
3	National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan-(NARC, Component-VII)	Mr. Banarus Hussain Niazi, Pr. Scientific Officer, LRRP, INRES, NARC, Islamabad	17.07.2003 to 30.06.2006	3.993	2899000/-	2704406/-
4	Increasing and Sustaining Crop Productivity of Water Eroded Lands through Rainwater	Dr. M. Shafiq, Pr. Scientific Officer, WRRP, NARC, Islamabad	27.07.2004 to 30.06.2007	7.500	4434000/-	3266743/-
5	Improving Root-association of	Mrs. Shahida Nasreen Khokhar, Sr. Scientific	27.07.2004 to	2.233	1953225/-	1934958/-

	Diazotrophs (Azorhizobium ssp, Azospirillum spp.) in Rainfed Wheat	Officer, Soil Bio. Lab. LRRP, INRES, NARC, Islamabad	30.06.2007			
6	Modeling Leaching Losses of Fertilizer Nutrients from Root-Zone and Environmental Implications	Dr. M. Mahmood-ul-Hassan, Sr. Scientific Officer, LRRP, INRES, NARC, Islamabad	17.07.2004 to 30.06.2007	2.409	1878250/-	1738438/-
7	Use of Nitrogen Fixing, Plant Growth Promoting Rhizobacteria (PGPR) for Development of Bio-Fertilizer for Crops of Economic Importance (Coordinated Project, NARC, Component - I)	Dr. Muhammad Aslam, Sr. Scientific Officer, Soil Biology & Biochemistry, LRRP, INRES, NARC, Islamabad	02.04.2005 to 01.04.2008	4.230	2397000/-	1552011/-
8	Nutrient Indexing and Integrated Nutrient Management for Sustaining Sugarcane Yields	Dr. Sagheer Ahmad, Sr. Scientific Officer, Sugar Crops Res. Program, CSI, NARC, Islamabad	25.03.2004 to 24.03.2008	5.800	5119200/-	5086113/-
9	Assessment of Productivity Potential and Utilization of Rangelands and Sown Pastures in Pothowar Plateau	Dr. Javed Afzal, Sr. Scientific Officer, Rangeland Res. Program, INRES, NARC, Islamabad	27.09.2004 to 30.06.2008	3.580	2717400/-	2665317/-
10	Assessment of Nutritional Potential and Performance of Range Species in Balochistan	Dr. Sarfraz Ahmad, Sr. Scientific Officer AZRC, Quetta	24.04.2002 to 30.06.2005	1.933	1542000/-	1529837/-
11	Soil Fertility Monitoring and Management in Dry land Cropping Systems of Balochistan (AZRC, Quetta, Component-III)	Mr. Ahmad Sami Ullah, Sr. Scientific Officer, AZRC, Quetta	02.05.2002 to 30.06.2005	1.150	1035500/-	1035940/-
12	Testing and Evaluation of Low-cost Lining Materials for Watercourse in Drought Endangered Areas of Balochistan	Mr. Nadeem Sadiq, Scientific Officer, AZRC, Quetta	01.09.2004 to 31.08.2007	2.776	1510200/-	1450000/-
13	Refinement of Skimming Well Design and Operational Strategies for Sustainable Groundwater Management	Dr. M. Ashraf, Director, Pakistan Council of Research in Water Resources, (PCRWR), Islamabad	05.05.2004 to 15.10.2007	2.100	1509000/-	1508799/-
14	Use of Low Quality Groundwater for Sustainable Crop	Dr. Ashfaq Ahmad Sheikh, Dy. Director PCRWR, Islamabad	05.05.2004 to 15.10.2007	1.700	1449800/-	1449039/-

	Production					
15	National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan (NIAB, Component-I)	Dr. Zahoor Aslam, Coordinator, Nuclear Institute for Agriculture & Biology, Faisalabad	06.09.2003 to 30.06.2006	4.017	1276000/-	1106153/-
16	Use of Nitrogen Fixing, Plant Growth Promoting Rhizobacteria (PGPR) for Development of Biofertilizer for Crops on Economic Importance (NIBGE, Component-II)	Dr. M. Sajjad Mirza, Principal Scientist, National Institute for Biotechnology and Genetic Engineering (NIBGE), Faisalabad	19.03.2005 to 18.03.2008	3.254	2500300/-	2451470/-
17	Determination of Growth, Wood Properties and Water Table Control Following Afforestation of Proven Provenances/Species Under Saline and Waterlogged Conditions in Pakistan	Mr. Muhammad Khan, Sr. Scientific Officer/ Geneticist, Pakistan Forest Institute, Peshawar	28.12.2004 to 27.12.2007	2.998	1606450/-	1597649/-
18	Recycling of Organic Wastes for Sustainable Crop Productivity (Uni. of Agri., Faisalabad, Component-I)	Dr. M. Arshad, Prof., Dept. of Soil & Env. Sciences, University of Agriculture, Faisalabad	13.04.2002 to 30.06.2005	2.013	1574500/-	1577070/-
19	National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan (Univ. of Agri. Faisalabad, Comp. - III)	Dr. Javid Akhtar, Asso. Prof., Dept. of Soil & Env. Sciences, University of Agriculture, Faisalabad	06.09.2003 to 30.06.2006	4.287	3254500/-	2747881/-
20	Sustainable Rice-Wheat Farming System on Salt-Affected Soils Using Brackish Water and Amendments	Dr. Ghulam Murtaza, Asso. Prof., Inst. of Soil & Env. Sciences, University of Agriculture, Faisalabad	19.07.2004 to 30.06.2007	2.923	2113300/-	2131076/-
21	Evaluation and Formulation of Calcium Carbide Based Soil Amendment for Improving Crop Production	Dr. M. Arshad, Prof., Inst. of Soil & Env. Sciences, University of Agriculture, Faisalabad	17.05.2004 to 16.05.2007	2.993	2031900/-	2018047/-
22	Management Aspects of Surface and Groundwater Resources for Irrigated Areas	Dr. Rai Niaz Ahmed, Asso. Prof., Water Mgt. Res. Centre, University of Agriculture, Faisalabad	29.05.2004 to 28.05.2007	2.534	1915500/-	1915253/-
23	Testing and Evaluation of Lining and Control	Dr. M. Rafiq Choudhry, Prof., Dept.	28.05.2004 to	4.128	2047600/-	1999999/-

	Structure Alternatives for Irrigation Channels	of Irri. & Drainage, Uni. of Agri. Faisalabad	27.05.2007			
24	Silicon Nutrition for Enhancing Crop Productivity	Dr. Rahmat Ullah, Asso. Prof., Inst. of Soil & Env. Sci., Uni. of Agri., Faisalabad	19.07.2004 to 30.06.2007	3.431	2235052/-	2209282/-
25	Management Strategies for Metal Contaminated Soils Receiving City Waste Effluent for Sustainable Crop Production and Food Security	Dr. Abdul Ghafoor, Prof., Inst. of Soil & Env. Sci. , University of Agriculture, Faisalabad	26.07.2005 to 31.12.2008	4.211	3393500/-	3360187/-
26	Recycling of Organic Wastes for Sustainable Crop Productivity (AAU, Rawalpindi, Component-II)	Dr. Mushtaq Ahmad Khan, Dean, Faculty. of Crops & Food, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi	25.04.2002 to 30.06.2005	1.642	1280000/-	1102593/-
27	Impact of Tillage Systems, Legume and Mulches on Soil Profile Moisture Dynamics and Wheat Production	Dr. Safdar Ali, Prof., Department of Soil Sciences & SWC, Pir Mehr Ali Shah, Arid Agriculture University, Rawalpindi	19.07.2005 to 30.06.2008	2.000	1310300/-	1249773/-
28	Diagnosis and Remedial Measures of Micro-Nutrient Deficiencies in Fruit Plants of Economic Importance in Pakistan (AARI, Faisalabad, Comp. - I)	Dr. M. Ibrahim, Agri. Chemist (Soils), Ayub Agricultural Research Institute, Faisalabad	13.04.2002 to 30.11.2006	2.337	1562500/-	1206595/-
29	National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan (Pindi Bhattian, Component-II)	Mr. Abdul Rasool Naseem, Agri. Chemist, Soil Salinity Research Institute, Pindi Bhattian	30.06.2003 to 30.06.2006	3.190	3060800/-	2816677/-
30	National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan (SALU, Khairpur, Comp. - IV)	Dr. A. Razak Mahar, Asso. Prof., Dept. of Botany, Shah Abdul Latif University, Khairpur,	04.09.2003 to 31.12.2006	3.513	3168937/-	3162294/-
31	Optimal Tillage Practices for Wheat-Fallow and Chickpea-Fallow Rotations in Southern NWFP	Dr. M. Jamal Khan, Prof./ Chairman, Dept. of Water Mgt., NWFP Agricultural University, Peshawar	13.04.2002 to 30.06.2005	2.500	2139000/-	2138624/-
32	Recycling of Organic Wastes for Sustainable Crop Productivity	Dr. Zahir Shah, Professor, Dept. of Soil & Env. Sci., NWFP	25.04.2002 to 30.06.2006	1.642	1652537/-	1625050/-

	(NWFP Agri. Uni. Peshawar, Comp.-III)	Agricultural University, Peshawar				
33	National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan (NWFP Agri. University, Peshawar, Component-V)	Dr. Izhar-ul-Haq, Prof., Dept. of Soil & Env. Sci., NWFP Agricultural University, Peshawar	26.07.2002 to 30.06.2006	3.094	2589400/-	2365118/-
34	Improving Yields and Nitrogen Use Efficiency in Cereal Based Cropping System	Dr. M. Tariq Jan, Prof., Dept. of Agronomy, NWFP Agricultural University, Peshawar	17.05.2004 to 16.05.2007	1.234	1005300/-	997384/-
35	Increasing Crops Production Through Humic Acid in Rainfed and Salt Affected Soils in Kohat Division (NWFP)	Dr. Riaz A. Khattak, Prof., Dept of Soil & Env. Sci., NWFP Agricultural University, Peshawar	28.10.2004 to 31.12.2007	4.179	3843300/-	3708743/-
36	Field Evaluation of Vesicular Arbuscular Mycorrhizal Fungi and Their Significance in Wheat-Maize Cropping System under Different Soil Series of NWFP	Dr. M. Sarirullah, Prof., Dept of Soil & Env. Sci., NWFP Agricultural University, Peshawar	20.12.2004 to 19.12.2007	1.411	1134171/-	1123554/-
37	Micronutrients Management in Apple and Citrus Orchards in Swat Valley	Dr. Zahir Shah, Prof., Dept of Soil & Env. Sci., NWFP Agri. University, Peshawar	22. 08. 2006 to 30. 06. 2009	3.829	3495700/-	3494528/-
38	Impact of Sewage Wastes (Effluent and Sludge) on Soil Properties and Quality of Vegetables	Dr. M. Qasim Khan, Prof., Dept. Soil Sci., Faculty of Agri., Gomal University, D. I. Khan	17.07.2003 to 30.06.2006	4.153	2936472/-	2890789/-
39	Improvement of Groundnut Production Through Rhizobial Inoculation in NWFP	Dr. Sabir H. Shah, Dir., Soil & Plant Nut., Agricultural Research Institute, Tarnab, Peshawar	22.05.2004 to 21.05.2007	1.701	1662200/-	1662114/-
40	Diagnosis and Remedial Measures of Micro-Nutrient Deficiencies in Fruit Plants of Economic Importance in Pakistan (ARI, Sariab, Quetta, Component –II)	Mr. M. Idris, Director, Water Management and High Efficiency Irrigation System, Agricultural Research Institute, Sariab, Quetta	31.03.2003 to 28.02.2007	1.563	715596/-	715596/-
41	National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan (AARI, Sariab, Quetta, Component-VI)	Mr. Shahjahan Khan, Dy. Dir., Soil Fertility, Agricultural Research Institute, Sariab, Quetta	28.08.2003 to 30.06.2006	2.930	1226000/-	1224903/-

42	Soil Fertility Monitoring and Management in Major Cropping Systems of AJK (AJK, Muzaffarabad, Component-II)	Dr. M. Bashir Butt, Soil Chemist, Dept. of Agriculture, Muzaffarabad, AJK	13.04.2002 to 30.06.2005	1.150	1129000/-	1112896/-
43	Studies on IPM with Reduced Chemical Beekeeping Approach to Avoid Related Treatment Resistance of Parasitic Mites, Honeybee Diseases and Pests	Dr. Elizabath Stephen Waghchoure, Sr. Scientific Officer, HBRP, NARC, Islamabad	07.11.2006 to 06.11. 2009	3.517	2818000/-	2747882/-
44	Determination of Soil Moisture Movement and Salinity Buildup Patterns under Different Sizes of Bid Furrow Irrigation Systems; Component-1 of Umbrella Project "Soil Salinity Monitoring under Various Resource Conservation Technologies (RCTS) Adopted in Various Agro-ecologies"	Mr. Muhammad Munir Ahmad, PSO, WRRI, NARC, Islamabad	20. 07. 2007 to 30. 06. 2010	3.049	1966400/-	1901812/-
45	Studies on Rice-Wheat Cropping System in Sheikhupura and Maize-Potato in Okara District; Component-II of Umbrella Project "Soil Salinity Monitoring Under Various Resource Conservation Technologies (RCTS) Adopted in Various Agro-ecologies"	Dr. Arshad Ali, Sr. Scientific Officer, LRRP, INRES, NARC, Islamabad	20. 07. 2007 to 30. 06. 2010	4.605	4111700/-	4015951/-
46	Management and Improvement Potential of Rangelands of Balochistan with Community Participation	Dr. Sarfraz Ahmad, Sr. Scientific Officer, AZRC, Quetta	23. 07. 2007 to 30. 06. 2010	5.303	3523000/-	3538201/-
Social Sciences:						
1	Application of Farm Planning Models to Analyze the Oilseed Crops at Regional and National Levels	Dr. Khalid Mahmood Aujla, Sr. Scientific Officer, SSD, PARC, Islamabad	02.09.2002 to 01.09. 2005	3.000	795000/-	781730/-
2	Structure, Conduct and	Dr. Ali Muhammad	18.04.2002	2.500	2095000/-	2126790/-

	Performance of the Marketing Systems, Margins and Seasonal Price Variation of Selected Fruits and Vegetables in Pakistan	Khushk, Sr. Scientific Officer, TTI, ARI, Tandojam	to 17.04.2004			
3	Determination of Profitability and Efficient Production Packages for Various Vegetables	Dr. Bashir Ahmad, Vice Chancellor, University of Agriculture, Faisalabad	03.04.2002 to 30.06.2006	2.500	1936500/-	1440711/-
4	Identification and Analysis of Technology Transfer for Sustained Growth in Agriculture as Used by Extension in Sindh, Pakistan	Dr. S. S. Bukhari, Professor, Dept. of Agri. Edu. Ext. & Short Courses, Sindh Agriculture University, Tandojam	01.01.2003 to 31.12.2005	0.500	276000/-	80000/-
5	WTO Trade Liberalization Move: Implication for Pakistan's Agriculture with Special Reference to Sustainable Development, Poverty Alleviation and Environmental Concern	Dr. Anwar F. Chishti, Professor, NWFP Agricultural University, Peshawar	03.04.2002 to 02.04.2005	3.000	2295500/-	2042818/-
6.	Farmer's Capacity Building Through Information Technology in Pakistan	Dr. M. Zakria Zakir, Chairman, Dept. of Sociology, Uni. of Punjab. Lahore	01.07.2004 to 30.06.2008	2.201	1218500/-	1223545/-
7	The Economic Valuation of Indus Delta Mangrove Ecosystem	Dr. Abida Tahirani, Director, Sindh Dev. Study Centre, Uni. of Sindh, Jamshoro	17.05.2002 to 16.05.2004	0.580	571000/-	592416/-
8	Structure, Conduct, and Performance of the Marketing System, Margins and Seasonal Price Variation of Selected Fruits and Vegetables in Balochistan, NWFP, Northern Areas and AJK	Dr. Muhammad Sharif, DDG (TT), Social Sciences Division, PARC, Islamabad	19.10.2004 to 31.12.2007	3.881	3043200/-	2113104/-
9	Socio-economic, Institutional and Policy issues Constraining the Productivity of Livestock in the Desert of Pakistan	Dr. Umar Farooq, Sr. Scientific Officer, Social Sciences Institute, NARC, Islamabad	01.10.2004 to 31.12.2007	3.770	1733325/-	874964/-
10	Poverty Alleviation through Increasing Agricultural Productivity by	Dr. A. D. Sheikh, Sr. Scientific Officer, TTI, PARC, Faisalabad	18.08.2004 to 17.08.2007	5.115	4369600/-	3458814/-

	Transferring Improved and Tested Technology at the Farm Level					
11	Enhancing Agricultural Productivity through Transfer of Demand Driven Technologies to the Farmers in the Selected Districts of Sindh	Mr. Manzoor Ali Memon, Sr. Scientific Officer, TTI, PARC, Tandojam	18.08.2004 to 17.08.2007	4.360	3996800/-	3884393/-
12	Poverty Alleviation through Enhancing Agricultural Productivity by Implementing Priority Interventions in the Selected Areas of NWFP	Mr. Muhammad Ishaq, Scientific Officer TTI, PARC, Tarnab, Peshawar	18.08.2004 to 17.08.2007	5.029	4251600/-	4094373/-
13	Poverty Alleviation through Introducing Improved and Tested Technologies for Rural Agricultural Farming Communities in the Selected Districts of Balochistan	Mr. Muhammad Afzal, Director, TTI, PARC, Quetta	28.08.2004 to 27.08.2007	4.822	3253200/-	2354739/-
14	Poverty Alleviation through Enhancing Agricultural Productivity by Implementing Priority Intervention in the Selected Areas of AJK	Mr. Ghulam Sadiq Afridi, Sr. Scientific Officer, TTI, PARC, Muzaffarabad, AJK	27.08.2004 to 26.08.2007	4.279	3020000/-	2646996/-
15	Development of Agriculture from Subsistence Level to Productive Level through Transfer of Tested Technology in the Northern Areas of Pakistan	Mr. Shaukat Hayat Sadozai, Director TTI, KARINA, Gilgit	18.08.2004 to 17.08.2007	3.926	3641300/-	3640243/-
16	Impact of Sanitary and Phytosanitary Agreement (SPS) on Agricultural Exports from Pakistan	Dr. Khalid Mustafa, Asso. Professor, Dept. of Agri. Maketing, Uni. of Agri., Faisalabad	17.03.2005 to 16.03.2007	1.438	911750/-	574388/-
17	Comparative Advantage and Competitiveness of Major Crops in Pakistan - Price Risk Analysis	Dr. M. Siddique Javed, Asso. Professor, Dept. of Agri. Economics, Uni., of Agri., Faisalabad	25.11.2005 to 30.06.2008	1.722	1084600/-	1020986/-
18	The Impact of Domestic Support to Punjab's	Mr. Qamar Mohy ud-Din, Asso. Prof.,	28.10.2004 to	1.565	988000/-	870730/-

	Agriculture under WTO Regime	Dept. of Agri. Marketing, Uni. of Agri., Faisalabad	27.10.2006			
19	Socio-economic and Health Implication of Female Unpaid Work in Agriculture and Livestock Sector: A Study of the Cropping Zones of Punjab	Dr. Muhammad Iqbal Zafar, Asso. Professor, Dept of Rural Sociology, Uni. of Agri., Faisalabad	04.10.2004 to 03.10.2007	1.155	1017500/-	426746/-
20	Strengthening of Design and Analysis Capabilities in the National Agricultural Research System	Dr. M. Inayat Khan, Professor/Chairman, Dept. of Mathematics & Statistics, Uni. of Agri., Faisalabad	28.08.2004 to 30.09.2009	2.833	1777400/-	1107702/-
21	Economic Analysis of agro-Forestry Plantation in Sindh Province of Pakistan	Dr. Heman Das Lohano, Asso. Prof. Dept. of Agriculture Economics., Sindh Agri. Uni., Tandojam	28.10.2004 to 27. 10. 2006	1.328	397911/-	339208/-
22	Extension Interventions through Public and Private Sector in Agriculture of Balochistan	Syed Muhammad Arif, Associate Professor Dept. of Economics, Uni. of Balochistan, Quetta	13.09.2005 to 31.12.2007	1.865	1209000/-	1021859/-
23	Bridging the Gender Gap in Agri. Extension through Designing and Testing an Innovative and Holistic Out-Reach (Extension) Program of the University of Agriculture, Faisalabad	Dr. Tanvir Ali, Director, Department of Agriculture, University of Agriculture, Faisalabad	17.05.2005 to 16.03.2008	2.193	6394000/-	1440142/-
24	The WTO Agreement and its Impacts on the Farm Sector with Emphasis on Small and Landless Holders	Prof. Dr. Sarfraz Ahmad, Prof./Ch., Dept. of Agri. Eco. & Sociology, PMAS Arid Agriculture University, Rawalpindi	26.08.2005 to 30.06.2009	1.621	5870000/-	1141000/-
25	Human Resources Development (HRD) in the Changing Environment of Globalization – Collaboration with APO.	Dr. Abdul Hayee Qureshi, Sr. Scientific Officer, Social Sciences Division, PARC, Islamabad	27.04.2005 to 30.06.2009	4.735	8523000	4493941/-

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26.	Income Generation through Integration of National Agricultural Research System' (NARS) Technologies and Community Participation in District Lahore	Dr. Rozina Tufail, General Secretary, Green Biotechnology Management Society, Lahore	07.11.2006 to 30.04.2009	5.778	7 4 2 5 0 0 /-	1713000/-
27.	Economic Analysis of Intercropping in Sugarcane in Sindh: Implications for Research and Extension	Dr. Ali Muhammad Khuskh, Director, TTI-PARC, Tandojam	25.08.2008 to 24.08.2011	1.953	1898000/-	1897378/-

Annexure-II

List of On-Going ALP Project as on January 1, 2011:

(Rs.)

S. No	Name of Project	PI/Institute	Duration	Total Cost (million)	Release (30.06.2010)	Expdt. (30.06.2010)
Animal Sciences:						
1	Pond Culture and Reproductive Performance of Seengharee *Aorichthys aor* (Hamilton 1822)	Mr. Muhammad Ramzan Ali, Sr. Scientific Officer, Aquaculture and Fisheries, NARC, Islamabad	22.08.2008 to 30.06.2011	5.628	3318700/-	3334598/-
2	Phenotypic and Genetic Characterization of Indigenous Breeds of Caprine and Ovine Species in Punjab	Dr. Khalid Javed, Associate Professor, University of Vet. and Animal Sciences, Lahore	28.07.2008 to 27.07.2011	5.061	3560200/-	3371285/-
3	Identification of Molecular Markers for Fecundity in Goats Breeds of Pakistan	Dr. Manzoor Ellahi Babar, Professor, University of Vet. and Animal Sciences, Lahore	24.07.2008 to 30.06.2011	7.080	5347900/-	5288900/-
4	Production of genetically superior breeding bulls of kundhi buffalo breed in Sindh province.	Mr. Mashook Ali Bhutto, President Livestock Development Foundation, Shahzad Town, Islamabad	27-01-2010 to 26-01-2013	9.414	1551000/-	1244000/-
5.	Angora Rabbit Farming as High Value Livelihood Source for Pakistani Women	Nustrat Batool Director, Benazir Bhutto Directorate of Cottage Industry & Livelihood, PARC, islamabad	18.01.2010 to 17.01.2013	4.568	896000/-	350000/-
Crop Sciences:						
1	Evaluation of Sugarcane Gemrplasm for Frost Tolerance; A Component of the Coordinated Project "Screening of Sugarcane Germplasm and Use of Induced Mutation/Callus for Frost Tolerance, High Cane and Sugar Yield" (NARC, Islamabad, Component-I)	Dr. Muhammad Zubair, PSO/Coordinator, Sugar Crops Research Program, CSI, NARC, Islamabad.	01.07.2008 to 30.06.2011	3.528	1649865/-	1648840/-
2	Screening of Sugarcane (*Saccharum officinarum* L.) Germplasm and use of Induced Mutations	Mr. Roshan Zamir, Principal Scientists, Nuclear Institute for Food and Agriculture	01.07.2008 to 30.06.2011	2.853	2115700/-	2071777/-

	for Frost Tolerance, High Cane and Sugar Yield; A Component of the Coordinated Project "Screening of Sugarcane Germplasm and Use of Induced Mutation/ Callus Culture for Frost Tolerance, High Cane and sugar Yield (NIFA, Peshawar Component-II)	Peshawar.				
3	Screening of Sugarcane *(Saccharum officinarum* L.) Germplasm for Frost Tolerance, High Cane & Sugar Yield; A Component of Coordinated Project "Screening of Germplasm and use of Induced Mutation/Callus for Frost Tolerance, High Cane and Sugar Yield. (SCRI, Mardan, Component-III).	Mr. Sartaj Ali, Research Officer, Sugar Crops Research Institute, Mardan	01.07.2008 to 30.06.2011	2.539	1764400/-	1030553/-
4	Enhance the Cane Yield, Sucrose Contents and Frost Tolerance of Genotypes using Callus Culture; A Component of the Coordinated Project "Screening of Sugarcane Germplasm and use of Induced Mutation/Callus for Frost Tolerance, High Cane and Sugar Yield" (SSRI, Jhang, Component-IV)	Dr. Shahid Afghan, Director Research, Shakarganj Sugar Research Institute, Jhang.	01.07.2008 to 30.06.2011	0.785	415000/-	375404/-
5	Use of Spectral Reflectance to Estimate Growth, Biomass and Yield of Different Wheat Cultivars under Moisture Stress Conditions	Dr. Ashfaq Ahmad, Associate Professor, Department of Agronomy, University of Agriculture, Faisalabad.	01.07.2008 to 30.06.2011	3.713	1740900/-	1593628/-
6	To Determine the Optimum Maturity Indices of Various Mango Varieties (Langra, Dusehri, and Samar Bahisht) to Enhance Export and	Mr. Abdul Rahim Khan, Assistant Research Officer, Post Harvest Research Center, Ayub Agricultural Research Institute, Faisalabad.	01.07.2008 to 30.06.2011	3.947	2928900/-	2926503/-

	Minimize Post Harvest Losses					
7	Investigations on Pesticide Residues in Fruits and Vegetables Grown under Agro Climatic Conditions of NWFP.	Dr. Barkat Ali Khan, Senior Research Officer, Agricultural Research Institute, Tarnab, Peshawar.	01.07.2008 to 30.06.2011	5.441	4382400/-	3403545/-
8	Enhancement of Quality and Storage Stability of Dhakki Dates using Advanced Technology	Dr. Shahzada Arshad Saleem, Post Harvest Technologist, ARI, D. I. Khan	01.07.2007 to 30.06.2011	4.099	3732100/-	3730624/-
9	Development of Salt Tolerance in Sugarcane through Genetic Engineering	Mr. Ikram-ul-Haq, Lecturer, Institute of Biotechnology and Genetic Engineering, University of Sindh, Jamshoro	01.07.2008 to 30.06.2011	2.707	2024100/-	1866291/-
10	Establishment of a System Based on HACCP Guidelines for Drying and Storage of Exportable Chilies to Control Aflatoxin Contamination (SARC, Karachi-Component-I)	Dr. Mubarik Ahmed, PSO/Director, Grain Storage Research Institute, SARC, PARC, Karachi.	01.07.2008 to 30.06.2011	6.429	3199700/-	2395380/-
11	Evaluation of Commercial Potential of Sugar beet Genotypes for their Adaptability in Different Ecologies of Pakistan (Coordinating Unit-NARC, Islamabad)	Dr. Muhammad Zubair, Pr. Scientific Officer/ Coordinator, Sugar Crop Research Program, CSI, NARC, Islamabad	01.07.2008 to 30.06.2011	0.924	262700/-	310840/-
12	Evaluation of Sugar beet Genotypes for their Adaptability under Different Soil and Environmental Conditions of Punjab (NARC, Islamabad - Component-I)	Dr. Sagheer Ahmad, Sr. Scientific Officer, Sugar Crops Research Program, CSI, NARC, Islamabad	01.07.2008 to 30.06.2011	2.426	2835700	2747232/-
13	Testing of Adaptability of Different Sugar beet Genotypes and their Agronomic Management in NWFP (Al-Moiz, D. I. Khan,-Component-II)	Mr. Karim Bakhsh Malik, Advisor R & D, Al-Moiz Industries Ltd, Chashma Road, D.I. Khan	01.07-2008 to 30.06.2011	2.962	1319900/-	1498788/-
14	Introduction of Sugar beet as a Sugar Crop in Lower Sindh (NSCRI, Thatta, Sindh-	Mr. Ghulam Mohyudin Kaloi, Sc. Officer, National Sugar Crops Research Institute,	01.07.2008 to 30.06.2011	2.454	1671900/-	1635000/-

	Component-III)	PARC, Thatta, Sindh				
15	Phenotypic Plasticity of Safflower (*Carthamus tinctorius)* in response to Environment and Integrated Nutrient Management	Dr. Fayyaz-ul-Hassan Associate Professor, Dept. of Agronomy, PMAS Arid Agri., University, Rawalpindi	01.07.2008 to 30.06.2011	1.913	1191000/-	1176226/-
16	Development of Small Scale Bone-Fertilizer Plant.	Mr. Zulfiqar Ali Senior Engineer, ABEI, NARC, Islamabad	01.09.2010 to 31.08.2013	4.661		
17	Development of Mechanized Multipurpose Nursery Raising Facility at NARC, Islamabad	Mr. Shabbir Ahmad Kalwar, PSO/ Principal Engineer, ABEI, NARC, Islamabad	01.09.2010 to 31.08.2013	39.000		
Natural Resources:						
1	Evaluation of Nitrification Inhibitors for Reducing Nitrogen Loss under Irrigated Cotton-Wheat System using ^{15}N-Balance Technique	Dr. Tariq Mahmood, Principal Scientist, Soil Biology & Plant Nutrition Division, NIAB, Faisalabad	28. 07. 2008 to 30. 06. 2011	5.557	3839300/-	3757480/-
2	Enhancing Stone Fruits (Peach, Plum and Apricot) Orchards Productivity through Integrated Nutrients (NPK) Management; A Component of the Coordinated Project "Stone Fruits Productivity Enhancement through Appropriate Nutrient Management"	S. Mahmood Shah, Dy. Chief Scientist, Soil Science Division, NIFA, Peshawar	28. 07. 2008 to 30. 06. 2011	4.743	2766700/-	2677320/-
3	Assessment of Toxic Metals in Agriculture Products and their Relation with Nutritional Status in NWFP-Pakistan	Dr. Ihsanullah, Dy. Chief Scientist, Food Science Division, NIFA, Peshawar	28. 07. 2008 to 30. 06. 2011	2.926	1919800/-	1862277/-
4	Microbial ACC-deamnise Biotechnology for Sustainable Production of Legumes	Dr. Zahir Ahmad Zahir, Asso. Prof., Inst. of Soil & Envi. Sc., Uni. of Agri., Faisalabad	22.08.2008 to 30. 06. 2011	4.289	2911500/-	2889478/-

5	Carbon Sequestration through Tillage, Organic Matter and Mulch: Managing the Soil Quality for Sustainable Crop Production	Dr. Anwar-ul-Hassan, Prof., Inst. of Soil & Envi. Sc., Uni. of Agri., Faisalabad	22. 08. 2008 to 30. 06. 2011	4.881	2179000/-	2012456/-
6	Diagnosis and Control of Leaf Reddening in Cotton	Dr. Jawed Akhtar Memon, Agri. Chemist (Soil Fertility), ARI, Tandojam	24. 07. 2008 to 30. 06. 2011	3.643	1508000/-	1466091/-
7	Micronutrient Studies on Stone Fruit Orchards in Peshawar Valley; A Component of Coordinated Project "Stone Fruit Productivity Enhancement through Appropriate Nutrient Management"	Mr. Mir Abbas Khattak, Agricultural Chemist (Soil), ARI, Tarnab, Peshawar	29. 01. 2009 to 30. 06. 2011	3.166	1876300/-	1865032/-
8	Effect of Different Irrigation Intervals and Mulching Materials on the Growth, Yield and Quality of Onion under Agro Climatic Conditions of Southern Regions (NWFP)	Mr. Muhammad Suleman, Asstt. Vegetable Botanist, ARS, Karak	28. 07. 2008 to 30. 06. 2011	3.554	1199000/-	1194618/-
9	Micronutrient Studies on Stone Fruit Orchards in Balochistan; A Component of the Coordinated Project "Stone Fruits Productivity Enhancement through Appropriate Nutrient Management"	Mr. M. Nasim, Horticulturist, ARI, Sariab, Quetta	24. 07. 2008 to 30. 06. 2011	2.126	1305000/-	1304103/-
10	Centre Pivot Irrigation System for Enhancing Water Productivity of Seed Multiplication System and Crop Production Systems (WRRI, NARC, Islamabad Component-I)	Mr. Asaf Ali Bhatti, PSO, Water Resources Research Institute, WRRI, NARC, Islamabad	01.03.2010 to 28.02.2013	8.386	1463000/-	219193/-
11	Centre Pivot Irrigation System for Enhancing Water Productivity of Seed Multiplication System and Crop Production Systems (FO&S, NARC, Islamabad Component-II)	Mr. Talat Farid Ahmed, Sr. Engineer, FO & S, NARC, Islamabad	01.03.2010 to 28.02.2013	21.231	319000/-	29993/-

12	Centre Pivot Irrigation System for Enhancing Water Productivity of Seed Multiplication System and Crop Production Systems (AZRI, Bahawalpur Component-III)	Dr. Rukhsana Anjum, PSO, Arid Zone Research Institute - PARC, Bahawalpur	01.03.2010 to 28.02.2013	8.639	302000/-	-
13	Centre Pivot Irrigation System for Enhancing Water Productivity of Seed Multiplication System and Crop Production Systems (WRRI Field Station, Thana Bula Khan, Hyderabad, Sindh Component-IV)	Mr. Abdul Ghani Soomro, SO, Water Resources Research Institute (WRRI), Field Station - PARC, Thana Boula Khan, Hyderabad	01.03.2010 to 28.02.2013	18.884	414000/-	324701/-
14	Centre Pivot Irrigation System for Enhancing Water Productivity of Seed Multiplication System and Crop Production Systems (AZRC, Quetta Component-V)	Dr. Basharat Hussain, SSO, Arid Zone Research Centre - PARC, Quetta	01.03.2010 to 28.02.2013	8.432	340000/-	278000/-
15	Centre Pivot Irrigation System for Enhancing Water Productivity of Seed Multiplication System and Crop Production Systems. (AZRI, D. I. Khan, Component-VI)	Mr. Noman Latif, SSO, Arid Zone Research Institute - PARC, Ratta Kulachi, D. I. Khan	01.03.2010 to 28.02.2013	8.689	346000/-	244893/-
16	Use of Alternate Energy Sources for Pumping Water in Agriculture (WRRI, NARC, Islamabad Component-I)	Mr. Abdul Wahab Siyal, Asstt. Agri. Engineer, WRRI, NARC, Islamabad	01.03.2010 to 28.02.2013	10.414	2608000/-	1631520/-
17	Use of Alternate Energy Sources for Pumping Water in Agriculture (AZRC, Bahawalpur, Component-II)	Dr. Rukhsana Anjum, Director, AZRI - PARC Bahawalpur	01.03.2010 to 28.02.2013	6.912	1257000/-	-
18	Use of Alternate Energy Sources for Pumping Water in Agriculture (AZRC, D. I. Khan Component-III)	Mr. Noman Latif SSO, AZRI - PARC, D. I. Khan	01.03.2010 to 28.02.2013	7.176	1257000/-	569596/-
19	Use of Alternate Energy Sources for Pumping Water in Agriculture (AZRI, Umerkot,	Dr. Hamaz Ali Samoon, Asstt. Engineer, AZRI - PARC,	01.03.2010 to 28.02.2013	4.980	1661000/-	202596/-

	Component-IV)	Umerkot				
20	Solubility Enhancement of Phosphorus from Rock Phosphate (NARC, Islamabad, Component-I)	Mr. Matiullah Khan SSO, WRRI, NARC, Islamabad	08.01.2010 to 07.01.2013	5.749	1729000/-	906652/-
21	Solubility Enhancement of Phosphorus from Rock Phosphate (KPK Agricultural University, Peshawar, Component-II)	Dr. Muhammad Sharif Professor, Department of Soil and Environmental Sciences, KPK Agri. Uni. Peshawar	08.01.2010 to 07.01.2013	3.867	1227000/-	1114580/-
22	To Improve the Palatability and Nutritive Value of Comparatively Low Palatable Forage Species	Dr. Imtiaz Ahmad Qamar, SSO, Rangeland Research Institute, NARC, Islamabad	18.01.2010 to 17.01.2013	7.140	1410000/-	938865/-
23	Seed Production of Multi-purpose Trees and Forage Species (RRI-NARC, Islamabad Component-I)	Dr. Javed Afzal, SSO Rangeland Research Institute, NARC, Islamabad	02.02.2010 to 01.02.2013	3.242	761000/-	640314/-
24	Seed Production of Multi-purpose Trees and Forage Species (MARC, PARC, Gilgit Component-II)	Mr. Munir Hussain, SSO, Mountain Agricultural Research Centre (MARC) - PARC, Gilgit	02-02-2010 to 01-02-2013	1.320	213000/-	206560/-
25	Seed Production of Multi-purpose Trees and Forage Species (AZRC-Quetta Component-III)	Mr. Muhammad Afzal, SSO, Arid Zone Research Centre - PARC, Quetta	02.02.2010 to 01.02.2013	1.320	213000/-	185535/-
26	Seed Production of Multi-purpose Trees and Forage Species (AZRI, Bahawalpur Component-IV)	Malik Muhammad Yousaf, SSO, Arid Zone Research Institute - PARC, Bahawalpur	02.02.2010 to 01.02.2013	1.320	213000/-	70000/-
27	Seed Production of Multi-purpose Trees and Forage Species (AZRI, D. I. Khan Component-V)	Mr. Aman Ullah Khan, SSO, Arid Zone Research Institute - PARC, D. I. Khan	02.02.2010 to 01.02.2013	1.320	213000/-	187898/-
28	Seed Production of Multi-purpose Trees and Forage Species (AZRI, Umerkot Sindh Component-VI)	Mr. Ghulam Shabbir Bohio, PSO, Arid Zone Research Centre (AZRI), Umerkot	02.02.2010 to 01.02.2013	1.320	213000/-	97370/-
29	Management of Rawal Watershed under Changing Landuse	Mr. Muhammad Saleem Pomee, Scientific Officer, WRRI, NARC, Park	28.09.2010 to 27.09.2013	21.722	1945600/- (Upto Dec. 31, 2010)	

		Road, Islamabad.				
30	Commercialization of Biofertilizer (inoculant) for Important Crops	Dr. Muhammad Aslam, PSO, Soil Biology, LRRI, NARC, Islamabad	25.10.2010 to 24.10.2013	10.818	4465500/- (Upto Dec 31, 2010)	
31	Formulation and Quality Improvement of Biofertlizer (inoculants) for Crop Production	Dr. Tariq Sultan, SSO, Soil Biology, LRRI, Islamabad	27.10.2010 to 26.10.2013	9.988	4756500/- (Upto Dec 31, 2010)	
Social Sciences						
1.	Model Women Network of Livestock Farmers for Poverty Reduction	Hamida Masood Shah, Director, Gender & Social Development, PARC, Islamabad	18.01.2010 to 17.01.2013	7.933	2347000/-	450424/-
2	Establishment of Milk Cooperative Marketing System in Tehsil Fateh Jang	Mr. Noor Ul Hassan Tehseen, General Manager, IDARA-E-KISAN, Lahore Milk Plant, Lahore	01.09.2010 to 31.08.2013	27.100	10060000 (Upto Dec. 31, 2010)	*5447000/-*