Introduction

The Government of Pakistan has established an Agricultural Research Endowment Fund (AREF) in 1999 for Rs.1.3 billion under Agricultural Linkages Program (ALP) with the assistance of USA. The ALP fund is being utilized by Pakistan Agricultural Research Council (PARC) for operating agricultural research and innovation through competitive grant mechanism. PARC being the apex research organization at national level has been implementing the program. The Planning Directorate which was declared to perform the functions of ALP Secretariat, is launching the program from processing & approval to the completion stage of projects. Since its initiation, the ALP Secretariat has implemented projects in three batches, in priority areas on competitive basis, in various research centers/institutes, organizations and universities.

The ALP projects covers plant sciences, natural resources, animal sciences and social sciences sectors. In total 216 projects have been completed by December 31, 2008, whereas 65 were in operation as on January 1, 2009. The sector wise numbers of projects completed by December 31, 2008 in various research institutes and universities are as follows:

Completed Projects by December 31, 2008:

S.No	*Name of Institutions*	*No of Projects*				*Total*
		Animal Sciences	*Crop Sciences*	*Natural Resources*	*Social Sciences*	
Federal						
1	PARC/NARC, Islamabad	***11***	***31***	***09***	***04***	***55***
2	AZRC-PARC, Quetta	-	-	***03***	-	***03***
3	PCRWR, Islamabad	-	-	***02***	-	***02***
4	NIAB, Faisalabad	-	***03***	***01***	-	***04***
5	NIBGE, Faisalabad	***02***	***04***	***01***	-	***07***
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	-	-	-	***02***	***02***
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	-	***02***	-	-	***02***
	Total	***16***	***55***	***17***	***11***	***99***
Punjab						
18	University of Agriculture, Faisalabad	***12***	***11***	***08***	***07***	***38***
19	PMAS Arid Agri. Uni., Rawalpindi	-	***02***	***02***	***01***	***05***
20	UVAS, Lahore	***05***	-	-	-	***05***
21	AARI, Faisalabad	-	***05***	***01***	-	***06***
22	RRI, Kala Shah Kaku	-	*01*	-	-	*01*
23	BARI, Chakwal	-	***02***	-	-	***02***

24	SSRI, Pindi Bhattain	***-***	***-***	***01***	***-***	***01***
25	LPRI, Bahadurnagar, Okara	***01***	***-***	***-***	***-***	***01***
26	Fisheries Hatchery, Govt. of Punjab, Rawal Town, Islamabad	***01***	***-***	***-***	***-***	***01***
27	University of Punjab, Lahore	***-***	***-***	***-***	***1***	***01***
28	B.Z.U., Multan	***-***	***02***	***-***	***-***	***02***
	Total	***19***	***22***	***12***	***10***	***63***
Sindh						
29	Shah Abdul Latif Uni., Khairpur	***-***	***-***	***01***	***-***	***01***
30	University of Karachi, Karachi	***03***	***05***	***-***	***-***	***08***
31	Sindh Agri. University, Tandojam	***01***	***-***	***-***	***02***	***03***
32	ARI, Tandojam	***-***	***02***	***-***	***-***	***02***
33	Kundi Buffalos Farm, Rohri	***01***	***-***	***-***	***-***	***01***
34	Indus Dev. Resource Centre, Sehwan Sharif, Sindh	***01***	***-***	***-***	***-***	***01***
35	University of Sindh, Jamshoro	***-***	***-***	***-***	***01***	***01***
	Total	***06***	***07***	***01***	***03***	***17***
NWFP						
36	NWFP Agri. University, Peshawar	***03***	***08***	***06***	***01***	***18***
37	Gomal University, D. I. Khan	***-***	***02***	***01***	***-***	***03***
38	ARI, Tarnab, Peshawar	***-***	***02***	***01***	***-***	***03***
39	ARS, Mangora, Swat	***-***	***01***	***-***	***-***	***01***
40	CCRI, Pirsabak	***-***	***01***	***-***	***-***	***01***
41	VRI, Peshawar	***02***	***-***	***-***	***-***	***02***
42	ARI, D. I. Khan	***-***	***01***	***-***	***-***	***01***
	Total	***05***	***15***	***08***	***01***	***29***
Balochistan						
43	ARI, Sariab, Quetta	***-***	***03***	***-***	***-***	***05***
44	University of Balochistan, Quetta	***-***	***01***	***02***	***01***	***02***
	Total	***-***	***04***	***02***	***01***	***07***
Azad Jumma & Kashmir						
45	Agri. Department, Muzaffarabad	***-***	***-***	***01***	***-***	***01***
	Total	***-***	***-***	***01***	***-***	***01***
	Grand Total	**46**	**104**	**41**	**25**	**216**

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, 2009

S.No	***Name of Institutions***	***No of Projects***				***Total***
		Animal Sciences	***Crop Sciences***	***Natural Resources***	***Social Sciences***	
Federal						
1	PARC/NARC, Islamabad	***03***	***05***	***03***	***-***	***11***
2	AZRC-PARC, Quetta	***01***	***-***	***01***	***-***	***02***
3	NIAB, Faisalabad	***-***	***02***	***01***	***-***	***03***
4	NIBGE, Faisalabad	***-***	***01***	***-***	***-***	***01***
5	NIFA, Peshawar	***-***	***01***	***02***	***-***	***03***
6	SARC-PARC, Karachi	***-***	***01***	***-***	***-***	***01***

7	NSCRI-PARC, Thatta	***-***	***01***	***-***	***-***	***01***
8	TTI-PARC, Tandojam	***-***	***-***	***-***	***01***	***01***
9.	CABI Bio Sciences, Rawalpindi	***-***	***01***	***-***	***-***	***01***
	Total	***04***	***12***	***07***	***01***	***24***
Punjab						
10	University of Agriculture, Faisalabad	***05***	***04***	***02***	***-***	***11***
11	PMAS Arid Agri. Uni., Rawalpindi	***-***	***02***	***-***	***-***	***02***
12	UVAS, Lahore	***04***	***-***	***-***	***-***	***04***
13	AARI, Faisalabad	***-***	***02***	***-***	***-***	***02***
14	BARI, Chakwal	***-***	***01***	***-***	***-***	***01***
15	Shakar Ganj Sugar Res. Inst., Jhang	***-***	***01***	***-***	***-***	***01***
16	Green Bio Tech., Lahore	***-***	***-***	***-***	***01***	***01***
	Total	***09***	***10***	***02***	***01***	***22***
Sindh						
17	University of Sindh, Jamshoro	***01***	***01***	***-***	***-***	***02***
18	ARI, Tandojam	***-***	***02***	***01***	***-***	***03***
19	SHRI, Mir Pur	***-***	***01***	***-***	***-***	***01***
	Total	***01***	***04***	***01***	***-***	***06***
NWFP						
20	NWFP Agri. University, Peshawar	***-***	***01***	***01***	***-***	***02***
21	ARI, Tarnab, Peshawar	***-***	***01***	***01***	***-***	***02***
22	ARI, D. I. Khan	***-***	***01***	***-***	***-***	***01***
23	ARS, Kohat	***-***	***01***	***-***	***-***	***01***
24	ARS, Karak	***-***	***-***	***01***	***-***	***01***
25	Sugar Crop Res. Inst. Mardan	***-***	***01***	***-***	***-***	***01***
26	Al-Moiz Indus. D. I. Khan	***-***	***01***	***-***	***-***	***01***
	Total	***-***	***06***	***03***	***-***	***09***
Balochistan						
27	ARI, Sariab, Quetta	***-***	***-***	***01***	***-***	***01***
28	University of Balochistan, Quetta	***02***	***-***	***-***	***-***	***02***
	Total	***02***	***-***	***01***	***-***	***03***
FATA						
29	Agri. Research (FATA), Parachinnar, Kurram Agency	***-***	***01***	***-***	***-***	***01***
	Total	***-***	***01***	***-***	***-***	***01***
	Grand Total	**16**	**33**	**14**	**02**	**65**

The list of ongoing projects which remain in operation as on January 1, 2009 is given at Annexure-II. The progress of ongoing projects of implemented during 2007-08 is extracted from various mid year and annual technical progress reports. The progress shows both financial and technical information of the projects. The report will be useful for future reference and record.

Summary

The ALP research projects are funded for three years for conducting scientific and research activities related to agriculture including production, processing, marketing and agricultural services.

Research areas covered under completed projects were: wheat diseases, control measures of damage/losses by porcupines, wheat varieties improvement, management of fruit plants, nematodes management, maize technology improvement weed management studies, production of doubled haploids of wheat, hybrid seed production and incorporation of resistance fine rice in varieties, ground nut varietal improvement, management of citrus decline and die back, evaluation of walnut germplasm, wheat breeding for drought stress and Zn efficiency, development of botanical pesticides, weed management through allelopathic crops development of nitrogen fixing rhizoid and mass production of bio-control agents for field application. Major output/outcomes of the projects are;

Nine different organic substrates were used for mass multiplication of bio control agents. Grains were generally found more suitable for multiplication of bio control agents. Dextrose and sucrose were found to be the most suitable carbon sources. Amendment of selected C and N sources to organic substrates resulted in great growth and significantly higher population than the organic substrates alone.

Scientists are in a position to undertake control trials under real conditions (godowns) at larger scale to authenticate the results and further improve IPM based control of stored grain pests by using bio-pesticides.

Eight rice hybrids have been developed and evaluated for yield and grain quality characteristics. LH-69, LH72, LH-76, LH-64 and LH-39 are the potential two line rice hybrids having better quality and agronomic characters than the approved check variety. Among three line hybrids, LH-1, LH-18 and LH-19 selected for large scale testing and these hybrids can be approved for general cultivation.

Three promising Groundnut lines/varieties were evaluated for their yield potential under different ecological zones. New promising line 2KCG020 gave higher yield as compared to two approved varieties; Golden and BARI-2000 sown at 7 different locations with average yield 2595 kg/ha, followed by approved varieties having yields Golden 2201 kg/ha and BARI-2000 1930 kg/ha respectively. This line gave excellent results with yield 3462 kg/ha at Tamman, Distt; Chakwal under barani conditions and gave a yield of 3313 kg/ha under irrigated conditions at Piplan.

Several indigenous genotypes of Walnut excelled exotic approved walnut varieties in various nut quality traits including nut diameter, nut length, in-shell nut weight, kernel weight and kernel percentage. Out of these genotypes, 46 desirable types were selected for further in-situ evaluation. Phenological data were recorded in respect of the selected genotypes as well.

As a result of yield response to drought stress studies of Wheat Breeding material lines have been identified with yield advantage of up to 30% over the local checks and will further be tested in the coming years in the regional and national trials over a wide range of rain fed ecology and areas with limited water availability.

Allelopathic properties of sorghum, sunflower and brassica were used for weed management in rice, maize and cotton. Results of the experiments revealed that these crops offer great potential for suppression of weeds. Combination of allelopathic water extracts of sorghum, sunflower and mulberry with reduced doses of herbicides gave significant weed control in rice, maize and cotton which was comparable to full doses of herbicides.

The decline in citrus has been investigated, pathogens responsible identified and fungi isolated assessed for their pathogenecity. To manage the problem experiments were laid out at NARC and Kot Momin using fungicide and nematicide alone and in combination. Citrus growers were briefed about the causes of citrus decline, proper cultural practices and management strategies to check the citrus decline at a work shop arranged at Orange Research Institute, Sargodha.

Zinc-efficient wheat cultivars have been identified, tested under field condition and maintained ranking of Zn efficiency in hydroponics study. Another study was conducted to screen out wheat genotypes for Zn efficiency through molecular markers. These results provided valuable information for fingerprinting at molecular level and more efficient selection of genotypes for crossing and enhancing wheat breeding strategies to control zinc deficiency in human nutrition.

Fifty four haploid plants germinated from embryos recovered from F1 crosses and after colchicines application 33 of them matured to produce seed that were subsequently planted in the field for seed multiplication. The parents have been identified, crosses have been made and the techniques for embryo rescue have been standardized. The required equipment and laboratory/green house facilities have been established. Success of the technique has provided the breeders with an opportunity to develop near isogenic lines efficiently for genome mapping and quantitative trait loci (QTL) analysis of desired traits.

Agro bacterium strain Ca-18 and nitrogen fixer Brady (*rhizobium*) strain MN-S resulted in enhanced grain yield of 1216kg/hectare, which is 28% increase over the control. Combined application of fungicide and bacteria enhanced seedling vigor and crop yield. Six new bacterial strains were isolated from the Peas (*Pisium sativum L.*) plant. They were named as MP-1, MP-2, MP-3, MP-4, MP-5, and MP-6. Three bacterial strains isolated from Mungbean were coded as pink 1, pink 2 and pink 3. These isolates did not pick Congo red stain from the agar, so showed *rhizobium* like characteristics.

To incorporate multiple resistance genes in Basmati rice line for the stable and long lasting resistance against Bacterial Blight (BB), twenty two plants were selected from 58 BC3F1 genotypes as a result of foreground selection for three BB genes i.e. Xa-4, Xa-5 and Xa-13 by using STS-SSR markers and phenotypic field performance. Artificial inoculation of

IRBB lines and 58 BC3 F3F1 plants was also accomplished to study their response against bacterial blight disease.

Pathotyping of *A. rabiei* isolates in Chickpea collected from different areas throughout Punjab revealed that two isolates were highly virulent (A-45 & P-22) and nine isolates were found to be moderately virulent. The isolates were used for host resistance studies. Out of 68 tested genotypes 51 were tolerant, 12 were moderately susceptible and 5 were susceptible. Tolerant genotypes are to be used in future breeding programs based on their agronomic traits. Studies on Induced Systemic Resistance (ISR) revealed that ISR technology will be helpful in *Ascochyta* disease management. Upon completion of all the studies a geographical map of different Chickpea growing areas will be prepared to show the prevalence and distribution of virulent pathotypes that will help in the release of resistant cultivars for specific areas. These studies will help to formulate disease management toolkit for the growers.

Research under completed projects of natural resources was conducted on micro-nutrient management of fruit plants, nutrient management for sugarcane yield, soil fertility and crop productivity, management of salt affected soil and brackish water, recycling of organic wastes, impact of sewage wastes on soil properties, water harvesting and quality management, plant growth through use of nitrogen, rhizobial inoculation & biofertilizer, utilization of rangelands and sown pastures in Pothowar, development of bio-fertilizer for crops, crop production through use of humic acid in rainfed and salt affected soils and significance of vesicular arbuscular mycorrhizal fungi in wheat maize cropping system etc. Research under the ongoing projects continued on soil salinity monitoring under various conservation technologies, management of rangelands of Balochistan, honeybee diseases and treatment, micronutrient management in apple and citrus orchard in Swat valley, micronutrient studies on stone fruits orchards, evaluation of nitrification inhibitors for reducing nitrogen loss under irrigated cotton-wheat system, control of leaf reddening in cotton, carbon sequestration, water conservation and pollution control through organic farming, microbial ACC-deaminase biotechnology for production of legume and assessment of toxic metals in agriculture products. Some of the salient achievements are:

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 NWFP Agricultural University, Peshawar is working efficiently.

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 Fateh jang and Gojar Khan area. (WRRI, NARC)

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)

Research work under project of animal sciences focused on genetic improvement & characterization of buffaloes, enhancement of milk yield in Kundi & Nili Ravi buffalo, fish production & aqua culture, trout farming in mountains of northern areas calf rearing, epidemiology of ruminants, local starter culture for preparation of fermented milk products, development of milk production and renetic evaluation model, animal health, disease identification, preparation of vaccines for poultry & cattle, physiology of camels, breeding management packages for range sheep and goat in Balochistan, calculate the economic losses due to mastitis in NWFP and role of steroid hormones in *Tor putitora*. The salient achievements under these projects are:

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. (University of Agriculture, Faisalabad)

Developed methodology for farming mud crab in the coastal earthen ponds. This will help in promoting crab aquaculture. (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 rateand 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)

Five medicines namely Ivomec, Endectin, Dectomax, Euvectin and Projecting were found 100% effective in controlling warble fly (ASI, NARC).

The Infectious Brionchitis Virus (IBV) has been prepared for Chicken (ASI, NARC)

Milk Starter Bank has been developed for fermentation of milk products (Dairy Technology, NARC)

Percentage ingredients composition of early wearing diet and milk replacer has been identified after the nutritional comparison of whole milk, milk replacer and early wearing 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 morphmetric or performance traits was found in neighbouring regions of Pakistan and Afghanistan (NWFP Agricultural University, Peshawar

The projects of social sciences sector focused on transfer of technologies to the door steps of farmers, WTO trade liberalization: study the existing situation in domestic markets and international arena and to pinpoint adverse effects of liberalization and suggest ways & means to minimize such effects, focusing on market margins of different fruits and vegetables and economic analysis of agro forest and mangrove ecosystem.

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 involved in universities for their thesis research work for award of Master and Ph.D degrees. The projects also contributed in development of new technologies and their adoption by end users. The tables showing human resource development, knowledge generated and transferred in forms of research papers, seminars and workshops etc. 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*

On completion of ALP projects, hopefully the research results will contribute in from of new knowledge, development and adoption of new technologies, control measures against different diseases and training of scientists/research fellows etc. It will further contribute in enhancing agricultural productivity which leads to increase in farm income of farmers/end-users, which ultimately helps in poverty reduction in the country.

The progress and achievements of the ongoing projects is reported in coming section. The progress of ongoing projects was monitored through mid year/annual progress reports with the help of technical divisions.

Name of Project: **Genetic Improvement of Buffaloes in Pakistan (GIBP)**

Name of PI/ Institute: **Dr. Muhammad Anwar,**
Senior Scientific Officer,
Animal Sciences Institute (ASI), NARC, Islamabad

Duration: 12.11.2004 to 11.11.2008

Financial Status: Total Cost: Rs.2.287 million
Funds Released: Rs.1447200/-
Funds Utilized: Rs.1362482/-

Objectives:

To initiate a strategic buffalo breeding program on Kundhi buffaloes in Sindh province.
To supplement the on-going improvement program in the Punjab province.
To produce performance tested buffalo bulls and superior frozen semen for domestic use and export.

Achievements:

Selected five adult bulls from Semen Production Unit at Kundi Buffalo Farms, Rohri to be used as sires for selected bull mothers. Nine young buffalo bulls were purchased for production of semen in future. Established Artificial Insemination centers around Rohri and Hyderabad to provide insemination services to registered buffaloes with semen collected from selected bulls. Rearing of male buffalo calves purchased under the project at LPRI Bahadurnagar. Furthermore, Insemination and monitoring of registered buffaloes was undertaken regularly.

Name of Project: **Development of Milk Replacer and Early Weaning Diets for Sustainable Calf Rearing**

Name of PI/ Institute: **Dr. Attiya Azim,**
Principal Scientific Officer,
Animal Nutrition, ASI, NARC, Islamabad

Duration: 24.08.2004 to 23.08.2007

Financial Status: Total Cost: Rs.6.076 million
Funds Released: Rs.4592500/-
Funds Utilized: Rs.4563500/-

Objectives:

Development of milk replacer and early weaning diets for calf feeding.
Evolving suitable feeding system based on milk replacer and early weaning diets for sustainable and bio-economical calve rearing.

Achievements:

Samples of feedstuffs, i.e. green and dry roughage were collected from i) Livestock Research Station NARC Islamabad, ii) Cattle Breeding and Dairy Farm, Harichand, iii) Barani Livestock Production Research Institute, Kherimurat and their peripheral private farms. Green fodders were collected in both i.e. Rabi and Kharif seasons. Kharif fodders were also collected from rain-fed and irrigated areas of districts Rawalpindi and Islamabad. Concentrate feed ingredients collected from five different markets of Rawalpindi, Islamabad and from different public farms has analyzed for macro and micro minerals. Phosphorus was analyzed by spectrophotometer and calcium, magnesium, sodium, potassium, copper, manganese cobalt; iron and zinc were analyzed by atomic absorption spectrophotometer.

A study to determine the effect of supplementation of Ca and P on nutrient utilization, milk production and milk composition and reproductive performance of buffaloes was conducted at LRS, NARC. Twelve milking buffaloes of Nili-Ravi breed were involved in the study.

The selected animals were fed with total mixed ration having 15% CP and 66% TDN twice a day. Mineral supplementation was done in the morning feed allowance. Daily feed intake and refusal was recorded. Milk yield was also recorded at both milking (morning and evening). Milk and blood sample were collected fortnightly. Milk samples were analyzed for total solid protein, fat, ash, lactose, Ca and P contents. Serum samples were analyzed for Ca and P. Reproductive performance was also monitored. It was noted that milk yield was significantly higher in 120 % NRS as compared to 100 and 80% NRC requirement, however, no significant difference was observed in 80 and 100% NRC.

Name of Project: **Development of Database on Minerals Profile of Feedstuffs, their Availability and Strategic Supplementation of Minerals Block to Dairy Animals**

Name of PI/ Institute: **Dr. Attiya Azim**
Principal Scientific Officer,
Animal Sciences Institute, NARC, Islamabad

Duration: 17.09.05 to 16.09.08

Financial Status: Total Cost: Rs.2.513 million
Funds Released: Rs 2527300/-
Funds Utilized: Rs 2036056/-

Objectives:

To generate database on minerals profile of feedstuffs i.e. crop residues, green fodder and concentrate feed ingredients.
To quantify availability of minerals to dairy animals.
Execution of minerals supplementation strategy through minerals powder mixture and particularly minerals block development.

Achievements:

An experiment was conducted to develop economically suitable feeding system for calf rearing based on milk replacer and early weaning diet (EWD) at NARC. Twelve mother detached buffalo calves at the age of 21 to 25 days were divided into three groups, viz., A, B and C for experimentation. In group A calves were reared on milk replacer, B on conventional practice (milk replacer feeding with concentrate i.e., EWD) and C on economical feeding system (milk replacer feeding stopped at the age of 45 days and fed on early weaning diet only). Growth performance, nutrient digestibility and carcass evaluation trials were performed. Results of growth performance revealed that average daily weight gain of calves in groups A, B and C was 420, 458 and 515 gm, respectively. Dry matter (DM) intake was also significantly higher in group C than A and B. There was a linear increased in dry matter intake in all groups. The maximum increase (87%) from first to third month was in group C from 671 g to 1259 g/ day. Feed efficiency was better in calves fed on A (1.55) and B (1.62) compared to C (1.94). Economic efficiency (cost of feed per kg body weigh gain) was calculated to be Rs. 210, 134 and 101 for diet A, B and C. Cost of feed per kg body weight gain of calves in group C (economical feeding system) was almost 52 % and 25 % less than calves fed on milk replacer only (group A) and milk replacer and concentrate (group B), respectively.

Two digestibility trials I and II were performed at 8 and 12 week during growth trial to determine the nutrient utilization (digestibility) of the diets. During digestibility trial-I, dry matter digestibility was 96.28, 87.53 and 88.32 % and crude protein digestibility was 94.32, 85.92 and 84.46 % in group A. B and C, respectively. Digestibility of DM and CP was higher

in group A than B and C. In group B and C the nutrient digestibility was almost same. Similar results of dry matter and crude protein digestibility were observed in digestibility trial II. However, the digestibility of nutrients was less in trial II as compared to trial I.

At the end of the experiment, three animals per treatment were slaughtered to collect data on carcass characteristics. Highest dressing percentage showed in group C. No significant difference was found in group A and B. Results of chemical composition of veal showed that dry matter, crude protein and ether extract were 28.67, 29.51, 30.17% in group A, 79.21, 78.77, 77.80% in group B and 13.49, 15.41, 17.22% in group C, respectively. It may be concluded from the results that calves could be reared economically on milk replacer and EWD at the age of 21 days with efficient performance.

Another experiment was conducted at Livestock Research Station, NARC to evaluate the growth efficiency of calve on early weaning diet. Buffalo calves were reared on routine farm practice i.e., milk feeding through dam (one front teat) and some green fodder and concentrate throughout the period (group A and group B fed on early weaning diet). Results showed that 51 % higher weight gain was observed in group B fed on early weaning diet. Feed efficiency was almost similar in both groups A and B (1.77 vs 1.79). By feeding early weaning diet to calf, 2.5 litters milk can be saved daily for human consumption.

An on-farm demonstration trial conducted in private farm around ICT area, ten cross-bred cattle calves (Friesian and Sahiwal) were used at the age of 21-28 days. Calves were randomly divided into two groups. Group A served as control (milk and concentrate) and B fed on milk and EWD. Average daily weight gain of the calves was 0.495 kg and 0.512 kg in group A and B, respectively. Daily dry matter intake of calves was higher in group B fed on EWD compared to control group (A). Feed efficiency was better in control group, however, economic efficiency i.e., feed cost/kg weigh gain was about 57% less in group B fed on EWD.

Name of Project:	**Studies on Epidemiology of Peste des Petites Ruminant (PPR) in Pakistan**
Name of PI/ Institute:	**Dr. Aamer Bin Zahur,** Senior Scientific Officer, Animal Sciences Institute, NARC, Islamabad
Duration:	17.09.2005 to 28.02.2009
Financial Status:	Total Cost: Rs.5.969 million Funds Released: Rs 4245000/- Funds Utilized: Rs 4035967/-

Objectives:

To study the epidemiological factors responsible for persistence/ transmission of PPR virus in small ruminants.
Development of laboratory assay for the diagnosis of PPR.
Isolation and characterization of PPR virus from field cases.

Achievements:

Seven (7) outbreaks attended throughout the country (2 in AJK, 3 in Punjab & 2 in ICT). Serum samples (n = 734) collected from NWFP & AJK. Samples were analyzed using C-ELISA. Cytopathic PPRV was isolated from 2 outbreaks. 44 samples out of 116 found positive by RT-PCR. Further sequencing & phylogenetic analysis is in process.

Five workshops; i.e. 2 in Sindh, 2 in Punjab and 1 in AJK were organized in collaboration with FAO and on the current status of PPR in the country & future control strategies.

Name of Project:	**Development of Local Starter Culture Technology for Preparation of Fermented Milk Products**
Name of PI/ Institute:	**Mr. Tariq Aziz,** Senior Scientific Officer, Animal Sciences Institute, NARC, Islamabad
Duration:	14.04.2004 to 13.04.2008
Financial Status:	Total Cost: Rs.3.75 million Funds Released: Rs.3329100/- Funds Utilized: Rs.3135463/-

Objectives:

Identification and characterization of local strains of starter cultures.
Maintenance and preservation of defined local starter culture in lyophilized form.
To develop and expand the modern cheese and yogurt production technology.

Achievements:

Starter culture technology which includes isolation, identification, propagation and freezing drying of dairy starter has been developed for fermented dairy products particularly yogurt and cheese. Yogurt production technology using defined starter for cottage industry has been developed. A small dairy starter culture collection has also been established.

Name of Project:	**Studies on Biology & Mapping of Warble Fly Infested Areas**
Name of PI/ Institute:	**Dr. M. Qasim Khan,** Senior Scientific Officer, Animal Sciences Institute, NARC, Islamabad
Duration:	21.05.2004 to 30.06.2008
Financial Status:	Total Cost: Rs.6.072 million Funds Released: Rs.3400500/- Funds Utilized: Rs.3383295/-

Objectives:

To study the biology of warble fly in different ecological zones of Pakistan.
Mapping of warble fly areas and identification of high and low intensity habitats.
Development and demonstration of controlled strategies in different disease frequency zones.

Achievements:

For creating awareness about warable fly disease and sensitizing field among veterinarians and livestock farmers, six workshops were held in all the four provinces (D.G. Khan, Mianwali, Peshawar, Rawalpindi, Quetta and Tando Muhammad Khan). The participants were appraised of the causative agent and the ill effects of the disease on the over all economy of the country. The disease has been reported from all the provinces of Pakistan particularly from hilly, semi hilly and sandy desert areas (Cholistan and Nara, District Sanghar) of Pakistan. The nodules formation on the back of the infested animal started appearing from September through last week of December. The incidence of disease varied from 5-75%. It was found higher in interior of hilly areas and its intensity gradually decreased while moving to plain area. The disease was physically verified in the reported areas. The data was computerized and a map of warble fly infested area was developed.

To study the efficacy of different drugs indicated for the control of warble fly disease and to demonstrate it to the field staff, four field trials were conducted in all the four provinces. A total of 2096 cattle and 3016 goat were given five different injectable (Avermectins) namely Ivomec, Endectin, Euvectin, Dectomax and Promectin during the 1^{st} – 3^{rd} week of September. A control group was also kept which was given normal saline as placebo. All the medicines were found effective for controlling the grubs whereas in control animals the disease was seen in 27-50% cattle and in 27-39% goats.

Name of Project: **Studies on Breeding and Seed Production of Channel Catfish (*Ictalurus Punctatus*) in Pakistan**.

Name of PI/ Institute: **Dr. Abdul Rab,**
Senior Scientific Officer (Fisheries)
Animal Sciences Institute, NARC, Islamabad.

Duration: 19.07.2007 to 18.07.2010

Financial Status: Total Cost: Rs.3.704 million
Funds Released: Rs.1380000/-
Funds Utilized: Rs.1131655/-

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:

Brood stock of channel catfish was developed from imported channel catfish fingerlings. Hundred channel catfish with an average weight of 1650g were stocked in 0.1 hectare earthen pond @ 1000 fish/ha and fed on artificial diet coating 30% Crude Protein (CP) prepared form locally available feed ingredients. Growth and survival of fish were recorded on monthly basis. These were also randomly sampled and dissected to observe their gonadal development.

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 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. During the current year only eight pairs of channel catfish were bred. Out of eight pairs, five pairs, spawned in tin containers and two in wooden container and one in the plastic container. On the basis of spawning, tin containers were found to be more suitable for the breeding channel catfish. However, hatching was recorded only in four pairs. This might be due to non-availability of males as 50% mortality was recorded in brood stock during the month of January 2008; when the water temperature fell down to 6ºC due to extreme cold weather. Approximately fifty thousands of channel catfish larvae were obtained from breeding of channel catfish during current year which were shifted to the 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). The diet was first soaked in water and then offered to the larvae in the dough form. 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 3.5g compared to their initial weight of 0.034g in 45 days.

Name of Project: **Evaluation of Indigenous Medicinal Plants for the Steroid Hormonal Activities for Veterinary and Medical Usage**

Name of PI/ Institute: **Dr. Nazir Ahmad,**
Associate Professor,
Department of Animal Reproduction, University of Agriculture, Faisalabad

Duration: 08.09.2005 to 07.09.2008

Financial Status: Total Cost: Rs.5.046 million
Funds Released: Rs.3361000/-
Funds Utilized: Rs.3054487/-

Objectives:

To study the steroid sex hormonal or like activities (oestrogen, progesterone and testosterone) of several common indigenous medicinal and fodder plants.
To isolate and purify the active hormonal or like substances in the indigenous medicinal plants.
To investigate feasibility of production of hormonal preparations from the indigenous medicinal plants for therapeutic purposes in animals.

Achievements:

During project period (Sep. 2005 to Sep. 2008) evaluated *Medicago sativa* plants for their estrogenic or like activity using animal bioassay. Plants were collected, dried under shade, grounded into powder form and extracted in 90% ethanol. The extraction was used to evaluate its estrogenic or like activities in immature rats. 250 and 500 mg/kg body weight of ethanol extract of plant was given orally for 14 days to 2 batches of immature female rats (12 each) and one was kept controlled. At the interval of 7 days, rats were killed. Weight of internal organs was recorded and blood samples were also taken. Serum was stored at -20^{o}c and analyzed for estradiol, hormones and other tests, using commercially available kits. After 14 days, weight of ovaries increased. Weight of other organs did not change in all the groups. Serum estradiol and serum cholesterol concentration was less than control group. Serum progesterone concentration was high than control grouped. AST was decreased and ALT increased than control group.

A research paper has been finalized and submitted for publication in FITOTHERAPIA

Name of Project:	**Mott Grass as a Potential Source of Dietary Forage for Lactating Sahiwal Cows**
Name of PI/ Institute:	**Dr. Muhammad Qamar Bilal,** Assistant Professor, Department of Livestock Management, University of Agriculture Faisalabad
Duration:	14.09.2005 to 13.09.2008
Financial Status:	Total Cost: Rs.1.66 million Funds Released: Rs.1559100/- Funds Utilized: Rs.1459769/-

Objectives:

To determine the proper stage of cut for Mott grass feeding and silage making.
To establish the best additive, level of additive and fermentation period for Mott grass silage making.
To determine the effect of Mott grass and its silage on the performance of lactating Sahiwal cows

Achievements:

Research indicated that; proper stage of cut for Mott grass after its cultivation is 45 days. Molasses is the best additive as compared to corn. 3% level of molasses is sufficient for making quality silage. Silage feeding can be started after 35 days fermentation period. Molasses additives improved the palatability of Mott grass and minimized the wastage as fermentation makes the stems soft. Mott silage had no negative impact on production performance of dairy animal and it proved a good substitute of green forage that can be practiced to a great extent in dairy animal even during the periods of green fodder scarcity. Feeding of Mott grass and Mott silage in combination proved the best feeding regimes in dairy cows.

Name of Project:	**Studies on the Reproductive Physiology of One-Humped Camel (C*amelus 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.5.00 million Funds Released: Rs.3100500/- Funds Utilized: Rs.2395508/-

Objectives:

The main purpose of this study is 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 make recommendations on improved methods of production based on manipulations of reproductive physiology.

Achievements:

Ecological baseline survey was carried out at three experimental sites including Faisalabad, Attock & Bhakkar and monitoring data has been analyzed. In order to study the traditional system of camel husbandry, survey through a questionnaire was also carried out. Histological studies on reproductive system of males and female based on slaughter house material was completed.

To study the reproductive activities, observation on the manifestations of oestrus cycle was recorded. Collected blood samples from selected experimental animals kept at Faisalabad, Bhakkar and Attock in the four seasons of year and performed hormonal analysis.

The seasonal nutritional status of the animals was determined through scoring of the pasture conditions and body condition of animal

Two students are doing research for Ph. D. study while two students have completed their research work for M Phil thesis under this ALP project.

Name of Project:	**Clinical and Biochemical Studies on Genital Prolapse in the Buffalo**
Name of PI/ Institute:	**Dr. Laeeq Akbar Lodhi,** Professor/Chairman, Dept. of Clinical Medicine and Surgery, University of Agriculture, Faisalabad
Duration:	25.10.2005 to 24.10.2009
Financial Status:	Total Cost: Rs.6.641 million Funds Released: Rs.2689500/- Funds Utilized: Rs.2405573/-

Objectives:

To conduct survey of the genital prolapse under different agro-ecological zones and production systems in the country.
To study haematological, biochemical and hormonal profile in buffaloes suffering with the problem and in clinically healthy buffaloes as a control.
To investigate level of macro and micro minerals in soil, fodder and blood of the buffaloes suffering with genital prolapse for the adoption of therapeutic measures.
Development of suitable packages for treatment, prevention and control of the problem according to various zone

Achievements:

Blood samples were collected from 600 buffaloes. Serum were harvested and preserved. Blood analysis for macro and micro minerals has been completed. Six hundred blood samples and 120 fodder samples have been analyzed for macro and micro minerals. Analysis for estradiole and progesterone is in progress.

Sixty soil samples were analyzed and sixty digested and preserved for analysis. Higher incidence of prolapse have been observed in buffalo maintained at kacha (earthen) floor with no concentrate feeding, Older buffaloes were more prone to the problem. High producing buffaloes were also more affected. The level of Calcium, Phosphorus and Sodium were less in buffaloes affected with genital prolapse compared with healthy buffaloes. Increased level of Magnesium and Chlorine was determined in affected animals than healthy animals and slightly higher Potassium level was also reported in affected buffaloes. The Copper, Iron, Zinc and Selinium were slightly lowered in affected buffaloes compared with normal buffaloes.

Name of Project:	**Development of Supplementary Feed Based on Apparent Nutrient Digestibility of Different Feed Ingredients for Labeo Rohita Fingerlings**
Name of PI/ Institute:	**Dr. Muhammad Salim,** Assistant Professor, Department of Zoology & Fisheries, University of Agriculture, Faisalabad
Duration:	14.09.2005 to 13.09.2008
Financial Status:	Total Cost: Rs.2.137 million Funds Released: Rs.1439000/- Funds Utilized: Rs.1339345/-

Objectives:

To determine apparent nutrient digestibility of twenty feed ingredients.
Development of compatible and suitable supplementary diet.
To increase the integrated period of the test and reference diets.

Achievements:

The research project was carried out to evaluate the apparent nutrient digestibility of twenty feed ingredients (animal source and plant source) for *Labeo rohita* fingerlings. Feed ingredients were:

i) fish meal, ii) meat meal, iii) blood meal, iv) feather meal, v) wheat bran, vi)soybean meal, vii) rice polish, viii) wheat, ix) rice broke, x) soybean meal, xi) corn gluten 30%, xii) corn gluten 60%, xiii) cottonseed meal, xiv) dry bread, xv) rapeseed meal, xvi) guar meal, xvii) corn, xviii) coconut meal and xix) barley

The experiments were conducted in V-shaped tanks, specially designed for the collection of fecal material of fish via sedimentation technique. This developed system titled US system was attached with water supply and aeration system. The feed ingredients were analyzed for chemical composition prior to the formulation of experimental diets. The reference diet was prepared to supply adequate levels of required nutrients for normal fish growth. Each test diet was formulated by mixing 70 % reference diet and 30 % test ingredient. After acclamation, fingerlings *Labeo rohita* were stocked into 60L V-shaped tanks (UA system) with assigned to reference and test diets randomly. The fingerlings were fed experimental diets at the rate of 2 % of live body weight twice a day. After feeding session of two hours, the tanks were completely cleaned from feed ingredients and then feces were collected repeatedly from each replicate. The collection of feces was lasted for ten weeks. The samples of diets and feces were analyzed for chemical composition by standard methods of AOAC.
The apparent digestibility values of twenty test ingredients determined during 1st year were

verified in 2nd year of the research project. The test ingredients with higher digestibility values were used for the formulation of four experiments diets for *Labeo rohita* fingerlings i.e. fish meal, rice broken, wheat bran, wheat, corn, corn gluten, sunflower meal, soybean meal, dry bread and soybean meal. The apparent nutrient digestibility and growth performance of fish were better on test diet-1 (fish meal based diet) and test diet–4 (sunflower meal based diet). Carboxy methyl cellulose was added as binder to increase the integrated period of experimental diets.

Name of Project:	**Pharmacokinetics and Dosage of Flouroquinolones in Animals**
Name of PI/ Institute:	**Dr. Faqir Hussain Khan,** Associate Professor, Department of Physiology and Pharmacology, University of Agriculture, Faisalabad
Duration:	11.02.2006 to 10.02.2008
Financial Status:	Total Cost: Rs.3.1 million Funds Released: Rs.2623300/- Funds Utilized: Rs.2432306/-

Objectives:

- Establish therapeutic norms/ dosage regimen in the indigenous domestic animals and environments.
- Pharmacokinetics of quinolones would provide a basis for determination of an optimal dosage regimen of these antibacterial agents in indigenous animals under indigenous conditions.
- The rational dosage regimen of fluoroquinolones on the basis of the original kinetic data under our own specific indigenous conditions would be helpful for successful treatment of infectious diseases in animals.
- Describe the preslaughter withdrawal period to provide wholesome food to human beings.

Achievements:

The experimentation on animals for sampling for norfloxacin has been completed. Total 6-8 healthy adult sheep, goats, cows and buffaloes were used for studying pharmacokinetics, renal clearance and urinary excretion of norflaxin. Doctorjin 10% inj. was given as 7 mg/kg body wt. blood sample was collected. Plasma was separated at 3000 rmp for 15 minutes at room temperature and stored at -4°C for analysis.

The experimentation on animals for sampling for enrofloxacin has also been completed. Same number of animals i.e. 6-8 healthy adult sheep, goats, cows and buffaloes were used for studying disposition kinetics, renal clearance and urinary excretion of norflaxin. Enroti 10 % inj. was given as 5 mg/kg body wt. blood sample was collected. Plasma was separated at 3000 rpm for 15 min. at room temp and stored at -4°C for analysis.

Name of Project:	**Inter-relationship of Mycotoxin Levels in Feed, Organs/Tissues and Health of Poultry and Livestock**
Name of PI/ Institute:	**Mr. Muhammad Zargham Khan,** Chairman/Associate Professor, Department of Veterinary Pathology, University of Agriculture, Faisalabad
Duration:	25.07.2006 to 30.06.2009
Financial Status:	Total Cost: Rs. 9.356 million Funds Released: Rs. 8311900/- Funds Utilized: Rs 7567259/-

Objectives:

Determination of aflatoxin and ochratoxin levels in poultry livestock feed/ feed ingredients, organs/ tissues of poultry and livestock as well as in milk produced for human consumption.
Establishment of relationship between:

Dietary mycotoxins levels and its tissues/ organ contents.
Dietary/ tissue mycotoxins levels and pathological alterations.

Achievements:

Samples collected from 133 broiler and 53 "Desi" farms and data was analyzed for presence of aflatoxins and ochratoxin in composite samples of each of liver, kidney and muscles of birds from each farm. The gross lesions, if any, present on these organs were recorded. Aflatoxins and ochratoxins in the pooled samples were extracted by immunoaffinity column method and determined quantitatively by HPLC with fluorescent detector. The detection limit was 0.02 ng/g. Out of 133 poultry farms, samples from 112 (84.21%) farms contained aflatoxins (B1, B2, G1 & G2) in different combinations. Aflatoxin B1 was detected in samples from 106 (79.69%) livers, 72 kidneys (54.13%) and 43 muscles (32 %) samples. A strong positive correlation was present among the aflatoxin levels of liver, kidneys and muscles. Highest concentration of total aflatoxin was 10.41, 4.75 and 2.2 ng/g in liver, kidneys and muscles; respectively. Highest concentration of aflatoxin B1 was 7.9, 3.9 and 1.8 ng/g in liver, kidneys and muscles; respectively. AF residues could not be detected in 21, 52 and 85 samples of liver, kidneys and muscles, respectively. AFB1 residues could not be detected in 27, 61 and 90 samples of liver, kidneys and muscles, respectively. Out of 133 broiler poultry farms, samples from 93 (70%) farms contained OTA in different organs. OTA was detected in 70 livers (52.63%), 92 kidneys (69.17%) and 41muscles (30.82%) samples. Highest concentration of OTA was 1.798, 4.74 and 0.52 ng/g and OTA residues could not be detected in 63 (47.36%), 41 (30.82%) and 92 (69.17%) samples of liver, kidney and muscle respectively.

Samples collected from 53 "Desi" farms were analyzed for the presence of aflatoxins and ochratoxins in composite samples of each of liver, kidney and muscles of birds from each farm.

Out of 53 poultry farms, samples from 40 farms contained aflatoxins (B1, B2, G1 & G2) in different combination. Aflatoxin B1 was detected in 36 livers (67.92%), 12 kidneys (22.64 %) and 3 muscles (5.66%) samples. Highest concentration of total aflatoxin was 0.66, 0.34 and 0.2 ng in liver, kidneys and muscles, respectively, Highest concentration of aflatoxin B1 was 0.287, 0.153 and 0.0784 ng/g in liver, kidneys and muscles, respectively. The residues of AF in 17 (32.07%), 44 (83.01), and 52 (98.11) while of AFB1 in 17 (32.07%), 41 (77.35 %) and 50 (94.33%) samples of liver, kidney and muscles were found below the detection limit respectively.

Out of 53 farms of desi birds, samples from 36 (67.92%) farms contained OTA in different organs. OTA was detected in 18 livers (33.96%), 36 kidneys (67.92%) and 9 muscles (16.98%) samples. Highest concentration of OTA was found 2.11, 2.95 and 0.61 ng/g in liver, kidneys and muscles samples, respectively. The residues of OTA in 35 (66.03%), 17 (32.07%) and 44 (83.01%) samples of liver, kidneys and muscle, respectively were found below detection limit.

Name of Project:	**Development of Milk Recording and Renetic Evaluation Models in Sahiwal Cattle**
Name of PI/ Institute:	**Dr. Muhammad Sajjad Khan,** Associate Professor, Department of Animal Breeding & Genetics, University of Agriculture, Faisalabad
Duration:	22.05.2004 to 31.03.2008
Financial Status:	Total Cost: Rs.3.695 million Funds Released: Rs.2811800/- Funds Utilized: Rs.2704485/-

Objectives:

To develop an information system for Sahiwal cattle for data recording in public and private sector to be used for dairy cattle recording in future.

Computerization of the available data on the breed from various public institutions maintaining Sahiwal breed for use in genetic evaluation.

Development of recording schemes for milk recording at institutional as well as tenant herds to introduce recording culture at farmer level.

Development of genetic models for different recording plans and identification of genetically best animals for use as dam/sire lines for up-gradation and propagation of Sahiwal population.

Achievements:

Study involved Sahiwal cattle located at Livestock Experiment Station Bahadurnagar, Okara and the surrounding area and Livestock Experiment Station, Jahangirabad, Khanewal. The cows were monitored for development of recording protocol at farmers level. The result obtained were:

Phenotypic performance of Sahiwal cows at the five main institutional herds in Punjab was deteriorated over the past 40 years.

Additive genetic variation was adequate in most of the productive traits but genetic parameters of most of the traits were low. High permanent environmental portion of variance however, indicated that culling may be effective using first few records of a cow.

Accurate recording of pedigree and performance may help improve genetic parameters for productive traits. Genetic selection is possible to bring permanent increase in milk yield.

Although, the extent of inbreeding in the institutional herds was low, deterioration due to

inbreeding in most of the economic traits was quite high. Improved pedigree recording and planned effects of inbreeding have been done.

Lack of genetic superiority of bulls used in artificial insemination (AI) indicated that AI failed to bring desired genetic improvement.

Under small holder set-ups, field-recording may require substantial resources and dedication generally lacking in government sponsored programs.

Name of Project:	**Application of PCR Technology for the Detection of Avian Mycoplasma in Poultry Birds and Farm Environment**
Name of PI/ Institute:	**Dr. Sajjad-ur-Rahman,** Associate Professor, Deptt of Vet. Microbiology, University of Agriculture, Faisalabad
Duration:	03.02.2006 to 28.02.2009
Financial Status:	Total Cost: Rs.2.939 million Funds Released: Rs.2734000/- Funds Utilized: Rs.2293136/-

Objectives:

To establish methods for isolation and biocharacterization of avian mycoplasma species from respiratory problems in birds and from poultry farm house environment.

Screening test antigens of MS, MG and MM will be prepared from local isolates separately and techniques for conventional screening tests like RSA and HI will be standardized using hyper immune serum.

Latest technique of PCR based diagnosis of avian mycoplasma will be adopted in the Mycoplasma Research Laboratories (MRL), Department of Veterinary Microbiology.

To compare the efficacy of conventional screening methods (RSA, HI) and latest diagnostic technique of PCR for the detection of mycoplasma species in birds and farm house environment.

To introduce the latest technology for raising mycoplasma free flock to the farmers in public and private sector and field veterinarian, particularly to meet the requirements of World Trade Organization (WTO) programs in the country through seminar and workshop.

To establish Mycoplasma Research Laboratories (MRL) in the Department of Veterinary Microbiology in collaboration with National Agricultural Research Center (NARC).

Achievements:

The results of the study indicated that direct specimen sampling may be feasible to extract minimum quantity of DNA material to be required for successful PCR procedures. MG known samples were recovered after amplification reaction mixture electrophoresed on 1.5 % "Agarose" gel at 732 bp which indicated optimization of PCR technique for the specimen and for the culture isolate samples.

MG and MS were recovered. Control positive samples showed clear demarcation of PCR products specifically identifiable in the reaction mixture electrophoresed on 1.5 % "Agarose: gel and resolved at 732 bp and 207 bp respectively. Optimization of MG and MS PCR techniques were successfully completed which give rise to specific indication of 187 bp and 214 bp respectively whereas, the Multiplex PCR technology was accomplished during the stipulated time period with 732 bp of MG and 207 bp of MS.

Name of Project:	**Effect of Long Term use of Bovine Somatotropic (bST) Hormone on Milk Production, Reproduction, Health and Various Physiological Parameters in Nili-ravi buffaloes**
Name of PI/ Institute:	**Dr. Makhdoom Abdul Jabbar,** Chairman/Associate Professor, Department of Animal Nutrition, University of Veterinary and Animal Sciences, Lahore
Duration:	17.07.2004 to 31.10.2007
Financial Status:	Total Cost: Rs.3.464 million Funds Released: Rs.3113200/- Funds Utilized: Rs.3033994/-

Objectives:

To study the long term effect of bST hormone on milk production in Nili-Ravi buffaloes.
To study the effect of use of bST on reproductive behavior and other physiological parameters in buffaloes.
To compare the efficiency and economics of milk production of treated animals versus control.
To determine the quality of milk under influence of bST hormone through chemical composition.

Achievements:

The study was conducted to determine the effect of long term use of bovine somatotropic hormone (bST) on milk production, milk composition, reproduction, health and physiological parameters from 2004 to 2007. For this study thirty Nili-Ravi lactating buffaloes with similar milk production and stage of lactation were selected and randomly divided in two groups A and B with 15 animals in each group. The group A served as control while animals in group B were given injection of bovine somatotropic hormone (250 mg / animal) with trade name of Boostin-250 at an interval of 14 days. Nutritional requirements of experimental animals were met through available green fodder (45-50 kg/day) supplemented with concentrate ration @ half of milk production. The composition of concentrate ration was 17.0 % CP and 2.20 ME/kg. The over all daily milk production per animal was 6.86 vs. 7.92 liters for groups A and B, respectively. The milk production was increased by 15.5% in treated group compared with controlled group. Statistical analysis revealed that difference was significant ($P< 0.05$). Numerical variations in the values of fat, SNF, and TS percent were observed but these variations were non significant. The calving interval, dry period and lactation length were shorter by 14.0, 26.0 and 2.7 percent in treated group compared with the control. The postpartum estrous period, service period and services per conception were 98.2 ± 76.40 vs. 160 ± 56.9 days, 115.10 ± 107.0 vs. 207.04 ± 85.0 days and 1.31 ± 0.50 vs. 1.47 ± 1.11 in the group B and A respectively. Statistically differences were significant for postpartum estrous

and service period but for services per conception the difference was non-significant which reflected positive effect of bST on reproductive parameters. Prevalence of mastitis was 57.14 % higher in treated animals. There were variations in body weights for animals in group A and B but these changes over the time were non-significant. The differences among hematological and biochemical parameters were also non-significant.

Name of Project:	**Studies on Mineral Imbalances in the Livestock of Canal Irrigated Districts of the Punjab**
Name of PI/ Institute:	**Dr. Talat Naseer Pasha,** Professor, Department of Animal Nutrition, University of Veterinary and Animal Sciences, Lahore
Duration:	21.09.2005 to 20.09.2008
Financial Status:	Total Cost: Rs.8.596 million Funds Released: Rs.6665800/- Funds Utilized: Rs.6413538/-

Objectives:

- The long-term project objective is the efficient and balanced feeding resulting in better health of the livestock at lower cost of production leading to increased productivity of milk and meat of livestock resulting in higher income, better nutrition and improved food security for small holder farms.
- Mineral (macro and micro) mapping of the ten canal irrigated districts of the Punjab based on water, forages, feedstuffs, soil and serum analyses.
- Development of mineral mixers, feed supplements for livestock as per needs of the different districts of the Punjab.

Achievements:

To accomplish the objectives of the project, sampling of soil, water, feedstuff, fodder and blood (small and large ruminants) has been done in the Hafizabad, Okara, Lahore, Kasur, Gujranwala and Sheikhuura districts. Analysis of macro-mineral and some of the micro-minerals also been carried out in project area.

Plasma of different blood samples, feed stuffs, soil, milk and water samples from district Pakpatan and Sahiwal districts were analyzed for Na, K, Ca, Mg, Mn, Cu, Zn, Fe and Cr Development of maps is under process at GIS center, PUCIT, University of the Punjab, Lahore.

Name of Project: **Epidemiology of Helminthiasis in Sheep**

Name of PI/ Institute: **Dr. Haji Ahmad Hashmi,**
Associate Professor/Chairman,
Department of Parasitology,
University of Veterinary & Animal Sciences, Lahore

Duration: 21.09.2005 to 20.09.2007

Financial Status: Total Cost: Rs.0.547 million
Funds Released: Rs.432100/-
Funds Utilized: Rs.275429/-

Objectives:

To determine epidemiology of helminthiasis in sheep by studying various epidemiological determinants.
To devise forecasting methods for helminthosis
To generate epidemiological information which may lead to the development of integrated methods of control of important helminth parasites of small ruminants with a view to increase their productivity.

Achievements:

Epidemiological studies were carried out in two districts namely Kasur & Sheikupura. During the period of study, following parameters were noted to see the monthly prevalence of gastro intestinal parasites.

Mean fecal egg count: The maximum no of eggs per gm (EPG) of faeces was observed in June, 2006 as 1400 & 1560 in the district Sheikupura & Kasur respectively. *H. contortus*, *Trichostrongylus colubriformis*, *Ostertagia* and *circumcincta* eggs were found most common and the number of ova of these parasites was greater as compared to other parasites eggs like *fasciola sp*, *cooperia*, *oespohagostomum* & *chabertia* which were observed in negligible number. Similarly month wise prevalence of alive Snails has been studied during the period from December 2005 to June 2006. A total of 8000 snails were collected from five places around Sheikupura & Kasur, which included different genera namely; *Lymnaea*, *Gyrayulus*, *Physa*, *Bulinus & Oncomelania*. During December, 2005 & January 2006, the minimum temperature ranged between 8.5°C & 6.2°C respectively is detrimental for survival of snails. So *Lymnaca* were minimum during the month of January & maximum in June. *H. contortus*, *Trichostrongylus colubriformis* & *Ostertagia circumcincta* were more prevalent on pastures.

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

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

Duration: 23.07.2007 to 22.07.2010

Financial Status: Total Cost: Rs.4.938 million
Funds Released: Rs.2532000/-
Funds Utilized: Rs.2470450/-

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:

Three experiments were conducted so far. The result from the first experiment indicated that administration of hormones (EB and GnGH) as a tool for synchronization of estrus result in early emergency of follicular wave in CIDR (hormone/progesterone coated device) treated postpartum buffaloes. Furthermore, overall pregnancy rate averaged 30% in CIDR treated buffaloes. In the second experiment it was found that interval to estrus and ovulation was earlier, size of ovulatory follicle was smaller due to another hormone (FSH) in CIDR treated an estrus buffaloes during low breeding season.

In the third experiment cyclic buffaloes responded very well in terms of estrus to $PGF_2 \propto$ treatment showed less variability in behavioral estrus due to this hormone (*estradiol dipropionate*) and the overall pregnancy rate was 33%. In other experiment the protocols (ovsynch and $PGF_2\propto$) seem equally good methods of synchronization of estrus in buffaloes.

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, University of Veterinary & Animal Sciences, Lahore
Duration:	23.07.2007 to 22.07.2010
Financial Status:	Total Cost: Rs.6.382 million Funds Released: Rs.2043300/- Funds Utilized: Rs1021858/-

Objectives:

To evaluate the capacity of whole milk replacer feeding fro 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:

The data collected so far indicated significant effect of milk feeding according to body weight and calves started early consumption of starter ration. The calves also showed increased feed efficiency weight gain and body conditions with the early introduction of starter diet.

An experiment was conducted to know the DMI in buffalo & cows. For this purpose three different groups of cows with group, 1, 2 and 3 being fed green fodder, green fodder plus 0.5% starter supplement and green fodder plus 1% starter supplement respectively. Mean DMI was highest in calves of groups 3 while lowest in group 1. There was significant difference in all the groups for all the growth traits studied (body weight, girth and length).

Name of Project:	**Microbiological Studies on Caprine Mycoplasma in Balochistan**
Name of PI/ Institute:	**Dr. Mohammad Arif Awan,** Veterinary Officer, Center for Advanced Studies in Vaccinology and Biotechnology (CASVAB), University of Balouchistan, Quetta.
Duration:	26.10.2004 to 28.02.2009
Financial Status:	Total Cost: Rs.4.8 (million) Funds Released: Rs.2697100/- Funds Utilized: Rs.2422831/-

Objectives:

To study the clinical manifestations and pathology in the mycoplasma suspected affected animals.

To carry out the isolation and identification of caprine mycoplasmas particularly Mccp from the morbid tissues.

To reproduce an experimental disease in the susceptible goats using the local field isolates of *mycoplasma* Spp.

Prepare an effective vaccine from the suitable local field isolates of mycoplasma.

Achievements:

Bacteriological, serological and PCR-RFLP based studies were conducted which showed the occurrence of *Mycoplasma mycodies* subspecies *mycodies* LC in the investigated goats. As the mycoplasma isolates were in the final process of characterization based on biochemical and serological parameters, they would be further used to produce the experimental disease in goats at CASVAB. Many of the goats were purchased showing the symptoms of respiratory disease including pleuropneumonia and penenmonic lesions of various types on postmortem examination. The clinical disease together with the gross pathology could be beneficial in the preliminary diagnosis of caprine pleuropneumonia.

The supplemented PPLO *Mycoplasm* growth medium was found quite satisfactory for the isolation of most of the small ruminants *Mycoplasma* species. Many of the Mycoplasma isolates were characterized as *Mycoplasma mycoides* subspecies *mycodies* LC (MmmLC) and Mycoplasma mycodies sub spp Capri (Mmc). The Mycoplasma isolates will further be used to establish their pathogenicity (Production of experimental disease) in the goats in order to fulfill the Koch's Postulates.

Name of Project: **Development of Health, Nutrition and Breeding Management Package for Increased Output from Range-Sheep/Goats Production Operations in Balouchistan**

Name of PI/ Institute: **Dr. Abdul Razzaq,**
Scientific Officer,
Arid Zone Research Center, PARC, Quetta.

Duration: 01.04.2006 to 31.03.2009

Financial Status: Total Cost: Rs.3.867 million
Funds Released: Rs.2808200/-
Funds Utilized: Rs.2176534/-

Objectives:

To study feeding, breeding and health management impacts on the AZRC research flock and the farmers' flocks for improving small ruminant's productivity, controlling year to year fluctuations and making the sheep/goats production operations. Profitable on sustained basis in Loralai and Kalat areas.

To ascertain the fattening potential of native lambs/kids for increased mutton production under intensive feedlot research

Studies for economic modulation of these activities.

Achievements:

Research experiments for fattening operations using AZRC and farmer's lambs/kids for increased mutton production were conducted under intensive feedlot research trials. Native lambs/kids fattening with concentrated ration resulted encouraging live weight gain and profitable business. Overall, highest live weight gain (14 kg) was recorded in Shinwar breed lambs, followed by Babrik (12.54 kg), Harnai (12.35 kg), Rakhshani (10.88 kg) and Balochi (6.59 kg). Kids from Khurasani breed gain higher live weight (9.82 kg) than Lehri breed kids (7.49 kg). Economic analysis of the experiment showed higher net profit per lamb of Babrik Breed (Rs. 612/-) followed by Shinwar (Rs. 606/-), Harnai (Rs. 560/-), Rakhshani (Rs. 511/-) and Balochi (Rs. 233/-) during the 127 days of the experiment. Lamb fattening is profitable by these rations and needed to commercialize with joint efforts of technical persons and potential farmers.

Experiments on farmer's lambs also showed profitable enterprises that resulted 6 to 12 kg more live weight gain and profit from Rs.400/- to Rs.1200/- per lamb. Higher disease prevalence needs special attention as resulted up to 60 % mortality and economic losses. Beside the fattening ration grazing in orchards resulted higher weight gain then the grazing on range land.

Internal parasitic control is highly important as almost all the flocks infested up to 60 -80 % with many types of internal parasite that resulted low with weight gain. Regular de-worming of all the animals is recommended for higher productivity.

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 10.09.2009
Financial Status:	Total Cost: Rs.3.459 (million) Funds Released: Rs.1691000/- Funds Utilized: Rs.454408/-

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:

Working seed has been produced from the master seed of Thermostable Newcastle Disease Virus obtained from Australia. Heamagglutination Test (HA) has been standardized in the laboratory for the rapid and preliminary detection of the ND virus. After the preparation the working seed of the Thermostable virus trials are under way for the test production of the Thermostable vaccine.

Name of Project:	**Taxonomical Studies of the Prevalent Ticks Species on Different Livestock Hosts Throughout NWFP**
Name of PI/ Institute:	**Dr. Rahim Ullah Shah,** Research Officer, Veterinary Research Institute, NWFP, PO Box 367, Peshawar
Duration:	25.04.2006 to 30.06.2008
Financial Status:	Total Cost: Rs.2.629 million Funds Released: Rs.2217500/- Funds Utilized: Rs.2135023/-

Objectives:

Survey for collection/ preservation and processing of the prevalent Ticks.
Collection, preservation and mounting of collected tick specimens.
Taxonomical identification of prevailing ticks throughout NWFP using proper keys.

Achievements:

Survey was conducted where 37770 cattle and buffaloes were examined for the presence of ticks in Swat, Dir (Upper), Dir (Lower), Shangla, Buner, Malakand (Agency), Kohat, Karak, Hangu, Bannu, Tank, Lakki, D.I. Khan, Abbotabad, Haripur, Mansehra, Batgram, Peshawar, Swabi and Mardan districts and Mahmand, Khyber, Orakzai/Kuram agencies. It was found that 50.53 % animals were infested with ticks. Cattle were more prone to tick infestation than buffaloes. Achai & Gabrani breeds in the North were found more prone to infestation (49.26 %) as compared to other breeds (28.06%). Few districts were not surveyed due to the law and order situation.

Tick specimens were collected and preserved in 70 % ethanol and mounted on glass slides for preservation. Six species of ticks namely lxodes (5.06%) Dermacentor (7.72 %), Boophilus (9.71%), Rhipicephalus (27.24%), Hemophysalis (30.54%), Amblyoma (5.62%) and Hyaloma (11.29%) with different percentage of infestation were identified.

Name of Project: **Epidemiological Survey of Mastitis and Evaluation of Economic Losses Due To Clinical & Subclinical Mastitis in NWFP**

Name of PI/ Institute: **Dr. Mirza Ali Khan,**
Senior Research Officer,
Veterinary Research Institute, Peshawar

Duration: 08.09.2005 to 07.09.2008

Financial Status:

Total Cost:	Rs.3.248 million
Funds Released:	Rs 2833100/-
Funds Utilized:	Rs.2709996/-

Objectives:

Survey for prevalence of mastitis and determination of various epidemiological factors in different zones of NWFP.
Study of somatic cell count and bacteriology of mastitis milk.
Evaluation of economic losses due to different forms of mastitis.

Achievements:

Survey was conducted through visiting the animals at 199 farms in different regions. Data indicated that; at farm level 2.5 % farmers were using weighing balance, while 97.5 % were using Lota (estimated) for milk recording. During survey; 27.64 % respondents informed that high producing animals were infected with Mastitis, 65.33 % narrated that mastitis infection was found in combination (fresh calved, first calved and others) types of animals, while 7.03 % replied about the infection in all types of animals. 43.72 % farmers have knowledge about Mastitis occurrence season, while 54.77 % did not have any knowledge. 22.11 % farmers narrated that front quarters of Buffalo infected with Mastitis, while 50.75 % replied that hind quarters infected more. 23.11% farmers viewed that young animals infected with Mastitis, while 64.82% replied animals of other than young animals. 25.12 % respondent's farmers told that only single calved animal infected more with Mastitis while other respondents did not agree and 11.05 % farmers responded that cows are more likely to infest in mastitis than Buffalo. Majority (99.5 %) of respondents told that no veterinary Lab services were available in area, While 68.34 % respondents were availing the facility of veterinary care treatment in veterinary hospitals. It is also reported that 21.08 % farmers cleaned the teats before administering treatment. Only14.07 % farmers replied that they have received mastitis control advices by the local veterinary staff. Majority (53.77%) of the respondents replaced cow/buffalo from local market and 37.18 % from other markets while 9.05 % replace from Punjab/other provinces.

Name of Project: **Enhancing Milk Yield of Kundhi Buffaloes Through**

Production of Performance Tested Bulls. (Component-II)

Name of PI/ Institute:	**Dr. Alam Solangi,** Veterinary Officer, Breed Improvement and Development Centre (SPU), Kundi Buffalo Farm, Rohri
Duration:	14.08.2005 to 13.08.2008
Financial Status:	Total Cost: Rs.3.556 million Funds Released Rs.1976700/- Funds Utilized: Rs.2013100/-

Objectives:

To exploit the production of Kundhi buffalo through genetic improvement.
To initiate a strategic buffalo breeding program on Kundhi buffaloes in Sindh province.
To produce performance tested Kundhi buffalo bulls for AI.
Community involvement in the genetic improvement of Kundhi buffaloes.

Achievements:

At experimental farm, once in a month milk yield of all registered buffaloes has been recorded. Other information such as Lactation period, Calving interval, Date of estrus, Number of services etc has also recorded. Five Bulls were selected for semen collection; three from Semen Production Unit, Rohri and two from Kundi Buffalo Farm Rohri and registered under the project. Nine young buffalo bulls for future production of semen have been purchased under ALP project. An Artificial Insemination center at Rohri have been established to cover the area of registered Buffaloes at Rohri and surrounding area. Another A.I. center at Kundi Buffalo Farm Rohri for A.I nucleus herd has also been established. Seven thousand doses of Semen from these Bulls have been collected and utilized in registered buffaloes. Extra dose of semen have been supplied in the field to all Livestock Production Officers of Sindh. Nine young bulls have been purchased for future production of semen.

Name of Project: **Aquaculture of Fin Fishes (Snappers and Groupers) in Ponds Along Hub River Estuary/ Gharo Creek**

Name of PI/Institute: **Syed Makhdoom Hussain,**
Professor, Center of Excellence in Marine Biology, Karachi University, Karachi

Duration: 17.04.2004 to 30.06.2008

Financial Status: Total Cost: Rs.679 million
Funds Released: Rs.4090700/-
Funds Utilized: Rs.3587498/-

Objectives:

Growth potential and survival rate of one species each from Snapper and Grouper out of the two species mentioned below will be studied:

Snappers: *Lutjanus Lutjanus Bloch*, 1790 and *L. johni* (*Bloch*, 1792)
Groupers: *Epinephelus fuscoguttatus* (*Forsska*l, 1775) and *E.tauvina* (*Forsskal*, 1775). The selection of the species will be based on the easy availability of seed from wild.
Step wise development of grow-out techniques on different protein level diets based on locally available ingredients.
Determine economic feasibility of marine fin fish culture.

Achievements:

The study has been conducted on the aspects; site selection, experimental planning, seed collection (Juvenile fish collection of *Lutjanus lutjanus* (Bloch, 1970) and *Lutjanus Johni Lutjanus* (Bloch, 1972) and *Epinephelus fuscoguttatus* (Forsskal, 1775), Stocking design (Like mono culture, bi-culture, and multiple culture of all three species), Study of growth in monoculture, bi-culture and multiple culture, Study of reproductive development of Grouper Epinephelus fuscoguttatus and attempt on induce breeding of grouper. Results shows that the coastal area of Sindh especially the brackish area extending along Keti Bunder is ideal for establishing farming units for marine fish and prawn. Salinity at places can fluctuate from 10% to 30 % or sometimes areas to 37% that is tolerable for many marine fish species. Surveys towards the coastal areas like Sandpit, Gadani and Sonmiani Coasts have indicated that there are some site which may create hurdle to set up a farming unit i.e. high water currents during monsoon, high windy conditions and sandy soil where seepage could not be controlled unless certain treatments are made. After the detail assessment and having observed advantage and disadvantages the present site which is along the Gahro Channel was selected from the experimental farming.

Regular fishing trips were conducted along the coast for about three months using various nets used to catch juvenile fishes. Sufficient numbers of *L. lutjanus* and *Epinephalus juveniles* were

successfully collected and stocked in the ponds as per stocking plan. The seed of *L. johni* was collected in small quantity which did not fulfill the requirement however stocking were enough for bi-culture setup. Experiments conducted for monoculture, bi-culture and multiple cultures were successfully accomplished and growth analyses were made for each setup. Over all investigation indicated that *L. lutjanus* and *Epinephelus fuscoguttatus* have very strong potentials for culture but its size doesn't exceed 600-700 mm as the fish starts breeding at an early size. *Epinephelus fuscoguttatus* is found very suitable for culture and attains marketable size in 3-6 months up-to 1-2 kg. This species can grow more and attain 4-5 kg of weight in one year given artificial feed supplant in addition to the natural feed available in ponds. Attempts to breed this fish (*Epinephelus fuscoguttatus*) under the influence of hormone injected directly were made. A detail histological study is in progress as part of Ph. D research fellow.

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 Narerjo**,
Professor,
Department of Fresh Water Biology & Fisheries,
University of Sindh, Jamshoro

Duration: 23.07.2007 to 22.07.2010

Financial Status: Total Cost: Rs.1.124 million
Funds Released: Rs.443000/-
Funds Utilized: Rs.443000/-

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:

Experiments were conducted on Ova diameter & GSI. The results of the studies indicated the values of both ova diameter and GSI which were on its peak during the month of July; 1.40 and 12.15 and 2.80 in female and male respectively. It indicated that the fish *R. rita* breeds once in a year in the month of July. The estimation of fecundity was based upon 10 mature fishes ranged from 33.0 to 41.0 cm and 450 g to 800 g in total length and weight respectively. The number of ova per gram of body weight was 475.80 eggs and the number of ova per gram over weight was 15.85 eggs. The fecundity data were plotted against their respective length, weight and gonad weight. The fecundity- gonad weight relationship showed better relationship as compared to fecundity-total length and fecundity-body weight relationship. For induced breeding experiment (preparation of brooders) about 50 live specimens of different sizes has been reared (stocked) in cemented cisterns of the department of Fresh Water Biology and Fisheries.

Name of Project: **Production of Breeding Bulls to Improve Milk Production of Nili Ravi Buffalo in Rural Areas of Punjab. (Component-III)**

Name of PI/Institute: **Dr. Rafiq Ahmed**
Research Officer
Livestock Production Research Institute, Okara

Duration: 20.12.2004 to 19.12.2007

Financial Status: Total Cost: Rs.3.764 million
Funds Released: Rs.3306000/-
Funds Utilized: Rs.3156591/-

Objectives:

- Production of genetically superior bull progeny testing program to improve the milk production in rural buffaloes with the semen of superior bulls.
- Motivation of registered buffalo breeders through educational tools like personal contacts, group meetings and discussions.
- Holding farmer days and milk competitions at quarterly intervals among the registered buffalo breeders.

Achievements:

Registed 770 Nili-Ravi buffaloes (261 at Kasur, 257 at Nankana Sahib and 252 at Vehari), ear tagged and their record of productive and reproductive performance along with pedigree record have been maintained. The buffalo male calves purchased are reared at L.P.R.I., Bahadurnagar, District Okara. The weight of the calves was recorded on monthly basis individually and their growth rate/average daily gain is being calculated. The body weight of different batches at the age of 12, 15, 18, 21, 24, 27 and 30 months was also recorded. Sixteen (16) buffaloes bulls have been shifted to SPU, Qadirabad for collection of semen. Furthermore, 157 registered breeders have been motivated through group discussion/ meeting at different sub-centers. The farmers have been acquainted with knowledge about keeping of good genetic potential animals, importance of A.I, record keeping and taking of preventive measures against different diseases.

Name of Project: **Role of Steriod Hormone in Regulation of Ovarian Folliclar Development in Tor Putitora**

Name of PI/Institute: **Mr. Zafarullah Bhatti,**
Dy. Director (Fisheries),
Fish Hatchery & Research Center, Rawal Town, Islamabad

Duration: 27.09.2005 to 26.09.2008

Financial Status: Total Cost: Rs.8.5 million
Funds Released: Rs.6482400/-
Funds Utilized: Rs.6171175/

Objectives:

To generate information which would enable us to better understanding of hypophyseal and steroidal regulation of the ovarian follicle in *Tor putitora*
Determination of maturation of inducing steroids *T. putitora*
Development of techniques for artificial manipulation of fish in aquaculture and fish farming in the country.

Achievements:

Different sites such as Wah Garden, Simly Dam, Mangla Dam, Rawal Dam and different sites in district Attock like Jand & Ziarat (Indus River), Hattian Nursery Unit Attock, Fateh Jang area, Sah Pur Dam and Shakar Dara Dam have been visited for checking the availability of live *Tor putitora*. Preliminary work on ovarian cycle and gonadomatic index of female *Tor putitora* was carried out. Extraction of steroid hormones from blood has been started and is in progress. Histology of ovarian tissue of the fish was carried out.

The macroscopic analysis reveals that the ovaries in *Tor putitora* are quiescent immediately following spawning (Oct-Nov). Recrudescence of the ovary begins in January and batches of oocytes pass asynchronously through primary growth and secondary growth phase in sucking months (March) during which vitellogensis occurs, yolk sequestration is completed in the largest oocytes and maturation progress (breakdown of germinal vesicle migration) become evident, marking reinitiation of meiotic progress in preparation for spawning season in late March to May & June. During spawning season, batches of secondary and tertiary stages follicles that would ultimately under maturation, sequentially, also exist in the ovaries of this species. The result is based on field observation as well as on macroscopic analysis of ovaries of the species.

Name of Project: **Trout Farming in the Mountains of Northern Areas. A Research Project at TRMC Juglote**

Name of PI/Institute: **Mr. Faridullah Khan,**
Scientific Officer,
Karakuram Agricultural Research Institute for Northern Areas, PARC, Juglote, Gilgit

Duration: 16.09.2005 to 15.09.2008

Financial Status: Total Cost: Rs.5.713 million
Funds Released: Rs.3972100/-
Funds Utilized: Rs.3966836/-

Objectives:

To conduct research on fattening, reduction in mortality rates in early stages, disease diagnoses and their proper control.
To enhance per year growth rate of trout fish.
Introduce trout farming in Northern Areas through trainings of fish farmers' about pond culture to enhance income of the rural communities.
Develop packages of technology on trout production in ponds, striking in streams and commercial farming through the communities.
To motivate communities like water waste, land for income generation.
Capacity building through training etc.

Achievements:

In order to see the enhance growth/ reduction in mortality rates of trout fish, diseases and their control, five experimental feeds were designed with different protein levels with costs by composition of different feed ingredients as indicated in Table 1. The experiment was conducted for a period of 12 months. According to the collected data F1 and F5 as indicated in Table 2 were selected on the basis of enhancement of growth rate as well as reduction in diseases.

Table 1: Percent composition of feed ingredient in different experimental feed

Ingredients	F1 (treatment)	F2 (treatment)	F3 (treatment)	F4 (treatment)	F5 (treatment)
Fish meal	50	45	40	35	30
Meat meal	3	-	6	7	6
Bone meal (D.C.P.)	2	2	2	2	2
Soybean meal	6	8	8	6	8
Sun flower meal	6	8	10	12	-
Dried skim milk	2	3	-	3	3
Wheat flour	8	10	10	12	10
Wheat bran	3	4	5	6	7
Vitamins C	0.075	0.075	0.075	0.075	0.075

Premix	0.075	0.075	0.075	0.075	0.075
Feeding oil	3	3	3	3	3
Cholin chloride	0.02	0.02	0.02	0.02	0.02
BHT	0.001	0.001	0.001	0.001	0.001
Salt	1	1	1	1	1
Corn gluten	10	12	10	-	14
Cotton seed meal	5	-	3	12	14

Table 2: Average monthly growth performance of trout fish under different experimental feeds.

Ingredients	**F1 (treatment)**	**F2 (treatment)**	**F3 (treatment)**	**F4 (treatment)**	**F5 (treatment)**
Jan – Dec, 2006	136	76.66	63.745	113.57	113.54
Jan – June, 2007	42.76	24.46	30.3	23.1	35.86
Average/month	14.9	8.42	7.83	11.38	12.45

Advance fry of trout were introduced in the farmers' ponds which were already constructed under adaptive research component of KARINA. 10 ponds out of 17 were in functional condition. About 30000 fry were released into these ponds during the period of 2006-07. Twelve thousand fry were also release to other farmers belongs to Gilgit district. Trout farms have been established in Diamer district with close coordination and technical expertise of KARINA Scientist. Package of technology has already been transfer to farming communities specially feed formulation, stripping and management of brood stock.

Name of Project: **Investigation on Barley Yellow Dwarf Virus (BYDV) in Wheat Crop in Pakistan. (Component- II)**

Name of PI/ Institute: **Dr. Shahid Hameed,**
Senior Scientific Officer,
CDRP, IPEP, NARC, Islamabad

Duration: 01.01.2004 to 31.12.2007

Financial Status:

Total Cost:	Rs.3.892 million
Funds Released:	Rs.2691700/-
Funds Utilized:	Rs.2526396/-

Objective:

Epidemiological studies on BYDV.
Characterization of Pakistani isolates of BYDV
Identification of source of resistance against BYDV

Achievements:

The overall incidence on the basis of ELISA based survey conducted during 2004-05 to 2006-07 indicates that year 2005-06 has high incidence of BYDV in NWFP, then in Punjab, Sindh and Balochsitan. The serological diversity studies show that BYDV-PAV/MAV was more prevalent than CYDV-RPV like isolates during the year 2005-06.

The experimental host range shows that other than wheat, *Zea mays* (maize), *Avena sative* (oats) *Triticum* aestivum (wheat), *Saccharam officinarum* (sugarcane), *Sorghm halepense*, *Echenocloa colonum*, *Eragristis mino* were found to be susceptible to BYDV-PAV under controlled conditions which were confirmed by DAS-ELISA.

All the commercial wheat varieties were screened to confirm the presence of Bdv1 and Bdv2 genes by PCR based molecular markers. Out of 98, in 86 varieties a product of 250bp was amplified, confirming the presence of Bdv1 gene, which confers field resistance, while in 12 verities no product was amplified indicating the absence of gene. Some varieties were subjected for the presence of Bdv2 gene which gives true resistance by restricting the cell to cell movement of virus. None of the varieties has expected size of amplified product indicating the absence of this gene.

The ICARDA bread wheat nurseries 2004 and 2007 comprised 30 lines. All of them found susceptible to BYDV with different level of tolerance both under natural and controlled conditions when analyzed by DAC-ELISA. Only two lines (No.2 & 9) showed moderate tolerance to BYDV.

Only TC-14 and Mackellar were found resistant against BYDV under local conditions. As the Bdv1 gene induces slow yellowing but does not provide any resistance to varieties, so it is essential to incorporate Bdv2 gene available in TC-14 and Mackellar into commercial wheat varieties to provide true resistance against BYDV and CYDV.

Name of Project: **Studies on Monitoring of Contaminants in Exportable Food Commodities**

Name of PI/ Institute: **Dr. Zahida Perveen,**
Senior Scientific Officer,
Southern Zone Agricultural Research Centre, PARC, Karachi.

Duration: 01.01.2005 to 31.12.2008

Financial Status:

Total Cost:	Rs.4.997 million
Funds Released:	Rs.3698000/-
Funds Utilized:	Rs.2567000/-

Objectives:

Standardization of analytical techniques for pesticide and heavy metal residues in fruits/vegetables.
Monitoring of pesticide/metal residues in fruits and vegetables.
Identification/distribution of areas on basis of pesticide contamination.

Achievements:

Pesticide residue contamination in fruits and vegetables is at alarming level. Maximum residue levels (MRL's) violation (35%) is in fruits and vegetables. Fruit samples were less contaminated as compared to vegetable samples. In case of vegetables, leafy vegetables were found highly contaminated. Other groups of vegetables were also found to contain residues at very higher levels. Methamidophos, Endosulfan, Carbofuran and Imidacloprid were the prominent compounds violating MRL's most frequently; however, quantities of residues of other pesticides were within safe limits.

Generally exporters avoid providing sample mostly on pretext of unavailability of consignment ready for shipping. However, few exporters cooperate and provide samples from consignments ready for shipping. In general exporters do not care for residue levels, they tend to switch over their export markets from the countries having tough phyto-sanitary regulations to those countries where their product is accepted.

The most common pesticides residue found in fruit and vegetable were Endosulfan, Methamidophos, Imidacloprid, Deltamethrin, Bifenthrin, Cyhalothrin, Profenophos, Thiophnate- Methy1 and Fosety Aluminum.

Name of Project:	**Developing Forage-plus-grain Winter Wheat Production System for the Northern Areas**
Name of PI/ Institute:	**Dr. Iftikhar Hussain Khalil,** Associate Professor, Department of Plant Breeding & Genetics, NWFP Agricultural University, Peshawar.
Duration:	26.08.2004 to 25.08.2007

Financial Status:	Total Cost:	Rs.1.458 million
	Funds Released:	Rs.1075000/-
	Funds Utilized:	Rs.787000/-

Objectives:

- To introduce winter wheat germplasm for forage-plus-grain production in severe winter regions of Northern Areas.
- To develop dual-purpose (forage-plus-grain) winter wheat production system in Northern Areas.
- To increase and diversify source of income of the farmers of the Northern Areas by raising both livestock and wheat.

Achievements:

The results of research trials conducted on wheat used for dual purpose showed that selection merit exists for forage production and re-growth potential after clipping among the winter wheat lines obtained from Oklahoma State University, Kansas State University and other wheat breeding programmes. However, moderate to severe adverse effect of forage clipping during vegetative period in early spring was noticed on yield and yield component of almost all winter wheat lines evaluated. Similarly spike emergence (heading) and maturity were also delayed due to forage cutting.

Two students has completed their M.Sc. degree under the project

Name of Project:	**Integrated Weed Management in Wheat, Cotton, Rice and Pulses in Punjab (Component-III)**	
Name of PI/ Institute:	**Dr. Abdus Sattar,** Director, Agronomic Research Institute, AARI, Faisalabad	
Duration:	26.08.2004 to 29.08.2007	
Financial Status:	Total Cost: Funds Released: Funds Utilized:	Rs.2.120 million Rs.1505000/- Rs.1218432/-

Objective:

- To establish authentic weed spectra for Wheat, Cotton, Rice and Pulses in Punjab based on survey.
- To find out effective cultural and chemical weed control methods for various weeds of Wheat, Cotton, Rice and Pulses in Punjab.
- To impart training to extension workers and farmers about weed control methodology of Wheat, Cotton, Rice and Pulses.

Achievements:

Wheat:
From weed survey of wheat in different crop zones, it was found that Avena fetua, Phalaris minor, Chenopodium album, Chenopodium murale and Convovulus arvensis were major weeds in cotton-wheat cropping system and central mixed crop zone. On the basis of average 56 trials, wheat grain yield was increased by 24 to 38 % depending upon the herbicide used. Combined application of Puma Super @ 1250 ml/ha and Buctril Super @ 750 ml/ha gave the best results.

Cotton:
Itsit, Deela, Madhana grass and Tandla are problem weeds of cotton. On the basis of average seed cotton yield data of 39 farmer field trials, cotton seed yield increased by 42 to 74 % by adopting weed control. Stomp 330 EC sprayed @ 3 liter/ha and Dual gold 960 EC @ 2.0 lit/ha increase the maximum seed cotton yield (62 to 66%).

Rice:
Deela, Dhiddin & Goin are problem weeds of rice. On the basis of average data of 10 farmer field trials, paddy yield was increased 9-25% by adopting weed control. Macheta 60 EC sprayed @ 2 liter/ha and Acetore 50 EC @ 0.25 lit/ha increases the paddy yield by 15 and 9% respectively.

Pulses:
In Mung bean, the problem weeds found are Itsit, Deela and Tandla. In Lentil and Gram in irrigated areas, Wild oat, Sitti botti, Bathu and Piazi in Thal area are major problem weeds.

Transfer of Technology:
To demonstrate the weed control technology of pulses, 5 trials were laid out at farmer fields in Thal area of the Punjab. These trials have proved good source of transfer of weed control technology to the farmers.

Forty research workers were trained regarding lay out of herbicides trials, calibration of water for spray & adjustment of nozzle, precaution for herbicidal spray. 1110 Extension workers were trained regarding weed control technology. 1030 Farmers were provided information regarding losses due to weeds and weed control technology of Wheat, Cotton, Rice and Pulses. Eight Radio talks and one T.V. talk were recorded about weed control practices. A weed bank was established at research area of Plant Physiology Section, in which 30 weeds were grown.

Checklist of weeds of Wheat, Cotton, Rice and Pulses was prepared and got published, enlisted about 200 weeds.

Name of Project:	**Nematodes of Fruit and Vegetable Crops and their Management in Karachi and Hyderabad Districts using Plant Extracts**	
Name of PI/ Institute:	**Dr. Aly Khan,** Principal Scientific Officer, Crop Diseases Research Institute, SARC, Karachi	
Duration:	01.01.2005 to 31.12.2007	
Financial Status:	Total Cost: Funds Released: Funds Utilized:	Rs.2.641 million Rs.2032000/- Rs.1448000/-

Objectives:

Collection of root and soil samples of mango, papaya, chili, tomato and onion.
Identification of plant parasitic nematodes.
To test efficacy of plant extracts in pot and field trials.
Analysis of data using different statistical procedures to achieve environmental safety.

Achievements:

The nematodes associated with tomato in Karachi and Hyderabad districts were *Helicotylenchus indicus; Meloidogune javanica; Meloidogne incognita; Hopolaimus indicus; Basiria graminophila;* and *Longidorus dipsaci.*

The dendrogram derived from agglomerative clustering shows two major groups i.e group 1 and 2. Group 1 is characterized by the localities of species abundance of *Meloidogyne incognita*. On the other hand group 2 contains localities where species *Ditylenchus dipsaci* is dominant in the nematode communities associated with tomato root zones. In chilli seedling nurseries located at different localities of the two districts, *Helicotylenchus* was highly prevalent genus, most likely reflecting the plasticity of this genus.

Ethanol Plant Extracts of *Withania somnifera* were most significant in controlling population of nematodes associated with tomato in field trials.

A Research Fellow conducted research for his Ph. D studies in the project. Seven Research Papers have been published under this ALP project.

Name of Project:	**Identification of Superior Soybean Cultivars for Different Agro-ecologies of Pakistan**	
Name of PI/ Institute:	**Dr. Muhammad Ashraf,** Senior Scientific Officer, Oilseed Program, NARC, Islamabad	
Duration:	20.10.2004 to 30. 06. 2008	
Financial Status	Total Cost: Funds Released: Funds Utilized:	Rs.2.796 million Rs.2205300/- Rs.1744525/-

Objectives:

To collect and acquisition various germplasm.
To develop base material with high yield potential for future breeding needs.
To screen/evaluate soybean germplasm for specific cropping systems.
To enhance land utilization and farmers income through induction of soybean in various cropping system.

Achievements:

Forty cultivars/ varieties including 30 cultivars (top yielder over the 10 location) were multiplied at NARC, Islamabad. The germplasm comprised 240 accessions were also multiplied.

The desirable yield contributing traits such as days to maturity, 100 seed weight, number of pods (filled) per plant and grain yield could be exploited for crop improvement and developing new varieties.

Sixty three genotypes were selected and tested in replicated trials.

Name of Project: **Management of Apple Spider Mites in NWFP**

Name of PI/ Institute: **Dr. Inamullah Khan,**
Associate Professor,
Department of Plant Protection, NWFP Agricultural University, Peshawar.

Duration: 01.10.2004 to 30.09.2007

Financial Status:

Total Cost:	Rs.1.408 million
Funds Released:	Rs.1150000/-
Funds Utilized:	Rs.836000/-

Objectives:

Rate of consumption, and functional and numerical responses of the predators, *Stethorus pauperculus*.

Achievements:

Predation is an important component of ecological aspects because through predator the flow of energy continues throughout a community. An effective biological agent is mainly selected on the basis of its rate of consumption functional and numerical responses to its prey.

Research study reveals that *S. pauperculus* would be a potential predator for biological control of two spotted spider mites, *T. urticae* in Swat, NWFP Pakistan. It is an effective predator and has the ability to green population of the *T. urticae* below one mite per leaf; however, they prefer high population density of the prey.

Name of Project: **Transgenic Tomato with Resistance to Bacterial Wilt**

Name of PI/ Institute: **Dr. Zubaida Ch.,**
Scientific Officer,
Crop Physiology, CSI, NARC, Islamabad

Duration: 25.10.2004 to 24.10.2007

Financial Status:

Total Cost:	Rs.4.085 million
Funds Released:	Rs.3301000/-
Funds Utilized:	Rs.2262000/-

Objectives:

Amelioration of tomato cultivars through Agrobacterium mediated transformation to develop resistance against bacterial wilt disease.
Selection of desired R1 & R2 transgenic lines in the glass house.

Achievements:

The work was started with three tomato cultivars (Roma, Riogrande and Money maker). Its source material was maintained in vitro through out the research period. Tissue culture studies for direct regeneration from leaf discs and hypocotyls explants were carried out. The project focused on development of resistance against bacterial wilt in tomato cultivars by Agrobacterium mediated transformation. Results obtained by glasshouse evaluation of transgenic plants produced by Agrobacterium mediated transformation containing gene for disease resistance of three tomato cultivars (Money maker, Roma & Riogarande) were recorded. The transgenic plants were compared with control plants for various agronomic traits. There is no significant morphological difference between transgenic plants and control plants of these two varieties. Although transgenic plants showed late flowering compared to control plants in regeneration, the number of seeds harvested /fruits in both transgenic plants and control plants are almost same. Similarly, genomic DNA from 4 independently obtained transgenic plants one each of cvs Roma, Money maker and two of cv Riogrande, along with a control (non-transgenic) plant was subjected to PCR analysis for presence of introduced gene. Two specific primer sequences for the hygromycin coding region were designed to amplify hygromycin gene from genomic DNA. All the samples from transgenic plants gave the predicted DNA fragment band of (670bp) of the hygromycin gene. No DNA amplification was detected in the samples from the control plant.

Name of Project:	**Utilization of Seaweeds in the Biological Control of Soil Borne Pathogens and Growth of Crop Plants**	
Name of PI/ Institute:	**Prof. Dr. Viqar Sultana,** Professor, Biogeochemistry, University of Karachi, Karachi.	
Duration:	26. 07.2004 to 31.12.2007	
Financial Status:	Total Cost:	Rs.1.780 million
	Funds Released:	Rs.1220150/-
	Funds Utilized:	Rs.974000/-

Objectives:

To collect and identify the potential seaweeds having nematicidal and fungicidal activity.
To use potential seaweed as organic amendments alone or with microbial antagonists in green house, micro-plots and farmer's fields for the control of plants parasitic nematodes and root infecting fungi, instead of hazardous pesticides which will result in better crop production in safe environment.
To compare the efficacy of seaweeds with chemical fertilizers and pesticides.
To develop a simple and cost effective method for the field application of seaweeds.
To produce seaweed-based agrochemicals such as seaweed-extract products and seaweed fertilizer.
To isolate and characterize fungicidal and nematicidal compounds from potential seaweeds.

Achievements:

Efficacy of several seaweeds for the control of root rotting fungi and root knot nematode and growth of crop plants were tested in screen house, in field plots and at farmer's fields. Application of some brown, one red and one green seaweed as soil amendment showed significant suppressive effect on root infecting fungi *Macrophomina phaseolina*, *Rhizoctonia solani* and *Fusarium solani* by reducing their infection on test plants like chili, cotton and soybean by reducing number of galls per root system and or nematode penetration in roots. Seaweeds showed stimulatory effect on plant growth and significantly increased plant height and fresh shoot weight.

Soil amendment with some seaweed significantly increased *rhizosphere* population of fluorescent *pseudomonas,* plant growth promoting *rhizobacteria*. Application of one red and one brown potential seaweeds tested at farmer's field at Kathor, Malir, Karachi showed significant suppressive effect on root rotting fungi of tomato and chili and enhanced plant growth.

Name of Project: **Increasing Oil Content in Sunflower Germplasm**

Name of PI/ Institute: **Mr. Mukhdoom Hussain,**
Director,
Oilseed Research Institute, AARI, Faisalabad

Duration: 01.07.2005 to 30.06.2008

Financial Status:

Total Cost:	Rs.0.768 million
Funds Released:	Rs.301500/-
Funds Utilized:	Rs.301500/-

Objectives:

To increase the level of oil percentage in the sunflower germplasm through recurrent selection cycles. The following quantitative objectives will be achieved in each cycle of selection during the project period.

Bench mark (Existing level) 45%
Cycle 1 (3 % increase over the bench mark) 48%
Cycle 2 (3 % increase over the bench mark) 51%

Achievements:

The existing material of sunflower (77 CMS+73 Restorer) inbred lines were analyzed for their oil contents. Eleven CMS and 4 restorer inbred lines having more than 45% oil were selected. The seed of above inbred lines was bulked and sown in isolation for natural crossing during spring 2006. This produced cycle 0 population. Cycle 0 population was sown in autumn 2006. Six hundred plants were bagged, out of which about five hundred plants with desirable traits were harvested separately. The seed of these plants was analyzed for their oil contents. The plants with more than 48% oil were bulked and sown in isolation for random mating to increase the frequency of genes for high oil content. This will produce seed for cycle 1 population. The cycle 1 population was sown and about 600 plants were selfed to fix the desired genes. Out of these 500 plants were retained on the basis of other desirable traits. The seed of these selected plants was tested for their oil content through NMR technique and plants with at least 51% oil content were selected. The seed of these selected plants was bulked and sown in isolation tunnels for random mating to increase the gene frequency for high oil content. This produced seed for cycle 2 population. The cycle 2 population was utilized for the development of inbred lines with high oil content and was preserved for future use of the sunflower breeders.

Name of Project: **Characterization to Determine the Adaptive Role of Dehydrance under Drought Stress in Wheat, (*Triticum Aestivun*)**

Name of PI/ Institute: **Dr. Rehana Asghar,**
Professor,
Department of Botany, Pir Mehar Ali Shah Arid Agriculture University, Rawalpindi.

Duration: 30.04.2006 to 29.04.2009

Financial Status:

Total Cost:	Rs.2.943 million
Funds Released:	Rs.1987000/-
Funds Utilized:	Rs.1821363/-

Objectives:

Characterization of dehydrins in the promising cultivars of wheat using immunoblots.
Isolationof dehydrin genes using Dhn gene probs in genome.
Determination of adaptive role of dehydrins under drought stress.
Use of dehydrin antibodies for screening the drought tolerant varieties of wheat.

Achievements:

Wheat seeds of 15 selected cultivars (Chakwal-97, Zarghoon-79, Wafaq-2001, GA-2002, Inqilab-91, Pavon, Rawal-87, Sariab-91, Punjab-85, Haider-2002, Tatara, Saleem-2000, Zameendar-80, Ufaq, Iqbal-2000) were germinated in a growth chamber at 20^{o}C for 10 hours photoperiod. Seeds were germinated on filter paper moistened with Polyethylene glycol (PEG) solutions of variable osmolarities up to three-leaf stage. Sample tissues (whole seedlings) were taken and stored at-20^{o}C. Frozen samples were used for protein extraction. The amount of protein was estimated using Bradford Reagent. 5µg protein was loaded on Polyacylamide Gel Electrophoresis (PAGE). Immunobloting with dehydrin antibody permitted the detection of dehydrin bands at MW ranging from 169 to 29 kDa.

Name of Project:	**Survey of Midges and their Natural Enemies Associated with Mango and to Develop Non Pesticides Measures for their Control in Pakistan (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: Funds Released: Funds Utilized:	Rs.4.715 million Rs. 2497500/- Rs. 882499/-

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:

The mango midges, due to their multifarious mode of feeding have become a serious threat to mango production in Pakistan. More than 20 species of midges cause damage to various parts of mango plant including bark, shoots, leaves (14 types of galls have been reported on the leaves), pre-flowering shoot buds, inflorescence buds, axis of inflorescence panicles, flowers, newly formed mustard sized fruit and post flowering shoot buds in various parts of the world.

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. Two each of the midges (*Procontarinia mangiferea* and *Dasineura amaramanjarae*) and parasitoids *(Synopeas mangiferae* and *Synopeas procon*) have been identified while identification of two other species of midges and their parasitoids is awaited.

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 occurred by the midges in sprayed and unsprayed orchards at Rahim Yar Khan to ensure the continuous supply of fresh newly formed leaves for the oviposition and further breeding of midges in controlled conditions.

Name of Project:	**Survey of Midges and their Natural Enemies Associated with Mango and to Develop Non Pesticides Measures for their Control in Pakistan (Component-II)**	
Name of PI/ Institute:	**Dr. Ghulam Jilani,** Sr. Director, IPEP NARC, Islamabad.	
Duration:	01.07.2007 to 30.06.2010	
Financial Status :	Total Cost:	Rs. 2.547 millions
	Funds Released:	Rs. 737000/-
	Funds Utilized:	Rs. 393098/-

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:

Neem seed extract in 2% concentration was evaluated against midges attack in tender mango nursery plants. Batches of untreated five plants of about one month and those treated with 2% neem seed extract at 15 days interval were kept under the canopy of mango trees having midges infestation during October to December, 2007. Midges infestation of 0.2 galls/plant was observed on untreated plants as compared with 0.08 galls/plant on December, 2007. Effect of different concentrations of neem seed extract on midges infestation in mango inflorescence was studied during March-May, 2008. There were 2.2 punctures of mites in the panicles of untreated inflorescence which were significantly higher than 1.48, 1.38 and 1.40 punctures recorded where 2.0, 1.0 and 0.5% neem seed extract was applied. Reduction in midges infestation 32.73, 37.27 and 36.36% in 2.0, 1.0 and 0.5% neem seed extract as compared with control.

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

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

Duration: 01.07.2007 to 30.06.2010

Financial Status:

Total Cost:	Rs.2.632 millions
Funds Released:	Rs.1303000/-
Funds Utilized:	Rs.1208559/-

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:

Survey and monitoring of midges were carried out only on leaves and flowers. For this purpose, ten (10) orchards of Hyderabad, Tando Allahyar and Mirpukhas districts were surveyed for gall midges on the nine varieties (Early, middle and late).The observation, collected from these districts on gall midges indicated that variety Langra and Sindhri are susceptible while the variety Began pali found resistant to mango leaf gall midges.

In un-manage garden the over all mean attack leaves were observed 2.97/branch on variety Sindhri followed by 2.76/branch on variety Langra. The over all gall midges/leaves were 35.00/ leaf on variety Sindhri fallowed 33.19/leaf on variety Langra. In managed garden the over all mean attacked leaves/branch were observed 1.22/branch on variety Sindhri followed by 1.00/ branch on variety Langra while over all gall midges/ leaves were found 5.33/ leaves on variety Sindhri followed by 4.66/ leaves on variety Langra.

The data indicated that the variety Langra and Sindhri were found susceptible while, the variety Began pali found resistant to mango gall midges (circular gall midges). The overall mean gall were 14.75/ leaves in variety Langra followed by 13.57/ leaves on variety Sindhri. The overall gall damage percentage of leaves was 15.14% on variety Langra and 13.14% on variety Sindhri. The gall infested leaves were brought in the Laboratory for emergence of parasitoids and adult.

The phonological study was carried out on susceptible variety Langra. The gall infestation was found on variety Langra. The 15-20 years old garden with good management and regular spray had less infestation of mean gall 14.75/ leaves, while in un-managed 40-50 years old garden with no spray had 23.69 galls per leaves. Similarly, in intercropping with mango has low infestation of mango midges. This may be due to availability of more moisture. This will be further investigated.

In the month of June the red colour larvae were collected from the infested inflorescences and kept them with infested inflorescence in the jars and cages for the hatching purpose of the mango gall midges in the lab conditions. The larvae were pupate in the jar and adult emerged.

Name of Project: **Investigation of 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,**
Senior Scientific Officer,
Crops Diseases Research Program, IPEP, NARC

Duration: 01.07.2007 to 30.06.2010

Financial Status:

Total Cost:	Rs.5.436 millions
Funds Released:	Rs.2121000/-
Funds Utilized:	Rs.1421398/-

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:

Field surveys of major sugarcane growing districts of NWFP and ten districts of Punjab were conducted. The samples collected were tested through DAS-ELISA against four major viruses viz. Sugarcane Mosaic Virus (SCMV), Maize Streak Virus (MSV), Maize Dwarf Mosaic Virus (MDMV) and Sugarcane Bacilliform Virus (SCBV). SCMV was found almost equally prevalent throughout the sugarcane growing areas except Peshawar in NWFP and Sargodha & Toba Tek Singh in Punjab province.

In NWFP (Mardan, Peshawar, Charsada & Dargai), relative incidences of SCMV, MSV, MAMV and SCBV in random samples were 15, 22.5, 26.25 & 16.25% 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. In Punjab (Mandi Bahaudin, Sargodha, Faisalabad, Jhang, Toba Tek Singh, Okara, Rehim Yar Khan, Bahawalpur) the relative incidences of SCMV, MSV, MDMV & SCBV in random samples 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 to be free of SCMV infection while the highest incidence among viruses in random samples was found of SCBV (95%) in Toba Tek Singh district.

Two representative isolates of SCMV one from each province are being maintained under glasshouse conditions. The number of isolates of SCMV, MSV, MDMV & SCBV (obtained from survey collection) preserved from both provinces were, 29, 25, 19 & 29 respectively.

For SCMV host range studies, wheat (Chakwal-97, NARC No.1542 & Barani-73, Sorghum (JS-62), Millet (MB-87, Super-1 & Acc. No.8808), Oats (PD2LV65), Maize (EU-5098, Rakaposhi, Islamabad Gold & Islamabad white) & Barley (Soorab-96) were tested by mechanical inoculation using the isolates of NWFP & Punjab under glass house conditions. The only crop varieties MB-87, Super-1, Acc. No.8808 (millet) & EU-5098, Rakaposhi, Islamabad Gold and Islamabad white (Maize) were found positive for SCMV through ELISA.

SCMV was successfully transmitted by mechanical inoculation as well as through two aphid species. Aphid species *(Sitobion sp. & Macrosiphum euphorbiae)* were collected from sugarcane field of NARC, Islamabad, identified and were reared on healthy plantlets of Maize, Millet, Sorghum and Oats in separate cages under glasshouse conditions. Adult form of both non-viruliferous vectors were provided acquisition-feeding period of 5 minutes each on SCMV-infected sugarcane plants in Perspex cages separately. Atleast 25 viruliferous vectors of each insect species were given inoculation feeding periods of 1, 3 and 5 minutes each separately to test plants viz. Millet (MB-87, Acc. No.8808) Oats (PD2V65), Maize (Islamabad white, Islamabad Gold, EU-5098), Sorghum (JS-62) and Barley (Soorab-96). In the case of *Sitobion sp*. 1, 3 and 5 minutes inoculation feeding periods, Islamabad Gold (Maize), MB-87 (Millet) and Islamabad white & EU-5098 (maize) were found SCMV-ELISA positive respectively while in the case of *Macrosiphum euphorbiae*, 1.3 and 5 minutes inoculation feeding period, Islamabad Gold (Maize), Islamabad white (Maize) & Acc. No.8808 (Millet) and EU-5098 (Maize) were found SCMV-ELISA positive respectively.

Field days/awareness seminars were organized on "Viral diseases of sugarcane crop and their management" at Sugarcane Research Institute, AARI, Faisalabad on 23rd June 2008 and Sugar Crops Research Institute, Mardan on 21st June, 2008.

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

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

Duration: 01.07.2007 to 30.06.2010

Financial Status:

Total Cost:	3.616 millions
Funds Released:	Rs.1691500/-
Funds Utilized:	Rs.1597248/-

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:

Survey was carried out for red palm weevil insect pest from four different locations/Taulkas viz. Kotdiji, Kingri, Rohri and Pano Akil. Five acres from each location/taulka were selected for pest scouting infestation. From each location 25 trees were observed and different stages (egg, larva, pupa and adult) of the pest were recorded visually.

The maximum percent (11.8%) of RPW was recorded at Panoakil and lowest (8.6%) at Kingri. The monthly mean temperature ranged between 26.93^{o}C to 30.5^{o}C favored the pest attack. The mean attack (10.25+6.66%) remained higher due to removal of suckers. During survey and lab studies, no natural enemies of RPW and lesser date moth were found. In life table study more mortality (73.0%) from egg to pupae was recorded in RPW in laboratory conditions.

During survey of date orchards of different talukas, all orchards were infested with fruit borer. The maximum mean infestation (13.4-16.8%) was recorded in the months of May - June in the immature fruits and maximum temperature favored the pest attack.

Name of Project:	**Development of High Yielding and Powdery Mildew Resistant Varieties in Peas**	
Name of PI/ Institute:	**Nausherwan Nobel Nawab,** Scientific Officer, Vegetable Research Institute, AARI, Faisalabad	
Duration:	01.07.2007 to 30.06.2010	
Financial Status:	Total Cost: Funds Released: Funds Utilized:	Rs. 1.474 millions Rs. 660600/- Rs. 436640/-

Objectives:

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

Achievements:

The basic objective of the project is to develop powdery mildew resistant varieties with high yield potential. Pea is an important winter season crop of high nutritional value being grown in Pakistan. The normal sowing season for this crop in Punjab is October to November. Green pods become ready during February through March. This sowing time becomes more essential as most of the seed production in peas is practiced during this period. This is the crucial time when the crop is badly affected by the powdery mildew disease, affecting the seed crop in particular.

Under the present circumstances, there is no commercial variety resistant to powdery mildew disease available with the farming community for general cultivation. Some resistant and tolerant germplasm is available, from which the gene for powdery mildew resistant/tolerant could be utilized for the development of powdery mildew resistant varieties in peas.

The project activity is in initial stage. Pedigree method was followed and F0, F1, F2 and F3 were studied to advance the next generations. Three fresh crosses were attempted. Three F1 were planted along with parents to check the purity of the crosses. One cross in F2 and two crosses in F3 were planted and high yielding and powdery mild disease resistant/tolerant plants were selected to proceed the next generations.

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,
Food Technology Section, ARI, D.I.Khan.

Duration: 01.07.2007 to 30.06.2010

Financial Status:

Total Cost:	Rs.4.099 millions
Funds Released:	Rs.401917/-
Funds Utilized:	Rs.382605/-

Objectives:

Study of maturity indexing and artificial ripening using different ripening accelerators.
Shelf life extension of Dhakki date using different drying and other preservation methods.
Storage studies of date with respect to different temperatures, environment and relative humidity etc.

Achievements:

The specific area was selected at the sites where most of Dhakki dates activities exists namely Dhakki, Paharpur, Rangpur & Paniyala. Survey completed and data regarding the amount of produce, area under date cultivation was collected. Causes of quality deterioration were assessed to find out the extent of damage to the produce. The attention was focused to examine the problems faced by the date growers regarding post-harvest losses, availability of appropriate storage and transportation facilities, technical know how about preservation methodology and technology.

The methodology for the evaluation of moisture, pH, acidity, total soluble solids water activity and browning determination was standardized. The procedure for maturity indexing was also established. The experiments on artificial ripening were set and required salt and acetic acid solutions were prepared to treat the Doka of Dhakki dates treated for stimulated ripening, colour, firmness, total soluble solids, fruit ripening %, fruit pulp and weight of the fruits determined.

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.2304700/-
Funds Utilized:	Rs.1715320/-

Objectives:

Construction of leaf cDNA libraries from CLCuV resistant and susceptible cotton lines (year-I).
Identification of differentially expressed genes (year-2).
Evaluation of isolated genes for CLCuV resistance in a model plant system (year-3).
Establishment of gene pool resource for development of Transgenic CLCuV resistant cotton lines (overall output).

Achievements:

During the first year of project execution, resources of gene pool from cotton leaf curl (CLCu) virus resistant and susceptible cotton varieties have been generated. *G. arboretum* is a diploid cotton species and is naturally resistant to CLCu disease. The CLCu virus is transmitted through whiteflies which feed on the cotton leaves and transmit the virus to phloem tissues. The virus resistance genes are expressed in leaf tissues and provide the best source for isolation of virus resistance genes. Therefore, leaves from *G. arboretum* were used to construct cDNA library from this CLCu disease resistant cotton variety. In addition, cDNA library from CLCuV susceptible cotton line (*G. Hirsutum* var. coker) was also developed to cross check and confirm the expression of potential CLCuV resistance genes selected from *G. arboretum*. The transformation efficiency and average insert size of the libraries has been determined. The glycerol stocks of the libraries and the purified clones are preserved at -80^{o}C for further use.

Identification of differentially expressed genes can also be facilitated by constructing subtractive cDNA libraries between the resistant and susceptible cotton varieties. *G. hirsutum* var. coker is reported to be highly susceptible to CLCu disease. The cDNA's synthesized from the leave mRNA of green house grown (CLCu disease free) *G. hirsutum* var. coker were used for subtraction from the field grown *G. arboretum* leaf cDNA's . the forward and reverse subtractive libraries were constructed using "PCR Select cDNA's subtractive library construction kit". (Clontech, USA). Each of the clones obtained from this libraries has been purified and preserved in glycerol at –80^{o}c. The generation of gene pool was included in the first year of the project and has been accomplished.

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

Name of PI/ Institute: **Dr. Mushtaq Ahmad**
Dy. Chief Scientist,
Plant Protection Division, Nuclear Institute of Agriculture and Biology (NIAB), Faisalabad

Duration: 01.07.2007 to 30.06.2010

Financial Status:

Total Cost:	Rs. 2.293 millions
Funds Released:	Rs. 1025500/-
Funds Utilized:	Rs. 628721/-

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 by day. Mealybug (*Phenacoccus solani*) was found highly resistant to endosulfan, profenofos, bifenthrin and deltamethrin. Mineral oil was also not effective against mealybug. Potato aphid *(Myzus persicae*) seemed to have developed resistance to all the major chemicals such as organophosphates, carbamates, pyrethroids and neonicotinoids. Cabbage aphid (*Brevicoryne brassicae*) showed no resistance to insecticides, whereas resistance in whitefly (*Bemisia tabaci*) has started developing to the new chemistry insecticides. 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 carnea.*

Name of Project:	**Development of Wheat Heat Tolerant Breeding Material during Grain Fill Period**	
Name of PI/ Institute:	**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.1001600/-
	Funds Utilized:	Rs.831129/-

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:

One hundred genotypes were grown (two sets) in earthen pots under normal conditions. After complete anthesis one set of 100 genotypes was shifted in glass house where temperature was maintained 2 to 3 degree higher than that of hottest temperature of the Punjab during that period. Data were recorded under both normal and heated conditions. The genotypes which showed better performance under heated conditions were selected for hybridization.

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.522000/- Funds Utilized: Rs.338080/-

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:

A detailed survey of rose-ringed parakeet population has been carried out around seven well distributed roosting/breeding sites. The results have shown that the bird population at these study sites ranged between 170 to 330 individuals and found to co-relates with position of tree cover at each roost, frequency of feeding sites in the locality, condition of feeding site with respect to food availability around the year, use of pest repellent or control devices in the vicinity and poaching stress at breeding sites.

Being fruit eating bird, rose-ringed parakeet has been regarded a serious universal fruit pest. During first year, damage assessment experiment has been carried out on two fruit crops i.e. Guava and Mango. Data was collected twice a day and the number of incoming and outgoing position of the birds was noted and accordingly damaged/fallen fruits were collected to

assess the volume of damage done at respective site. Guava crop was ready in the area therefore maximum data is given in the data sheets relates to this crop. Mango fruit crop is at early growth stage and immature fruit falling is natural phenomenon at this time. However, it has been observed that in some cases parakeets have started feeding on some developed fruits. Further studies on maize, sunflower and citrus will be completed successively with the sowing or fruit setting of the crops.

Name of Project:	**Genetic Biodiversity Improvement of Nuts (Almond and Walnut in FATA**	
Name of PI/ Institute:	**Dr. Syed Asghar,** Senior Research Officer (Horticulture), Agricultural Research, FATA, Kurram Agency, Parachinar.	
Duration:	01.07.2007 to 30.06.2010	
Financial Status:	Total Cost: Funds Released: Funds Utilized:	Rs.1.495 million Rs.233500/- Rs.221850/-

Objectives:

To collect promising varieties of walnut and almond
To conduct primary selection in the species
To preserve superior germplasm by in vivo techniques to use as scion wood for future regeneration
To multiply the outstanding varieties in the nurseries to produce disease free, true-to-type plants of the species.

Achievements:

The general survey of the area shows that there is diversification in the indigenous material of almond and walnut, and there is great need for conservation of this material through conventional methods of multiplication. Similarly, the observations recorded through the field experiments have revealed that there are great variation in the germination data of hard, semi hard and thin shelled nuts of almond and walnut. These observations are not enough to draw a conclusion and, therefore, long-term experimentations are needed for the final recommendation of seed type as a root stock.

Name of Project:	**Mass Production of Biocontrol Agents for Field Application**	
Name of P.I/ Institute	**Dr. Saleem Shahzad,** Assistant Professor, Department of Botany, University of Karachi, Karachi.	
Duration:	10.08.2005 to 30.06.2008	
Financial Status:	Total Cost: Funds Released: Total Expenditure:	Rs.1.145 million Rs.683400/- Rs.552000/-

Objectives:

Evaluation of different substrates for mass production of biocontrol agents.
Field application of biocontrol agents for the control of root-rot and root-knot disease of crop plant.

Achievements:

During the study, nine different organic substrates viz, rice grains, sorghum grains, wheat grains, millet grains , wheat straw, rice husk, cow dung, sawdust and poultry manure were used for mass multiplication of biocontrol agents viz; *Trichoderma harzianum*, *T. polysporum* and *T. pseudokoningii*, *Rhizobium sp; Bradyrhisobium sp;* and *Gliocladium virens*. Sorghum grains were found to be the best substrate for *Trichoderma* species and *Rhizobium sp;* millet grains were best for *Bradyrhizobium sp*; whereas, rice grains were best for *Gliocladium virens*. Grains were generally found more suitable for multiplication of biocontrol agents than wheat straw, rice husk, cow dung, sawdust and poulty manure. Dextrose and sucrose were found to be the most suitable carbon sources for *G. virens, Trichoderma species, Rhizobium* sp. and *Bradyrhizobium* sp. Similarly, the best nitrogen sources were ammonium nitrate for *Trichoderma* species, sodium nitrate for *G. virens* and NPK for *Rhizobium sp;* and *Bradyrhizobium sp.* Amendment of selected C and N sources to organic substrates resulted in great growth and significantly higher population than the organic substrates alone.

Name of Project: **Development of Botonical Pesticides from Traditionally used Plant Derivatives Against Stored Grain Pests.**

Name of PI/ Institute: **Dr. Ghulam Jilani,**
Senior Director,
Institute of Plant and Environmental Protection, NARC.
Islamabad.

Duration: 21.07.2005 to 31.12.2008

Financial Status:

Total Cost:	Rs.3.385 million
Funds Released:	Rs.2208000/-
Funds Utilized:	Rs.1635000/-

Objectives:

Determination of pest control properties of indigenous plant derivatives.
Preparation of effective formulations based on active plant extracts/fractions.
Demonstration of botanical pesticide based Integrated Pest Management of stored grain insects.

Achievements:

A. Repellency Studies: (i) Repellency of plant extracts against *Triboleum castaneum*: Out of the Seven promising plants (viz roots of "*Kuth" Saussurea lappa, "Balchar" Valeriana jatamansi*, seeds of "Harmal" *Peganum harmala*, "Neem" *Azadirachta indica*, rhizomes of "Turmaric" *Curcuma longa*, "Sweetflag" *Acorus calamus* and leaves of "Ner" S*kimmia laureola). Acorus calamus* showed the highest average repellency of 76.54 percent at 1000 µg/cm^2 followed by 64.21 and 62.23 percent at 500 and 250 ug/cm2 respectively against *Triboleum castaneum* (for a material to be promising repellent, it should have 40 percent or higher average repellency over 8 weeks test period against *T. castaneum*). It was followed by *Azadirachta indica* which had 61.58, 55.86 and 51.17 percent repellency at 1000, 500 and 250 µg/cm^2 respectively.

(ii) Repellency of plant extracts against *Rhizopertha dominica*: The highest average repellency of 49.38% was shown by *Saussurea lappa* at 500 µg/cm^2, *Valeriana jatamansi, Acorus calamus* and *Azadirachta indica* also showed high repellency. Petroleum ether was better than acetone and ethanol for preparing repellent extracts. The repellency was dose-development and time-dependent. It was high in the first week and decreased progressively in the fourth and eighth weeks.

*B. Growth Inhibition Studies***:** (i) Oviposition Inhibition: The lowest number of 50.75 eggs was laid by *T. castaneum* fed on wheat flour treated with extracts of *C. longa* at 1000 ppm which were significantly lower than 87.67 in control. However, highest egg hatching inhibition of 27.76 percent was shown by *A. calamus* at 1000 ppm. There was no significant difference in plants and solvents used for extraction on oviposition and hatching.

(ii) Larval Inhibition: All the plants had significant effect on larval development as compared with control except *S. laureola* at 250 ppm. Minimum number of larvae were 32.42 at 1000 ppm of *A. calamus* followed by 33.08 in *A. indica* at 250 ppm as compared with 67.58 in control.

(iii) Pupal inhibition: Maximum pupal inhibition of 46.20 percent was recorded in *A. indica* at 250 ppm. It was followed by 45.00 percent inhibition in *C. longa* at 1000 ppm and *V. jatamensi* at 500 ppm.

(iv) Adult Inhibition: Minimum number of 19.58 adults were recorded in *A. indica* at 250 ppm followed by 20.33 in *A. calamus* at 1000 ppm as compared with 59.75 in control which was significantly higher. All the plants had significantly lower number of adults than in control. Among solvents, ethanol exhibited 7.22 percent inhibition as compared with significantly lower 5.05 and 2.99 percent inhibition in acetone and petroleum ether extracts.

C. Chemical Studies: A. calamus being the most promising repellent against *T. castenaum,* its petroleum extract was further selected for chemical fractionation by thin layer chromatography and column chromatography. Out of six fractions obtained, F1 had the highest average repellency of 91.38 percent which was not significantly different from 80.13, 76.88 and 85.00 percent in F3, F5 and petroleum ether extract of *A. calamus*. All the fractions persisted well for eight weeks except F2 showing 37.00 perecent repellency in the eighth week. Highest average repellency of 83.31 percent was exhibited in the first week followed by 78.25 percent in the second week. There was no significant decrease in repellency in the second week. However, it dropped significantly to 69.13 and 54.44 perecent in the forth and eighth weeks.

D. Field Studies: Being a promising repellent and growth inhibitor, petroleum ether extract of *P. harmala* was evaluated as grain protectant in the public sector food grain godowns. It was applied to 100 Kg gunny bags before storage of grains and compared with *A. indica* oil-the standard and PEPF Technology (Polyethylene enclosure and Phosphine fumigation). During fortnightly sampling infestation of *T. castaneum, R dominica, Oryzphilus surinamensis, Trogoderma granarium* and *Sitophillus oryzae* was recorded in the grain samples. Population of these pests in the bags treated with *A. indica* oil and petroleum ether extract of *P. hermala* were almost at similar level but prominently lower than that of control. However, their population was slightly higher in *P. hermala* than that of *A. indica* oil especially after September. Insect population in the bags applied PEPF was the lowest but close to that of *A. indica* oil. Population level remained higher in control than those in the treated bags. Generally pest population remained lower due to disturbance in inventory of godowns because of wheat flour crisis.

Five research papers have been published in scientific journals from project work. Two students have completed their research in the project for their master degree program.

Name of Project: **Hybrid Seed Production of Rice**

Name of P.I/: **Dr. Muhammad Akhtar**,
Institute: Rice Botanist,
Rice Research Institute, Kala Shah Kaku

Duration: 10.08.2005 to 30.06.2008

Financial Status:

Total cost:	Rs.1.483 million
Funds Released:	Rs.1466300/-
Funds Utilized:	Rs.1452931/-

Objectives:

To develop hybrid rice seed production technology.
To develop Basmati and coarse rice hybrids in the Punjab.
To enhance per hectare yield of the Punjab.
To increase the farmers income from the same piece of land.
To boost up rice export and foreign exchange earnings.

Achievements:

Ten rice hybrids have been developed and evalauted for yield and grain quality characteristics. From 170 testcrosses, 7 restorers, 33 partial restorers, 19 partial maintainers and 10 maintainers were categorized. Fourteen back crosses were attempted from the back cross nursery and thirty four new back crosses were made.

One hundred sixty nine entries were evaluated in Source Nursery-1 and 218 lines were planted in Source Nursery-2 and 3. Desirable lines from source nursery were utilized for making 152 fresh testcrosses. Out of these, 148 successful testcrosses were harvested for further evaluation.

For hybrid seed production, the row ratio 2:10 (Restorer: CMS) gave the maximum seed yield i.e. 1.5 t/ha. The TGMS line IR 73834-21-26-15-25-4 produced the maximum seed (0.815 kg) at Swat and (0.47 kg) at Farhatabad followed by IR75589-31-27-8-33 which produced 0.598 kg seed at all the locations. Seven hundred and eighty six (786) lines from AxR and RxR crosses of F2 to F7 filial generations were studied during 2006-07. At maturity, 790 single panicles were selected on field performance basis for further studies in the subsequent filial generations. Nine hundred and fifty three (953) lines from AxR crosses and RxR crosses of F2 to F8 were studied in the field. At maturity 208 single panicles were selected on field performance basis. Fifteen uniform lines were also selected. To transfer cms system in to nuclear background of elite maintainer lines, 58 back crosses were studied and desirable plants were again backcrossed with the male parents. From 235 testcross hybrids, fourteen (14) restorers and twenty one (21) maintainers were categorized on the basis of pollen and spikelet sterility/ fertility studies. The frequency of restorers were (6%) and maintainers (9%) respectively.

Twenty three cms lines were maintained along with their maintainers. From these, IR58025A, IR79156A, IR68897A, IR68886A were selected for the development of hybrid rice on the basis of their better floral and agronomic characteristics. LG 141, PK7868-3-1-1, IR63870-123-2-2-2-2R, Basmati 385, Basmati 198, PK 7375-2-3-7-1 were identified as potential restorers. LH-69, LH72, LH-76, LH-64 and LH-39 two line rice hybrids are selected having better quality and agronomic characters than the approved check variety. Among three line hybrids, LH-1, LH-18 and LH-19 are selected for large scale testing and these hybrids can be approved for general cultivation. Twenty seven Kg seed of CMS line IR58025A and 3 Kg seed of IR 75596A were produced for its maintenance and the production of rice hybrids. Seed quantity of LH-1 (30 gram), LH-16 (70 gram), LH-17 (120 grams), LH-18 (540 gram), LH-20 (210 gram), LH-21 (290 gram), LH-22 (520 gram) and LH-23 (30 gram) was produced. Furthermore, seed of ten test hybrids was also produced for their evaluation. Besides this, seed of forty five new two line hybrids was multiplied.

Name of Project:	**Development of High Yielding, Disease Resistance Varieties of Groundnut through Hybridization and Mutation Breeding alongwith Nodulation Studies for N2 Fixation under Rainfed Conditions.**	
Name of PI/:	**Mr. Naeem-ud-Din,**	
Institute:	Botanist, Barani Agriculture Research Institute (BARI), Chakwal	
Duration:	22.07.2005 to 30.06.2008	
Financial Status:	Total cost:	Rs. 3.221 million
	Funds Released:	Rs. 2949700/-
	Funds Utilized:	Rs.2945172/-

Objectives:

To enhance the production per unit area by developing high yielding, disease resistant, drought tolerant, good quality varieties of groundnut.
To minimize the use of nitrogenous fertilizers through enhancement in nodulation ability.
Provision of good quality seed to groundnut growers.

Achievements:

Eight advance lines along with two check varieties; BARC-2000 and Golden were evalauted for their yield performance at BARI-Chakwal. In this trial only one entry 02CG002 gave higher pod yield (3222 kg/ha) than check variety Golden (3157 kg/ha). Entry 02CG007 gave the lowest yield (2593 kg/ha). Three promising lines /varieties are evaluated for their yield potential under different ecological zones. New promising line 2KCG020 gave higher yield as compared to two approved varieties; Golden and BARI-2000 sown at 7 different locations with average yield 2595 kg/ha, followed by approved varieties having yields Golden 2201 kg/ha and BARI-2000 1930 kg/ha. This line gave excellent results with yield 3462 kg/ha at Tamman, Distt; Chakwal in barani conditions and gave yield 3313 kg/ha in irrigated conditions at Piplan.

Six fungicides/chemicals were tested for the control of Cercospora leaf spot. An in-vitro experiment containing 12 different chemicals was conducted. Peanut seeds infested with dry spores of *Aspergillus niger* inoculum treated with chemicals were plated. Data on seed germination and seedling rot were recorded when all seeds in any one of the plates germinated. Maximum seed germination (80%) recorded in Top 333 and check followed by Propeneb (70.8%), Maximum seedling rotted (30%) in Thiophanate methy 13 year old and check.

Studies on bio-efficiency of seed dressing fungicides on peanut seeds were conducted in growth rooms of plant pathology section. As in earlier studies Topsin M and Propeneb performed better than other fungicides so to study their synergistic effect these were mixed as

a new treatment. Disease incidence data were recorded after 35 days of sowing. Propeneb, a foliar fungicide, Thiophanate methyl + Propeneb and Benzimedazole are at par with each other (100% Bio efficiency).

To study the effect of fungicides on peanut seeds infested with *A. niger* were sown in infested soil. Treated with thiophanate methy1, Thiophanate methy1 + Propeneb and propeneb alone trial was conducted in earthen pots. Disease germination, root length and rotting of seeds were recorded after five days of seed sowing. The results indicate that Thiophanate methy1 + Propeneb is the best combination for peanut seed treatment.

Two advance lines along with check variety Golden were evaluated for assessing the effect of NPK and Ca fertilizer on nodulation and other desirable traits under field conditions at BARI, Chakwal. The maximum mean yield of 2565 kg/ha was recorded with application of 20-120-20 kg NPK/ha+ 500kg gypsum/ha; while the control (no fertilizer & gypsum application) secured the bottom position with yield of 1679 kg/ha. The genotype 02CG005 produced significantly higher pod yield (2189 kg/ha) than 2KCG020 (2088 kg/ha) and Golden (2034 kg/ha). Interaction of genotypes and fertilizer treatments showed that 02CG005 gave the highest pod yield (2885 kg/ha) with fertilizer dose of 20-120-20 KG NPK/ha plus 500kg gypsum/ha. Maximum weight of nodules/plant (Average of three repeats in each treatment) was recorded with the application of 20-120-20 kg NPK/ha + 500 kg gypsum/ha (1.175G) followed 20-80-30 KG NPK/ha + 500kg gypsum/ha (1.103g). The entry 02CG005 produced higher weight of nodules/plant (1.028g) than Golden (0.913 g) and 2KCg 020 (0.804G).

Sowing of 217 blocks for nucleus seed production was done. All other agronomic practices were kept uniform. Gypsum @ 500 kg/ ha was also applied on 19-07-2007. Fifteen hundred kg nucleus seed BARI-2000 was produced and was available for distribution/sale among groundnut growers.

Name of Project:	**Investigation on Disease Control of Die Back/Citrus Decline in NWFP.**	
Name of PI/:	**Dr. Mahmood Khan,**	
Institute:	Plant Pathologist, Agricultural Research Institute, Tarnab, Peshawar	
Duration:	16.08.2005 to 30.06.2008	
Financial Status:	Total Cost:	Rs. 2.838 million
	Funds Released:	Rs. 2806600/-
	Funds Utilized:	Rs.2764681/-

Objectives:

To find out the biotic and abiotic factors responsible for citrus die back/decline in the major citrus growing areas of NWFP.

To find the most effective, safe and economical control measures for the solution of the problem.

Train farmers on the use of integrated disease management practices for citrus die back.

Achievements:

From study of isolation of the various fungi from plant parts and soil samples, it seems that *Phytophthora sp*; *Fusarium sp*; and *Diplodia sp*. are responsible for affecting the bark and roots of citrus trees. Presence of nematodes also indicate that this pathogen is part in the causal complex. *Colletortichum gleosporides* being a weak pathogen may be colonizing the twigs of already stressed trees by the soil pathogen. The deficiency of major nutrients is also making the trees prone to the attack of fungi and nematodes. The information obtained through the field experiments reveal that great variation existed in the yield data from plant to plant in the same treatment showing that in orchards one year data will not give any meaningful information on which some conclusion could be based. Therefore, long-term experiments are needed to find some solid solution for the problem. A brochure titled "Die Back of Citrus" in Urdu language has been published.

Name of Project:	**In-Situ Evaluation of Indigenious Walnut Germplasm in Malakand Division, NWFP, Pakistan**	
Name of PI/ Institute:	**Mr. Jamshaid Khan,** Director, Agriculture Research Station, Mingora, Swat	
Duration:	20.08.2005 to 30.06.2008	
Financial Status:	Total Cost:	Rs.0.784 million
	Funds Released:	Rs.673200/-
	Funds Utilized:	Rs.670607/-

Objectives:

Identify promising walnut genotypes growing wild in Malakand Division.
In situ evaluation of local germplasm to select promising genotypes for Horticultural purpsoes (i.e, variety evaluation).
Incorporate the selected types in the routine fruit variety evaluation against exotic types.

Achievements:

Walnut growing areas of Malakand Division, including districts Swat, Chitral, Dir Upper and Dir Lower were surveyed for the identification and evaluation of desirable walnut genotypes. Nut samples from 123 genotypes including 74 from district Swat, 29 from twin Dir Districts, 20 from Chitral were collected and compared with exotic approved varieties for several nut quality traits. Preliminary data revealed that several indigenous genotypes excelled exotic approved walnut varieties in various nut quality traits including nut diameter, nut length, in-shell nut weight, kernel weight and kernel percentage. Among these genotypes, 46 desirable types were selected for further in-situ evaluation. Phenological data was also recorded on the selected genotypes.

Name of Project:	**Utilization of Genetic Variation in Yield Response to Drought Stress for the Development of Improved Wheat Germplasm**	
Name of PI/:	**Dr. Muhammad Yaqub Mujahid,**	
Institute:	Principal Scientific Officer/Coordinator Wheat Programme, NARC, Islamabad	
Duration:	08.09.2005 to 30.06.2008	
Financial Status:	Total Cost: Funds Released: Funds Utilized:	Rs.3.861 million Rs.3211900/- Rs.2711914/-

Objectives:

To develop the improved wheat germplasm adapted to drought stress through the use of new genetic variability.

To create genetic variability for drought resistance/tolerance in the wheat germplasm through hybridization.

Exploration of the amount of appropriate genetic variability for drought resistance in the species.

To know the physiological and biochemical aspects of drought resistance especially in relation to osmotic adjustment and water relations.

To identify and recommend desired genotypes for cultivation in rainfed, canal tail end and water shortage areas.

To identify possible molecular markers for drought tolerance.

Achievements:

Progress has been made in terms of, advancement of breeding generations, preliminary and advance line yield testing, multilocation yield trials and national testing of the available wheat genotypes and utilization of genetic variability to develop the desirable new recombinants with the use of diverse parental material having drought and disease resistance traits specially for stem rust race of Ug99.

233 segregating population (F2-F7) developed in the program and received from overseas are further enhanced in the subsequent generations at NARC and Summer Wheat Nursery, Kaghan to enhance the breeding generations and fix the homozygosity. 300 fixed lines developed through breeding and selected from international trials/nurseries, were tested in the preliminary and advance line yield. These trials have shown encouraging results in terms of yield advantage under local rain fed conditions.

Nine promising genotypes (NR's) developed at NARC were tested over seven locations under moisture stress conditions to identify stable and widely adapted lines over a varying degree of changing environments. Top yielding lines have been identified with yield

advantage of up to 30% over the local checks and will be further tested in the coming years in the regional and national trials over a wide range of rain fed ecology and areas with limited water availability.

Two hundred new recombinants were developed through hybridization involving the diverse parental material from national and international research institutes. The desirable traits like drought resistacne/tolerance, disease resistance (especially against three rests), yield and yield components and wide adaptation in the target environments were incorporated to develop the improved wheat germplansm for the rainfed areas of Pakistan.

Name of Project:	**Adoptation and Promotion of Ultra Low Volume (ULV) Pestisides Sprayer**
Name of PI/ Institute:	**Dr. Abdul Rehman Tahir,** Associate Professor, Department of Farm Machinery, University of Agriculture, Faisalabad
Duration:	21.10.2005 to 30.06.2008
Financial Status:	Total Cost: Rs.2.3870 million Funds Released: Rs.1009000/- Funds Utilized: Rs.855403/-

Objectives:

The overall objective of this study is to transfer ULV sprayer's technology and promote its application among the farmers. Specific objectives include:

To appraise socio-economic and technical problems being encountered in the adoption of ULV sprayers.

To transfer ULV sprayers technology by fabricating handheld and tractor mounted ULV sprayers using local materials and workmanship.

To evaluate the performance of locally developed ULV sprayers by conducting laboratory and field trials in terms of aerial coverage, droplet size/distribution and air pollution.

To promote adoption of locally developed ULV sprayers among farmers and agro industry through field demonstration, seminars, newspapers and electronic media.

Achievements:

In order to know the problems in adoption of ULV sprayer, a socioeconomic and technical survey of manufacturers, pesticide dealers, scientists and farmers was conducted. Survey revealed that presently, single nozzle handheld Ultra Low Volume (ULV) sprayers are being imported from abroad mostly by Syngenta are not easily available to many farmers. Moreover, awareness of farmers and sprayers manufacturers about advantages of ULV sprayers is very poor which seems to be a major hindrance in the adoption of this sprayer. A few minor problems in the use of ULV technology may the availability of pesticide formulation, drift during spray and social problems. ULV is mostly being used for 4 to 5 sprays of cotton out of total 8 to 9 sprays. Survey shows that the use of ULV sprayer has increased during last 5 years among farmers especially during humid and rainy season when tractor mounted boom sprayers can not be used. Farmers reported that ULV is effective to control bollworms like American bollworm, sotted bolworm, pink bollworm and not good for flying insects (whitefly, mites, thrips, etc) Further, the efficacy of ULV spray is 80% as compared to 50% in case of knapsack and boom sprayers. Due to its high efficacy the spray interval of ULV is 11 days as compared to 7 days in case of knapsack sprayer. ULV formulations are available and therefore, it is not a problem in the adoption of ULV sprayer.

Most of the farmers and farm supervisors are not fully trained and educated about the use of ULV sprayers. Resultantly, under/over-dosing spoil the crop and farmers attribute this drawback to ULV machine. A major social problem in the adoption of ULV sprayer is its invisible spray drops which give an impression to the farmers that spray has not been applied since they are used to see mist while using knapsack and boom sprayers. Testing of locally manufactured ULV sprayers have shown leakage problems which not only leads to wastage of pesticide but also a hazard to human and animal health. Nozzles supplied by local manufacturers are imprecise resulting into overdosing. The spinner speeds are not standardized which could lead to different droplet size and spray density. Mesurement of droplet size using water sensitive paper and scanner has been tried with the help of a computer software. Microscope coupled with digital camera which is in the process of import will also be used to measure droplet size.

Name of Project:	**Utilization of Allclopathic Properties of Sorghum, Sunflower and Brassica For Weed Management In Some Field Crops**	
Name of PI/ Institute:	**Dr. Zahid Atta**, Professor, Weed Science Laboratory, Department of Agronomy, University of Agriculture, Faisalabad.	
Duration:	02.08.2005 to 30.06.2008	
Financial Status:	Total Cost:	Rs.3117000 million
	Funds Released:	Rs.1119600/-
	Funds Utilized:	Rs.951391/-

Objectives:

- Evaluate suppressive effects of allelopathic crop when used as intercrop and in rotation in various cropping systems.
- Explore the possibility of using different crop water extracts alone and in combination for weed control in major field crops.
- Investigations for reducing the herbicide doses in combination with natural allelopathic substances.
- To develop a handy and effective concentrated formulation of allelopathic water extracts that is economical and environmentally benign.

Achievements:

Allelopathic crops viz sorghum and sunflower were raised and their water extracts prepared in the Weed Science Laboratory. Field experiments were conducted on rice, maize and cotton. Allelopathic properties of sorghum, sunflower and brassica were used for weed management in rice, maize and cotton. Results of the experiments revealed that these crops offer great potential for suppression of weeds. Combination of allelopathic water extracts sorghum, sunflower and mulberry with reduced doses of herbicides gave significant weed control in rice, maize and cotton which was comparable to full doses of herbicides. It can be concluded on the basis of results of the studies that allelopathic properties of sorghum, sunflower and mulberry not only provide excellent weed control but are also safe for environment through reducing reliance on synthetic herbicides.

Name of Project: **Sustainable Approaches toward Adaptatin of Sorghum and Millet Improved Varieties for Grain and Fodder Purpose in Rainfed Areas of Kohat Division**

Name of PI/ Institute: **Mr. Mirza Hassan,**
Research Officer,
Barani Agricultural Research Station, Jarma Kohat, NWFP.

Duration: 10.04.2006 to 31.03.2009

Financial Status:

Total Cost:	Rs.1.476 million
Funds Released:	Rs.1196500/-
Funds Utilized:	Rs.1077400/-

Objectives:

Collection and Introduction of Germplasm from local and exotic sources.
Screening and selection of high yielding Genotypes under agro-climatic conditions of Kohat and their dissemination in the farming community.
Dissemination of new high yielding and drought tolerant varieties in the area.
Development of better production technology and its dissemination among the farmers.

Achievements:

Sorghum varieties/lines RARI-S-4, CSL-13, RS-29, SV-15, No.1863 and DS-03 were found the highest grain yielding varieties with grain yield of 5100, 4723, 4666, 4300, 3150 and 2806 kg per hectare respectively. Sorghum varieties/lines Hegari, JS-2002, Sandalbar, JS-263 and Johar were the highest fodder producer with 28850, 28666, 28000, 27778 and 23583 kg per hectare respectively. Millet varieties/lines DB-03, No.786, KG-98 and Supper-1 produced grain yield of 2383, 2066, 1900 and 1685 kg per hectare respectively, while fodder No.786, Supper-I and DB-03 produced fodder yield of 39583, 39266 and 33800 kg per hectare respectively. The above mentioned varieties/lines performed well in the agro-climatic conditions of Kohat and are being recommended to farmers for cultivation.

Name of Project:	**Investigation of Citrus Decline and Preliminary Management Studies In Punjab**	
Name of PI/ Institute:	**Ms. Khurshid Burney,** Senior Scientific Officer, CDRP, NARC, Islamabad	
Duration:	21.07.2005 to 30.06.2008	
Financial Status:	Total Cost: Funds Released: Funds Utilized:	Rs.2.801 million Rs.2501600/- Rs.243043/-

Objectives:

Survey of Citrus growing areas and citrus nurseries of Punjab.
Investigation of the presence of the pathogen in citrus nurseries.
Isolation of pathogens from diseased plant and soil samples.

Achievements:

Surveys of citrus growing areas of Punjab comprising Sargodha, Sahiwal, Toba Tek Singh, Faisalabad, Jhang and Kasur (Pattoki) were conducted for assessment of citrus decline and collection of diseased plant and soil samples. The decline in citrus has been investigated through multidisciplinary approach. During the first year surveys, it was noticed that citrus nematode is prevalent in all the citrus grooves except on Sweet lime (Mitha). Kinnow and Rough lemon are highly susceptible to citrus nematode.

The percentage of different fungal pathogens of 152 plant samples analyzed was *Fusarium* 59, *Nattrassia* 10, *Diplodia* 4 and *Phytophthora* 2. An average of 26% of diseased leaf samples tested positive for *Spiroplasma citri* by amplification of the pathogen DNA using universal primers for mycoplasma. Soil was analyzed for presence of plant parasitic nematodes by Baermans funnel technique. A total of 152 soil samples revealed that most frequently present plant parasitic nematode in the soil is *Tylenchulus semipenetrans* being present in 38% of soil samples. Among the districts 100% samples from Jhang are infested with this pathogen and the least infested district is Sahiwal. Seven citrus nurseries were visited in Pattoki and soils of three have been found infested with *T. Semipenetrans*. The rootstock of Rough Lemon and Sour Orange that are mostly used for citrus are both found to be highly susceptible to the nematode.

Fungi isolated have been assessed for their pathogenecity in available environmental conditions on different citrus rootstock that are already being used with new ones.

Soil samples from different districts have been analyzed for NPK and micro nutrients, Boron, Zinc, Manganese and Iron.

Incidence of CTV and Spiroplasma is prevalent in most of the citrus growing areas of Punjab. Some of the samples showing clear symptoms of CTV were -ive. These symptoms can be due to Viroids for which further work needs to be be done. Spread treatment of nematicide and fungicide is more affective than band treatment.

Pathogenecity test of fungi and nematode isolated was performed in controlled conditions using Rough lemon seedlings. *Fusarium solani, F. oxysporium, Nettrrasia manginefera* and *Phytophthora citrophora* and plant parasitic nematode *Tylenchulus semepnetrans* were found pathogens. Four root stocks sweet lime, trio citrange, rough lemon and sour orange were screened against the same pathogens in the green house. The results show that disease symptoms appear earlier in plants inoculated with fungi together with the nematodes.

Assessment of soil after three months from under citrus trees treated with Furadan at NARC show a decrease in the number of nematode population. Spread application seems to be better than band application of Furadan.

A workshop was arranged at Orange Research Institute, Sargodha where citrus growers were briefed on proper management and cultural practices of citrus.

Name of Project:	**Selection of Zinc Efficient Wheat Genotypes for a Balance Human Nutrition**	
Name of PI/ Institute:	**Dr. Muhammad Imtiaz,** Senior Scientific Officer, Nuclear Institute of Agriculture, Tandojam, Sindh.	
Duration:	11.10.2005 to 10.10.2008	
Financial Status:	Total Cost:	Rs.1.705 million
	Funds Released:	Rs. 997600/-
	Funds Utilized:	Rs.916266/-

Objectives:

To assess Zn contents in the seed of different wheat cultivars existing in Pakistan.
To assess the capability of different wheat cultivars for absorbing Zn from Zn deficient meddium.
To study the mechanism(s) which govern the utilization efficiency of Zn in wheat.
To identify the gene involved in higher uptake of Zn in Zn-efficient cultivars and transfer it to high yielding Zn-inefficient cultivars to utilize Zn for better human nutrition.

Achievements:

Mineral elements like Cu, Fe and Zn are very crucial for human health and play a key role in various biochemical processes. The daily dietary requirement of a young adult human being ranges from 1-60 mg for Fe, 2-3 mg for Cu and 15 mg per day for Zn. Intake less than these values can slower physiological processes. The information on the reserves of these elements in staple foods like wheat is scarce.

In the present study, 78 bread wheat genotypes were analyzed for these nutrients. Zinc concentration in the seeds of different wheat genotypes ranged from 12.7 to 55.5 μg^{-1}, when determined on oven dry weight basis. The genotype SI-9965 showed the highest accumulation of Zn (55.5 μg^{-1}; whereas, the lowest Zn concentration was recorded in Maxi Pak (12.7 μg^{-1}). The relative Zinc (Zn) efficiencies of 40 cultivars were determined by growing them in chelate-buffered culture solutions. Zinc efficiency, determined by growth in a Zn-deficient solution relative to that in a medium containing an adequate concentration of Zn, was found between 32.80 and 71.89% amongst the cultivars tested. Out of the 40 cultivars tested, 19 proved to be Zn efficient, 09 were Zn-inefficient, while remaining 12 varieties were classed as intermediate. The most Zn-efficient cultivars included: Drawar-95, Bakhtawar, ZA-77 and TJ-83 while the most Zn-inefficient included, RWM-9313, Maxi-pak, Uqab-2000 and Chakwal-86. Zinc-efficient cultivars accumulated greater amounts of Zn in their shoots, than inefficient cultivars but the correlation between shoot-Zn and shoot dry matter production was poor. All the cultivars accumulated higher concentrations of iron (Fe), copper (Cu) and manganese (Mn) at deficient levels of Zn, compared with adequate Zn concentrations. The Zn-inefficient cultivars accumulated higher concentrations of these

elements at Zn deficient level compared to efficient cultivars. Twenty wheat genotypes (classified as Zn efficient and Zn-inefficient in hydroponics study) were tested under field condition to assess any change in their Zn efficiency or in their response to Zn fertilization. The efficiency of these genotypes was enhanced under field as compared to the hydroponics conditions which varied between 48.5 to 94.2%. However, these genotypes maintained their ranking of Zn efficiency assigned to them in hydroponics study.

In another study the mechanism of Zn efficiency was determined using higher levels of P and by assessing the mycorrhizal infection on roots. The results showed that Zn efficient genotypes have extracted 72 and 17% higher Zn at P 25 and 250 mg kg^{-1} soil respectively, compared to Zn inefficient genotypes. The roots of Zn efficient genotypes have greater association with mycorrhiza and have up to 96% infestation at lower level of P and Zn, however, the infestation was reduced to 23% with heavy application of P even in the presence of Zn. Zinc inefficient genotypes have significantly lower infestation ranging from 10% to none.

Another study was conducted to screen out wheat genotypes for Zn efficiency through molecular markers. The Zn primer was designed for the identification of Zn-efficient genotypes through molecular markers. An STS is a short stretch of genomic sequences that are used as landmarks in genome mapping and can be detected by the Polymerase Chain Reaction (PCR). These results provide valuable information for fingerprinting at molecular level and more efficient selection of genotypes for crossing and enhancing wheat breeding strategies.

Name of Project:	**Production of Doubled Haploids of Wheat by using Wheat X Maize Crosses Technique**	
Name of PI/ Institute:	**Dr. Abid Mahmood,** Director, Barani Agricultural Research Institute, Chakwal,	
Duration:	26.07.2005 to 30.06.2008	
Financial Status:	Cost of the Project: Funds Released: Funds Utilized:	Rs.3.817 million Rs.3657400/- Rs.3585974/-

Objectives:

Reduction in variety evolution period (breeding period) from 12 to 4 years.
To increase the durability of varieties by having 100% homozygosity which is not possible by conventional breeding method.
Transfer of this modern technology to other scientists in the country will be done.
Production of drought tolerant, good quality and high yielding varieties for Barani areas.
Create maximum variability to develop germplasm of specific nature for the utilization of lines in crossing programme.

Achievements:

Based on screening for drought tolerence, yield and quality, sixteen wheat x wheat crosses were made during 2006-07 crop season. In addition, fifteen croses from regular breeding programme were also used for doubled haploid (DH) production. These F1 seed of crosses, along with their parents were planted after 7-days interval in green house (10-earthen pots for each genotype) and in field (1 line for each genotype). Simultaneously six genotypes of open pollinaed maize genotypes including popcorn were also sown in green house (10 pots each) as well as in field prior to onset of winter (1 line for each genotype) so that continuous supply of wheat spikes and maize pollen for wheat x wheat and wheat x maize crosses may be ensured.

Seed Multiplication of Doubled Haploid (DH) Lines: The seeds obtained from doubled haploid plants were grown in pots in green house. Seeds from these DH plants-in-pots were collected at maturity. The seed of thirty three DH lines was planted under field conditions. Data for days to heading, anthesis and quantity of seed produced of each DH line was recorded.

Hybridization of Wheat Genotypes: New parents selected for various important drought related features were also included in the crossing programme. Parents selected on the basis of previous years screening and new parents were utilized. Sixteen wheat x wheat crosses were made.

Haploid Production: The collected germplasm was screened for drought tolerance, yield and quality parameters (protein%) during first and second year. The crosses were made to combine desirable traits. A total of 31 F1s of wheat x wheat crosses attempted during last year were utilized for production of doubled haploids through maize crossing. In addition to these F1s, sixteen cultivars were also utilized for haploid production. The wheat x maize crosses were attempted under green house and field conditions. Cut tiller method was also utilized during peak anthesis season. Wheat spikes of F1's after emasculation were pollinated with maize genotypes. The pollination was followed by injection of 2,4-D in peduncle and drop of this solution on each pollinated floret. Emasculated wheat spikes were pollinated with maize pollen of cultivar popcorn. The tillers were injected with 100 g/1 of 2-4, D solution to the uppermost inter-node of wheat spikes one day after pollination. One drop of 2, 4-D solution was also applied to each pollinated floret. Fourteen to sixteen days old caryopsis (light green colored seeds) were harvested for embryo rescue. Harvested embryos were cultured on MS and B5 salts supplemented with 20 g/1 sucrose and 8 g/1 agar. Embryos were incubated at 18-24C^{o} (in the dark). From the embryos rescued during last year, fifty four haploid plants germinated from embryos recovered from F1 crosses and after colchicines application 33 of them matured to produce seed that were subsequently planted in the field for seed multiplication. The parents have been identified, crosses have been made and the techniques for embryo rescue have been standardized.

Name of Project:	**Biochemical and Molecular Approaches to Study the Effect of Pesticide on Nitrogen Fixing Bacteria In Legumes.**	
Name of PI/ Institute:	**Mr. Sohail Hameed,** Principal Scientist, National Institute for Biotechnology and Genetic Engineering, Faisalabad	
Duration:	03.08.2005 to 30.06.2008	
Financial Status:	Total Cost:	Rs.1.650 million
	Funds Released:	Rs.1204000/-
	Funds Utilized:	Rs.1182373/-

Objectives:

Isolation and development of pesticide resistant bacterial strains from mungbean (spring and summer crop) and pea (winter crop) toxicity.
Selection of beneficial bacterial strains and pesticides with low toxicity.
Evaluation of these resistant bacterial strains in vivo. Improvement of biofertilizers with pesticide resistant bacterial strains and their application in the field.

Achievements:

Field experiments conducted on mungbean for grain yield showed positive effect with rhizobial inoculation and pesticide treatments. The results were comparable with the last year field experiments, grain yield of 1318 kg/hectare. The Brady (rhizobium) strain MN-S resulted in enhanced grain yield of 1216kg/hectare, which is 28% increase over the control. New Bacillus strains M2 and M6 inoculation showed a very minor increase in the grain yield, rather a negative effect when used in combination with pesticides.

Experiments conducted on peas under control conditions, showed a beneficial effect of bacterial inoculants on root length, shoot length, root fresh weight, shoot fresh weight, root dry weight, shoot dry weight, and root area etc at 20 day after plant germination. Bio-inoculants showed a very positive effect on all the parameters. Data showed that maximum root length was observed when mixed bacterial treatment was applied. Also PS-I showed very high root elongation. PS-II and Ca-18 show same result as compared to control. Similar behavior was seen in root dry weight. Isolated six bacterial strains from the Peas (*Pisum sativum L.*) plant var. Meteore grown at NIBGE, Pakistan field soil on the basis of colony morphology. They were named as MP-1, MP-2, MP-3, MP-4, MP-5, and MP-6. Three bacterial strains from mungbean were also isolated coded, pink 1, pink 2 and pink 3. These isolates did not picked Congo red stain from the agar, so showed Rhizobium like characteristics. These isolates are being characterized. Ultrastructural studies showed that bacterial strains showed high occupancy in the root nodule cell depicting that bacterial strains are highly root colonizing and contribute their growth promoting attributes in plant development. It was seen that pesticide Dorosal has some negative impact on bacterial occupancy in nodule cells.

Name of Project:	**Molecular Marker Facilitated Pyramiding of Bacterial Blight Resistance Genes In Super Basmati Rice**	
Name of PI/ Institute:	**Dr. Muhammad Arif,** Principal Scientist Plant Biotechnology Division, NIBGE, Faisalabad	
Duration:	16.08.2005 to 31.12.2008	
Financial Status:	Total Cost: Funds Released: Funds Utilized:	Rs.3.458 million Rs.3206600/- Rs.2690949/-

Objectives:

Evaluation and identification of IR24 based near isogenic lines with single major gene or gene combinations effective against virulent Xoo strains in Pakistan.

Incorporation of four bacterial blight resistance genes into high yielding commercial Super Basmati rice variety.

Achievements:

Twenty two plants were selected from 58 BC3F1 genotypes as a result of foreground selection for three BB genes i.e. Xa-4, Xa-5 and Xa-13 by using STS-SSR markers and phenotypic field performance. Artificial inoculation of IRBB lines and 58 BC3 F3F1 plants was also accomplished for their response against bacterial blight disease. No disease symptoms were developed due to non conducive environment for the disease. At maturity, selfed seed of the desired plants were harvested for their studies in the subsequent year. Off-season genotypic and phenotypic studies of 9 BC3.

F2 populations enabled us to select 54 plants for their further evaluation. Seedlings of these 54 plants were raised for further studies.

Molecular survey for targeted 3 BB resistance genes have been initiated to select the seedlings having our desired genes. The rice nursery of 26 IRBB lines possessing different BB resistance genes and approved rice varieties including Super Basmati were transplanted in the field at three locations i.e; Faisalabad, Gujranwala and Kala Shah Kaku to document the disease response of these genotypes against different pathogen strains prevalent in Pakistan. Further results are awaited.

Name of Project:	**Screening of Citrus Cultivars Grown in Pakistan against Citrus Canker and its Management**	
Name of PI/ Institute:	**Dr. Shahbaz Talib Sahi,** Assistant Professor, Department of Plant Pathology, University of Agriculture Faisalabad	
Duration:	25.07.2006 to 30.06.2009	
Financial Status:	Total Cost:	Rs.2.952 million
	Funds Released:	Rs.1577600/-
	Funds Utilized:	Rs.1055854/-

Objectives:

To screen out the citrus cultivars against various isolates of the causal bacterium for resistance.
To study the ecology of citrus canker with respect to incidence, distribution, losses and relationship with meterological factors.
To study the cultural and physiological requirements of citrus canker pathogen and to differentiate the pathovars on molecular basis.
To develop integrated management strategy for citrus canker.

Achievements:

During the period under report, the infection index of citrus canker disease was recorded from the three districts (Faisalabad, Sahiwal and Sargodha) of Punjab province and three districts (Nawabshah, Sanghar and Naushehro Feroz) of Sindh province. The disease ranged from 12 to 31 and 25 to 39.21 in Sahiwal and Sargodha districts, respectively, while, the range of infection index of disease was 16.21 to 26.25, 15 to 20.45 and 17.26 to 23.25%, from Nawabshah, Sanghar and Noshero Feroz, respectively.

In addition, the spots selected for continuous recording of data were visited on weekly basis. The disease infection index in Faisalabad, Sahiwal and Sargodha ranged from 7 to 18.5, 5.5 to 19.3 and 5 to 20.4%, respectively. It was observed that a temperature range of 29-39, 23.5-38.5 and 24.5-37^{o}C was the most favourable for disease development at Faisalabad, Sahiwal and Sargodha districts, respectively, while 31-37% of relative humidity was found to be the most favourable for disease development in the three districts.

Regression analysis of disease infection index versus different environmental factors (in all possible combinations) was done for the data from all the eight localities. The rate of disease development was significant in most of the combinations at all the localities (The R2 values being significant in most of the cases). Moreover, the maximum and average temperature has a significant and positive correlation with the disease infection index at almost all the localities, but the relationship of minimum temperature was significant at five out of eight

localities. The relative humidity also had a significant but negative correlation with disease infection index at all the localities.

A large number of diseased specimens were collected from the orchards visited for the purpose and the causal bacterium has been isolated from these specimens. The bacterial isolates have been stored and their cross reactivity on various citrus cultivars/varieties and studies on various physiological and biochemical characters has been started, which will be reflected in the next report.

Name of Project: **Evaluation of Chickpea Germplasm against Aggressive Isolates of *Aschochyta Rabiei* Identified by Biological and DNA Molecular Marker Techniques and Disease Management through Induced Systemic Resistance (ISR).**

Name of PI/ Institute: **Dr. Nighat Sarwar,**
Chief Scientist,
Nuclear Institute for Agriculture & Biology (NIAB),
Faisalabad.

Duration: 25.07.2006 to 30.06.2009

Financial Status:

Total Cost:	Rs.3.909 million
Funds Released:	Rs.2324200/-
Funds Utilized:	Rs.2258936/-

Objectives:

- Characterization of pathotypes/races of *Ascochyta rabiei* through biological pathotyping and genetic analysis.
- Identification of virulent *A. rabiei* isolates from different chickpea growing areas and Screening of Chickpea germplasm against them to identify chickpea germplasm having durable resistance.
- Enhance resistance in high yielding, good quality chickpea cultivars by inducing systemic resistance with safe chemicals/reagents.

Achievements:

Reappearance of *Ascochyta* blight during 2007 indicated that the disease still persists as a major challenge to sustainable crop production. It also confirmed the existence and viability of the inoculum which can result in disease epidemic under conducive environmental conditions. Pathotyping of eleven selected isolates of *A. rabiei* revealed that two isolates were highly virulent (A-45 & P-22) and nine isolates moderately virulent (C-64, C-66, I-92, P-18, SP-1, SP-3, M-12, M-14). The isolates identified as highly virulent are used for host resistance studies. Screening of pathogen population for identification of virulent strains is prerequisite for reliable screening of host population to determine whether prevailing varieties of host will remain resistant or there is need to introduce new resistant to changing pathogen population. Out of 68 tested genotypes, 51 were tolerant, 12 were moderately susceptible and 5 were susceptible. Tolerant genotypes can be used in further breeding programs based on their agronomic traits. Studies on induced systemic resistance revealed that treatment of plants with low concentrations of environmentally safe chemicals have reduced blight disease under controlled and field conditions. Bion and SA showed highest reduction in the disease under both environmental conditions and had synergistic effect on reduction of blight disease under growth room conditions. These results indicate that ISR technology will be helpful in Ascochyta disease management.

Name of Project:	**Integrated Control of Root Rot of Pepper in Peshawar and Malakand Divisions.**	
Name of PI/ Institute:	**Dr. Shokat Hussain,** Associate Professor, Department of Plant Pathology, NWFP Agricultural University Peshawar	
Duration:	27.01.2007 to 26.01.2010	
Financial Status:	Total Cost: Funds Released: Funds Utilized:	Rs.2.622 million Rs.1537520/- Rs.1802000/-

Achievements:

Characterization of Isolates: Isolates were significantly different with respect to radial growth. Isolates ranged from 3.68 - 7.75 cm in colony diameter. No clustering was observed for isolates collected from adjacent locations. Variability exists in the population structure of *Phytophthora capsici* based on this phenotypic marker. Significant differences were found among the isolates with regard to metalaxyl sensitivity. Isolates formed two distinct groups referred to as resistant and sensitive. Resistant isolates showed 40% or more growth as compared to the known standard. Isolates showing less than 40% or more growth as compared to the known standard. Isolates showing less than 40% were rated as sensitive. 94% of the isolates were resistant and 6% were rated as sensitive. Only the sensitive isolates were collected from Talash (Lower Dir). Significant differences were observed amongst the collected isolates of biocontrol agent, *Trichoderma harzianum.* Isolates clustered into three different groups in checking the growth of the pathogen. These were rated as excellent, good and poor. Variability exists in the population structure of the pathogen and is suggestive of sexual recombination and re-assortment of alleles. Screenings of both. *P. capsici and T. harzianum* has yielded promising candidate isolates of both pathogen and biocontrol agent. Such results will be further tested and authenticated in subsequent field trials.

Name of Project:	**Use of Nitrogen Fixing, Plant Growth Promoting Rhizobacteria (PGPR) for Development of Bio-Fertilizer for Crops of Economic Importance (Coordinated Project - NARC Component -I)**
Name of PI/ Institute:	**Dr. Muhammad Aslam,** Senior Scientific Officer, Soil Biology & Biochemistry, LRRP, INRES, NARC, Islamabad
Duration:	02. 04. 2005 to 01. 04. 2008
Financial Status:	Total Cost: Rs.4.230 million Funds Released: Rs.2397000/- Funds Utilized: Rs.1552011/-

Objectives:

To exploit the role of plant growth hormones (induced or produced) in rhizosphere on growth and yield of wheat and sugarcane for improving quality of biofertilizers.

Isolation, identification and selection of bacterial strains showing high nitrogen fixing activity and phytohormone production in pure culture.

Evaluation of promising strains showing beneficial effects on their respective host crops under lab. as well as field conditions and development of crop specific biofertilizers based on single multiple strains in a carrier material for wheat and maize.

Identification and quantification of phytohormones produced by rhizobia associated with wheat and maize and their beneficial effects on plant growth.

The influence of wheat root exudates application on the growth of rhizobia and their promotion for phytohormone production.

Selection of beneficial strains of rhizobia (most efficient in plant growth promoting hormone production) for biofertilizer production for wheat.

Achievements:

A total of 88 plant growth promoting rhizobacteria (PGPR) isolates have been acquired from wheat (46) and rice (42) rhizosphere from Faisalabad, Toba Tek Singh, Sheikhupura, Gujranwala, Norowal districts and Potowar. After studying in lab eight (8) wheat and five (5) rice PGPR isolates were characterized for various aspects. Half of the isolated PGPR also have phosphorus solubilizing ability, in addition to plant growth promotion and yield increase. All these isolates produced reasonable amount of IAA (plant growth promoting hormone). Biofertilizer of PGPR isolates has been prepared for wheat and rice crops.

In two lab/field studies, all 4 rice PGPR isolates used alone and in mixture increased most of growth and yield parameters of rice. The paddy yield was increased by 12-30% over control. In Petri plates, PGPR isolates promoted early germination of wheat and improved vigor of seedlings. Also, the PGPR isolates increased shoot biomass of wheat grown in growth

chamber in the lab.

In greenhouse (pot) and field studies, all the 7 PGPR isolates and their mixture increased most of the growth and yield parameters of wheat. The wheat grain yield was generally increased by 15-35% over control. Three wheat isolates i.e., WPR-42, WPR-51 and WM-3, used alone and in mixture successfully controlled pathogenicity (disease effect) of *Rhizobia solani* by 55-100%.

The biofertlizer of wheat and rice PGPR isolates has proven its efficiency to :

Improve crop growth
Increase crop yield and quality (protection content)
Control fungal pathogenic disease of wheat.

One research paper prepared from project work has been reviewed and approved for publication and two scientific publications are in channel.

Two students got their M. Sc (Hons) degrees after completing their thesis research in the project. One student is doing Ph. D and one post doctoral study with the assistance of the project for their research work. A research paper of the post doctoral student has also been reviewed and approved for publication.

Name of Project:	**Assessment of Productivity Potential and Utilization of Rangelands and Sown Pastures in Pothowar Plateau**
Name of PI/ Institute:	**Dr. Javed Afzal,** Senior Scientific Officer, Rangeland Research Program, INRES, NARC, Islamabad
Duration:	27. 09. 2004 to 30. 06. 2008
Financial Status:	Total Cost: Rs.3.580 million Funds Released: Rs.2717400/- Funds Utilized: Rs.2665317/-

Objectives:

- To carry out various studies of grass/legume pertaining to different agronomic physiological and utilization aspects.
- To find out the present status of range vegetation through phytosociological surveys and quantitative observation on vegetation dynamics.
- To determine the forage production/utilization characteristics and performance of gazing lambs.

Achievements:

Different project activities were carried out at three locations, namely, Pabbi Hills, Kharian; National Agricultural Research Centre (NARC), Islamabad; and Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi. Information on standing crop forage production, plant cover and composition at Pabbi Hills, Kharian were collected. Forage production and chemical composition of different forage plants were determined at different sites of the project.

Carrying capacity of Pabbi Hills, Kharian at 50 percent utilization level was estimated as 12 ha AU^{-1} $year^{-1}$. The animal unit was taken as a young cow having live-body weight of about 300 kg and consuming 6 kg dry matter (DM) day^{-1}. Based on these estimate, one ha of land would be suffice to feed a sheep/goat of 25 kg round the year. The highest contribution of perennial grasses toward vegetation cover showed that range has a good potential for sheep production. The second highest contribution of mesquite (*Prosopis juliflora*) inferred that mesquite being an unpalatable plant is gradually invading the area, which needs to be discouraged for improving grazing potential of the area.

Based on establishment response, forage production, palatability value, and seeding potential, Buffel Grass (*Cenchrus ciliaris*) is recommended for range seeding in the semi-arid conditions of Pabbi Hills, Kharian. The vegetation dynamic study revealed that carrying capacity of Pabbi Hills could be improved substantially through protection from grazing and cutting. Birdwood grass (*Cenchrus setigerus* Vahl), Gangir (*Grewia populafolia*), Peeli buti (*Abutilon indicum*), and Sakkar (*Ehretia laevis*) being comparatively more proteinaceous and palatable ones, are recommended for improving grazing/browsing potential of Pabbi Hills. In a nutrient

digestibility trial, the dry matter digestibility was found to be the highest in sheep fed on elephant grass (59.10%) followed by Green Panic Grass (53.88%), Blue Panic Grass (44.89%) and Buffalo Grass (40.40%).

Diet composition of sheep and goats by bite count method showed that both the animals grazed indiscriminately on the plant that came on their way except mesquite (*Prosopis juliflora*). However, during winter, animals mostly grazed on the filled (seeded) pods of Phulai (*Accacia modesta*) while discarded the empty ones. In spring, these preferred to graze on the new grass growth particularly, on Mushki Ka (*Cymbopogon jwarancusa*) as it formed bulk of the ground cover.

During winter, sheep and goat ceased to gain weight as forage became increasingly scarce and lower in nutritive quality. Therefore, supplemental feeding like Lucerne hay or barley grain may be fed during the winter to ensure proper animal growth. An average DM intake of 0.72 kg day^{-1} of a grazing sheep was estimated at the stocking rate of 49 sheep or four animal unit day^{-1} ha^{-1}.

The results of the studies conducted, concludes that growth of unpalatable plants may be discouraged. Grazing potential of the area may be improved by planting native palatable trees and shrubs. Kahi (*Sacharum spontaneum*) in early growth stage may be cut, chopped, preserved and mixed with the pods of Phulai (*Acacia modesta*) in the ratio of 1:3, respectively for feeding to the animals during the time of feed shortage, particularly in winter. Buffel Grass (*Cenchrus ciliaris*) and Birdwood grass (*Cenchrus setigerus*) in the semi-arid areas of Pabbi Hills and Mot grass (*Pennisetum purpureum* var. Mott) in the irrigated conditions of Pothwar Plateau may be grown to mitigate forage shortage in the area. Considerable potential exist for improving ecological status of rangelands of Pabbi Hills within a foreseeable time period through protection from grazing and cutting.

A student from Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi got his M. Sc (Hons) degree in 2008 on the basis of his work in collecting data on rangeland inventory of Pabbi Hills for master level research.

Name of Project:	**Nutrient Indexing and Integrated Nutrient Management for Sustaining Sugarcane Yields**
Name of PI/ Institute:	**Dr. Sagheer Ahmad,** Senior Scientific Officer, Sugar Crops Research Program, Crop Sciences Institute, NARC, Islamabad
Duration:	25. 03. 2004 to 24. 03. 2008
Financial Status:	Total Cost: Rs.5.800 million Funds Released: Rs.5119200/- Funds Utilized: Rs.5086113/-

Objectives:

- Soil fertility mapping by diagnosing the nature, extent and severity of nutritional disorders in sugarcane and sugarcane soils of the project area.
- Use / recycle press mud / filter cake, produced in quantities of 200,000 tonnes in the project area, as organic fertilizer for improving soil fertility, soil physical conditions, and sugarcane yields.
- Develop a package of technology for on-site integrated, balanced nutrient management, including micronutrients, for an expected yield increase of 20 to 35% and improve quality by 1 to 1.5%.
- Reduce environmental pollution by recycling press mud/ filter cake in agriculture.

Achievements:

Nutrient indexing survey of sugarcane fields of Sargodha and Jhang district was carried out during September-October 2004 for collection of sugarcane plant tissues and associated soil samples. Diagnostic sugarcane plant tissues (Leaf sheaths and leaf blades) and soil were sampled from 63 sites of district Jhang and 48 sites of district Sargodha. During nutrient indexing all the fields of Jhang and Sargodha districts were found low in NO_3-N. Most of the fields were low in Phosphorus (P) while about 50% were low in Potassium (K). Zinc and Boron were also low in these fields. Sugarcane plants had deficiency of these mineral nutrients. Despite this most of the farmers used lower rates of N & P fertilizers while only a small number of farmers used K fertilizers. Hence integrated use of fertilizers could enhance sugarcane yield and quality.

Fresh pressmud was collected from sugar mills of Sargodha and Jhang district and processed for chemical analysis i.e. weight, air dried sieved and analyzed for EC, pH, N, P, K and micronutrients. It had EC (1:10), 2.1- dS m^{-1}; pH (1:10), 6.23; N 2.93%; P 1.41%; K 0.77%; Fe 718 mg kg^{-1}; Zn 111 mg kg^{-1} and B 14.7 mg kg^{-1}. Chemical analysis showed that it is rich source of plant nutrition, especially of N, P and K an d due to a source of organic matter, can be used as an effective fertilizer.

Quality analysis of tube-wells waters reveal that sixty percent of the tube-wells waters in the main sugarcane growing areas of Sargodha and Jhang districts are giving waters completely fit for irrigation. Further, Boron was found in tube-well waters more in quantity than canal water that could act as a source of boron nutrition for plants.

Field experiments conducted in district Sargodha and Jhang for determining nutritional needs of sugarcane during 2005 to 2008 included i) pressmud usage along-with chemical fertilizer, ii) deficient micronutrients (Zn & B) usage along N, P and K fertilizers alone or in combination with pressmud and iii) ratoon management of experiments during 2007-08. The treatments included farmers practice (FP), recommended rate of NPK (210, 125 and 135 kg ha^{-1}, respectively) with and without zinc and boron, and half and quarter rate of NPK along with pressmud/compost application. Quantity, quality and method of pressmud application had varying effect on cane yield and quality under different soil and environmental conditions. Application of pressmud at @ 10 tons ha^{-1} (~ 4 trolley load of pressmud per acre) along with or without Zn (7.5 kg ha^{-1}) + B (1.5 kg ha^{-1}) and 50% of recommended NPK fertilizers (N; 105, P_2O_5; 112, K_2O; 118 kg ha^{-1}) gave better cane yield and maximum net benefit over other treatments. Hence, pressmud as an organic source of fertilizer can reduce up to half of the chemical fertilizers utilization.

Micronutrient (Zn + B) application also had beneficial effect on sugarcane crop at some sites. An increase in yield of 15.7 to 38.5 % over that of farmers' practice has been recorded with the application of Zn (7.5 kg ha^{-1}) + B (1.5 kg ha^{-1}) along with recommended rate of N (210 kg ha^{-1}), P_2O_5 (210 kg ha^{-1}) and K_2O (210 kg ha^{-1}) fertilizers. Integrated use of pressmud and deficient micronutrient (Zn and B) even enhanced this effect. However, these studies need further elaborative work.

A paper has been published in proceeding of 41st annual convention of PSST, August 21-22, 2006 Rawalpindi, Pakistan, Two brochures in Urdu language has been printed for distribution among farmers.

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.2584000/- Funds Utilized: Rs.2430018/-

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 carried out in beekeepers colonies for surveillance on spot of the seasonal mite incidence and distribution and secondary infection. First survey carried out during December 2006 to January 2007 in Chakwal and Dhudial, where 36 apiaries were visited and random samples of brood and bees were collected from eight apiaries. These colonies were mostly placed in Canola fields. Second survey was carried out in May - June, 2007 on honeybee disease in beekeepers apiaries at NWFP (Peshawar and Swat area) and Punjab (Attock). Samples of brood with visual symptoms of fungal chalk brood disease were collected from bee colonies and examined in the laboratory under the microscope. The parasitic mite *Tropilaelaps clareae* was found in *A. melifera* colonies in Northern Punjab in winter in the beginning of the year. *Tropilaelaps clareae* is the first mite with which the bee colonies get infested naturally in the winter. Later the *Varroa destructor* also infests the colonies and reproduces toward late spring and early summer. Infestation with *Varroa* increases to an alarming situation during June, July, August and September if not checked in early stages.

Matta, Khowaza Khela and Madyan area in Swat was visited for samples of bees and

brood from *Apis cerana* bees for any mite infestation. These samples when examined revealed that a Pakistani haplotype of *Varroa destructor* exists in the local bee *A. cerana* which is different from the Korean genotype found infesting the *A. mellifera* colonies in Pakistan.

Assessed the combination of organic acids and essential oils to control the parasitic mites. Thymol and formic acid were used and found to be effective against parasitic mites.

Assessed the performance of daughter queens from 3 breeders colonies tested for hygienic behavior. Observations recorded on survival of these queens, brood area and honey production for comparative study.

Training course of three days on advance IPM technique to control parasitic mites and secondary infections was conducted to progressive beekeepers during April 2007. Beekeepers and Bee scientists were trained in management of honeybee colonies with modern techniques to obtain maximum yield by exploiting the mite resistant vigor in the colonies. The PI conducted a study tour to Sydney, Canberra, Melbourne, Australia and attended the '40^{th} International APIMONDIA Beekeeping Congress' during September 4-15, 2007, focused on the latest trends of apiculture covering pests and disease threat, control management and quarantine aspect.

The Co-PI of the project registered for his Ph. D is working in the project for his thesis research on "Integrated Management for Ectoparasitic Mites *Varroa destructor* (Anderson and Truman) and *Tropilaelaps clareae* (Delfinado and Baker) on Honey Bee *Apis mellifera* L. in Relation to Honey Yield".

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:	**Mr. Muhammad Yasin** Director/PSO, 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.778500/- Funds Utilized: Rs.698000/-

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:

Research study was undertaken under wheat-maize cropping system at Mardan in NWFP. Three sizes of bed-furrows i.e. 65, 90 and 120 cm were selected for comparison with flat sowing method of basin. Soil samples were taken for textural analysis and determination of bulk density. The soil of the experimental field is silt loam. The bulk density increased with the depth of soil. The maximum bulk density was observed in furrows. The bulk density was more than bed centre and bed edges. Irrigation application data indicated that on an average 22, 41 and 48% saving in irrigation water was observed in small, medium and large beds, respectively as compared to basin. The increase in grain yield of wheat was 7.33, 8.27 and 10.40% in medium, large and small beds, respectively as compared to basin. The increase in straw yield was 29.09, 31.18 and 24.41% in small, medium and large beds, respectively. The water use efficiency in basin was 12.59 kg/ha/mm while it was 18.17, 23.28 and 28.94 in small, medium and large beds, respectively. The water use efficiency increased with increase in bed size. Thus the maximum water use efficiency was found in large beds.

Name of Project:	**Studies on Rice-Wheat Cropping System in Sheikhupur Maize-Potato in Okara District; Component-II of Um Project "Soil Salinity Monitoring Under Various Res Conservation Technologies (RCTs) Adopted in Various Ecologies"**
Name of PI/ Institute:	**Dr. Arshad Ali,** Senior Scientific Officer,, Land Resources Research Institute, INRES, NARC, Islamaba
Duration:	20. 07. 2007 to 30. 06. 2010
Financial Status:	Total Cost: Rs.4.605 million Funds Released: Rs.2358000/- Funds Utilized: Rs.2038614/-

Objectives:

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

Achievements:

Impact of resource conservation technologies (RCT) on salt build up and crop yiel studied in rice-wheat system in Pakistan. Practicing of zero tillage improved wheat yiel conventional tillage in coarse textured soils whereas yield decreased in clayey soils. See fertilizer placed at optimum depth contributed towards more yield in ZT wheat broadcasting of seed and fertilizer. IN ZT wheat, saving in time, labor and input cos observed. Continuous ZT wheat sowing in clayey soil was not useful and decreased yi ZT soils pH and EC increased to varying degree under zero tilled fields and there v movement of salt in lower depths.

In another study foliar application of B produced better yield of rice than soil applicatior Application of 0.5 and 1.0 kg B/ha gave higher yield than control. Similarly foliar appli of K, using 4 and 6% K_2SO_4 solution increased rice yield both in transplanted and seeded rice. However, combination of K and gypsum in 1:1 ratio produced highest yield K, application of Zn, improved paddy yield significantly over control in direct seede transplanted rice. Application of Zn @ 5 and 10 kg/ha produced better yield than 15 kg Use of P along with Zn showed better performance than Zn alone. Results indicated that dose of Zn along with optimum P produced good yield. Incorporation of residue @ 5 a t/ha improved paddy yield significantly over control. However, utilization of residue with N is more efficient. Use of 10 t/ha along with 20 kg N ha^{-1}produced maximum yield.

Name of Project:	**Testing and Evaluation of Low-cost Lining Materials for Watercourse in Drought Endangered Areas of Balochistan**
Name of PI/ Institute:	**Mr. Nadeem Sadiq** Scientific Officer, Arid Zone Research Center, PARC, Quetta
Duration:	01. 09. 2004 to 31. 08. 2007
Financial Status:	Total Cost: Rs.2.776million Funds Released: Rs.1510200/- Funds Utilized: Rs.1450000/-

Objectives:

Devise mechanism to minimize the water course losses.
To analyze financial and economic feasibility of various lining materials.

Achievements:

The conveyance efficiency of water is low due to earthen water channels in the farms of targets areas in Quetta, Pishin and Mastung districts. Average farm size in the area is around 10 to 25 acres and four sites covered under the project were below 10 acres. Apples, grapes and vegetables are the main crops in the farms.

In order to assess minimum water course loss and low cost lining material, two sites in district Pishin and three each in district Mastung and Quetta were covered under the project. Three treatments tested were Polyethylene (PE) sheets 300 micron thickness, Bitumen applied on newly constructed earthen channels and farmers practice. An area of 9.2 acres and 15 acres at Pishin, 10 acres, 8 acres and 18 acres at Mastung and 5 acres, 8 acres and 10 acres at Quetta sites respectively was irrigated under these treatments. Out of eight experiments, one at Siddiqabad in Mastung and other at Sara Gurghai in Quetta could not give encouraging results due to poor management by the farmers. Average discharge of tube-wells and karezes ranged from 0.55 to 1.35 cusecs. The irrigation method is flood irrigation through water storage pond in Quetta, Pishin and Mastung target areas whereas in Quetta (Sara Gurgai) karezes flow continuously. The farmers apply annually a number of irrigation to orchards and vegetables. A total of 20-24 irrigation applied annually to apple orchards where as for grapes and wheat crops applied 8-12 irrigation.

The conclusion drawn from the study showed that PE sheet has encouraging performance as compared to Bitumen and is recommended as low cost lining material.

Two research papers were prepared from project work for presentation in 11th

International Congress of Soil Science, March 28-31, 2006 at Islamabad and 1st International Conference on Agriculture Food and Animal Sciences from November 27-29, 2007 at Tandojam.

Name of Project:	**Management and Improvement Potential of Rangelands of Balochistan with Community Participation**
Name of PI/ Institute:	**Dr. Sarfraz Ahmad,** Senior 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.2419000/- Funds Utilized: Rs.2133581/-

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:

The project activities conducted at three districts (Mastung, Ziarat, Loralai) of Balochistan. Three communities in Mastung district, two in Loralai and two in Ziarat were chosen for the project activities based on the availability of large range area, community willingness, and community involvement in range-livestock and rainfed agriculture. Existing range-livestock production systems documented.

Different range management and improvement trials conducted at various sites. Trial on grazing response of perennial bunchgrasses (*Cymbopogon jwarancusa* and *Chrysopogon aucheri)* was conducted at Tomagh and Ziarat. Three months (March-May) rest period was provided to the vegetation for recovery and again total above ground biomass production was monitored. Total above ground biomass in exclosures before grazing ranged from 539 to 998 kg/ha. After three months rest period the total above ground biomass ranged from 338 to 617 kg/ha. The results indicated that at least three months rest period during active growth period of natural perennial bunchgrasses are required for recovery of vegetation. Trials on the effect of minimum supplemental feeding and grazing on productivity of Harnai sheep indicates that supplemental feeding and grazing ewes live weight gain performance was satisfactory in two groups either fed 250 or 500 grams feed daily/head during the reproductive stages. Winter season burning has

positive impact on growth and forage production. Fresh and dry forage production during fist sampling of burned treatment was recorded 2316 and 1548 kg/ha compared with 466 and 309 kg/ha, respectively of unburned treatment. Growth response of perennial grasses to defoliation intensity and season in Balochistan indicate that heavy utilization of grasslands during winter season when grasses are in dormant period have no major affect on growth and production. The grasslands management strategies should be focused on heavy utilization of available resources during the winter season and restriction to grazing during the active growth period of grasses.

Growth response of *Artemisia quettensis* to defoliation intensity and season in Balochistan indicate no major differences between defoliation intensities and control for plant height and canopy cover. Standing biomass production was recorded 475, 551 and 847 kg/ha in 100%, 50% and control treatment, respectively. The dry wood production was more in control as compared with 100% and 50% defoliation. Similarly, the grazable forage production was also greater in control than the defoliation treatments. Both 100% and 50% winter season imposed defoliation treatment have potential for recovery of growth and production at least after 4-5 months during the optimal growth period. *Atriplex canescens* response to winter season defoliation exhibited more standing biomass and grazable forage production per plant than the un-clipped plants. Range fertilizer trails at various sites in Balochistan were conducted. Variable response of fertilizer application was observed at different sites. At Tomagh, on the grazed grassland all the fertilizer treatments had slightly increased in dry forage production. At Mastung, NP fertilizers have some impact on the dry matter forage production of *Artemisia quettenis.* Similarly, at AZRC, Quetta some increase in dry forage production of some species but not same response of all range species was observed.

The degraded grassland showed a good recovery potential for forage production. The average dry forage production in open area was recorded 13.85 and 1.25 kg/ha for *Cymbopogon jwarancusa* and *Chrysopogon aucheri,* respectively. After one year protection the dry matter forage production was 207.42 and 53.8 kg/ha for *Cymbopogon jwarancusa* and *Chrysopogon aucheri,* respectively. Therefore, range management strategies must focus on recovery potential of degraded range areas and proper grazing for sustainable range-livestock production. Range nurseries established at AZRC, Quetta for testing potential of different species for range rehabilitation on degraded community lands.

One M. Sc (Hons.) student from Balochistan Agriculture College is doing research work under the project required for his degree in range and forestry.

Name of Project: **Use of Nitrogen Fixing, Plant Growth Promoting Rhizobacteria (PGPR) for Development of Bio-Fertilizer for Crops of Economic Importance (Coordinated Project - NIBGE, Faisalabad Component-II)**

Name of PI/ Institute: **Dr. M. Sajjad Mirza,**
Principal Scientist,
National Institute for Biotechnology and Genetic Engineering (NIBGE), Faisalabad

Duration: 19. 03. 2005 to 18. 03. 2008

Financial Status:

Total Cost:	Rs.3.2538 million
Funds Released:	Rs.2500300/-
Funds Utilized:	Rs.2452470/-

Objectives:

- Development of crop-specific biofertilizer for sugarcane and cotton based on nitrogen-fixing, plant growth promoting rhizobacteria (PGPR).
- Production of biofertilizers based on beneficial bacteria (nitrogen-fixing, phytohormones producing bacteria) for sugarcane and cotton.

Achievements:

Roots of cotton and sugarcane were collected from different cropping areas for isolation of plant growth promoting rhizobacteria (PGPR). A total of 21 bacterial strains were obtained from sugarcane. Among the isolates, two have been identified as *Azotobacter* on the basis of morphological characteristics as well as by PCR amplification of partial nigh gene which codes for nitrogen fixing enzyme (nitrogen's). Twelve isolates were identified as *Pseudomonas* strains on the basis of cell shape, motility and colony morphology while the remaining five isolates could not be identified. Two isolates obtained from sugarcane resembled *Azospirillum* in cell morphology and spiral motility.

From cotton 22 bacterial isolates were obtained. Among these isolates, only 7 showed resemblance to genus *Azospirillum* of nitrogen fixing bacteria. One of these isolates from cotton i.e. *Azospirillum* strain CN1 was further identified by PCR-amplified 16S rRDNA sequence analysis. The strain CN1 showed highest sequence similarity to *Azospirillum lipoferum* sequences. This strain was also investigated for the presence of acdS (ACC deaminase) gene which is considered a plant-beneficial trait in PGPR. AcdS gene was successfully PCR amplified and sequenced from this bacterium.

All the *Azospirillum* and *Azotobacter* strains from sugarcane and cotton reduced acetylene to ethylene in Acetylene Reduction Assay (ARA) in pure culture, confirming their identification as nitrogen fixers. All the bacterial isolates produced phytohormone

indoleacetic acid (IAA) in the growth medium containing tryptophan as a precursor of IAA biosynthesis. Phytohormone indoleacetic acid (IAA) from cell-free growth medium of 38 strains was extracted and quantified on HPLC.

Among the PGPR obtained from cotton, the isolates U4 and U21 produced highest amount of IAA (12 mg/L and 14 mg/L) while the isolate A3 from sugarcane was found to be the most efficient producer (2.6 mg/L). For rapid screening of the isolates for plant-beneficial traits, the isolates from sugarcane were tested on heterologous hosts (millet, soybean, sorghum and brassica) grown in Falcon tubes filled with sand. This was followed by testing of selected bacterial isolates as inoculants for plants grown in pots and cemented microplots (12 X 5 feet) filled with soil. Performance of the isolates tested, as reflected by the beneficial effects on inoculated plants, was comparable to that of standard PGPR strains used as positive control. Based on these studies about 3000 bags of inoculum, containing selected bacterial strains was developed for sugarcane and provided to farmers.

The studies conducted under the project conclude that isolation of a number of bacterial strains belonging to different genera from roots of cotton and sugarcane indicates that diverse bacteria colonize rhizosphere of these crops. Among nitrogen fixers, *Azospirillum* strains appear to dominate in the rhizosphere as compared to *Azotobacter* strains. Several bacterial strains exhibited plant-beneficial traits like nitrogen fixation and phytohormone production. Beneficial effects of bacterial inoculations were observed on plant growth as reflected by increase in root area and plant weight of inoculated plants over non-inoculated controls. However, extensive testing of bacterial inocula at farmer's field is required before commercial scale production of biofertilizer is initiated for these crops.

Two students of Quaid-e-Azam University, Islamabad conducted research work under the project required for writing their M. Phil thesis. Both the students have completed their M. Phil program.

Name of Project: **Determination of Growth, Wood Properties and Water Table Control Following Afforestation of Proven Provenances/Species under Saline and Waterlogged Conditions in Pakistan**

Name of PI/ Institute: **Mr. Muhammad Khan**,
Forest Geneticist/SRO,
Pakistan Forest Institute, Peshawar

Duration 28. 12. 2004 to 27. 12. 2007

Financial Status:

Total Cost:	Rs.2.998 million
Funds Released:	Rs.1606450/-
Funds Utilized:	Rs.1597649/-

Objectives:

To establish species cum demonstration plots on farm lands over 5 acres area at two sites in two districts in NWFP under water logged and saline conditions.
To monitor water table and to recommend suitable salt tolerant species for the specific sites in NWFP.
To develop agro forestry models for problematic area through community participation to overcome environmental issues.
To determine wood properties of the species established on marginal lands for farmer's use.

Achievements:

The saline and water logged area can not be used for any construction work because of loose and friable nature of soil due to higher soil concentration. If some suitable tree species are planted and water table is lowered; these sites can serve as excellent grazing grounds for livestock. The environment could be ameliorated if trees are planted and marginal land is improved. The afforestation through suitable species is the economical way to over come the problem. The project started in December 2004 has been completed in December 2007.

Two plots to test various salt tolerant tree species on farm lands were laid out in Turo village, district Mardan and Nazar village, district Swabi in 2005 and 2006 respectively. Twelve species viz. *Eugenia jambulana, Tamarix aphylla, Casuarina gluaca, Casuarina obesa, Eucalyptus camaldulensis, Albezia procera, Acacia albida, Terminnalia arjuna, Acaica nilotica, Acacia amplicipes, Salix viminalis and Phoenix dectylefera* were planted and their survival and height data was recorded with following conclusion:

The data recorded on survival and height at both the experimental sites of Turo village, district Mardan and Nazar village, district Swabi suggest suitability of *Eucalyptus camaldulensis, Acacia ampliceps, Tamarix aphylla, Casurina obesa* and *Casuarina gluaca* for planting on saline and waterlogged areas.

The soil analysis at Turo, district Mardan has shown improvement of soil conditions after planting where the number of normal soil spots has increased from 6 to 24. The second soil analysis at Nazar village, district Swabi shows that the number of normal soil spots

has increased from 8 to 13.

The tree species planted at both the experimental sites are too small to be used for conclusive results. Maintenance of both the experimental station was agreed by Forestry Sector Research and Development Project of Pakistan Forest Institute, Peshawar. This will help in getting data from the experimental sites for 2/3 years which will provide the requisite results regarding suitability of salt tolerant tree species on saline and waterlogged farmlands.

Name of Project:	**Management Strategies for Metal Contaminated Soil Receiving City Waste Effluent for Sustainable Crop Production and Food Security**
Name of PI/ Institute:	**Dr. Abdul Ghafoor, Professor,** Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad.
Duration:	01.07.2005 to 31.12.2008
Financial Status:	Total Cost: Rs.4.211 million Funds Released: Rs.3393500/- Funds Utilized: Rs.2717012/-

Objectives:

Quantification of metal uptake and accumulation in different parts of cereal and fodder crops grown on contaminated soil.

Identification of plant species from areas receiving sewage having hyper- accumulation capabilities for metals.

Effectiveness of organic and inorganic amendments to retard the bio-availability of metals in contaminated soils.

Achievements:

A series of experiments were conducted during the project from July 2005 to December 2008:

Identification of metal accumulating natural vegetation from contaminated soils

Response of grain crops for metal assimilation from metal contaminated soils

Absorption of metals by fodder and grain crops from contaminated soils receiving amendments

- 3.a Nickel absorption by wheat from contaminated soils receiving organic amendments
- 3.b. Inorganic composition of maize as affected by Ni application in sand culture
- 3.c. Phyto-availability of Ni to maize fodder grown in contaminated soils as affected by organic amendments
- 3.d. Maize growth and Ni phyto-availability responses to application of organic acids on to N-contaminated soil

4. Cadmium assimilation by rice and wheat crops from contaminated soils receiving inorganic amendments
   - 4.a. Rice and wheat growth response to inorganic amendments treated Cd-contaminated soils in a pot experiment
   - 4.b. Rice and wheat growth responses to inorganic amendments treated Cd-contaminated soil in a field experiment
5. Concentration of heavy metals in soils in different land forms

On the basis of results from these studies, it could be concluded that:

- There is a wide variation in shoot concentration of several metals (Cd, Ni, Pb, Zn, Cu, Mn) in a large number of agronomic crops, fruit plants, higher trees, natural shrubs and grasses found in the raw sewage irrigated areas. This bio-diversity needs to be quantified more precisely for practical utilization of promising plant species for phyto-remediation of contaminates soils and waters.
- In general, roots retained major share of the absorbed metals and less were transported to shoots and economic plant parts. The mechanisms of selective transport need controlled condition studies on plants to help plants breeding programs to develop metal resistant and tolerant plant species for safe food production for human and animal consumption.
- Among the agronomic crops, maize owing to high biomass production seems better in crop rotation as fodder crop in metal contaminated soils and/or raw sewage receiving areas.
- For in-situ remediation of metal contaminated calcareous alkaline soils, application of P- and Ca- containing materials proved very useful, particularly MAP and gypsum. But gypsum proved the most cost-effective. Since gypsum is easily available in the local market, it should be recommended for commercial scale treatment of metal contaminated soils. Even continuous use of ammonium sulphate and single supper phosphate as source of N and P should be practiced in metal contaminated soils for producing relatively low metal crop produce.
- Organic manures from several sources remained effective for crop yields, to decrease phytoavailable metals in soils and consequently affected low metal concentration in shoots, therefore, addition of organic matter as green manuring, poultry manure, press mud, farm yard manure or plant residues must be promoted in metal contaminated or raw sewage irrigated areas.
- Both the available and total metal concentration was the highest in surface than that in the subsoils but still within safe limits for general cropping. The higher metal concentration in flowing water indicated raw sewage input into these rivers and later soil contamination.

Three papers prepared from project research and studies have been published in national scientific journals while one has been accepted for publication. Thirteen papers prepared on the basis of project findings presented in international seminar, conference at Faisalabad and national congresses at Islamabad and Peshawar and shared the knowledge with other scientists.

Two Ph. D students completed their thesis partially or in full in the project. Five M. Sc students also completed their graduate thesis on the basis of their work under the project.

Name of Project:	**Increasing Crop Production Through Humic Acid in Rainfed and Salt Affected Soils in Kohat Division (NWFP)**
Name of PI/ Institute:	**Dr. Riaz A. Khattak,** Professor, Department of Soil and Environmental Sciences, NWFP Agricultural University, Peshawar
Duration:	28.10.2004 to 31.12.2007
Financial Status:	Total Cost: Rs.4.179 million Funds Released: Rs.3843300/- Funds Utilized: Rs.3707138/-

Objectives:

- To study the effect of different levels of lignitic coal derived humic acid (HA) alone and in integration with different levels of chemical fertilizers on the growth and yield of wheat and maize crops in rainfed conditions, and cotton and sugar beet in saline irrigation system.
- To understand the mechanism of the beneficial effect of HA on soil condition and crop production, with respect to soil microbial and enzymatic activities.
- To develop the facility of extraction of humic acids from lignitic coals of various location of Pakistan for large-scale utilization in crop production.
- To formulate recommendations for the application of lignitic coal derived humic acid for low fertility and salt-effected arid zone soils.

Achievements:

A total of 23 experiments were conducted on wheat, maize, cotton, sugar beet and groundnut at three different locations i.e. Nasimabad and Jalalabad in Lachi (Kohat) and Tarkha Kohi (Karak) under saline conditions with electrical conductivity of irrigation water (EC_{iw}) ranging from 1.0 to > 6.0 dSm^{-1}. Main objective of the experiments was to optimize dose of humic acid for various crops under different soil conditions and investigate its effect with and without fertilizers.

During third and final year (2006-07) eight field experiments were completed mainly focused to see the possibility that whether the fertilizer input could be reduced without compromise on yield through application of humic acid for wheat and sugar beet crops. Different humic acid application methods along with pre-sowing seed dry coating with HA was also tested to find out the appropriate method of HA application.

Beside field experiments intensive work was done on the mechanism of the beneficial effects of HA on soil. Various laboratory experiments were designed and executed including effect of HA on microbial activity, moisture retention of soil, acid and alkaline phosphatase and urease enzymes.

An indigenous humic acid extraction unit was designed with collaboration of PCSIR, Peshawar and NWFP University of Engineering and Technology, Peshawar. The unit designed by Turchmir Engineering Works, Lahore after been supplied with design, installed at Agricultural University Research Farm is working properly and about 200 kg of HA was extracted and distributed among farmers, research organizations and staff and students of the university for field trials during rabi 2007-08.

Following conclusion could be drawn from the series of field and laboratory experiments:

- Application of humic acid significantly increased the growth and yields of wheat, sugar beet, maize, cotton and groundnut to varying extent in all sites of project area irrespective of NPK level.
- Alone application of 1.0 kg HA ha^{-1} increased seed cotton yields by 15.58 and 17.71% in Nasimabad and Jalalabad, respectively over control (no HA). Such increases for maize were 20.99 and 15.11% over control. Yields of wheat at Tarkha Kohi and sugar beet at Nasimabad and Jalalabad enhanced by 16.67, 12.40 and 8.5%, respectively with alone application of 1.0 kg HA ha^{-1}.
- Addition of HA with NPK showed additive effects increasing maize grain yields by 40.48, 51.54 and 55.0% in Nasimabad and 35.52, 46.38 and 43.05% in Jalalabad with 0.5, 1.0 and 2.0 kg ha^{-1}, respectively as compared with control (HA:0 NPK:0) during 2005. The same increases for wheat at Tarkha Kohi were 33.05, 34.18 and 37.85% respectively.
- In Nasimabad during 2006-07, wheat grain yield was increased by 190, 201 and 382 kg ha^{-1} with addition of 2.0 kg ha^{-1} HA applied alone, with half and full NPK as compared with control, half and full NPK treatments, respectively suggesting that the farmers income can be increased by Rs.3820 to 7640 ha^{-1} with application of HA.
- Similarly, in Jalalabad site with moderately better soil, wheat grain yield was increased by 28.75% with HA over control, 21.28% with half NPK+HA over half NPK and 27.90% with full NPK+HA over full NPK amount to net increase of 454, 537 and 840 kg ha^{-1} grains, respectively. The increase in yield showed substantial enhancement of Rs.9080 to Rs.16800 ha^{-1} in the income of the farmers due to 2.0 kg HA. Biological yield increased substantially (33%) with HA when applied alone and 10% when added with NPK.
- Application of HA with Zn and Cu improved wheat plant growth and grain yield over alone application of these nutrient at all three sites of Nasimabad, Jalalabad and Tarkha Kohi. In Nasimabad HA plus Zn and CU increased grain yield by 3.44 to 9.82 and biological yield by 4.77 to 8.414% over Zn, Cu and Zn+Cu treatments. In Jalalabad such increase in grain yield and biological yields were 10.0 and 6.35% while in Tarkha Kohi were 6.03 and 6.36% over Zn+Cu alone.
- Alone application of 1.0 and 2.0 kg HA ha^{-1} at Nasimabad increased sugar beet by 10.0 and 17.65% over control (HA:0 and NPK:0) and 12.10 and 20.23% when combined with NPK as compared with NPK alone.
- During 2007-08, application of 2.0 kg HA ha^{-1} with 0, half and full NPK increased sugar beet yield by 42.0, 25.3 and 6.8% over control, half NPK and full NPK. Such increases were 98.6, 45.0 and 3.0%, respectively at Jalalabad site during the same year.
- Methods of HA application alone revealed encouraging results. Application of HA through

soil spray was found more efficient than to banding or broadcast. Alone application of 1.0 kg HA ha^{-1} through soil spray, banding and broadcast increased wheat grain yield by 23.4, 12.31 and 10.4% in Nasimabad and 15.2, 14.9 and 10.4% in Jalalabad, respectively.

- Seed coating with HA is better than its application through soil spray. Application of 2.0 kg HA ha^{-1} as pr-sowing seed dry coating was more effective in increasing wheat plant height, spike length, grain yield and biological yield as compared to soil spray, banding and broadcasting of same amount during 2007-08.
- Post harvest soil and plant analysis of wheat, sugar beet, maize, cotton and groundnut showed that HA per se did not change the composition of soil and plant leaves. However, ECe and SAR markedly increased as compared to pre-sowing soil analysis during kharif season which may be associated with saline groundwater irrigation during the growing season. Soils were generally deficient in organic matter, N, P, Cu and Zn.
- Laboratory experiments on the mechanism of beneficial effects of HA showed that the activity of acid in alkaline phosphatase and urease increased with addition of HA. The activities of acid and alkaline phosphatase were higher in normal soil as compared to saline soil.
- Since the soils are alkaline in reaction the activity of alkaline phosphatase was 3-4 times higher than acid phosphates irrespective of HA treatments.
- Cation exchange capacity increased by 12 to 20% with 1.5 and 3.0 mg kg^{-1} HA in saline soil.
- Microbial activity, by CO_2 production increased significantly with addition of HA up to 1.0 mg kg^{-1} HA but declined it higher level of 2.0 mg kg^{-1} HA. The increase in CO_2 production reached to maximum during first three to four days of incubation and then decreased consistently with incubation time spread over a period of 67 days.
- While moisture retention increased at higher level (50 to 1000 mg kg^{-1}) of HA significantly but showed slight increase at low levels equivalent to the doses applied in the field.
- Alone application of 1.0 kg HA ha^{-1} gave mean additional monitory return of Rs.5028, 2405, 2044 and 4720 ha^{-1} for wheat, cotton, maize and groundnut, respectively as compared with control. When combined with NPK the same level of HA gave addition return of Rs.5724, 3305, 2408 and 3400 ha^{-1} as compared with NPK.
- Application of 1.0 kg HA ha^{-1} through soil spray gave monitory return of Rs.4392 to 6336 as alone and 2772 to 9996 ha^{-1} when combined with NPK over respective controls.

A paper was presented in 11th Soil Congress held at Islamabad from 28-31 March, 2006 and one was accepted for presentation in Humic Science & Technology Eleven Conference, Northern University, Boston, USA held on April 2-4, 2008. One Ph. D. two M. Sc and one B. Sc students produced thesis under sponsorship of the project.

Name of Project:	**Field Evaluation of *Arbuscular Mycorrhizal* Fungi and Their Significance in Wheat-Maize Cropping System Under Different Soil Series of NWFP**
Name of PI/ Institute:	**Dr. M. Sarirullah Sarir,** Professor, Department of Soil and Environmental Sciences, NWFP Agricultural University, Peshawar
Duration:	20.12.2004 to 15.06.2008
Financial Status:	Total Cost: Rs.1.411 million Funds Released: Rs.1134171/- Funds Utilized: Rs.1123554/-

Objectives:

- Selection of important soil series commonly use for wheat-maize cropping system in different agro-ecological zones of NWFP.
- Soil and roots sampling from different soil series of NWFP for spores isolation and their identification and estimation of the status of Vesicular Arbuscular Mycorrhizal (VAM) fungal infections.
- Determination of soil physicochemical characteristics of the survey sites.
- To conduct pot experiments for investigation of the scope of inoculating the non-mycorrhizal wheat and maize crops identifies during the field survey.

Achievements:

Soil and plant root samples collected from different important crop growing agro-ecological zones (series wise) of NWFP were analyzed for *Arbuscular mycorrhizal* (AM) fungal species and their root infection status. Physicochemical properties of these soils were also determined. Pot experiments were conducted to investigate the significance of inoculation of AM fungi alone and in different combination with different organic fertilizers on the yield and nutrient accumulation of wheat and maize crops in different series of salt affected and eroded soils in NWFP. Effects of AM inoculation on wheat and maize shoots yield and plant nutrient accumulation, intensity of AM infection of roots and soil spores density were determined.

Shoots dry matter and grains yield of wheat in salt affected soils and shoots dry matter yield of maize in eroded soils of NWFP increased significantly with the inoculation of AM fungi alone and in combination with farm yard manure (FYM), poultry (PM) and humic acid (HA) over control and NPK treatments. Root dry matter yield of maize showed significant increase with the inoculation of AM fungi alone and in combination with PM, FYM and HA when compared with control and NPK in missa soil series and with inoculation of AM fungi with PM and HA in missa gullied soil series.

In salt affected soils, N concentration in soil increased significantly over the treatment of NPK by the inoculation of AM fungi with HA in Shabqadar soil series and with PM, HA and FYM in Warsak soil series, while plants N inoculation increased with the inoculation of AM fungi alone and with PM and HA in these soils. In eroded soils, maximum and significantly increased soil N concentration was recorded in the treatments of AM inoculation with FYM followed by PM. Accumulation of N by maize shoots increased significantly by the addition of HA, PM and FYM plus NPK with or without inoculation of AM fungi over the treatments of NPK and control in missa soil series and in the treatments of AM fungal inoculation with FYM, PM and HA over all other treatments in missa gullied soil series.

Inoculation of wheat with AM fungi combined with FYM, PM and HA has an additive effect to increase post harvest soil P concentration and its accumulation by wheat shoots significantly over control and NPK treatments in salts affected soils. In eroded soils, post harvest concentration of soil P increased significantly over control and NPK treatments by the inoculation of AM fungi alone and in combination with PM, FYM and HA and plants P accumulation with the inoculation of AM fungi alone and in combination with FYM, PM and HA in missa soil series. In missa gullied soil series, significantly increased soil P concentration was noted with combined inoculation of AM fungi with FYM, PM and HA and plants P accumulation by the treatments of AM inoculation with PM followed by HA.

Roots infection rates by AM fungi in wheat crop increased significantly over NPK treatment by AM inoculation alone and in combination with FYM, PM and HA. Maximum root infection rate of 44% was recorded in the treatment where AM inoculated with HA followed by the treatment inoculated alone. Maximum and significantly increased spores numbers (55 in 20 g soil) were recorded by AM inoculation with HA.

It can be concluded from the results of the experiments that AM fungal inoculations of wheat and maize plants in combination with different organic fertilizers have the capability to increase shoots dry matter and grains yield of wheat in salts affected and shoots and roots dry matter yield of maize crop is eroded soils under investigations due to the improved mycorrhizal roots infection rates, soil spores density and plants accumulation of N, P, Fe, Cu, Zn and Mn. These fungi may play role as biological measure to reduce the effect of salts on soil and increase plants P accumulation in salt affected and eroded soils by improving the efficiency of P fertilizer for plant growth.

Eight research manuscripts have been published/ submitted for publication in various scientific journals of international repute from the research work conducted in the project. Eight students completed their M. SC (Hons) degrees in this research project. Three graduate students worked in the project completed their special problems, review papers and seminars for B. Sc (Hons) degrees.

Name of Project:	**Micronutrients Management in Apple and Citrus Orchards in Swat Valley**
Name of PI/ Institute:	**Dr. Zahir Shah,** Professor, Department of Soil and Environmental Sciences, NWFP Agricultural University, Peshawar
Duration:	22.08.2006 to 30.06.2009
Financial Status:	Total Cost: Rs.3.829 million Funds Released: Rs.2989000/- Funds Utilized: Rs.2916740/-

Objectives:

- To determine the soil fertility status of apple, citrus, peaches and apricot orchards in Swat Valley and nutrients status of plants especially the micronutrients, and prepare their maps.
- To evaluate the effect of deficient micronutrients on the yield of apple and citrus fruits by field trials and formulate fertilizer recommendations on the basis of soils and plant tissue analysis and field trials.

Achievements:

During the reporting period, surveys of two more crops i.e. 50 peach and 20 apricot orchards in Swat valley were conducted in addition to four surveys (52 apple and 50 citrus orchards) conducted in first year. Soil and plant samples were collected from each orchard and analysed for micronutrients and other important properties. Deficiencies of micronutrients such as Zn, Mn and B were diagnosed both in peach and apricot orchards.

Field experiments to assess the influence of Zn and B on yield and quality of apple and citrus fruits and also to compare the soil and foliar application of micronutrient on same crops were conducted at six locations viz apple at three and citrus at three locations in Malakand Division. The analysis of peach leaves showed that it is low mostly in Zn and to some extent in Mn. Zinc was low in 90% and Mn in 12% peach orchards. Other micronutrients (Cu, Fe, B) were adequate in all peach orchards. The soil analysis revealed that some (4-8%) of the peach orchards were low only in Zn. Other micronutrient (Cu, Mn, Fe, B were adequate in soil of peach orchards. The soil analysis for other soil characteristics showed that organic matter was medium to adequate in the surface 0-15 cm soil in all peach orchards but low in the lower soil depths in 9-17% orchards. The concentration of AB-DTPA extractable P & K were low in 32-75% and 9-17% peach orchards respectively depending on soil depth. The deficiency of nutrients generally increased with increasing soil depth. The soil pH of majority of peach orchards was between 6.5 and 7.5, and EC <4.0 dS m^{-1}. The soil of peach orchards generally contained large proportion of silt followed by sand with very small proportion of clay. The analysis of apricot leaves revealed that all orchards were adequate in Zn, Cu and Fe, but 2-3 were deficient in Mn and B.

It could be concluded from the research study that based on leaf test, peach orchards in swat were deficient in varying levels of micronutrients. Zn was deficient in 90%, Mn in 12% and B in 8% orchards. Apricot orchards were deficient only in B (15%) and Mn (10%). No or poor correlation was found between the soil and plant tests for diagnosing Zn deficiency in peach orchards. Based on literature, plant test was considered more reliable than soil test for diagnosing micronutrient deficiency in fruit orchards. Organic matter contents, available P and K were also deficient in majority of peach orchards. Soil pH of almost all peach orchards was near neutral (6.5-7.5) and EC below 4 dS m^{-1}.

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Name of Project:	**Impact of Tillage Systems, Legume and Mulches on Soil Profile Moisture Dynamics and Wheat Production**
Name of PI/ Institute:	**Dr. Safdar Ali,** Professor, Department of Soil Science & SWC, Pir Mehr Ali Shah, Arid Agriculture University, Rawalpindi
Duration:	01.07.2005 to 30.06.2008
Financial Status:	Total Cost: Rs.2.000 million Funds Released: Rs.1310300/- Funds Utilized: Rs.1280938/-

Objectives:

- To monitor the impact of different tillage systems, legumes and mulches on soil profile dynamics under three soil series of rainfed wheat production system.
- To investigate the effect of soil moisture and fertility status etc. on wheat production.
- Economic analysis of different factors under study for wheat production under rainfed conditions.

Achievements:

Field experiments were carried out from Summer 2005 to 2008 for a period of three years at three locations viz. PMAS Arid Agriculture University, Rawalpindi, Fateh Jang and Chakwal areas to scrutinize appropriate summer management practices for Pothwar area. Treatments were laid down in split pot design in conventional tillage (CT), deep tillage (DT) and zero tillage (ZT) in main plots while fallow, legume and mulch in shrub plots. The soil profile moisture varied through the year; however differences were negligible at any chosen stage. Wheat biomass and grain yields differed non-significantly. Biomass varied between 4.59-5.69, 7.97-8.11 and 6.84-11.25 Mg ha^{-1} at Rawalpindi, between 4.07-5.06, 6.34-7.01 and 6.57-8.49 Mg ha^{-1} at Chakwal and between 4.36-5.34, 5.10-5.78 and 1.30-3.35 Mg ha^{-1} at Fateh Jang site, during 2005-06, 2006-07 and 2007-08 respectively. Grain yield ranged between 1.58-1.94, 3.63-3.28 and 3.75-4.29 Mg ha^{-1} at Rawalpindi, 1.40-1.73, 2.91-3.25 and 1.79-2.40 Mg ha^{-1} at Chakwal and 1.47-1.80, 2.15-2.34 and 0.57-1.60 Mg ha^{-1} at Fateh Jang, during three years respectively. Promising gross margins of 62,321, 53,849 and 51,602 at Rawalpindi, Rs.40,497, 37,066 and 36,030 at Fateh Jang and Rs.35,248, 37,083 and 28,835 at Chakwal were achieved under legume combined with MB, CC and Mt respectively.

Although the soil profile moisture varied through the year depending upon rainfall incidence and soil type, the difference under tillage system, legume and mulch treatments were negligible at any chosen stage. Thereby, the effects of treatments on the subsequent wheat crop in agronomic terms were minimal. However, the economic parameter did differ considerably. Keeping in view the agronomic equivalence and economic superiority of legume, the three years study concludes that irrespective of the tillage system, growing the

legume crop during summer instead of fallowing can increase the farmer's profits without compromising wheat yields in high rainfall areas of Pothwar plateau. The study also indicates the possibility of reducing tillage in the area. However, the costly wheat straw mulch needs to be replaced with some cheaper alternative.

Two research papers have been prepared from research work conducted under the project and submitted to Agron. Journal and Pak, J, Bot. for acceptance and publishing. Two students one for Ph. D and one M. Sc enrolled in the university worked for their thesis research work in the project.

Name of Project:	**Farmers' Capacity Building through Information Technology in Pakistan.**	
Name of PI/ Institution:	**Dr. Muhammad Zakria Zakar** Chairman, Department of Sociology, Uni. of the Punjab, Lahore	
Duration:	01.07.2004 to 30.06.2008	
Financial Status:	Total Cost: Funds Release: Funds Utilized:	Rs. 2.201million Rs. 1218500/= Rs. 1223545/=

Objectives:

- To study the Knowledge, Attitude and Practices (KAP) of farmers (peasant-proprietors, tenants) about farming in different regions of Pakistan
- To analyze the role of existing information system at institutional and grass root level in the provision of extension services by government line agencies especially agricultural extension, mass media , indigenous /traditional sources, any other source To review the effectiveness of sector specific information provision for the equitable and sustainable farming i.e. the capacity existing sources to meet farmers' needs, the bottlenecks and difficulties in the way of effective transmission of information
- To strengthen the local agricultural extension system through the establishment of community managed Information and Communication Centre (ICC). ICC shall:
  - Provide two-way communication and information mechanism for innovative farming techniques between the farmers and the experts.
  - Develop information and service seeking behavior among peasant-proprietors and tenants through the development of social capital and competencies; and
  - Improve the level of information of women, ethnic and religious minorities, illiterate and other disadvantageous sections especially the tenants and workers.
  - Assess the viability and sustainability of ICC as social institution for subsequent broad based replication.

Achievements:

In line with the objectives of the study, information seeking and utilization behaviors of farmers were monitored at the ICC and various strategies were adopted to enhance the level of their information by harnessing modern ICT. The project drew the following conclusions:

- Farmers needed comprehensive, relevant and lucid information for solving their practical problems related to their day-to-day farming activities. Overall, farmers had positive attitude towards new information and innovative farming technology.

- Many farmers were dissatisfied with the overall "information environment" prevailing in the society. They narrated many inadequacies in the existing flow of information. Many farmers could not take risk of applying new information because they had meager resources and could not afford any risk.
- Some farmers were also cautious and, to some extent, worried about the misuse and exploitation of information for commercial purposes by the private business entities, especially the fertilizers and pesticide producers. They wanted credible and honest information.
- Some farmers wanted to know how to judge the credibility and correctness of information. There were frequent complaints that they got contradictory information from diverse sources.
- Because of small land-holdings and decreasing capacity of agriculture to generate enough money for house-hold expenses, many farmers considered agriculture as a "side-business". Hence they were not full-time farmers. For example, some farmers were engaged in trading of buffalos. They were also interested in trade related information which was difficult to get. They seemed less interested in learning innovative farming practices.
- Farmers needed comprehensive, integrated, transparent and updated information about the functioning of local public service departments like revenue department, registration, local government and rural department etc. They were not happy with the performance of functionaries of these departments, and wanted their accountability and demanded exploitation free civic services. Farmers' complained that these departments deliberately conceal information.
- Information about agriculture marketing was almost non-existent especially for vegetable growers. They needed precise information and exploitation-free mechanism of marketing their produce. Unfortunately, no proper information could be available to help these farmers.
- Marginalized sections especially the ethnic and religious minorities, handicapped, un-attendant elderly people, people with chronic ailments, extremely impoverished and homeless people were particularly deprived of very basic information for their dignified survival. Such people had extremely impaired ability to seek even basic information for their day-to-day life.
- Rigid social stratification was a major hurdle in the way of meaningful dialogue on available information. Poor farmers were conscious that they are "kept at distance" by the influential and rich farmers. There were complaints that government functionaries including extension workers were biased in favor of rich farmers.
- Framers were also conscious about the inadequacy of information and services in the areas of health, family planning, sanitation, disposable of solid waste and environmental degradation. Though, they were not able to use scientific and scholarly terms but their simple narrations were sufficient to reveal their deep concerns about the fast degrading agro-ecological environment. Many a times, discussions at ICC were related to these topics.
- Farmers were aware and concerned about the fast declining standards of various social and professional services. For example, they knew that medical quacks were not competent enough to treat them, the teacher in the school is not dedicated to educate their children, fertilizers and pesticides they buy may be spurious or partly adulterated. A

feeling of discontentment, powerlessness and social exclusion were quite noticeable among the small landholders.

- Despite the fact that they knew the importance of new information, but they wanted supportive and facilitating social and economic arrangements to use that new information.
- The most important conclusion this research has drawn is the importance flow of information among farming communities. Instant flow of information among farming communities is possible by increasing their connectivity. Connectivity is not only essential to improve their farming practices, but it is essential for sustainable agriculture and control over environment, land and resources. It is not possible to regulate and change the behavior of a farmer who is not connected. Understandably isolated, excluded and disconnected farmers cannot be rescued at the time of trauma and trouble. Furthermore, isolated and disconnected individuals remain beyond the "writ of science and modernity". Connectivity helps to make disaster resilience communities; the communities who can fight against Hepatitis C, manage water, conserve resources and save environment. The benefit of developing connectivity may not be only measured by the farm productivity alone (Zakar 2007).

Despite the many challenges and disappointments, it would be a serious error to underestimate the potential that ICTs can contribute towards the development of human capacities which are necessary to make them productive and contributing human beings. Experiences gained from this project suggests, that farmers, including illiterate and impoverished, were deeply dissatisfied with their social and economic conditions; they wanted a change. They were also aware that new information can change their life, but, they needed proper infrastructure to implement and apply that information in real life situations. It needs to be understood that technology can not substitute for entrepreneurship nor for well thought out strategies for development.

A research paper has been published from project work while one is under process of publication. Eleven students of M.A. in the discipline of developmental communication, rural sociology and social psychology of Punjab University, Lahore conducted research and completed their thesis for award of degrees. Two Ph.D. students were also supervised for their research program.

Name of Project:	**Comparative Advantage and Competitiveness of Major Crops in Pakistan- Price Risk Analysis**
Name of PI/ Institution:	**Dr. M. Siddique Javed** Associate Professor, Department of Agricultural Economics, University of Agriculture, Faisalabad
Duration:	25.11.2005 to 30.06.2008
Financial Status:	Total Cost: Rs. 1.722 million Funds Released: Rs. 1084600/= Funds Utilized: Rs. 1082500/=

Objectives:

- To analyze the impact of agricultural policies to assess the degree to which domestic and world input and output prices of agricultural commodities, differ from their equivalents in the international markets. The study will specifically focus on:
- Determining the degree of protection and policy distortions in major agricultural commodities.
- Estimate the comparative advantage and competitiveness of these commodities.
- Demonstrate the use of Policy Analysis Matrix (PAM) using different probability distribution of input and out put prices.

Achievements:

Free trade exposes countries to new production and management technologies that foster higher productivity at both the firm and industry level. It allows countries to export those goods and services they can produce efficiently and import those goods and services they produce inefficiently. Keeping in view the concept of free trade, the study was undertaken to determine the comparative advantage and competitiveness of major crops viz. rice, wheat. cotton and sugarcane in Pakistan. The objectives were to determine the degree of protection and policy distortions and to estimate the comparative advantage and competitiveness in the production of these crops.

The information about the production and marketing of the major crops for six harvesting years from 2000-01 to 2005-06 were collected from various secondary sources. Punjab and Sindh. the two main provinces, were the focus of the study. The policy analysis matrix (PAM) was used as an analytical framework. The crop budgets were constructed both in private and economic prices. The nominal protection coefficients for input (NPCI) and outputs (NPCO) and the Effective Protection Coefficient (EPC) were used to estimate the degree of protection. The domestic recourse cost ratio (DRC) was used to measure the comparative advantage while the private cost ratio (PCR) to measure the competitiveness was applied.

The analysis showed that the production of wheat as an import substitute crop was profitable in Punjab, Sindh and Pakistan. The NPCs of output were 0.67, 0.82 and 0.74 for Punjab, Sindh and Pakistan respectively which showed under pricing of wheat crop in the country. The EPC's were 0.55, 0.79 and 0.65 for Punjab, Sindh and Pakistan, respectively. The DRC ratios were 0.59, 0.67 and 0.62 for Punjab, Sindh and Pakistan respectively which showed that Pakistan has comparative advantage in wheat production as an import substitute crop. The PCRs were 1.04. 0.8-f and 0.94 for Punjab. Sindh and Pakistan, respectively which showed the degree of competitiveness its production in Sindh and Pakistan.

The results at export parity price for wheat showed that domestic wheat prices were higher than border prices. The NPCs of input showed protection to the wheat growers. The EPCs were 2.44, 2.20 and 2.32 for Punjab, Sindh and Pakistan respectively which showed incentives to wheat growers from input-output price policy. The DRC ratios were 2.59, 1.87 and 2.21 for Punjab, Sindh and Pakistan, respectively, which showed that Pakistan has comparative disadvantage in wheat production as an export item.

The NPCOs for cotton at export parity price were 0.84, 0.81 and 0.83 in Punjab, Sindh and Pakistan, respectively. This showed that domestic cotton prices were lower than border prices. The EPCs were 0.82, 0.78 and 0.80 for Punjab, Sindh and Pakistan, respectively, which showed disincentives to cotton growers as domestic market prices were lower than the world price. The ORe ratios were 0.62, 0.55 and 0.59 for Punjab, Sindh and Pakistan, respectively, which showed that Pakistan has comparative advantage in cotton production as an export item. The PCRs were 0.75. 0.70 and 0.73 for Punjab, Sindh and Pakistan respectively which showed the competitiveness in its domestic production.

The NPCO of rice (Basmati) was 0.74 in Punjab and Pakistan. This showed that domestic rice (Basmati) prices were lower than border prices. The EPC was 0.65 for Punjab and Pakistan, which showed disincentives to rice (Basmati) crop from input-output price policy. The DRC ratio was 0.69 for Punjab and Pakistan which showed that Punjab/Pakistan has comparative advantage in rice (Basmati) production as an export item. The PCR was 1.04 for Punjab and Pakistan which showed slight lack of competitiveness in its production.

The NPCOs of' rice (IRRI) were 1.29, 1.25 and 1.27 for Punjab, Sindh and Pakistan respectively. The IPCs were 1.98, 1.74 and 1.86 for Punjab, Sindh and Pakistan, respectively, which showed incentives to rice (IRRI) growers. The DRC ratios were 1.83, 1.43 and 1.64 for Punjab, Sindh and Pakistan, respectively, showing that Pakistan has comparative disadvantage in rice (IRRI) production as an export item but results showed competitiveness in its domestic production.

The production of sugarcane as an import substitution was found to be profitable in Punjab, Sindh and Pakistan. The NPCs on output were 0.86. 0.92 and 0.89 for Punjab, Sindh and Pakistan respectively which showed under-pricing of sugarcane crop in the country compared with world market. The EPCs were 0.85, 0.94 and 0.90 for Punjab, Sindh and Pakistan respectively. This indicated that the production was not supported by the policy incentives. The DRC ratios were 0.64, 0.60 and 0.62 for Punjab, Sindh and Pakistan, respectively, which showed that Pakistan has comparative advantage in sugarcane production

as an import substitution crop while the values of PCRs showed the competitiveness in its domestic production. The results at export parity price showed the protection to sugarcane growers from the output prices and comparative disadvantage in its production as an export item for Pakistan.

Through price risk analysis, the export parity price of wheat for Punjab was estimated as Rs. 264.84 per 40 kg. The projected value of revenue showed an increasing trend up to fifth year. In Punjab, the NPC on tradable inputs was estimated as 0.86 in the first year with decreasing trend in case of risk price of DAP. The DRC ratios were greater than one for all the five years showing comparative disadvantage in wheat production as an export item. The EPC showed heavy protection to wheat growers domestically. The results with risk price of urea showed lower input prices in the domestic market while the NPC for output was 1.29 for the first year which showed higher output prices in domestic market. The ORC ratio of 3.44 showed strong comparative disadvantage in its production.

The NPCI value with risk price of DAP was 0.85 for first year in Sindh at export parity price. The NPC or output was 1.29 for the first year and remained higher than one up to the fifth year. The DRC ratio was 1.83 with risk price of DAP and 2.26 with risk price of urea for Sindh indicating comparative disadvantage in its production. At national level, the results showed that Pakistan has comparative disadvantage in wheat production at export parity price. The increasing trend in the DRC value shows that its production as an export item is not favorable in the coming years.

The results at important parity price of wheat with risk value of DAP and urea showed strong comparative advantage in wheat production in Punjab and Sindh. The EPC showed disincentives to wheat growers in the projected years. The DRC ratio with urea was higher than the ratio with FOB price of DAP because of excessive quantity of urea used in production. At national level, the country has comparative advantage in wheat production as an import substitute item.

The dynamic analysis of cotton with mean risk value of DAP for Punjab at export parity showed the under-pricing of the produce in the domestic market as the NPCO was 0.83 for the first projected year which is less than the static value of 0.84. The DRC ratio was 0.62 for the first year showing comparative advantage in coming years. At national level, the country showed comparative advantage in cotton production for the coming years. The EPC ratio showed negative incentives to cotton growers from input and output price

The dynamic analysis of rice Basmati with mean risk value of DAP for Punjab/Pakistan at export parity showed lower output prices in the domestic market as NPCO was 0.77 for the first projected year and going down in subsequent years due to increase in FOB price of the output. The DRC ratio with FOB risk price of DAP and urea also showed comparative advantage in Basmati rice production in future. The EPC ratio showed a decreeing trend in its value due to an increase in FOB prices.

In Punjab, the DRC for IRRI production with risk mean values of DAP and urea showed comparative disadvantage in its production as an export item. In case of Sindh, in the first

year, the DRC ratios were 1.09 and 1.26 with risk price of DAP and urea, respectively, indicating comparative disadvantages in its production. The EPC shows the positive incentives to wheat growers. At national level, the results showed that Pakistan has comparative disadvantage in rice (IRRI) production at export parity price in the future. The decreasing trend in the DRC value showed that its production, as an export item, may be favorable in the coming years because of an increase in FOB prices of output. .

The dynamic analysis of sugarcane with risk value of OAP and urea for Punjab at export parity showed that the prices of output in domestic market were higher than the world prices. The DRC ratio was 0.95 with risk price of DAP for the first year showing the comparative advantage in coming years. The EPC value shows positive incentives to sugarcane growers while the ORC ratio with FOB risk price of urea showed comparative disadvantage for the first year due to an increase domestic factor cost. The NPCO ratio was 1.20 for Sindh with economic cost of DAP which is less than the static value of 1.37 showing an increase in world prices. At national level, the country shows the comparative advantage in sugarcane production in the coming years.

The dynamic analysis at sugarcane with mean risk value of DAP for Punjab at import parity price showed NPCO ratio of 0.75 for the first projected year which was less than the static value of 0.86. The ORC ratio was 0.54 for the first year showing the presence of comparative advantage in coming years because of increase in FOB prices. The EPC value showed positive incentives to sugarcane growers for all the projected years. The DRC ratio with FOB risk price of urea showed comparative advantage as an import substitution for the first year in Punjab. At national level, the country shows the comparative advantage in sugarcane production as an import substitute item for the coming years.

- The static analysis lead to the conclusion that Pakistan (Punjab and Sindh) has no comparative' advantage in both sugarcane and wheat production at export parity price as an export item because of high domestic resource cost and less foreign exchange earnings, on the other hand there is a comparative advantage in wheat and sugarcane production at import parity price as an import substitution crop both in Punjab and Sindh provinces and in the country as a whole, Therefore, it will be better for Pakistan to grow these commodities only to meet domestic demand. In case of cotton, Punjab and Sindh enjoyed a comparative advantage at export parity price as foreign exchange earnings were higher than the domestic cost of production. The Punjab holds comparative advantage in the production of Basmati rice but the production resource IRRI rice is not competitive in both Punjab and Sindh because of higher domestic resource cost.

In case of dynamic analysis it led to conclude that Punjab has comparative advantage in producing sugarcane in future. The risk analysis further showed the country will enjoy comparative advantage in sugarcane production in future trade scenario because of an increasing trend of FOB process. The country will still enjoy the comparative advantage in sugarcane production as an import substitute crop in the near future. In the future trade market, the country has comparative disadvantage in production of wheat as an export item because of an increase in domestic factor cost. There is comparative advantage in wheat production at import parity price as an import substitution item. In case of cotton, both

Punjab and Sindh will enjoy the comparative advantage in producing cotton for export purpose in the coming purpose. The results further showed a gradual increase in FOB prices of Basmati. But in case of IRRI, there is comparative disadvantage in its production which may remain in the near future.

Annexure-I

List of ALP Projects Completed on December 31, 2008:

(Rs.)

S. No	Name of Project	PI/Institute	Duration	Total Cost (million)	Release	Expdt.
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/-	2915784/-
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	3.75	3329100/-	3135463/-
6	Genetic Improvement of Buffaloes in Pakistan (GIBP)	Dr. Muhammad Anwar, Sr. Scientific Officer, ASI, NARC, Islamabad.	12.11.2004 to 11.11.2007	2.287	1447200/-	1112900/-
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	4592500/-	4563500/-
10	Development of Database on Minerals Profile of Feedstuffs, their	Dr. Attiya Azim, Sr. Scientific Officer, ASI, , NARC,	17.09.2005 to 16.09.2008	2.513	2527300/-	2293136/-

	Availability and Strategic supplementation of Minerals Block to Dairy Animals.	Islamabad				
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/-	650000/-
12	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/-	2036056/-
13	Immunobiology and Immunoprophylaxis of Coccidiosis in Chickens	Dr. Masood Akhtar, Asstt. Prof., Deptt. of Parasitology, University of Agriculture, Faisalabad	03.04.2002 to 02.03.2005	1.463	797800/-	786429/-
14	Studies on Tilapia Culture through Controlled Breeding in Saline Areas	Dr. Iftikhar Ahmed, Associate Prof., Fisheries Research Farms, Dept. of Zoology and Fisheries, Uni. of Agriculture, Faisalabad	03.04.2002 to 02.04.2005	0.898	688100/-	688100/-
15	Characterization of Tannins in Feeds and Forages of Pakistan and their Evaluation for Anthelmintic Activity	Dr. Zafar Iqbal, Associate Prof., Sets 9/10, Khalid Hall, Uni. of Agri., Faisalabad	13.08.2002 to 12.08.2004	0.968	872850/-	871232/-
16	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, Assistant Prof., Department of Livestock Management, University of Agriculture, Faisalabad	08.09.2004 to 07.09.2006	1.779	1464500/-	1428562/-
17	Genetic Characterization of Native Cattle and Buffaloes Breeds of Pakistan.	Dr. Safdar Ali, Assistant Prof., Uni. of Agriculture, Faisalabad	22.5.2004 to 21.5.2007	4.628	3651800/-	3599143/-
18	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.	28.5.2004 to 27.5.2007	5.058	4837200/-	4794360/-
19	Development of Milk Recording and Genetic	Dr. Muhammad Sajjad Khan,	22.5.2004 to	3.695	2811800/-	2704485/-

	Evaluation Models in Sahiwal Cattle.	Associate Prof. Department of Animal Breeding & Genetics, Uni of Agriculture, Faisalabad.	21.5.2007			
20	Evaluation of Indigenous Medicinal Plants for the Steroid Hormonal Activities for Veterinary and Medical Usage	Dr. Nazir Ahmad, Prof./Chairman, Department Animal Reproduction, University of Agriculture. Faisalabad	08.09.2005 to 07.09.2008	5.046	3361000/-	3054487/-
21	Mott Grass as a Potential Source of Dietary Forage for Lactating Sahiwal Cows.	Dr.Muhammad Qamar Bilal, Assistant Prof., Department of Livestock Management University of Agriculture, Faisalabad	14.09.2005 to 13.09.2008	1.660	1559100/-	1459769/-
22	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/-	1339345/-
23	Pharmacokinetics and Dosage of Flouroquinolones in Animals.	Dr. Faqir Hussain Khan, Associate Prof. , Department of Physiology and Pharmacology, University of Agriculture, Faisalabad	11.02.2006 to 10.02.2008	3.100	2623300/-	1459769/-
24	Preliminary Studies on the Efficiency of Locally Prepared *Staphylococcus Aureus* Vaccine in the Control of Mastitis in Dairy Buffaloes	Dr. Ghulam Muhammad, Associate Prof. & Chairman, Dept. of Clinical Medicine and Surgery, Faculty of Veterinary Sciences, Uni. of Agri. Faisalabad	25.04.2002 to 24.04.2004	0.754	452000/-	446556/-
25	Molecular Characterization and Pathogencity of Avian Adeno-Viruses Causing HPS	Dr. Mansur-ud-Din Ahmad, Associate Prof., Department of Microbiology, University of Veterinary and Animal Sciences	02.04.2003 to 30.03.2006	2.746	2474600/-	2046377/-

		(UVAS), Lahore.				
26	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/-	4426615/-
27	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/-
28	Epidemiology of Helminthiasis in Sheep	Dr. Haji Ahmad Hashmi, Associate Pro./Chairman, UVAS, Lahore	21.09.2005 to 20.09.2007	0.547	432100/-	275429/-
29	Studies on Mineral Imbalances in the Livestock of Canal Irrigated Districts of the Punjab.	Dr. Talat Naseer Pasha, Prof., Department of Animal Nutrition, UVAS, Lahore	21.09.2005 to 20.09.2008	8.596	6665800/-	2432306/-
30	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	1583080/-	1454059/-
31	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	2.76	2529975/-	2356597/-
32	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/-
33	The Status of Shrimp's Fisheries in Sonmiani Bay Lagoon, Balochistan Pakistan.	Dr. Naureen Aziz Qureshi, Assistant Prof., Centre of Excellence in Marine Biology, University of Karachi, Karachi.	28.07.2004 to 27.07.2007	4.471	3682300/-	2618744/-
34	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/-	3587498/-
35	Farming of Mud Crab (*Scylla serrata*) in the Coastal Earthen-Ponds	Prof. Dr. Javed Mustaquim, Prof. of Marine Biology, Center of Excellence	06.05.2002 to 05.05.2005	2.386	1984300/-	1961587/-

		in Marine Biology, Uni. of Karachi				
36	Strategic Breeding of Red Sindhi Cattle (SBRSC)	Dr. U. N. Khan, Director General, Southern Zone Agri. Research Center (SARC) - PARC, Karachi	23.04.2002 to 22.04.2005	2.785	2740000/-	2656118/-
37	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/-
38	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/-
39	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/-
40	Enhancing Milk Yield of Kindi Buffaloes through Production of Performance Tested Bulls	Dr. Alam Solangi, Breed Improvement and Development Centre (SPU) Kundi Buffalo Farm Rohri, Sindh.	14.08.2005 to 13.08.2008	3.556	1976700/-	2013100/-
41	Implementation of NIR Technique for the Evaluation of Animal Feeds.	Dr. Mohammad, Mohsin Siddiqui, Associate Prof., Department of Livestock Management, NWFP Agri. University, Peshawar	27.04.2002 to 26.04.2005	1.946	1555000/-	1542711/-
42	Efficient Utilization of Local Feed Recourses for Sustainable Increase in Livestock Production.	Dr. Ghulam Habib, Associate Prof., (Animal Nutrition), NWFP Agri. Uni. Peshawar	13.08.2002 to 12.08.2005	1.854	1700000/-	1698861/-
43	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/-
44	Taxonomical Studies of the Prevalent Ticks Species on Different Livestock Hosts	Dr. Raheem Ullah Shah, Research Officer, Veterinary Research	25.04.2006 to 30.06.2008	2.629	2217500/-	2135023/-

	throughout NWFP	Institute, NWFP, Peshawar				
45	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 07.09.2008	3.248	2833100/-	6171175/-
46	Trout Farming in the Mountains of Northern Areas. A Research Project at TRMC Juglote.	Mr. Faridullah Khan, Scientific Officer, Karakuram Agricultural Research Institute for Northern Areas, (PARC), Juglote, Gilgit	16.09.2005 to 15.09.2008	6.543	3972100/-	4035967/-
Crop Sciences:						
1	Development of High Yielding and Well Adaptive Indigenous Canola Hybrids.	Dr. Naazar Ali, Chief Scientific Officer, Oilseed Research Program, NARC, Islamabad	18.07.2002 to 17.07.2005	1.869	1575000/-	*149201 3/-*
2	Integrated Management of Fruit Flies in Pakistan, NARC (Component-I)	Dr. Ghulam Jilani, Senior Director, IPEP, NARC	21.03.2002 to 31.12.2005	3.675	2681500/-	2296648/-
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/-	1483886/-
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/-	2243672/-
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/-	1554029/-
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/-	947999/-
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/-	2419646/-
8	Collection, Conservation, Evaluation and Documentation of Horticultural Crops Germplasm and its Wild Relatives.	Mr. Muhammad Afzal, Sr. Scientific Officer, ABGRI, NARC, Islamabad	18.07.2002 to 30.06.2006	3.000	2266010/-	2112691/-
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/-	1255204/-

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/-	1258525/-
11	Study on Genetic Variation in *Xanthomonas 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	4821000	2680500/-	2599989/-
12	Molecular Breeding of Kabuli Chickpea for Ascochyta blight Resistance and High Yield Potential.	Dr. Ahmad Bakhsh Maher, Sr. Scientific Officer, Pulses, NARC	22.03.2002 to 21.03.2006	2.701	1374773/-	1374773/-
13	Studies on the Pphysiological Race Analysis of Fusarium monilifome Inciting Bakanae/Foot Rot in Rice	Dr. M. Afzal Akhar, Sr. Scientific Officer, CDRI, NARC	01.07.2005 to 31.05.2007	3.543	1387100/-	948054/-
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/-	1635141/-
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/-	859318/-
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, Principa Scientist, NIA, Tandojam.	26.04.2002 to 30.06.2005	1.070	784000/-	683643/-
18	Development of Canola Quality Mustard (*Brassica juncae L.)* Genotypes.	Syed Anwar Shah, Principal Scientist, NIFA, Peshawar.	22.03.2002 to 21.03.2005	1.350	1262000/-	1262000/-
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	Mr. Riaz Mehmood, Sr. Scientific Officer, CABI, Rawalpindi	21.03.2002 to 30.06.2005	4.166	3114500/-	3004700/-

	Pakistan.					
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/-	962502/-
23	Exploitation of forage legume diversity endemic to salt range in the Punjab.	Mr. Farrukh Javed, Asstt. Prof., Agricultural, Faisalabad.	06.04.2002 to 30.06.2005	1.095	510048/-	420889/-
24	Genetic improvement of brassica oilseed by integrative use of conventional and molecular biological approaches.	Dr. Zahoor Ahmed Swati, Professor, Inst. of Biotech. & Genetic Eng., NWFP Agric. University, Peshawar.	22.03.2002 to 21.03.2005	1.919	1291000/-	1280466/-
25	Management of parasitic weeds in rapeseed, onion and legume crops in NWFP.	Dr. Khan Bahadar Marwat Prof., Dept. of Weed Sci., NWFP Agric. University, Peshawar.	22.03.2002 to 30.06.2005	1753000	1730531/-	173009/-
26	Investigation of mechanism for weed seed dormancy in rice based cropping system.	Dr. Gul Hassan Prof., Dept. of Weed Sci., NWFP Agric. University, Peshawar	22.03.2002 to 21.03.2005	400000	405000/-	402271/-
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/-	2003547/-
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/-	836946/-
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/-	749649/-
31	Studies on malformation of mango	Dr. Ahmed Saleem Akhtar, Dir., Plant Prote. Inst., AARI, Faisalabad.	29.03.2002 to 28.03.2005	2.241	1544000/-	1519035/-
32	Increasing production of	Dr. Muhammad	06.04.2002	1.328	898500/-	892253/-

	Kabuli chickpea for its import substitution.	Afzal, Dir., Pulses Res. Inst., AARI, Faisalabad.	to 28.02.2006			
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	1958500/-	1956126/-
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/-	1025918/-
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	08.09.2005 to 07.09.2008	3.861	3211900/-	2711914/-
38	Investigation of Citrus Decline and Preliminary Management Studies in Punjab	Me. Khurshid Burney, Sr. Scientific Officer, IPEP, NARC	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/-	978211/-
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/-	916266/-
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/-	855403/-
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/-	951391/-
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/-	552000/-
44	Development of High Yielding, Disease	Mr. Naeem-ud-Din, Groundnut Botanist,	01.07.2005 to	3.221	2949600/-	2949540/-

	Resistant Varieties of Groundnut through Hybridization and Mutation Breeding along with Nodulation Studies for N_2 Fixation under Rainfed Conditions	Barani Agricultural Research Institute, Chakwal	30.06.2008			
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/-	1170585/-
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	7.840	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	1582000/-	1706691/-
51	Quantification of maize yield losses from leaf blights and improving maize populations for grain yield and leaf blight resistance.	Dr. Hidayat-ur-Rehman, Prof., (PBG), NWFP Agriculture University, Peshawar.	01.07.2003 to 30.06.2006	2.173	1520000/-	1215037/-
52	Production of doubled haploids wheat with longer coleoptile.	Dr. Fida Muhammad, Associate Prof., (PBG), NWFP Agriculture 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	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	2092800/-	1712483/-
58	Component 4: Identification of sources of resistance to Karnal bunt disease of wheat.	Mr. Javed Iqbal Mirza, Sr. Scientific Officer, CDRP, NARC	01.07.2003 to 31.07.2007	2.54	2059000/-	1956941/-
59	Studies on mycotoxins in corn.	Dr. Yasmin Ahmad, PSO, IPEP, NARC,	01.08.2003 to 30.06.2006	2.5	1720800/-	1579139/-
60	Introduction of soft fruit (strawberry, black berry, rasp berry, black currant) in the potential areas of Pakistan for economic returns.	Sudheer Tariq, Sr. Scientific Officer, IFHC, NARC, Islamabad.	01.07.2003 to 30.06.2006	4	3674200/-	3494648/-
61	Development of heat tolerant wheat varieties.	Dr. Muhammad Aqil, Director, Wheat Research Institute, AARI, Faisalabad.	01.10.2003 to 30.09.2006	2.955	2157000/-	2063019/-
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	1368800/-	1363479/-
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	01.01.2005 to 31.12.2007	1.780	1220150/-	1224410/-

		Karachi.				
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/-	2150508/-
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/ terminal 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 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/-	2386929/-
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	Mr. M. Sarfraz Iqbal, Director, Agronomic Research Institute,	30.08.2004 to 31.12.2007	2.120	1989300/-	1988648/-

	Punjab (Comp.-III)	AARI, Faisalabad				
77	Integrated Weed Control in Cereals (Wheat and Maize), Peshawar (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	Abdul Wahid Baloch, Deputy Chief Scientist ,	17.10.2003 to 16.10.2006	1.112	846000/-	846000/-

	Earliness in Non-Aromatic Rice (*Oryza sativa L.*)	NIA, Tandojam,				
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, Deptt. of Plant Breeding & Genetics, University of Agri., Faisalabad	02.12.2004 to 01.12.2007	5.230	3986433/-	3809091/-
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/-	2554522/-
93	Better Utilization of Food for Healthy and Productive Life in Agriculture Sector	Dr. Alam Khan, Prof., Department of Human Nutrition, NWFP Agricultural 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 & Agriculture (NIFA), Tarnab,	28.07.2004 to 27.07.2007	2.013	1762500/-	1746157/-

		Peshawar				
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), National Agricultural Research Centre (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 Rodent Damaging Date-Palm Orchards of Tehsil Nok Kundi Distt: Chagai-Balochistan	Syed Muzaffar Ahmed, Sr. Scientific Officer, Vertebrate Pest Control Research Institute , SARC, University Campus, PARC, Karachi	07.03.2005 to 06.03.2008	3.102	2621100/-	2320549/-
103	Development of Integrated Pest Management of Subterranean Termits in Agro-Ecosystem	Dr. Sohail Ahmed, Associate Professor, Department of Agri. Entomology, University of Agriculture, Faisalabad	27.07.2004 to 26.07.2007	2.431	1619000/-	1572131/-
104	Development and Testing of a Resource Conservation Tillage implement	Dr. Jehangir Khan Sial, Professor, Faculty of Agri. Engineering & Technology, University of Agriculture, Faisalabad	30.10.2004 to 30.12.2007	1.910	1083825/-	801367/-
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 Diazotrophs (Azorhizobium ssp, Azospirillum spp.) in Rainfed Wheat	Mrs. Shahida Nasreen Khokhar, Sr. Scientific Officer, Soil Bio. Lab. LRRP, INRES, NARC, Islamabad	27.07.2004 to 30.06.2007	2.233	1953225/-	1934000/-
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	1.973	1542000/-	1529837/-
11	Soil Fertility Monitoring and Management in Dry	Mr. Ahmad Sami Ullah, Sr. Scientific	02.05.2002 to	1.150	1035500/-	1035940/-

	land Cropping Systems of Balochistan (AZRC, Quetta, Component-III)	Officer, AZRC, Quetta	30.06.2005			
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	1509600/-	1509600/-
14	Use of Low Quality Groundwater for Sustainable Crop Production	Dr. Ashfaq Ahmad Sheikh, Dy. Director PCRWR, Islamabad	05.05.2004 to 15.10.2007	1.700	1449800/-	1449800/-
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/-	2452470/-
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, Professor, 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-	Dr. Ghulam Murtaza, Asso. Prof., Inst. of	19.07.2004 to	2.923	2113300/-	2131076/-

	Affected Soils Using Brackish Water and Amendments	Soil & Env. Sciences, University of Agriculture, Faisalabad	30.06.2007			
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 Structure Alternatives for Irrigation Channels	Dr. M. Rafiq Choudhry, Prof., Deptt of Irri. & Drainage, University of Agriculture, Faisalabad	28.05.2004 to 27.05.2007	4.128	2047600/-	1999999/-
24	Silicon Nutrition for Enhancing Crop Productivity	Dr. Rahmat Ullah, Asso. Prof., Inst. of Soil & Env. Sci., University of Agriculture, 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/- -	2717012/- (up to 30.06.2008)
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/-	1280938/-
28	Diagnosis and Remedial Measures of Micro-Nutrient Deficiencies in Fruit Plants of Economic Importance in Pakistan (AARI, Faisalabad, Comp.	Dr. M. Ibrahim, Agri. Chemist (Soils), Ayub Agricultural Research Institute, Faisalabad	13.04.2002 to 30.11.2006	2.337	1562500/-	1206595/-

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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 (NWFP Agri. Uni. Peshawar, Comp.-III)	Dr. Zahir Shah, Professor, Dept. of Soil & Env. Sci., NWFP Agricultural University, Peshawar	25.04.2002 to 30.06.2006	1.642	1652537/-	1625050/-
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/-	997364/-
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	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/-
38	Improvement of Groundnut Production Through Rhizobial	Dr. Sabir H. Shah, Dir., Soil & Plant Nut. , Agricultural	22.05.2004 to 21.05.2007	1.701	1662200/-	1662114/-

	Inoculation in NWFP	Research Institute, Tarnab, Peshawar				
39	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/-
40	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/-	1224841/-
41	Soil Fertility Monitoring and Management in Major Cropping Systems of AJK (AJK, Muzaffarabad, Component-II)	Dr. M. Bashir Butt, Soil Chemist, Dept. of Agriculture, Department of Agriculture, Muzaffarabad, AJK	13.04.2002 to 30.06.2005	1.150	1129000/-	1112896/-
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	3.00	795000/-	781730/-
2	Structure, Conduct and Performance of the Marketing Systems, Margins and Seasonal Price Variation of Selected Fruits and Vegetables in Pakistan	Dr. Ali Muhammad Khushk, Sr. Scientific Officer, TTI, ARI, Tandojam	18.04.2002 to 17.04.2004	2.500	2095000/-	1958554/-
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	3.00	2295500/-	1862753/-
6.	Farmer's Capacity Building through	Dr. M. Zakria Zakir, Chairman, Dept. of	01.07.2004 to	2.201	1218500/-	1223545/-

	Information Technology in Pakistan	Sociology, Uni. of Punjab. Lahore	30.06.2008			
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	0580	571000/-	571006/-
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 Transferring Improved and Tested Technology at the Farm Level	Dr. A. D. Sheikh, Sr. Scientific Officer, TTI, PARC, Faisalabad	18.08.2004 to 17.08.2007	5.115	4369600/-	3458814/-
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/-	3297405/-
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/-	2306550/-
15	Development of Agriculture from Subsistence Level to Productive Level through	Mr. Shaukat Hayat Sadozai, Director TTI, Karina, Gilgit	18.08.2004 to 17.08.2007	3.926	3641300/-	3532677/-

	Transfer of Tested Technology in the Northern Areas of Pakistan					
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/-	1082500/-
18	The Impact of Domestic Support to Punjab's Agriculture under WTO Regime	Mr. Qamar Mohy ud-Din, Asso. Prof., Dept. of Agri. Marketing, Uni. of Agri., Faisalabad	28.10.2004 to 27.10.2006	1.565	988000/-	870730/-
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 31.12.2007	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	867791/-	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	289000/-	727634/-
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	1889000/-	1361070//-
24	The WTO Agreement and its Impacts on the Farm	Prof. Dr. Sarfraz Ahmad, Prof./Ch.,	26.08.2005 to	1.621	5	1141000/-

	Sector with Emphasis on Small and Landless Holders	Department of Agri. Economics & Sociology, University of Agri., Faisalabad	31.12.2008		870000/-	
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 26.04.2008	4.735	852300/-	4493941/-

Annexure-II

List of On-Going ALP Project as on January 1, 2009:

(Rs.)

S. No	Name of Project	PI/Institute	Duration	Total Cost (million)	Release	Expdt.
Animal Sciences:						
1	Studies on Breeding and Seed Production of Channel Catfish (lctalurus punctuates) in Pakistan	Mr. Abdul Rab Sr. Scientific Officer, Aquaculture and Fisheries, NARC, Islamabad.	19.07.2007 to 18.07.2010	3.704	1380000/-	1131655/-
2	Pond Culture and Reproductive Performance of Seengharee *Aorichthys aor*	Mr. Muhammad Ramzan Ali, Sr. Scientific Officer, Aquaculture and Fisheries, NARC, Islamabad	22.08.2008 to 21.08.2011	5.628	2501500/-	240258/-
3	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/-
4	Inter-relation of Mycoloxins Levels in Feed Organs/Tissues and Health of Poultry and Livestock.	Mr. Muhammad Zargham Khan, Chairman/ Associate Professor, Deptt. of Veterinary Pathology, University of Agri., Faisalabad.	25.07.2006 to 30.06.2009	9.345	8311900/-	8236142/-
5	Application of PCR Technology for the Detection of Avian Mycoplasma in Poultry Birds and Farm Environment.	Dr. Sajjad-ur-Rahman Associate Professor, Deptt. of Vet. Microbiology, University of Agri., Faisalabad	03.02.2006 to 28.02.2009	2.939	2330700/-	2293136/-
6	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	3100500/-	2802902/-
7	Clinical and Biochemical Studies on Genital Prolapse in the Buffalo.	Dr. Laeeq Akbar Lodhi Professor/Chairman Department of Animal, Reproduction, University of Agriculture, Faisalabad	25.08.2005 to 30.06.2009	4.794	2689500/-	2405573/-
8	Growth Response of Broiler to Ideal Amino Acid Ratio	Dr. Muhammad Aslam Mirza, Asso. Professor, Animal Nutrition, University of Agriculture Faisalabad	11.10.2007 to 10.10.2010	1.595	434500/-	-
9	Feeding Management for Optimum Growth,	Dr. Muhammad Abdullah, Professor,	23.07.2007 to	6.382	2043300/-	2038154/-

	Early Maturity and Fish Lactation Performance in Sahiwal Cattle.	Dept. of Livestock Production, University of Vet. and Animal Sciences, Lahore.	22.07.2010			
10	Synchronization of Estrus in Buffalo's 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	3659900/-	3043732/-
11	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	2004000/-	422723/-
12	Identification of Molecular Markers for Fecundity in Goat Reeds of Pakistan	Dr. Masroor Ellahi Babar, Professor, Uni. of Vet. and Animal Sciences, Lahore	24.07.2008 to 23.07.2011	7.080	4408000/-	-
13	Induced Breeding and Fry Rearing Techniques of Indigenous Catfish, *Rita rita* (Hamilton) in Cemented Cistern.	Dr. Naeem Tariq Narejo, Professor, Department of Fresh Water Biology and Fisheries, University of Sindh, Jamshoro, Sindh	23.07.2007 to 22.07.2010	1.124	680000/-	561500/-
14	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.	01.04.2006 to 30.04.2009	3.867	2808200/-	2409534/-
15	Microbiological Studies on Caprine mycoplasma in Balochistan.	Dr. Mohammad Arif Awan, Veterinary Officer. Veterinary Research Institute, Livestock Complex,Brewery Road Quetta, 87300,	26.10.2004 to 28.02.2009	4.800	2796100/-	2791795/-
16	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	1691000/-	454408/-
Crop Sciences:						
1	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 30.03.2009	1.476	1196500/-	1190169/-

2	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/-
3	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.	01.07.2006 to 30.06.2009	3.909	2324200/-	2315191/-
4	Integrated Control of Root Rot of Pepper in Peshawar and Malakand Divisions.	Dr Shaukat Hussain, Associate Professor, NWFP Agricultural University, Peshawar.	01.07.2007 to 30.06.2010	2.622	1822000/-	1537520/-
5	Fabrication and Commercialization of a Gasifier (Operated with Crop Residues) for Sustainable Agriculture.	Dr. Manzoor Ahmad, Associate Professor, Department of Farm Machinery and Power University of Agriculture, Faisalabad.	01.07.2008 to 30.06.2010	2.119	829500/-	-
6	Genetic Improvement of Sugar Cane (*Saccharium Officinarium* L) for Frost Tolerance, Water Use Efficiency, High yield and High Sugar Contents Through Induced Mutations Biotechnology.	Dr. Muhammad Zubair, PSO/Coordinator, Sugar Crops Research Program, CSI, NARC, Islamabad.	01.07.2008 to 30.06.2011	3.528	1038000/-	200781/-
7	Screening of Sugarcane Germplasm and Use of Induced Mutation/callus Culture for Frost Tolerance, High Cane and Sugar Yield.	Mr. Roshan Zamir, Principal Scientists, Nuclear Institute for Food and Agriculture (NIFA), Peshawar.	01.07.2008 to 30.06.2011	2.853	1317500/-	770101/-
8	Screening of Sugarcane Germplasm and Use of Induced Mutation/callus Culture for Frost Tolerance, High Cane and Sugar Yield. (C-III).	Mr. Sartaj Ali, Research Officer, Sugar Crops Research Institute, Mardan.	01.07.2008 to 30.06.2011	2.539	711000/-	-
9	Screening of Sugarcane Germplasm and Use of Induced Mutation/callus Culture for Frost Tolerance, High Cane and Sugar Yield. (Component-IV).	Dr. Shahid Afghan, Director Research, Shakarganj Sugar Research Institute, Jhang.	01.07.2008 to 30.06.2011	0.785	218500/-	209071/-

10	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	1206500/-	-
11	To Determine the Optimum Maturity Indices of Various Mango Varieties (Langra, Dusehehri, and Samar Bahisht) to Enhance Export and Minimize Post Harvest Losses.	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	1587500/-	326786/-
12	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	1482500/-	1454546
13	Identification and Evaluation of *G. arboretum* goes for Cotton Leaf Curl Virus Resistance	Dr. Aftab Bashir, Principle Scientist, Plant Bio Technology Div., NIBGE, Faisalabad.	05.06.2007 to 04.06.2010	4.273	2304700/-	2241249/-
14	Insecticide Resistance Management of Key Pests of Vegetable.	Dr. Mushtaq Ahmad Dy. Chief Scientist, Plant Protection Div., NIAB, Faisalabad.	30.05.2007 to 29.05.2010	2.293	1025500/-	920647/-
15	Development of High Yielding and Powdery Mildew Resistant Varieties in Peas	Nausherwan Nobel Nawab, Sc. Officer, Vegetable Res. Inst., AARI, Faisalabad.	05.06.2007 to 04.06.2010	1.474	660600/-	639899/-
16	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, Sc. Officer, CDRP, IPEP, NARC	29.05.2007 to 28.05.2010	5.436	2121000/-	1554868/-
17	Management of Date Palm Insect Pests in Sindh.	Muhammad Usman Sher, Entomologist ARI, Tandojam	29.05.2007 to 28.05.2010	3.616	1691500/-	1597248/-
18	Enhancement of Quality and Storage Stability of Dhakki Dates using Advanced Technology	Dr. Shahzada Arshad Saleem, Post Harvest Technologist, ARI, D.I. Khan	05.06.2007 to 04.06.2010	4.099	401917/-	2558988/-
19	Survey of Midges and their Natural Enemies Associated with Mango to Develop Non-Pesticides Measures for	Dr. Abdul Sattar Buriro, Entomologist, ARI, Tandojam, Sindh.	08.06.2007 to 07.06.2010	2.632	1303000/-	1208559/-

	their Control in Pakistan Component-III)					
20	Survey of Midges and their Natural Enemies Associated with Mango and to Develop Non - Pesticides Measures for their Control in Pakistan	Dr. Ghulam Jilani Denior Director, IPEP NARC, Islamabad.	08.06.2007 to 07.06.2010	2.547	737000/-	518657/-
21	Survey of Midges and their Natural Enemies Associated with Mango and to Develop Non- Pesticides Measures for their Control in Pakistan	Mr. Riaz Mahmood Sr. Sc. Officer, CABI, Regional Biosciences Centre, Rawalpindi.	19.07.2007 to 18.07.2010	4.715	2497500/-	882499/-
22	Development of Wheat Heat Tolerant Breeding Material During Grain Fill Period	Mr. Muhammad Ashraf Mian, Asst. Botanist, Barani Agricultural Research Institute, Chakwal.	30.05.2007 to 29.05.2010	1.557	1001600/-	915213/-
23	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, Assitt. Professor, Department of Zoology and Fisheries, University of Agriculture, Faisalabad.	30.05.2007 to 29.05.2010	1.629	522000/-	454717/-
24	Genetic Biodiversity Improvement of Nuts (Almond and Walnut) in Fata	Dr. Syed Asghar, SRO (Horticulture), Agr. Research (FATA), Parachinar, Kurram Agency	11.09.2007 to 10.08.2010	11.9	233500/-	221850/-
25	Characterization to Determine the Adaptive Role of Dehydrins under Drought Stress in Wheat *(Tritium aestivum)*	Dr. Rehana Asghar, Professor, PMAS Arid Agriculture University, Rawalpindi.	01.04.2006 to 31.03.2009	3.044	1987000/-	1916984/-
26	Development of Salt Tolerance in Sugarcane through Genetic Engineering	Mr. Ikram-ul-Haq, Lecturer, Institute of Biotechnology and Genetic Engineering, IBGE, University of Sindh, Jamshoro	01.07.2008 to 30.06.2011	2.707	1172500/-	345866/-
27	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.	22.05.2008 to 21.05.2011	6.429	2442000/-	170789/-

28	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 13.07.2011	2.382	505000/-	-
29	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	06.06.2008 to 05.06.2011	0.924	129500/-	21542/-
30	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, CSI, NARC, Islamabad	06.06.2008 to 05.06.2011	2.426	1925500	165821/-
31	Testing of Adaptability of Different Sugar beet Genotypes and their Agronomic Management in NWFP (Component-II)	Mr. Karim Bakhsh Malik, Advisor R & D, Al-Moiz Industries Ltd, Chashma Road, D.I. Khan	26.06-2008 to 25.06.2011	2.962	800000/-	485292/-
32	Introduction of Sugar beet as a Sugar Crop in Lower Sindh (Component-III NSCRI, Thatta, Sindh)	Mr. Ghulam Mohyudin Kaloi, Sc. Officer, National Sugar Crops Research Institute, PARC, Thatta, Sindh	06.06.2008 to 05.06.2011	2.454	703500/-	199765/-
33	Phenotypic Plasticity of Safflower (*Carthamus tinctorius)* in response to Environment and Integrated Nutrient Management	Dr. Fayyas-ul-Hassan Associate Professor, Dep. of Agronomy, PMAS Arid Agri., University, Rawalpindi	14.05.2008 to 13.05.2011	1.913	361000/-	292344/-
Natural Resources:						
1	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	2584000/-	2544018/-
2	Determination of Soil Moisture Movement and Salinity Buildup Patterns under Different Sizes of Bid Furrow Irrigation Systems;	Mr. Muhammad Yasin, Director, WRRI, NARC, Islamabad	20. 07. 2007 to 30. 06. 2010	3.049	1119500/-	971000/-

	Component-1 of Umbrella Project "Soil Salinity Monitoring under Various Resource Conservation Technologies (RCTS) Adopted in Various Agro-ecologies"					
3	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	2588600/-	2422735/-
4	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	2814500/-	2431545/-
5	Evaluation of Nitrification Inhibitors for Reducing Nitrogen Loss under Irrigated Cotton-Wheat System using ^{15}N-Balance Technique	Dr. Tariq Mahmood, Principal Scientist, Soil Science Division, NIAB, Faisalabad	28. 07. 2008 to 30. 06. 2011	5.557	2670000/-	278396/-
6	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	2014000/-	368601/-
7	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	1011000/-	912200/-
8	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	2020500/-	204668/-

9	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/-	-
10	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 21. 08. 2009	3.829	3206200/-	3100421/-
11	Diagnosis and Control of Leaf Reddening in Cotton	Dr. Jawed Akhtar Memon, Agri. Chemist (Soil Fertility), ARI, Tandojam	24. 07. 2 008 to 30. 06. 2011	3.643	1134000/-	224000/-
12	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	01. 07. 2008 to 30. 06. 2011	3.166	1115000/-	-
13	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/-	193533/-
14	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	789500/-	534603/-
Social Sciences:						
1	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 06.11.2006	5.150	1742500/-	1713000/-
2	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	979000/-	498000/-