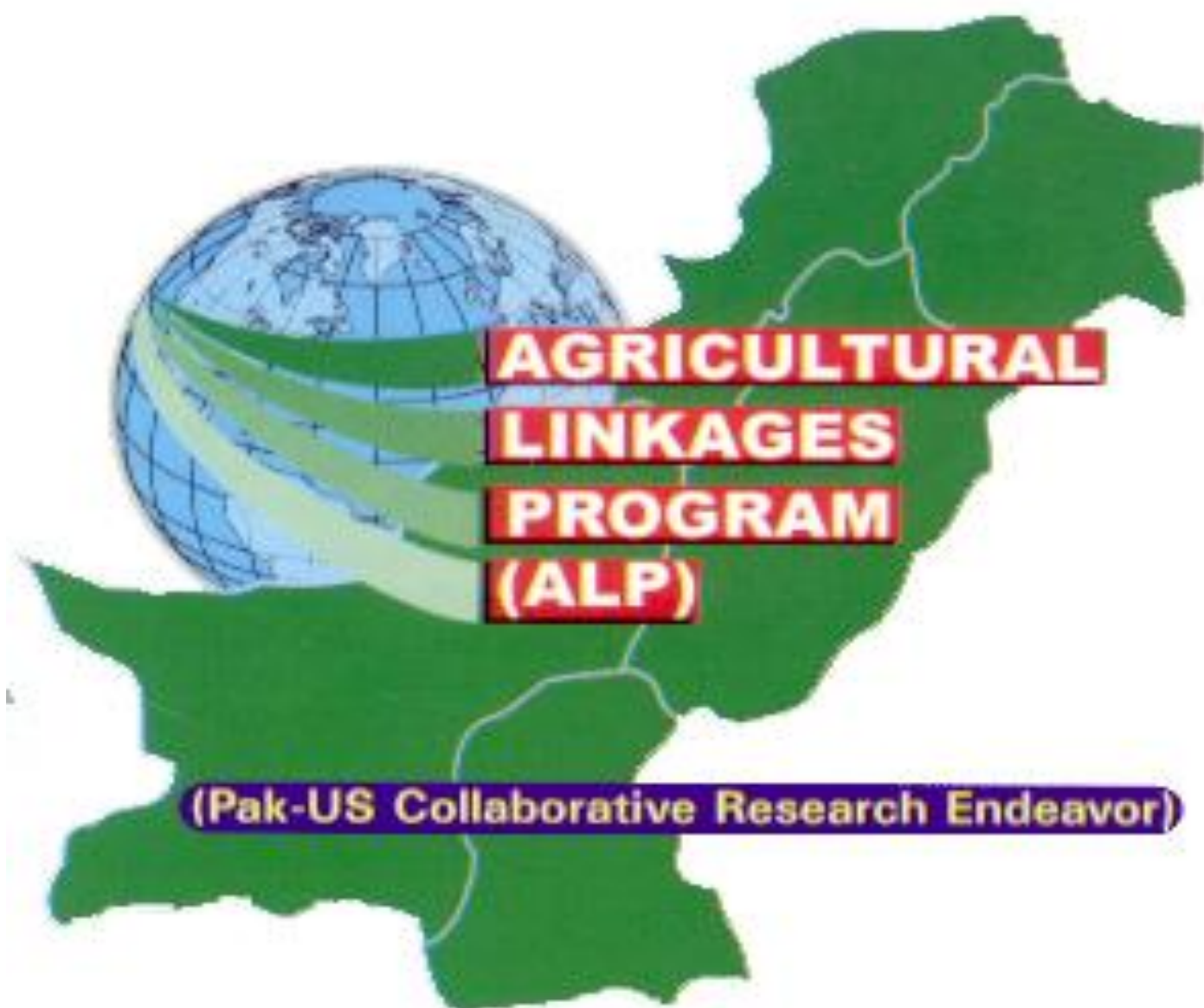


ANNUAL PROGRESS REPORT (2003-2004)



*2ND ANNUAL PROGRESS REPORT OF ALP ON-GOING ROJECTS
(2003-2004)*

ALP SECRETARIAT/DIRECTORATE OF PLANNING
PAKISTAN AGRICULTURAL RESEARCH COUNCIL
ISLAMABAD

ANNUAL PROGRESS REPORT (2003-2004)

AGRICULTURAL LINKAGES PROGRAM (ALP)

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**ALP SECRETARIAT/ DIRECTORATE OF PLANNING
PAKISTAN AGRICULTURAL RESEARCH COUNCIL
ISLAMABAD**

Acknowledgement

The allocation of funds to agriculture research has been declined over the years, and most of the given budget was sufficient to meet the establishment cost while leaving very little for operational research. With the induction of Agricultural Linkages Program, the agriculture scientists all over the country have been provided operational funding through a highly competitive grant system. The overall allocation to the operational funding through this program is over Rs. 100 million per year.

This program is fully functional since 2000 and more than 200 projects are in operation. The success of this program is due to tireless efforts of ALP Secretariat. The role of Technical Divisions of PARC for providing continuous guidance and support to ALP Secretariat in monitoring and review of the projects is deeply acclaimed.

The contribution of USDA in establishing the agricultural endowment fund is highly appreciated. The prudence of TAC and BOD members of ALP must be acknowledged for approving the projects of priority in the agriculture sector.

Lastly, a word of gratitude to Mr. Mushahid Raza, DEO (ALP) for typing and composing the annual progress report.

(Dr. Badaruddin Soomro)
Chairman, PARC

EXECUTIVE SUMMARY

Economy of Pakistan draws its strength and stability mostly from agriculture. Efficient management of agriculture is very crucial for her socio-economic development. With the rapid increase in population and very high pressure on land in Pakistan, which is one of the thickly populated countries of the world, it is no longer possible to expect the traditional farming system to evolve into an intensive system of agriculture production. To be responsive to the needs of the time, agricultural research has to be very effectively managed and directed to the pressing problems confronting the society.

Increased productivity of agriculture requires continued support of modern agricultural research, its usefulness, timeliness, and relevance. To support modern agriculture research, abundance of funds are required to achieve the objective of equipping the farmers with modern techniques /tools which help them in the productive use of natural resources. Unfortunately, due to lack of financial resources research sector always remained deprived off.

Since the last five years Agricultural Linkages Program (ALP) has played a vital role to re- activate / stimulate agriculture researcher activities. The Government of Pakistan is very grateful to the US Government for providing 200,000 M. tons of wheat valued US\$23.222 million as a grant to Pakistan. The Government of Pakistan allowed PARC to establish an Agricultural Research Endowment Fund (AERF) where all proceeds raised from the sale of US wheat have transferred. The income generated out of endowment fund is being used for ALP activities in line with Pakistan's long term research and development goals for agricultural sector. The goal focus on food security, poverty alleviation and promoting broad based equitable and sustainable agriculture.

Since the creation of Agricultural Research Endowment Fund (AERF), PARC has launched two batches of Agricultural Linkages Programs for funding the research projects as detailed below.

ALP 1st Batch (2001-2002)

ALP 1st Batch was announced in December, 2000 for inviting the preliminary proposals from the promising Pakistani Agricultural / Social Scientists for funding out of Agricultural Research Endowment Fund (AREF). In response 592 preliminary proposals were received from all over the country for funding under ALP 1st batch. Out of these, 218 preliminary proposals were short-listed by the Technical Divisions, PARC for developing detailed projects and 374 preliminary proposals, which do not fall under ALP laid down criteria were dropped. Finally, Board of Director (BOD) of ALP approved 116 projects. Out of 116 approved projects 102 projects are on-going, eight are in process of agreement, five have been completed (*two of Social Sciences and three of Animal Sciences*) and one project of crops sciences has been terminated due to poor performance.

So far an amount of Rs.137.594 million has been released against the overall total cost of Rs.305.089 million in respects of approved projects. Till now overall expenditure of Rs.92.765 million has been reported by the PIs of the projects.

ALP 2nd Batch (2002-2003)

ALP 2nd Batch was announced on 28th July, 2002. In response 644 preliminary proposals were received for funding under ALP 2nd batch. Out of these, 267 preliminary proposals were short-listed

by the Technical Divisions, PARC for developing detailed projects and 377 preliminary proposals, which do not fall under ALP laid down criteria, were dropped. Of 267 short listed projects, 222 projects (*completed in all respect*) were processed for final approval by TAC and BOD. Currently 90 approved projects are on going and remaining are in process of approval by TAC and BOD of ALP. So far an amount of Rs.77.157 million has been released against the overall total cost of Rs.286.876 million in respects of approved projects.

ALP 2nd International Workshop

The ALP Secretariat Organized 2nd International Workshop on 20th April 2004 at NARC, Islamabad. The main aim of this workshop was to internationalize the program through mutual exchange of knowledge and scientists with other countries and International research organizations. Sardar Yar Muhammad Rind, the then Federal Minister for Food, Agriculture and Livestock inaugurated the workshop. Dr. James Mosely, the Deputy Secretary USDA alongwith a team of senior officials from USDA participated in the workshop. Representatives of foreign missions located at Islamabad also attended the inaugural session. The workshop was also attended by senior officials of MINFAL, Vice Chancellor of Agricultural Universities and Head of Provincial Agricultural Research Institutes. P.Is. of 68 ALP ongoing projects also attended the workshop.

Dr. Badaruddin Soomro, Chairman, PARC welcomed the participants. Dr. James Mosely, Dy. Secretary USDA, in his address appreciated the institutional sustainability model established at the PARC. He ensured cooperation and efforts of USDA in strengthening the cooperative linkages between the scientific communities in United States and Pakistan in the field of agriculture to address the food needs of the two countries and world. Mr. Tariq Mahmood, the then Federal Secretary, Ministry of Food, Agriculture & Livestock presided over the concluding session. The workshop had four technical sessions, presided over by the former Chairmen PARC, Dr. Amir Muhammad and Dr. Umar Khan Baloch, Dr. Kausar Abdulla Malik, Member Administration & Biotech, Pakistan Atomic Energy Commission and Dr. Khalid Mehmood Khan, Vice Chancellor, University of Arid Agriculture, Rawalpindi, 20 scientists presented achievements of their projects in the respective technical sessions. The CSO/ Incharge of Technical Divisions organized their respective technical sessions.

In addition, Executive Director ALP presented salient features and achievements of ALP. Dr. M. Ashraf, Director General NARC and Mr. Michael Henny, Regional Director, USDA expressed vote of thanks to the participants of the workshop. The workshop concluded with a number of recommendations for the improvement of present procedure of ALP and also some fruitful ideas for new research projects. Proceedings of the workshop will be published separately.

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SUMMARY

ALP 1st Batch (2001-2002)

STATUS OF RESEARCH PROJECTS

(1ST Batch 2001-2002)

BACKGROUND

ALP 1st Batch was announced in December, 2000 for inviting the preliminary proposals from the promising Pakistani Agricultural / Social Scientists for funding out of Agricultural Research Endowment Fund (AREF).

In response 592 preliminary proposals were received from all over the country for funding under ALP 1st batch. Out of these 218 preliminary proposals were short-listed by the Technical Divisions, PARC for developing detailed projects and 374 preliminary proposals, which do not fall under ALP laid down criteria were dropped as detailed below.

Discipline	Recommended	Not Recommended	Total
Animal Sciences	47	67	114
Crops Sciences	122	192	314
Natural Resources	28	97	125
Social Sciences	21	18	39
TOTAL	218	374	592

APPROVAL STATUS

Short listed 218 detailed projects were considered by the Technical Advisory Committee (TAC) meetings and Board of Director (BOD) of ALP finally approved 116 detailed projects for funding under 1st batch as detailed below.

Discipline	Approved	Dropped	Total
Animal Sciences	24	23	47
Crops Sciences	62	60	122
Natural Resources	23	5	28
Social Sciences	7	14	21
TOTAL	116	102	218

IMPLEMENTATION STATUS

Out of 116 approved projects 102 projects are on-going, eight are in process of agreement, five have been completed (*two of Social Sciences and three of Animal Sciences*) and one project of crops sciences has been terminated due to poor performance. Following is the implementation status of ALP 1st Batch.

Projects Status	Animal Sciences	Crops Sciences	Natural Resources	Social Sciences	Total
<i>On-Going</i>	19	58	20	5	102
<i>In process of Agreement</i>	2	3	3	-	8
<i>Completed</i>	3	-	-	2	5
<i>Terminated</i>	-	1	-	-	1
TOTAL	24	62	23	7	116

List showing the title of projects, name of PIs, location & cost of projects is at Annexure-I

MONITORING & EVALUATION

Monitoring and review of the on-going projects is a regular activity of the ALP Secretariat in collaboration with Technical Division, PARC. The Chairman, PARC/BOD of ALP has reviewed the 1st year progress of the projects located at NARC, while the progress of other projects located outside Islamabad were reviewed/evaluated by the CSO/In charge, Technical Division, PARC. The second review of the projects by the Chairman, PARC/BOD of ALP is schedule to be organized in the next year.

However, on site evaluation of on-going projects is underway. The out comes of the evaluation will be published soon after its completion.

Currently, most of the projects have completed two years of their life span .The annual progress reports of the projects shows that significant task has been completed and the outcomes are very encouraging /cheering. The salient achievements of these projects have been complied in subsequent chapters of this annual report.

FINANCIAL STATUS

So far an amount of Rs.137.594 million has been released against the overall total cost of Rs.305.089 million in respects of the approved projects. Till now overall expenditure of Rs.92.765 million has been incurred as reported by the PIs of the projects. Discipline wise details are given below:

(Rs. in million)

Discipline	Total Cost	Releases	Expenditures
Animal Sciences	58.395	28.175	20.397
Crops Sciences	165.316	73.448	47.645
Natural Resources	67.097	28.721	19.238
Social Sciences	14.281	7.250	5.485
TOTAL	305.089	137.594	92.765

A list showing releases, expenditures and duration of each project is Annexed - I

SUMMARY

ALP 2nd Batch (2002-2003)

STATUS OF RESEARCH PROJECTS

(2nd Batch 2002-2003)

BACKGROUND

ALP 2nd Batch was announced on 28th July, 2002 for inviting the preliminary proposals from the promising Pakistani Agricultural / Social Scientists for funding out of Agricultural Research Endowment Fund (AREF).

In response 644 preliminary proposals were received for funding under ALP 2nd batch. Out of these 267 preliminary proposals were short-listed by the Technical Divisions, PARC for developing detailed projects and 377 preliminary proposals, which do not fall under ALP laid down criteria were dropped as detailed below:

Discipline	Recommended	Not Recommended	Total
Animal Sciences	59	59	118
Crops Sciences	128	219	347
Natural Resources	49	65	114
Social Sciences	31	34	65
TOTAL	267	377	644

Out of 267 short listed proposals 232 detailed projects were received and 35 PIs had not responded. Incomplete 10 projects were also found among detailed projects which were dropped and only 222 projects were processed further.

APPROVAL STATUS

Detailed projects (222) completed in all respects were processed for appraisal by the national referees/reviewers and USDA. Following results of technical appraisal reviewers were obtained:

<i>Recommendations</i>	<i>No. of Projects</i>
Projects Recommended by two national referees as such/ with some modification	164
Projects Not Recommended by the two referees	52
Dropped during processing	3
Result awaited	3
<i>TOTAL</i>	<i>222</i>

Detailed projects were also sent to USDA for their valuable comments; USDA recommended 108 projects keeping in view their own priorities.

After being the projects appraised by the two national referees and USDA, primarily 95 projects were submitted for the recommendation of Technical Advisory Committee (TAC) meeting and Board of Director (BOD) and 90 projects were finally cleared by the BOD for funding under 2nd Batch. The remaining projects are in process of the approval of TAC and BOD of ALP.

IMPLEMENTATION STATUS

Out of 90 approved projects 70 projects are on-going; 17 projects are in process of agreement, and three projects one of Crops Sciences and two of Natural Resource have been dropped due to the lack of interest of PIs. Following is the implementation status of ALP 1st Batch.

<i>Projects Status</i>	<i>Animal Sciences</i>	<i>Crops Sciences</i>	<i>Natural Resources</i>	<i>Social Sciences</i>	<i>Total</i>
<i>On-Going</i>	13	29	17	12	71
<i>In process of Agreement</i>	3	9	1	3	16
<i>Dropped</i>	-	1	2	-	3
<i>TOTAL</i>	16	39	20	15	90

List showing the title of projects, name of PIs, location & cost of projects is at Annexure-II

The projects approved under 2nd batch are in their first year of operation .Their progress will be published in next annual report.

FINANCIAL STATUS

So far an amount of Rs.77.157 million has been released against the overall total cost of Rs.286.876 million in respects of approved projects. Till now overall expenditure of Rs.4.091 million has been incurred as reported by the PIs of the projects. . Discipline wise details are given below:

(Rs. in million)

Discipline	Total Cost	Releases	Expenditures
Animal Sciences	67.935	23.574	2.057
Crops Sciences	111.284	22.189	0.675
Natural Resources	53.754	14.249	1.359
Social Sciences	53.903	13.173	0
TOTAL	286.876	77.183	4.091*

*Low level of expenditure against the total releases made so is due to the non-receipt of expenditure report by the PIs which are suppose to be submitted in December,2004.

A list showing releases, expenditures and duration of each project is Annexed – II

RESEARCH

ACHIEVEMENTS/PROGRESS

of

ON-GOING PROJECTS

ANIMAL SCIENCES

ANIMAL SCIENCES

BACKGROUND

ALP Secretariat received 114 preliminary proposals relating to animal sciences for funding under the 1st batch. In process of preliminary appraisal 47 proposals were short listed for the invitation of detailed projects and 67 proposals which were not up to the standard were dropped. Finally, 24 projects costing Rs.58.395million were approved by the Board of Director (BOD) of ALP for funding to conduct the research in following different disciplines.

For instance, there are projects on Animal Health covered in the research proposals consist of evaluation of indigenous medicinal plants for veterinary use, development of improved diagnostic techniques for rinderpest and other important viral diseases of livestock, control of parasitic diseases, etiology of Caprine mycoplasma, mapping and control of warble fly in Pakistan.

Four projects related to Animal Nutrition are expected to generate new and useful knowledge on nutritional quality of dairy rations, feeding system of lambs, application of balanced feeding at farmer's level and development of milk replacer for calf rearing. Two projects related to Animal Breeding and Genetics will address the important problem like genetic characterization of native cattle breeds and genetic evaluation models for dairy cows and buffaloes.

Genital prolapse is common problem of economic importance faced by our buffalo farmers, which will be investigated for its etiology and control in one of the project is underway.

Bovine somatotropin (bST) hormone is being used in the country to increase milk production of cattle and buffaloes, effect of this recombinant hormone on production and health of buffaloes is, however, not completely known. This important information is expected to be generated under one of the project of Animal Production.

In fisheries there are also projects to generate information on Aquaculture of marine fin fishes, fresh water prawn, American channel cat fish and Tilapia culture. The region wise detail of the on-going projects is summarized as under:

S.No	Region	Projects
1	PARC/NARC	9
2	PUNJAB	8
3	SINDH	3
4	NWFP	3
5	OTHER FEDERAL	1
TOTAL		24

IMPLEMENTATION STATUS

Out of 24 approved projects 19 are on-going and following three projects (*two projects of University of Agriculture, Faisalabad and one project of NWFP Agricultural University, Peshawar*) have been completed.

- *Preliminary studies on the efficiency of locally prepared Staphylococcus Aureus vaccine in the control of Mastitis in dairy buffaloes (University of Agriculture, Faisalabad).*

- *Implementation of NIR technique for the evaluation of animal feeds (NWFP Agricultural University, Peshawar).*
- *Characterization of tannins in feeds and forages of Pakistan and their evaluation for anthelmintic activity (University of Agriculture, Faisalabad).*

While two projects one of Kundi Buffalo Farm, Rohri and second of University of Agriculture, Faisalabad are in process of agreement .

- *Enhancing milk yield of Kundhi buffaloes through production of performance tested bulls (Component-II Kundi Buffalo Farm,, Rohri).*
- *Development of genetic evaluation models in Nili-Ravi buffalo (Component-IV University of Agriculture, Faisalabad).*

FINANCIAL STATUS

So far an amount of Rs.28.175 million has been released against the overall total cost of Rs.58.395 million in respects of approved projects. Till now overall expenditure of Rs.20.397 million has been incurred as reported by the PIs of the projects.

MONITORING & EVALUATION

The Chairman, PARC/BOD of ALP has reviewed the 1st year progress of the projects located at NARC, while the progress of other projects located outside Islamabad were reviewed/evaluated by the CSO/In charge, Animal Sciences Division, PARC. The second review of the projects by the Chairman, PARC/BOD of ALP is schedule to be organized in the next year.

However, on site evaluation of 13 on-going and three completed projects have been completed and evaluation of remaining projects is underway. The out comes of the evaluation will be published soon after its completion.

Currently, most of the projects have completed two years of their life span .The annual progress reports of the projects shows that significant task has been completed and the outcomes are very encouraging /cheering. The salient achievements of these projects have been complied in subsequent chapters of this annual report.

Project Title: Preliminary studies on the efficiency of locally prepared *Staphylococcus Aureus* vaccine in the control of Mastitis in dairy buffaloes.

Principal Investigator: *Dr. Ghulam Muhammad*
Associate Professor & Chairman

Location: Dept. of Clinical Medicine and Surgery, Faculty of Veterinary Sciences,
University of Agriculture, Faisalabad

<i>Duration (Months):</i>	24	<i>Total Cost (million):</i>	0.754
<i>Start Date:</i>	3/29/2002	<i>Fund Released (Rs):</i>	452000
		<i>Fund Utilized (Rs):</i>	461889

Objectives:

- To investigate the efficacies of locally prepared *S. aureus* vaccines in the control of mastitis in dairy buffaloes under experimental and field conditions.
- To determine the cost-effectiveness of mastitis control through vaccination.

Achievements/Progress:

- Four *Staphylococcus aureus* (The most important mastitis causing organism) vaccines (live attenuated (LASAV), plain bactrin, dextran sulphate (DXS) adjuvanted bactrin and oil adjuvant bactrin) were prepared and evaluated in laboratory animals and under field conditions in buffaloes. DXS-adjuvanted and live attenuated *S. aureus* vaccines gave better and almost comparable results in terms of IHA antibody titres, milk somatic cell count, incidence and prevalence of *S. aureus* and spontaneous cure rate under field conditions.
- LASA vaccine reduced the quarter prevalence rate from 36% at day 0 to 16 % at day 60 post vaccination. Whereas DXS-adjuvanted vaccine affected a reduction in prevalence from 40% at day 0 to 9% at day 60 post vaccination. Spontaneous cure rate during the entire study period (i.e. 6 months) was 56.2% in the case of LASA vaccine. Corresponding figure in the DXS adjuvanted vaccine group being 47.7%. It is tentatively concluded that both vaccine can be used prophylactically as well as therapeutically in bubaline mastitis.
- As a final lap of the project, evaluation of these two better performing varieties (Dextran sulphate adjuvanted and live attenuated vaccine) on 100 lactating buffaloes under field conditions is currently underway.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Electronic digital balance
- Micropipettes (- Single channel; - Multiple channel)
- Deep freezer
- Centrifuge machine
- Ultra homogeni
- Orbital shaker
- Filtration apparatus

Project Title: Farming of mud crab (*Scylla serrata*) in the coastal earthen-ponds.

Principal Investigator: *Dr. Javed Mustaqim*
Professor

Location: Center of Excellence in Marine Biology, University of Karachi, Karachi-75270

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	2.386
<i>Start Date:</i>	3/22/2002	<i>Fund Released (Rs):</i>	1603300
		<i>Fund Utilized (Rs):</i>	1456235

Objectives:

- The main objective of the project is to develop methodology for farming the mud crab in the coastal earthen ponds from seed (juvenile or less than 100 gram in weight) to marketable size (more than 450 gram in weight).
- To study the effect of salinity on growth and survival.

Achievements/Progress:

- Mud crabs were farmed in the coastal earthen pond of about 1000 square meter, for a period of 150 days. The growth rate was found to be 59 grams/month. The mortality rate was about 28.4%. Stocking density was approximately one crab per square meter (987 crabs/1000M.). Average weight at the time of stocking was 89 gram/crab whereas average weight at harvesting was 384 grams/crab. Juvenile crabs for stocking were collected from wild (mangrove swamps and adjacent areas). Trash fish, mussels, small crabs and shrimp waste (cephalothorax) were given as food. Food was given at a rate of about 8 to 10% of the crab biomass. Crabs were fed daily, preferably in the late evening.
- From the second crop, 55 crabs were dissected the average weight of meet was found to be 29.3% (± 1.9) of the total body weight, almost similar to wild crabs weight, average meat weight of 30.2% (± 2.6).
- Effect of salinity on growth was studies on two groups of crabs in small ponds with 100 crabs in each pond, with salinity of 32 ± 4 ppt and 41 ± 3.5 ppt. After five and half months the average weight was 390.34 ± 14.1 grams and 379.3 ± 35.64 grams respectively. Mortality rate was 32% and 27% respectively with no marked difference on growth found with two levels of salinity. Parasitization studies showed that 73% of crabs were found infested with full gill parasites. The formation studies showed that all the male & female crabs were fully mature ready for spawning.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Bench photometer
- Generator
- Pump with engine
- Photographic equipments
- Laser printer for computer

Project Title: Protection of buffaloes against brucellosis.

Principal Investigator: *Dr. Rukshanda Munir*
Senior Scientific Officer

Location: Animal Sciences Institute, NARC, Islamabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	2.458
<i>Start Date:</i>	3/21/2002	<i>Fund Released (Rs):</i>	1818000
		<i>Fund Utilized (Rs):</i>	1012882

Objectives:

- Evaluation of protective efficacy of commonly used *Brucella abortus* vaccines in buffaloes.
- To determine the most suitable age for vaccination brucellosis in buffaloes.
- To determine the best dose schedule for adult buffaloes so that the residual titers are minimum.
- To determine the protective antigens of *Brucella* for buffaloes.
- Develop and implement strategies for the control of brucellosis in farming systems' prospective of Pakistan.

Achievements/Progress:

- *Brucella abortus* strain 19 a smooth strain with reduced virulence and a rough mutated strain RB-51 were procured from NVSL, Ames Iowa US and C.Z Veteraneria, Spain respectively. These strains were characterized biochemically for confirmation and limited doses of vaccine from leach strain were prepared following the method of Corbel and Macmillan (1966) and Stevems (1994). Vaccine prepared from *Brucella abortus* strain RB-51 was tested for immunogenic response in buffaloes of different age groups i.e. adults, heifers and calves.
- Two serological tests i.e. Indirect ELISA for the detection of antibodies against strain RB-51 and strain 19 were developed and standardized. Humoral immune response of 3 groups of animals vaccinated with RB-51 was detected by an indirect ELISA. Animals in all groups showed non-significant difference in the mean antibody titers ranging from 0.513 to 0.780.
- Thirty buffaloes of various age groups were vaccinated with RB-51. Serum samples collected period to vaccination and after vaccination were stored at - 20° C. Vaccine was prepared from *B. abortus* strain RB-51 and was evaluated for the confirmation of immunogenicity in buffaloes of various age groups by using indirect EUSA test. Antigen and amboceptors was prepared for complement fixation test.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Bench top shaking incubator (1)
- Horizontal & vertical gel (4)
- Gel leveling table (1)

Project Title: Ovarian follicular dynamics and endocrine activity in postpartum anoestrus buffaloes.

Principal Investigator: *Dr. Nemat Ullah*
Principal Scientific Officer

Location: Animal Sciences Institute, NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.985</i>
<i>Start Date:</i>	<i>3/21/2002</i>	<i>Fund Released (Rs):</i>	<i>2522000</i>
		<i>Fund Utilized (Rs):</i>	<i>1955766</i>

Objectives:

- To study the ovarian activity in postpartum buffalo in order to understand anoestrus phenomenon.
- To study the effect of mineral supplementation on post partum ovarian activity in buffalo.

Achievements/Progress:

- Ultrasonography technique for monitoring of reproductive functions in dairy animals was established. Ten buffaloes comprising two groups (control and treatment of five buffaloes each) were maintained on feed comprising NRC recommendation, one month before parturition to seven months post partum. The treatment group received mineral supplementation (Calcium, Phosphorus, Zinc and Manganese) in addition to recommended ratio, and its effects on ovarian cyclicity were studied.
- The uterus of the parturating buffaloes involuted in control and treatment buffaloes at 30.6 ± 3.9 days and 29.2 ± 4.0 days, respectively. No significant effect of mineral supplementation was observed on involution of uterus. The buffaloes of treatment group started the ovarian activity at 55.3 ± 15.1 days post partum as compared to 91.6 ± 52.3 days in control buffaloes. The difference was significant ($P < 0.1$). The results indicated usefulness of supplementing the ratios with minerals for reducing the calving to oestrus interval.
- Two hundred thirty observations on ovarian cyclicity of ten buffaloes were recorded per rectum. Five hundred and 20 blood samples were collected, serum separated and stored at -20° C for later hormone and mineral analysis results are being prepared..
- Two hundred and thirty four blood samples were analyzed by radio immunoassay for progester and estradiol concentration. Two out of five buffaloes with mineral supplementation and one out of five without mineral supplementation resumed ovarian activity at day 39 of post partum.
- Sixty seven milk recordings of the experimental buffaloes were taken and fat and total solid analysis of milk samples were conducted. Ultrasonography on ovarian structures of buffaloes were performed where the ovarian picture could not be determined rectal palpation.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Ultrasonograph with accessories
- Animals

- Bench top centrifuge machine
- Spring balance
- Drenching gun buffaloes
- Micropipette
- Water bath

Project Title: Polyculture of freshwater prawn, *Macrobrachium malcolmsonii* with Indian major and Chinese carps at farmers ponds in Pakistan.

Principal Investigator: *Dr. Rafia Rehana Ghazi*
Director

Location: VPCI, Southern Zone Agricultural Research Centre (SARC), Karachi.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	1.984
<i>Start Date:</i>	4/1/2002	<i>Fund Released (Rs):</i>	1222000
		<i>Fund Utilized (Rs):</i>	1278684

Objectives:

- Study growth and survival of fish and prawns in polyculture system.
- Determine economic feasibility of fish/ prawn polyculture system.

Achievements/Progress:

- Ponds of progressive farmers were selected at Thatta and Mirpur Sakhro. Ponds were prepared by liming for dis-infection and manuring with poultry manure. Fish seeds were procured from Sindh Government fish Hatchery, Chilya, Thatta. Wild prawn seeds collected from lower belt of River Indus. Fish (*Labeo rohita*, *Cirrhinus mirgala*, *Catla Catla*, *Ctenopharyngodon idella*) and prawn seeds stocked in a density of 500 and 5000 respectively in Polyculture system and 500 fish Composite in fish culture system (control) for first growth cycle. Protective fencing was erected around the experimental ponds to avoid escape of prawn and entrance of wild animals. Regular daily feeding was done with a mixture of CG -30 and rape Seed cake. Growth rate of fish and prawn was monitored on monthly basis. Survival percentage of fish at Thatta and Mirpur Sakhro ranges from 78-83% and 29-33% respectively, while for prawn it ranges from 39-89% and 78-73% respectively. Regular monitoring and management of water quality was done to keep the water best suitable for fish and Prawn culture.
- First growth cycle at two sites has been successfully completed with encouraging results. Average weight gain per fish was 45 respectively for *C. mrigala*, 447.8 & 509.43 for *L. rohita*, 642.1 & 921.4 for *C. idella* and 506.9 and 585.3 for *C. catla* respectively at Dilshad fish farm, while average weight gain of *C. mrigala* was 634 and 712.1 in polyculture & fish culture ponds respectively for *L. rohita* 745.1 and 845.1 for *C. catla* it was 744.3 and 844 and *C. idella* average weight gain was 2005 & 1935.7 grams respectively in polyculture and fish culture at Jaferi fish farm, Sakhro. The yield for prawn was 155 Kg at Dilshad Fish Farm, Chilya and 91 kg at Jaferi Fish Farm, Shakro.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- | | |
|--|-------------------------|
| • Computer P-IV with accessories | • Electronic balance |
| • Dissolved oxygen meter with accessories | • Platform balance |
| • Water test kit | • Green house |
| • Leitz compound microscope with accessories | • Refrigerator/ Freezer |
| • Wild zoom microscope with accessories | • Refractometer |
| • Stereoscopic microscope | |

Project Title: Immunobiology and immunoprophylaxis of coccidiosis in chickens.

Principal Investigator: Dr. Masood Akhtar
Asstt. Professor

Location: Department of Parasitology, University of Agriculture, Faisalabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	1.463
<i>Start Date:</i>	3/21/2002	<i>Fund Released (Rs):</i>	638200
		<i>Fund Utilized (Rs):</i>	627739

Objectives:

- To establish baseline immune parameters in chickens after infection with coccidial parasites.
- To use coccidial antigen(s) as a possible immunoprophylaxis during experimental coccidial challenge as well as progeny protection.

Achievements/Progress:

- An overall prevalence of coccidiosis in broiler chicks was found to be 32.9 per cent. *Eimeria (E.) tenella* (54.5%) was found to be the most prevalent species followed by *E. maxima* (29.7%) and *E. acervulina* (6.3%). From the results of the present studies, it is assumed that coccidiosis in chicks has affected the growth and development of lymphoid organs (the source of T and B lymphocytes development and maturation). Mean bursal, thymic, splenic and caecal tonsil body weight ratio decreased as infective dose of coccidiosis increased.
- Results of humoral and cellular responses and lesion scoring revealed that Hubbard breed chicks are relatively resistant to coccidial infection as compared to Starboro and ArborAcr.
- Since the project work has been stopped because of non-release of funds since October 2002, hence progress onwards is nil. Project review team recommended for premature termination of the project and clearance of project liabilities.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer with printer
- Experimental birds

Project Title: **Studies on the prospect of introducing American channel cat fish (*Ictalurus punctatus*) in pond fish culture system of Pakistan – A pilot project.**

Principal Investigator: *Mr. Abdul Rab*
Senior Scientific Officer

Location: AFRI, NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>3.035</i>
<i>Start Date:</i>	<i>3/22/2002</i>	<i>Fund Released (Rs):</i>	<i>2500300</i>
		<i>Fund Utilized (Rs):</i>	<i>2332181</i>

Objectives:

- Feasibility study to test the suitability of channel cat fish (*Ictalurus punctatus*) culture to fill the void of catfish culture in pond system of Pakistan.
- To test through series of experiments the most desirable culture system of catfish culture using various quality and quantity of feed and other inputs.
- To disseminate the package of technology to promote catfish culture in Pakistan.

Achievements/Progress:

- Eight earthen ponds (size 160' x 80' x 6') were constructed at Aquaculture and Fisheries, NARC for culturing channel cat fish under quarantine conditions. A submersible pump of 10000 litres water per hour has been installed for continuous supply of water. 1000 fingerlings (average wt. 10.8 g, length 10.9 cm) of Channel Catfish were imported from Thailand on September 20, 2003 and kept in circular fiberglass tanks and concrete raceways under quarantine conditions to acclimatize in our environment. They were fed with imported artificial floating feed (37% CP). Weight gain of 8.2 g was recorded during the acclimatization period of 17 days. Morph metric and hydrological data were also recorded.
- In the feeding experiment on Channel Catfish fingerlings in circular fiberglass tanks, feed F1 containing 40% crude protein level showed a significant difference in the weight gain compared to feed F2 and F3 containing 35% and 30% crude protein levels respectively. One out of eight earthen ponds was prepared for the stocking of Channel Catfish. Two hundred Channel Catfish (average weight 27.5 gm, average length 16.5 cm) were stocked in the newly prepared pond. Weight gain of 65.7 gm was recorded from December to February @ 1.09 gm per day. Among the Channel Catfish fingerlings kept in raceways, some got severe body ulcers and fin rot. They were given 10 ppt. saline water bath followed by 20 ppt bath for five minutes daily for ten days and finally five days treatment with antibiotic (Tetracycline) was given. They were successfully cured after two weeks.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Tubewell and ponds & hatchery renovation
- Paddle wheel aerators
- Oxygen meter
- Microwave oven

- Digital balance
- Automatic feeders
- Computer with accessories
- pH meter
- Salinity refractometer

Project Title: Studies on Tilapia culture through controlled breeding in saline areas.

Principal Investigator: *Dr. Iftikhar Ahmed*
Associate Professor

Location: Fisheries Research Farms, Department of Zoology and Fisheries, University of Agriculture, Faisalabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>0.898</i>
<i>Start Date:</i>	<i>3/21/2002</i>	<i>Fund Released (Rs):</i>	<i>668100</i>
		<i>Fund Utilized (Rs):</i>	<i>355035</i>

Objectives:

- To collect large size Tilapia brooders from different areas of Pakistan.
- To control over breeding of Tilapia by different techniques.
- To produce marketable size fish.
- To compare the economics of Tilapia with major carps Cultured in saline water areas.
- To utilize the waste saline lands for profitable fish farming system.

Achievements/Progress:

- Mono-sex culture of tilapia resulted in better fish production than in mixed sex culture. Male tilapia showed better growth rate than female. The 100% sex reversed tilapia could not be achieved. Use of 17 alpha methyl testosterone @ 70 mg/kg of feed for a period of 30 days is the most suitable for the sex reversal of tilapia.
- Growth performance of male and female tilapia was determined by mono-sex culture. Male tilapia showed faster growth rate. Culture of tialpia with Channa marulius under different ratios was studied and the best ratio was 1:50 of C. mamlius to tialpia for growth of channa spp. and to control the tialpa young.
- Results of the study on effect of different salinity levels (TDS) (500-4000 ppm) on the growth of Tialpia, upto 60 gms weight. Experiments are in progress on production of marketable size Tilapia by genetic improvement farmed tilapia (GIFT) method.
- Mono-sex culture of tialpia resulted in better fish production than in mixed sex culture. Male tilapia showed better growth rate than female. The 100% sex reversed tilapia could not be achieved. Use of 17 alpha mehtyl testosterone @ 70 mg/kg of feed for a period of 30 days is the most suitable for the sex reversal of tilapia.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Glass aquaria with accessories
- Re-structuring of hatchery tables

Project Title: Molecular characterization of Pakistani infectious bronchitis virus variants and development recombinant vaccine.

Principal Investigator: *Dr. Khalid Naeem*
Senior Scientific Officer

Location: ASI, NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.967</i>
<i>Start Date:</i>	<i>3/21/2002</i>	<i>Fund Released (Rs):</i>	<i>1728700</i>
		<i>Fund Utilized (Rs):</i>	<i>949485</i>

Objectives:

- Isolation and molecular characterization of Pakistani strains of IBV.
- Cloning of S1 gene of IBV in pBHCX402 vector and transfection of Fowl poxvirus.
- Characterization and evaluation of immunogenicity of the recombinant vaccine.
- Examine the protection against challenge with virulent strains of IBV.

Achievements/Progress:

- The sero-prevalance evaluation of infectious bronchitis virus (IBV) resulted in the detection of the presence of IBV variants in poultry. A number of samples were subjected to lab evaluation for the isolation of IBV using cell culture and embryonated egg inoculation methodology.
- The samples were also tested for the presence of IBV using AGPT. A PCR based diagnostic assay was also standardized for the detection of IBV from clinical specimens using Mass-41 type of IBV. Out of 50 samples 2 isolates of IBV virus were isolated.
- However, out of the negative samples, 35 samples were diagnosed positive by PCR. The serological data revealed the presence of highly antibody titers of IBV variants in the field. Samples found negative by virus isolation and AGPT were subjected to PCR analysis. For this viral RNA was extracted and tested with RT-PCR kit for the detection of IBV. Here 35 samples were found positive for the presence of IBV, which were earlier detected, negative by AGPT.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- DNA thermal cycler
- Camera system with hood and platform
- Micro-pipette set
- Dry block heater and concentrator
- Gel documentation system
- Thermo mixture
- Biophotometer
- Easy pet
- Micro centrifuge mini spine plain
- Isotherm system (2)
- Microtube rack (6)

- PCR rack
- Micropipette
- PCR work station
- Horizontal mini gel system

Project Title: Implementation of NIR technique for the evaluation of animal feeds.

Principal Investigator: *Dr. Mohammad Mohsin Siddiqui*
Associate Professor

Location: Department of Livestock Management, NWFP Agricultural University,
Peshawar.

<i>Duration (Months):</i>	<i>24</i>	<i>Total Cost (million):</i>	<i>1.946</i>
<i>Start Date:</i>	<i>3/22/2002</i>	<i>Fund Released (Rs):</i>	<i>1555000</i>
		<i>Fund Utilized (Rs):</i>	<i>1542711</i>

Objectives:

- Use various chemical and biological procedures to measure the quality of available feeds and fodder.
- To identify chemical and biological parameters, which can be used for developing equations to predict digestibility and energy values of ruminant feeds.
- To develop an inventory of locally available feeds and fodder for farmers, extension workers feed manufacturers, feed dealers and researchers.

Achievements/Progress:

- 400 samples of roughages and 175 samples of concentrates feed ingredients were collected from livestock farmers, feed manufacturing units and markets of Mardan, D.I. Khan, Lahore, Multan, Rawalpindi, Gujranwala and Peshawar.
- Analysis of these samples for proximate composition have been completed. Chemical composition tables of locally available feed resources of Punjab and NWFP have been prepared. Preparatory work has been completed to start the in vitro digestibility studies of feed samples. The in-vitro digestibility trial was conducted during March, 2004.
- Experimental animals were purchased and surgically operated for rumen fistulation and were used for protein degradability trials, laboratory work is complete and results have been finalized for report writing. Data compilation and analysis is already completed. Samples preserved will be used for NIR spectrophotometry in Phase-II of the project for calibration of equipment to be used as routine tool for feed analysis. Sample composition tables will be prepared and available on-line for interested users, farmers, feed mills, researchers and students. The project has been completed.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Bomb calorimeter + accessories
- Renovations of Lab. & animal house
- Experimental steers
- Computer
- Laser Jet Printer
- Microwave oven
- Pipette (3)
- Washing machine

- Magnetic stirrer
- Deep freezer
- Microscope (4)

Project Title: **Molecular characterization and pathogenicity of avian adeno-viruses causing HPS.**

Principal Investigator: *Dr. Mansur ud Din Ahmad*
 Associate Professor

Location: Department of Microbiology, University of Veterinary and Animal Sciences, Lahore.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.746</i>
<i>Start Date:</i>	<i>3/1/2003</i>	<i>Fund Released (Rs):</i>	<i>1499000</i>
		<i>Fund Utilized (Rs):</i>	<i>1299337</i>

Objectives:

- Determining the role of immunosuppressive viruses in the causation of hydropericardium syndrome(HPS).
- Development and characterization of monoclonal antibodies for Avian adenovirus causing hydropericardium syndrome (HPS)
- Development of various diagnostic tools with particular emphasis on differentiation of virulent and non-virulent AAdVs.
- Evaluation of egg passaged local isolate for vaccine production.

Achievements/Progress:

- Different field isolates of HPS virus have been isolated in experimental broiler birds. Hyper immune sera against HPS virus are being raised against different types of vaccines available in broiler birds, indigenous layers and rabbits. The methods and protocols for primary chicken embryo liver cells culture (embryonic hepatocytes) have been standardized and different isolates of FAV (Local and Imported) are being propagated in primary chicken embryo liver cell culture and embryonated hen's eggs. Isolates collected by Co-PI i.e. from egg passaged virus is being propagated on embryonated hen's eggs. Ager Gel Immuno-diffusion haemmagglutination test have been standardized.
- Antisera have been raised in broiler birds and rabbits for immunization. Local HPS virus is isolated in broiler birds for propagation of inoculums to be used in cell culture.
- For the development of indirect immuno-peroxide assay, method has been standardized and a substrate unit has been purchased. Different field isolates of HPS virus have been isolated from HPS outbreaks .The seven isolates obtained and one of the selected strains was propagated in bulk for preparation and studying the virus behavior at different passage levels.
- These isolates have been confirmed by AGPT and by reproduction of diseases in broiler birds. Procedure for microtitration of virus was standardized and TCID50 of various passages have been determined (TCID50 end point of passage was $10^{5.6}$). Pathogenicity trials with varying doses of FAV through natural and parental routes have been conducted by Co-PI.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Ultra low freezer
- Liquid Nitrogen containers + flask with accessories
- Mini gel electrophoresis
- Microwave oven
- Refrigerator
- Egg/ Dental drill
- Rocker
- Computer with laser printer & other accessories
- Scanner
- Office table & chair
- Cupboard/ file cabinet
- File cabinet
- Horizontal electrophoresis
- Vertical electrophoresis
- Cryogenic container

Project Title: **Hyper-secretion of xylanase &/or cellulase thermophile for its application in poultry feed industry.**

Principal Investigator: *Dr. Farooq Latif*
 Principal Scientific Officer

Location: National Institute Biotechnology and Genetic Engineering (NIBGE), P. O. Box 577, Jhang Road, Faisalabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.743</i>
<i>Start Date:</i>	<i>7/1/2002</i>	<i>Fund Released (Rs):</i>	<i>1058000</i>
		<i>Fund Utilized (Rs):</i>	<i>832391</i>

Objectives:

- Chemicals mutagenesis of *Chaetomium thermophile* for enhanced xylanase expression.
- Genetic manipulations to decipher xylanase/ cellulase gene/s.
- The genetic construction will involve plasmid construction of amplified xylanase gene.
- Up-stream and down stream processing of enzymes from the mutant and wild type at lab scale and pilot scale.
- Study the in-vitro digestibility of feed treated with enzymes with regard to improvement in performance of chicks.

Achievements/Progress:

- Isolated the whole genomic DNA of *Chaetomium thermophile*. Primers were designed against the sequence of *C. thermophile xylanase* gene 11 A. Xylanase gene from the genomic DNA was isolated with the help of designed primers after the PCR optimization. The size of xylanase gene was confirmed at 889 bp. Isolated xylanase gene fragment was cloned in the T/A cloning vector for sequencing and the sequence was deposited in the Gene Bank. cDNA development was carried out through RT-PCR.
- As far as the purification of xylanase proteins to homogeneity level was considered a single band was obtained at 50 Kd (approx) on SDS-PAGE gel for one of the 3-4 proteins diagnosed on activity staining gel of the xylanases. UV mutagenesis resulted in obtaining a UV mutant N-VII with a 1.5 fold improvement in enzyme activity over the wild type.
- The enzyme obtained on bioreactor for the mutant showed over-production of 1.3 fold enzyme activity as compared to shake flask. The enzymes were further concentrated to use in the poultry feed experiments. In these experiments the enzyme treatment of fibrous feed showed an improvement of 115 g in body weight gain of broilers for enzyme added feed with a fiber level of 7.0 as compared to insignificant increase for the feed with a fiber level of 4.0.
- In the follow-up studies (Jan 2004-Jun 2004) effects of fiber degrading enzymes from *C. thermophile* supplemented in broiler rations with increasing concentration of sunflower meal (SFM) of 5, 10, 15 and 20% (w/w) were evaluated. The exogenous cellulases and xylanases particularly characterized for these studies were obtained by growing *C. thermophile* on wheat straw in a continuously stirred bioreactor. The concentrated liquid enzyme preparations was mixed at 1% (v/w) ratio with the feed. There was significant improvement ($p \leq 0.05$) in weight (1506 g) of the broiler chicks up to 15% SFM level (8.2% fiber) in the enzyme treated feed over the untreated feed (1342 g) after 0-6 weeks trial. Results showed that feed consumption increased in general up to 15% SFM and then decreased again at 20% SFM, however, the enzyme treatment had little effect. Enzyme inclusion significantly

improved the feed conservation ratio (FCR) of birds fed with 10%, 15% and 20% SFM (fiber level of $p \leq 0.05$). There was a significant increase in the carcass percentage from the enzyme treated rations at 15% SFM level as compared to the untreated ($p < 0.05$). Feed ingredients like SFM can play a vital role in the economics of feed produced in countries like Pakistan, especially when used with exogenous enzymes.

- The molecular biology of *C. thermophile* was further studied. The xylanase gene obtained from cDNA was transformed, into *E. coli* BL21 strain for expression. In this regard, heat shock transformation and electroporation transformation were carried out. The transformations were successful, however, the expression process is still under development stage.
- Moreover, work was spanned over to the development of intron free xylanase gene. For this purpose four primers were designed for both the segments of introns. Both the fragments were successfully cloned and ligated separately into cloning vector pTZ57R. These clones were transformed into *E. coli* 10B.
- In order to modify the xylanase gene to intron less for its expression in *E. coli*, four primers were designed for both the segments before and after the intron. Successful amplification of both the fragments of ~500 bp and ~300 bp were obtained cloned and ligated separately into cloning vector pTZ57R. Later, these clones were transformed into *E. coli* 10B.
- In another strategy these fragments were first ligated with each other to get one full length gene and later cloned into cloning vector pTZ57R. This ligation was confirmed by digestion. The third strategy was used to ligate both the fragments of gene into pET expression system one by one.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer P-IV (1)
- Printer HP LaserJet (1)
- Mustek Scanner for Computer
- Printer cartridge and diskettes

Project Title: **Refinement of multi-nutrient urea-molasses blocks technology through research and development.**

Principal Investigator: ***Dr. Imdad Hussain Mirza***
Senior Scientific Officer

Location: Animal Sciences Institute, NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>0.952</i>
<i>Start Date:</i>	<i>7/18/2002</i>	<i>Fund Released (Rs):</i>	<i>553000</i>
		<i>Fund Utilized (Rs):</i>	<i>508203</i>

Objectives:

- Improve utilization of low quality roughages.
- Improve utilization of molasses.
- Minimize wastage of ammonia.
- Reduce chances of ammonia toxicity.
- Improve health and production of animal.
- Improve livestock raisers income.
- Alleviate poverty from the country.
- Increase availability of livestock products like milk, meat etc. Overall we are expecting 5 to 15 percent improvement in animal's performance and about similar improvement in income generation.

Achievements/Progress:

- In the first experiment daily net benefit of body weight gain showed that inclusion of Yucca Schidigera Extract in blocks was not economical. In the second experiment it was revealed that out of 3%, 5% and 7% salt level, 7% was the best in terms of net benefit and supplementation with blocks was economically viable compared to no supplementation. Third experiment revealed that out of 9% and 11% salt level in the block 9% was better. Supplementation was proved essential to avoid weight loss in growing buffalo calves being fed on Mott grass as the sole roughage.
- Experiment on inclusion of three levels of corn gelatin meal in urea molasses blocks revealed average daily weight gain was best (242 grams) in animals fed on blocks with 10% corn gelatin meal. However, daily net benefit (Rs./day) was found best in 5% level (+5.38%).
- Experiment on three higher levels of urea in blocks i.e. 9, 11 and 13% on performance, economics, digestibility and N-balance revealed that highest body weight gain (535 grams) was achieved in 11% urea level followed by 13% feed conversion ratio and net benefit was also best in 11%.
- However, digestibility and N-balance were similar in all levels. Result of experiment to test the effect of using soybean meal (SBM) as a source of sypress protein revealed that average daily weight gain was 550 grams without SBM and 329 grams in 10% SBM. With net benefit of Rs. 23.68 and Rs. 9.97 respectively. Two levels of dicalcium phosphate (DCP) were also tested and it was found that average daily weight gain was 464 grams and 247 grams at 2% and 4% of DCP levels respectively and net benefit were 15.38 and 2.48 Rs./head respectively.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Metabolic cages for sheep (7)

Project Title: **Efficient utilization of local feed recourses for sustainable increase in livestock production.**

Principal Investigator: **Dr. Ghulam Habib**
 Associate Professor

Location: Animal Nutrition, N.W.F.P. Agriculture University, Peshawar.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	1.854
<i>Start Date:</i>	7/1/2002	<i>Fund Released (Rs):</i>	1496000
		<i>Fund Utilized (Rs):</i>	1280214

Objectives:

- To determine the nutritional characteristics of native tree fodders for ruminant livestock to optimize the use of local feed resources for sustainable development of livestock production.
- To identify promising species of tree fodder that could be used as reducing the cost of livestock feeding.
- To help alleviate the current feed gap through efficient management of local tree fodders, the untapped feed source, with in the existing farming system.

Achievements/Progress:

- The value of three foliage as a supplementary feed for ruminant livestock in arid and semi arid areas of NWFP varied enormously and suggested difference in compatibility with basal diets of green or dry forges. Protein contents in 13 native species of fodder trees ranked and ranged from 12.44 to 25.17% on dry matter basis. However, the efficiency of protein utilization greatly depended on its association with acid detergent fiber and tannin contents.
- A negative correlation was found between nitrogen degradability and ADF-N. Almost all tree leaves were found high in mineral matter especially in calcium, iron, copper, zinc and manganese and can be used as cheep source of mineral supplement in livestock rations. Leaves of *Grewia oppositifolia* were found superior and would effectively substitute conventional concentrates in dairy rations.
- Laboratory analysis of six species of summer tree fodder from Gadoon area for nutrient crop were completed, increasing the total number of spp. To 20 under investigation in the project. Macro mineral (Ca, P, K, and Na) and micro mineral (Cu, Zn, Fe, Mn) contents of all 20 spp. Of the foliage collected from these different project locations were determined. In vitro DM digestibility was determined for all the samples in 5 batches. Three cattle steers were surgically operated for fixing permanent rumen cannula and they were used for estimating the rumen degradability parameters with the in sacco technique.
- All the test samples were analyzed for rumen degradability of DM and protein for 4, 8 and 24 hours in the rumen of these fistulated steers. Degradability causes of each species of tree fodder were developed to determine the rate of degradability and results were used for protein evaluation of tree foliage.
- Three in-vitro metabolism experiments with sheep, each of 60-90 days duration were also conducted to determine in-vivo nutrient digestibility and nitrogen retention parameters in the animals when selected leaves are fed as a sole diet or feed supplement to the animals. All the results analyzed statistically and the effect of main factors such as the species and locations were determined for all the parameters.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Millipore filtration assembly
- Adjustable micropipettes
- Hot plate thermostatic
- Freezer
- Room Air Conditioner
- Weighing scale for animals
- Weighing for feed
- Vortex mixer
- Laboratory shaker
- Magnetic stirrer with hot plate
- Computer with printer & scanner
- Thermolyne cimerec - 3 Hot plate
- Hot plate
- Shaker electronic
- Micro pipette adjustable (2)
- Heavy duty platform

Project Title: Strategic breeding of red Sindhi cattle (SBRSC).

Principal Investigator: *Dr. U. N. Khan*
Director General

Location: Southern Zone Agriculture Research Center (SARC), Karachi

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.785</i>
<i>Start Date:</i>	<i>1/4/2002</i>	<i>Fund Released (Rs):</i>	<i>2468000</i>
		<i>Fund Utilized (Rs):</i>	<i>1766631</i>

Objectives:

- Assessment of production environment of Red Sindhi cattle.
- Introduction of Open Nucleus Breeding Scheme (ONBS) at LES, Karachi.
- In-vitro production of superior germplasm of Red Sindhi cattle.

Achievements/Progress:

- A nucleus herd of Red Sindhi cattle was established at Livestock Experiment Station, Karachi. Initially 25 heifers were selected. By December 2004, the herd strength has grown to 49 animals, including the followers and new purchases. (Pedigree and performance data of three Red Sindhi herds (Tando Muhammad Khan, Karachi and Hub) in the public sector have been computerized for the past 20 years. Using stratified random sampling with proportional allocation of sample size with respect to Red Sindhi population in the district, a benchmark survey of five districts Hyderabad, Thatta, Karachi and Malir (in Sindh) and Lasbella (in Balochistan province was carried out. A total of 665 farms were surveyed.
- Another survey to assess the production environment of Red Sindhi Cattle in Thatta, Hyderabad, Lasbella and Malir districts completed and result reported in annual progress report. Nucleus herd was maintained and bred further for invitro production of superior quality germplasm of Red Sindhi cattle, infrastructure at SPU, Karachi was strengthened as the existing infrastructure is incapable of producing frozen semen. Feeding and milk production data of animals were recorded.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Liquid nitrogen container (2)
- Red Sindhi cattle (05)
- PC with Laser Printer
- Air conditioner
- Portable milking machine
- Red Sindhi cattle (9)

CROPS SCIENCES

CROPS SCIENCES

BACKGROUND

ALP Secretariat received 314 preliminary proposals relating to crops sciences for funding under the 1st batch. In process of preliminary appraisal 122 proposals were short listed for the invitation of detailed projects and 192 proposals which were not up to the standard were dropped. Finally, 62 projects costing Rs.165.316million were approved by the Board of Director (BOD) of ALP for funding research in the following different disciplines.

For instance, there are projects on development of better cultivars having resistance to biotic and physico-chemical stresses (heat, drought) on mungbean, sugarcane, wheat, soybean and cotton. Further, there are 2 projects for development of hybrid seeds in sunflower and tomato. There is a project very well conceptualized to evaluate quality characteristic of oilseed crops.

Besides, there are 2 projects on farm mechanization, which are demand driven i.e. development of dryer for canola and sunflower, and development of resource conservation tillage implements. There are projects for integrated pest management in termites, weeds, rodents, nematodes and spiders control in apple. Again there are projects to solve major production problems of farmers in chilies and apples. Biotechnological tools are innovative approaches to understand molecular and genetic basis of resistance. There are 6 projects on biotechnology emerging from different institutions. The region wise detail of the on-going projects is summarized as under:

S.No	Region	Projects
1	PARC/NARC	27
2	PUNJAB	9
3	SINDH	4
4	NWFP	8
5	Balochitan	5
6	OTHER FEDERAL	7
7	OTHER PRIVATE/NGO	2
TOTAL		62

IMPLEMENTATION STATUS

Out of 62 approved projects following and 58 are on-going and following three projects are in process of agreement.

- *Novel methods to test & develop cotton heat-tolerance genotypes, exploiting male gametophyte as an effective plant breeding tool (Cotton Research Station, Usta Muhammad, Balochistan).*
- *Productivity improvement and seed multiplication of vegetable crops (NARC, Islamabad).*
- *Fruit cracking problem of pomegranates in Balochistan (District Loralai & Khuzdar).*

Only one project entitled “Implementation of NIR technique for the evaluation of animal feeds. NWFP Agricultural University, Peshawar” has been terminated on the recommendation of evaluation committee due to the poor performance.

FINANCIAL STATUS

So far an amount of Rs.73.448 million has been released against the overall total cost of Rs.165.316 million in respects of approved projects. Till now overall expenditure of Rs.47.645 million has been incurred as reported by the PIs of the projects

MONITORING & EVALUATION

The Chairman, PARC/BOD of ALP has reviewed the 1st year progress of the projects located at NARC, while the progress of other projects located outside Islamabad were reviewed/evaluated by the CSO/In charge, Crops Sciences Division, PARC. The second review of the projects by the Chairman, PARC/BOD of ALP is schedule to be organized in the next year.

However, on site evaluation of on-going projects is underway. The out comes of the evaluation will be published soon after its completion.

Currently, most of the projects have completed two years of their life span .The annual progress reports of the projects shows that significant task has been completed and the outcomes are very encouraging /cheering. The salient achievements of these projects have been complied in subsequent chapters of this annual report.

Project Title: Development of canola quality mustard (*Brassica juncea* L) genotypes.

Principal Investigator: *Syed Anwar Shah*
Principal Scientific Officer

Location: Nuclear Institute for Food and Agriculture, P.O.Box 446 , Tarnab, Peshawar

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	1.35
<i>Start Date:</i>	3/22/2002	<i>Fund Released (Rs):</i>	1042000
		<i>Fund Utilized (Rs):</i>	418409

Objectives:

- To develop improved mustard genotypes with the following desirable traits:
- Low erucic acid. (< 1%) and glucosinolates (less than 18 micro moles/ gram of oil free meal)
- High oil content (> 45%)
- High seed yield (~2.5 t/ha), short stature (~100-120 cm) and early maturity.
- Resistance/ tolerance to biotic and abiotic stresses such as diseases, insects and heat/drought.

Achievements/Progress:

- Genetic variability in easily recognizable characters such as early maturity, short stature etc. was induced in exotic mustard genotypes. A reduction of 25-35% in plant height has been achieved through gamma rays induced mutations. A total of 177 putative mutants were selected out of which 52 were selected at NIFA and 125 at Kaghan. 30 out of 53 previous selections showed genetic stability regarding different characteristics in M3 Plant-to-row progenies, which are currently being evaluated for yield, agronomic and quality traits in two yield trials at NIFA.
- The 177 new selections are being assessed for genetic stability in M3 plant-to-rows progenies. Under classical Mendelian breeding program, more than 1500 cross combinations were developed between double low exotic genetic genotypes and non-canola local varieties for developing the hybrids with canola quality and other desirable traits. The quality analyses (on NIRS) showed that 36% of the total selections are double low i.e. low in erucic acid and total glucosinolates contents.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Electronic note book (Laptop)
- Computing integrator for GLS
- GC capillary column megabore DB-WAX
- Opti flow digital flow meter. Accurate for all gases with 9-v battery.
- Digital camera

Project Title: **Development of high yielding and well adaptive indigenous Canola Hybrids.**

Principal Investigator: **Dr. Naazar Ali**
 National Coordinator/CSO

Location: Oilseed Research Programme, NARC, Islamabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	1.869
<i>Start Date:</i>	7/18/2002	<i>Fund Released (Rs):</i>	1278000
		<i>Fund Utilized (Rs):</i>	1002186

Objectives:

- To identify and provide essential rapeseed germplasm to encourage local hybrid development progress in Pakistan.
- To provide/adapt and uniformly maturing hybrids at affordable price to enhance canola cultivation in Pakistan.
- The preliminary work on the hybridization in canola was started 4 years limited program funds. The researchers were able to find and maintain the cytoplasmic male sterile source in canola. Through this project oilseeds research program will materialize on the earlier work of scientists.
- An active collaboration of private seed companies and provincial Agricultural Extension Department will also be established for sale and promotion of the released hybrids.

Achievements/Progress:

- There were significant differences among parents as well as among crosses for all traits. In heterosis study, seed yield varied from 2228 to 4105 kg/ha among the crosses. The highest seed yield of 4105 kg/ha was produced by the cross (CON-I x R-401). This was followed by the cross (Sponsor x R-401) with seed yield of 4067 kg. The lowest seed yield of 2228 kg/ha was recorded in the cross of Westar x R-26.
- The maximum heterosis (99% yield increase over mid parent and 97% over best parent) was recorded in CON-I x R-401 cross. The crosses CON-I x R-401, CON-I x R-26, BLN-877 x R0401, Sponsor x R-26 and CON-II x R-401 also showed more than 50% seed yield increase over mid-parent and more than 38% over best parent. The cross (Westar X R-26) showed minimum heterosis and seed yield decrease was 20% over mid parent and 32% over best parent.
- In combining ability study, the male parent R-401 showed highest GCA effects for days to flowering and maturity and seed yield and the female parents CON-I and Sponsor showed significantly higher GCA effects for seed yield and proved a better parent for seed yield than others. It is indicated that cms of CON-I and Sponsor are the best parents to produce hybrids using CMS-Restorer system. The 7 newly developed restorer lines were crossed with existing cms lines and produced sufficient F₁ seed was produced from 5 new F₁. The existing 12 cms lines (A-line) and their respective maintainer lines (B-lines) were maintained successfully. In this regard, intensive crosses were made between cms lines and B-Lines. At the same time plants from B-line were also self-pollinated to maintain genetic purity of B-lines.
- The 13 new F₁ were also successfully backcrossed with their respective parents. The male parents were also selfed to produce genetically pure seed. In addition, 42 new

varieties/strains were successfully crossed with cms source and sufficient F₁ seed was produced.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer P-IV
- Laser Printer
- Scanner
- Stereomicroscope Cole-parmer Catalog
- Brand Tech. Despensette-III
- Electronic temperature/ humidity meter
- Magnifying lens
- Furniture & fixture
- Research equipments
- Colored printer

Project Title: Genetic improvement of Brassica oilseed by integrative use of conventional and molecular biological approaches.

Principal Investigator: Dr. Zahoor Ahmad Swati
Director

Location: Institute of Biotechnology and Genetic Engineering, NWFP Agriculture University, Peshawar.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	1.919
<i>Start Date:</i>	3/22/2002	<i>Fund Released (Rs):</i>	1166000
		<i>Fund Utilized (Rs):</i>	1090519

Objectives:

- To identify, locate and characterize insect resistant genes in the wild relatives and cultivated Brassica grown in Pakistan
- To introduce the aphid resistant source gene or quantitative trait locus (QTL) into *Brassica napus* genome which has improved cultivars for low erucic acid and glucosinolates contents with higher oil yield.
- To follow the introgression of useful traits from the *B.napus* germplasm to the *B. juncea* and or *B.carinata*, both are well-adopted germplasm in Pakistan.
- Development of improved cultivars of oil seed rape for high oil content with low erucic acid and glucosinolates, and resistant to insect pests (aphids).

Achievements/Progress:

- To achieve the objectives, 120 varieties belonging to *Brassica napus*, *B. juncea*, *B. campestris* and *B. carinata* were planted at Kaghan research station in May 2002 and were inter crossed to achieve 500 inter and intraspecific crosses. These crosses alongwith parents were harvested in October 2002 and were planted in the field as well as in the pots at Peshawar in the same month. Crosses where seed setting was not achieved at Kaghan has been attempted again at Peshawar. F_{1s} were backcrossed to selected recurrent parents. F_{2s} seed harvested at Peshawar were taken to Kaghan and planted as space planted populations in May 2003. Crosses attempted at Peshawar were also sown at Kaghan as F_{1s}. Based on better morphological performance, 400 families were selected from F₂ space planted populations. These 400 F₃ families were planted at Peshawar in November, 2003. Data were recorded for plant length, No of pods/plant, pod size, pod- pod distance, pod- stem angle and 1000 grain weight.
- Screening against artificially created aphid attack at seedling and through visual observation in the field was done. Based on better morphological performance and resistance to aphid attack, 100 families are selected which shall be taken to Kaghan for plantation as F₄ families before the end of May 2004. We have successfully developed 100 super Brassica families out of which we shall be able to release improved Brassica varieties in 2-3 years time.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Incubator (Cooling)

- Incubator (Heating)
- Desktop computer P-IV
- HP LaserJet 1200 & Deskjet 930C
- HP Scanner, Printer
- Incubator
- Analytical balance

Project Title: **Integrated pest management of aphids in canola.**

Principal Investigator: **Dr. Mohammad Aslam**
 Associate Professor

Location: University College of Agriculture, Bahauddin Zakria University, Multan

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	1.346
<i>Start Date:</i>	7/1/2002	<i>Fund Released (Rs):</i>	661000
		<i>Fund Utilized (Rs):</i>	526011

Objectives:

- Collection and identification of aphids and their natural enemies from the field grown canola.
- Screening of available canola varieties for resistance against aphids.
- Determine the relationship between aphid numbers/plant and yield loss to establish Economic Threshold level.
- Testing insecticides for their effect on aphids and natural enemies.
- To develop an IPM package by integrating the use of resistant varieties, biological control agents and insecticides, particultural soft insecticides.

Achievements/Progress:

- The research was carried out at Multan and Bahawalpur during 2003-2004 crop season. Brassica napus varieties viz. Dunkald, Rainbow, Oscar, Westar, Shiralee CON-I, CON-II, CON-III, KS-75, Abaseen, 19-H and 20-E and Brassica Juncea, Viz, BARD-I, Sultan Raya, BRS-3, PIIR-I, UCD-6/10, P63R5, UCD-44/4, UCD-636, P-37, RC-280, 95101/163 and 95102/51 were screened by recording aphid population in the fields at Multan and Bahawalpur.
- Population of both cabbage aphid and mustard aphid was non-significantly different among the tested varieties of both crops at both locations. Population of cabbage aphid was more than turnip aphid on both crops at both locations. Lady beetle, *Coccinella septempunctata* L. was very low on both crop at Multan and Bahawalpur. In planting date experiment lowest population of aphids was recorded on canola planted in second week of October as compared to that on the crop sown in first and second week of November.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Air conditioner
- Autoclave
- top loading digital balance
- Leaf area meter
- Water distillation unit
- Refrigerator

Project Title: Some physiological studies on vegetative growth pattern and its impact on productivity and malformation of mango (*Mangifera indica* L.).

Principal Investigator: *Dr. Muhammad Ibrahim*
Professor

Location: Department of Horticulture
University of Agriculture, Faisalabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.384</i>
<i>Start Date:</i>	<i>3/22/2002</i>	<i>Fund Released (Rs):</i>	<i>753000</i>
		<i>Fund Utilized (Rs):</i>	<i>706994</i>

Objectives:

- To generate some basic information on vegetative and reproductive growth behaviour of the tree and to use this knowledge for the control of mango malformation.
- To identify the behaviour of different recommended varieties of mango towards mango malformation and their relationship with the growth pattern.
- To establish effects of growth retardants on growth management and control of malformation.
- To determine leaf nutritional standards to control malformation and enhance productivity of the mango orchards.
- To prepare a package of recommendations for orchard management which could be helpful to minimize or control completely the problem of malformation and increase per acre fruit yield.

Achievements/Progress:

- Detailed study of growth pattern and its impact on floral malformation is determined. Detailed morphological studies of healthy and malformed panicles is completed. Pruning of malformed panicles at different times indicated its effect on malformation of panicles during the following season. Spray of urea to improve N status of leaves appears as if increased malformation of inflorescence.
- Different doses and time table of fertilizer application appear ineffective on incidence of malformation. Spray applications of various fungicides at different times reduced the incidence of malformed panicles. Spray of low doses of GA3 reduced and higher doses increased the incidence of floral malformation in different varieties of mango.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer
- Micro kjedhal fume hood
- Micro kjedhals' distillation unit
- Aluminum light weight ladder
- Top loaded balance
- Lab. Distilleries

Project Title: **Studies on malformation of mango.**

Principal Investigator: ***Dr. Ahmed Saleem Akhtar***
 Director

Location: Plant Protection Institute, Faisalabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	2.241
<i>Start Date:</i>	3/29/2002	<i>Fund Released (Rs):</i>	1210000
		<i>Fund Utilized (Rs):</i>	1166838

Objectives:

- To conduct studies on etiology to establish the cause of the disease.
- To identify and classify fungal isolates through DNA finger printing.
- To devise a suitable integrated strategy to overcome a major problem of mango production in the country.

Achievements/Progress:

- The examination of malformed parts of 5 exotic cultivars viz. Tomyatkin, Swarnika, Maya, Zill and Kensington revealed the dominance of fungus *Fusarium subglutinans*. Tomyatkin proved to be the most susceptible variety showing 96.0% infection followed by Kensington with 93.0% infection.
- Twenty isolates of fungus *Fusarium subglutinans* identified from 14 locations of Pakistan were subjected to DNA fingerprinting to find out variability at molecular level. On an average, 76.33% polymorphic bands have been observed. Malformed and healthy mango buds were assayed using Transmission Electron Microscope. Ultra structural studies revealed the fungal infection in the malformed buds sap.
- The trial on consecutive clipping and chemical spray showed good results. The treatment where clipping was done at 1.5 ft. distance from top to downward proved to be the best giving 70.51% decrease over previous years count.
- Three abstracts have been published in the proceedings of the 4th National conference of Plant pathology. Acceptance for one paper has been received.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Laminar air flow horizontal
- Sprayer
- Air Conditioner
- Microwave oven
- Incubator
- pH meter
- Lux meter
- Humidity meter
- Dry Ice maker with container
- Heavy duty stabilizer
- Digital camera

Project Title: **Integrated management of fruitflies in Pakistan.(NARC, Component)**

Principal Investigator: **Dr. Ghulam Jilani**
 Program Leader

Location: Insect Pest Management Program, Institute of Plant and Environmental Protection, NARC, Islamabad

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>3.675</i>
<i>Start Date:</i>	<i>3/21/2002</i>	<i>Fund Released (Rs):</i>	<i>1997000</i>
		<i>Fund Utilized (Rs):</i>	<i>1746881</i>

Objectives:

- To enhance quality and quantity of various exportable fruits, i.e. mango, guava and citrus through the reduction of economic losses caused by fruit flies.
- To ensure pest and pesticides free fruit production of export, to meet WTO standards.
- To develop capabilities in farmer communities for controlling fruit flies through IMP technologies/eco-friendly management of fruit flies in the country.

Achievements/Progress:

- Surveys revealed that fruit fly infestation in mango orchards in Multan during the season was 2-8% in intact and 20-35% in fallen fruit . In guava in Sharaqpur highest infestation was 60-87% in intact 50-72% in harvested and 45-92% in fallen fruits during October.
- Field evaluation of extracts of neem, turmeric, Sweet flag 'balchar' and harmal each in petroleum ether acetone and ethanol indicated that although all the materials repelled fruit flies petroleum ether extract of sweet flag was the most effective. Their laboratory evaluation against two parasitoid species indicated a similar effect of Petroleum ether extract of sweet flag. This extract when chemically fractioned by thin layer chromatography and column chromatography using petroleum ether acetone (3.1) solvent system the first fraction (Rf 0.85) showed the highest repellency as compared with other four subsequent fractions in the laboratory evaluation. Implementation of an IPM package consisting of male annihilation bait spray sanitation and application of neem extracts on the most susceptible variety in an isolated patch of 450 acre mango plantation in Multan had less than 1% infestation in intact, 1% in harvested and 3% in fallen fruits as against 3, 2 and 9.5% in control in August.
- Review and planning meeting (11-13 June-2003), Traveling Workshop (26-30 July 2003) and training Course on Biological Control (9-12 December 2003 were organized under the umbrella project.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Automatic fraction collector
- Soxhlets extractor (with accessories)
- Environment chamber
- Multimedia
- Photocopier

- Computer with LaserJet printer
- Scanner
- Blender mixer
- Microwave oven
- Air conditioner
- CD Writer

Project Title: **Integrated management of fruitflies in Pakistan.**
(CABI Bioscience - Component)

Principal Investigator: **Dr. M. Ashraf Poswal**
Director

Location: CABI-Biosciences Centre, Data Gunj Bakhsh Road, Satellite Town,
Rawalpindi.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	4.254
<i>Start Date:</i>	3/21/2002	<i>Fund Released (Rs):</i>	3409000
		<i>Fund Utilized (Rs):</i>	2981477

Objectives:

- To enhance quality and quantity of various exportable fruits, i.e. mango, guava and citrus through the reduction of economic losses caused by fruit flies.
- To ensure pest and pesticides free fruit production of export, to meet WTO standards.
- To develop capabilities in farmer communities for controlling fruit flies through IMP technologies/eco-friendly management of fruit flies in the country.

Achievements/Progress:

- For certification of presence/absence of fruit flies the monitoring of fruit flies remained the regular activity of the project. Traps with different types of pheromones were put at Sharaqpur. Multan and Sargodha in cooperation with Agriculture Extension Department.
- The pheromone traps were put in the orchards and in main food market at each locality. Catches of fruit flies were examined at monthly intervals for their counts and identification of species. No fruit fly was caught in traps containing pheromone timelier, which is specific for Mediterranean fruit fly *Ceratitis capitata*. This confirms its absence from Punjab and probably also from Pakistan as it has not been reported so far from any part of the country in traps containing dorsa lure two species *Bactrocera dorsalis* and *B. zonata* were caught and of these *B. zonata* was the dominant species.
- In cooperation with Mango Growers association two farmer field schools, one each at Amir Pur. Kabir Wala and Chak 5 Faiz, Multan were established with the main objective of conducting experimentation for development of integrated crop management in mango with farmer participatory training research approach. To address mango issues the experts, where required, were invited for advice and necessary actions. The experimentation was done after unanimous decision taken in the light of discussions of participating farmers.
- Insects (mainly fruit flies, midges and scale insects) and disease (quick decline, powdery mildew and anthracnose) were identified as the main issues in mango production and at present pesticides cover sprays are the only option with farmers to address these issues. Farmers follow a schedule of 6-10 pesticides cover sprays in the orchards and this has raised the issue of pesticides residues in mango fruit.
- Impact of an IPM package comprising combined application of pheromones for male annihilation, spot sprays of bait mixtures (consisting of protein hydrolysate, water and pesticide) for attraction of females and their ultimate kill and crop sanitation (destruction of fallen blemished/fruit fly infested fruits) was studied on isolated large mango area of 450

acres at Chak 5 Faiz, Multan and on 55 acre area among main mango belt at Amir Pur, Kabir Wala.

- At Chak 5 Faiz where chances of fruit flies incursion, from the adjoining areas were comparatively lesser, suppression in their populations was successfully achieved. The damages to mango fruits was reduced to 0.3% at this locality . At Kabir Wala though IPM was effective in controlling fruit flies, the damage to fruits at the peak of flies populations was relatively higher than at Chak 5 Faiz. This was most probably because of frequent incursion of fruit flies from the adjoining areas.
- In a number of countries the natural enemies are being used in controlling fruit flies in combination with other control measures. The option of controlling fruit flies with parasitoids is being studied in guava at Taridewali (Sharaqpur).
- At Taridewali where augmentation of two species of parasitoids *Trybliographa daci* and *Diachasmimoroha longicaudata* was done the parasitism level increased about six times (53.3%) higher than in control where parasitoids were not released. The parasitism level in control did not exceed 9%. The damage to fruits in control was 95% whereas the damage was 45% in plots where laboratory reared parasitoids were augmented. This experiment provided foundation for using endemic natural enemies alone and in combination with other complementary control measures for controlling fruit flies. For conservation of parasitoids experiments were conducted to identify suitable conditions, for their population build up in orchards.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Dissecting microscope
- Lures bait
- Cage and racks

Project Title: **Integrated management of fruitflies in Pakistan.**
(NIFA, Peshawar Component)

Principal Investigator: **Dr. Sana Ullah Khan Khattak**
 Head, Entomology Division/PSO

Location: Nuclear Institute for Food & Agriculture (NIFA), Tarnab, Peshawar.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	2.368
<i>Start Date:</i>	3/22/2002	<i>Fund Released (Rs):</i>	1790200
		<i>Fund Utilized (Rs):</i>	1548089

Objectives:

- To enhance quality and quantity of various exportable fruits i.e. mango, guava and citrus through the reduction of economic losses caused by fruit flies.
- To ensure pest and pesticides free fruit production of export, to meet WTO standards.
- To develop capabilities in farmer communities for controlling fruit flies through IMP technologies/eco-friendly management of fruit flies in the country.

Achievements/Progress:

- Studies on integrated management of fruit flies were conducted in Kohat and Haripur districts. The results revealed that at Kohat, in Umbrella orchard using MAT, BAT and Bio-Pesticides, reduction in pest population incidence, fruit infestation and damage achieved was 77.44%, 10.58% and 5.45 (pupae/kg) than control during March-June, 2003. Similarly for the period July, 2003-March, 2004, the same treatment caused reduction in pest population, fruit infestation and damage by 60.7%, 63.65% and 59.96 (Pupae/kg), respectively.
- At Haripur, in umbrella orchard, mean fly population was 49 having population reduction of 29.85% than control for the period March-June, 2003. During July, 2003-March 2004, fly population was decreased by 28.37%, fruit infestation 56.56% and damage 42.22 (pupae/kg) than control. The relative abundance regarding fruit fly species showed that *Bactrocera zonata* was dominant (94.7%) at Kohat while *B. dorsalis* is (85.39%) at Haripur.
- Moreover fruit fly parasitoids including *Diachasmimorpha longicaudata* and *Trybliographa* sp. were recorded from infested collected fruits. Six farmer training workshops were organized and 150 persons were trained. About 300 lure baited traps were distributed in target areas.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Microscope accessories for photography
- Incubator
- Humidifier
- Air Conditioner
- Electro thermo hygrograph
- Power sprayer
- Electothermograph
- Digital camera
- Colored scanner

Project Title: *Integrated management of fruitflies in Pakistan.*
(ARI, D. I. Khan Component)

Principal Investigator: *Dr. Abdul Latif*
Entomologist

Location: Agricultural Research Institute, D.I. Khan.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	2.063
<i>Start Date:</i>	3/22/2002	<i>Fund Released (Rs):</i>	1670500
		<i>Fund Utilized (Rs):</i>	1525176

Objectives:

- To enhance quality and quantity of various exportable fruits i.e. mango, guava and citrus through the reduction of economic losses caused by fruit flies.
- To ensure pest and pesticides free fruit production of export, to meet WTO standards.
- To develop capabilities in farmer communities for controlling fruit flies through IMP technologies/eco-friendly management of fruit flies in the country.

Achievements/Progress:

- Survey was conducted to assess incidence/extent of damage caused by fruit flies to various fruits grown in the areas. The infestation in muskmelon, mango, guava and citrus ranged from 2 to 70%. Efficacy of different management techniques, such as male annihilation (MAT), bait application (BAT) and Biopesticide (Neem extract) were tested against fruit flies inflicting damage to melon, mango and guava fruits. All the treatments were found significantly effective in suppressing flies population and reducing fruit infestation.
- Studies on population fluctuation of mango fruit flies (*Bactrocera zonata*) were carried out in relation to seasonal variation. Weekly data on number of flies captured revealed peaks of population during the months of May/June and August/September.
- Detection of presence/absence of fruit flies species were carried out through trapping and by rearing adults from various fruits such as musk melon, bitter gourd, mango, guava, & dates taken by weight and/or by numbers. The species recovered were not other than already established one, mostly belonging to genus *Bactrocera*. Mass rearing in the laboratory and studies on behavioral aspects of fruit flies were undertaken.
- Transformation of management technology to stakeholders was carried on through training and field demonstration. A total of 16 training sessions were held and 318 persons trained; including 74 extension field staff and 244 growers.
- Parasitoid mass rearing training was received for biological control of fruit flies. The programme was organized by CABI Bioscience centre at Rawalpindi and Lahore.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Dissecting microscope
- Incubator
- Computer P IV with accessories and Laser Printer
- Air conditioner

- Humidifiers
- Bio assay
- Refrigerator
- Fruit flies scaling chamber
- Fruit flies scaling cage

Project Title: *Integrated management of fruitflies in Pakistan.*
(NIA, Tandojam Component)

Principal Investigator: *Mr. Nazir Ahmed*
Head, Entomology/PSO

Location: Nuclear Institute of Agriculture, Tandojam, Sindh

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	2.012
<i>Start Date:</i>	4/26/2002	<i>Fund Released (Rs):</i>	1110500
		<i>Fund Utilized (Rs):</i>	881340

Objectives:

- To enhance quality and quantity of various exportable fruits i.e. mango, guava and citrus through the reduction of economic losses caused by fruit flies.
- To ensure pest and pesticides free fruit production of export, to meet WTO standards.
- To develop capabilities in farmer communities for controlling fruit flies through IMP technologies/eco-friendly management of fruit flies in the country.

Achievements/Progress:

- Different studies were conducted during the year 2003-04 for the eco-friendly management of fruit flies in guava and mango orchards in the three selected districts of Sindh i.e. Mirpur Khan, Hyderabad and Larkana. Some traps of Trimed lure were also installed for the survey of *Ceratitidis capitata* but no *Ceratitidis capitata* was recorded. Results revealed that guava fruits were attacked only by the *Bactrocera zonata*, however, from the mango fruits, *B. dorsal* is was also observed with very low intensity. Further, two species of parasites, *Diachasmimorpha longicauda* and *Trybliographa* spp. were recorded from the pupae of *B. zonata*. Male annihilation alone or in combination with BAT and cultural practices proved significantly effective for the control of fruit flies as compared to the separate treatment of Bait spray and the farmer's practices. Bait Spray techniques controlled the infestation of fruit flies in guava and mango orchards, however, it was significantly less effective than MAT.
- In another experiment, the Neem spray treatment proved as effective as insecticides spray for the management of fruitflies. Feasibility studies of Sterile Insect Technique (SIT) revealed that fruit flies pupal recovery in the dropped fruits was significantly lowing insecticides treatments as compared to the SIT treated block, whereas, it was significantly high in the untreated control block. Results indicated that eco-friendly management techniques proved less effective as compared to insecticide when these were applied on small scale. Hence, these techniques will be applied on large scale during 2004-2005 seasons. Farmers are using insecticides indiscriminately for the control of fruit flies.
- Training to the farmers was provided through the demonstration of male annihilation technique and bait spray technique with the objectives to familiarize them with the eco-friendly modern techniques for the control of fruit flies. As a result of the trainings, a number of farmers purchased the fruit fly traps for the control of fruit flies through male annihilation technique.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Dissecting microscope
- Incubator
- Computer

Project Title: *Integrated management of fruitflies in Pakistan.
(ARI, Sariab, Quetta Component)*

Principal Investigator: *Mr. Muhammad Karim Shawani
Entomologist*

Location: Agricultural Research Institute, Sariab, Quetta.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.031</i>
<i>Start Date:</i>	<i>3/1/2003</i>	<i>Fund Released (Rs):</i>	<i>1113000</i>
		<i>Fund Utilized (Rs):</i>	<i>824472</i>

Objectives:

- To enhance quality and quantity of various exportable fruits i.e. mango, guava and citrus through the reduction of economic losses caused by fruit flies.
- To ensure pest and pesticides free fruit production of export, to meet WTO standards.
- To develop capabilities in farmer communities for controlling fruit flies through IPM technologies/ eco-friendly management of fruit flies in the country.

Achievements/Progress:

- In the experiment different IPM techniques used against fruit flies on guava orchard at Vender during the Year 2003-2004. The most effective was treatment No.1 (MAT, BAT, CP and Bio pesticide). Followed by treatment No.2 this comprised of MAT, BAT and CP. In the experiment No.2 "Reduction of fruit fly through MAT on guava orchard in Vender area. The results showed that Sex pheromone traps (MAT) attracts a great number of male fruit flies through out the fruiting season, total population of fruit fly decreased considerably.
- Experiments No.3 and 4 reduction of fruit flies used MAT against fruit fly on musk melon at Sibi and Dhadar gave more effective control than chemical control and untreated plot. Five farmers training courses were conducted under the fruit flies project, the following topics were covered; identification, biology of pest, mode of damage and control methods.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Microscope accessories for photography
- Room heater
- Incubator
- Humidifier
- Computer P-IV with monitor and printer
- Gas heater
- Computer trolley
- Knap sack sprayer
- Cages

Project Title: *Mass scale production of disease free true-to-type peach rootstock (GF 677) plantlets through tissue culture for productivity enhancement/ economic self reliance.*

Principal Investigator: *Dr. Hafeez-ur- Rahman*
Senior Scientific Officer

Location: Horticulture Research Institute,
National Agriculture Research Center, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.129</i>
<i>Start Date:</i>	<i>3/21/2002</i>	<i>Fund Released (Rs):</i>	<i>2411000</i>
		<i>Fund Utilized (Rs):</i>	<i>1269520</i>

Objectives:

- Mass clonal multiplication of GF-677 rootstock (givorus, performs better and longer than local rootstock used commercially and is also tolerant to some of the biotic and abiotic stress factors) for budding commercial varieties of peach, almond, plum and apricot.
- Supply of healthy clonal peach, plum, apricot, almond nursery plants to orchardists budded on GF-677 rootstock to bridge the gap between supply and demand of healthy planting material to the end users/gardeners.

Achievements/Progress:

- GF 677 is a interspecific hybrid (Peach x Almond). It is clonally propagated (cutting; micropropagation) and is specially used on alkaline soils because it is resistant to iron induced chlorosis and is also useful in replant situations. Highly vigorous (counteracts low soil fertility), do not produce suckers, resistant to peach rust, crown gall and root knot. However, it is difficult to multiply on mass scale through cutting because of very low rooting percentage. Through micropropagation it can be multiplied at a much faster rate as compared with conventional propagation. Thus present investigation is attempted to standardize a protocol for in vitro propagation of this rootstock.
- For in vitro rooting of peach rootstock GF 677, three auxins (IAA, IBA and NAA) were tested at concentrations of 0.2, 0.4, 0.6, 0.8 and 1.0 mg l⁻¹. The root number and root length were significantly (P<-0.05) affected by auxins type and concentrations. The optimum concentration was different for each auxin. Maximum number of roots (5) and roots >1.5 cm in length (4) were obtained with 0.4 mg l⁻¹ IBA without callus inter phase however, NAA and IAA affected the root growth negatively. Callus formulation was strongly stimulated by NAA. For these reasons IBA is preferable auxins for in vitro rooting of peach rootstock GF 677. Well rooted plantlets were transferred to greenhouse successfully and grown with 80% survival.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Autoclave
- pH meter
- Top Loading balance

- Refrigerator
- Digital micro pipettes set
- Computer with accessories
- UPS+ volt. Stabilizer
- Slide Projector
- Balance

Project Title: *Post Harvest Research on Perishable Fruits (Guava, Peach) and Vegetable (Tomatoes) In NWFP.*

Principal Investigator: *Mrs. Manzoor Nazli*
Grading & Packing Specialist

Location: Food Technology Section, Agriculture Research Institute, Tarnab, Peshawar.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.637</i>
<i>Start Date:</i>	<i>3/22/2002</i>	<i>Fund Released (Rs):</i>	<i>1363000</i>
		<i>Fund Utilized (Rs):</i>	<i>1270925</i>

Objectives:

- To reduce product losses occurring on the farm and in the marketing system.
- Increase the amount of food marketed by introducing improved Post Harvest techniques.
- To improve the welfare of the farming community.
- Development of Post Harvest Techniques that delay senescence and easy to adopt by the farmers.

Achievements/Progress:

- Economic Survey was conducted on “Post-harvest Economic Losses in Peach Crop (A Case of Swat Valley)”. Final report completed. Experiment on “Effect of grading, packing material and cold storage behavior on the shelf life of Guava” was completed. Experiment on the “Effect of grading, packing material and cold storage behavior on the shelf life of tomato” was completed third year data completed, analysis is in progress and final report will be submitted during next mid term progress report.

Equipments Purchased:

Following equipments have been procured for the project’s activities out of Agricultural Research Endowment Fund (AREF).

- pH meter
- Humidity meter
- Automatic titration kit
- Moisture tester portable
- Horticultural color chart
- Balance
- Juicer/ pulper
- Movie camera
- Refractometer
- Packaging material
- Water purification system
- Computer
- Laser Printer
- Computer table
- Office table
- Office chair

Project Title: **Morphological and biochemical variability of the genus *Trichogramma* (Hymenoptera: Trichogrammatidae) in Pakistan.**

Principal Investigator: ***Mr. Riaz Mahmood***
Senior Scientific Officer

Location: CABI Regional Biosciences Centre, Opposite 1-A Data Gung Baksh Road,
P.O. Box 8, Satellite Town, Rawalpindi

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>4.166</i>
<i>Start Date:</i>	<i>3/21/2002</i>	<i>Fund Released (Rs):</i>	<i>3114000</i>
		<i>Fund Utilized (Rs):</i>	<i>2536224</i>

Objectives:

- Survey and collection of different *Trichogramma* spp. from different ecological zones of Pakistan.
- To document morphological variability in *Trichogramma*.
- To document genetic variability due to DNA
- Electrophoretic studies of *Trichogramma*.
- To prepare taxonomic keys.

Achievements/Progress:

- Survey of this group of insects was continued in different ecological zones of Pakistan, about 90 species of plants were examined for eggs of insects. These included vegetables, fruits, forest trees, crops and weeds. More than 11367 eggs of insects were collected and kept in laboratory for the emergence of *Trichogramma* species.
- Considerable progress was made during the period under report, with regard to morphological studies. Four species of *Trichogramma* have been identified namely, *Trichogramma chilonis*, *T. semblidis*, *T. chiloetraeae* and *T. pintoii*. These have been confirmed from international experts. Three out of these are new to Pakistan. A key is constructed which will help the identification of presently known species of Pakistan.
- Crossing compatibility was investigated among *Trichogramma* species identified on the basis of morphological characters. These experiments were helpful in providing a test of the value of certain morphological characters for species discrimination. In seven inter-specific crosses i.e. *T. pintoii*, *T. semblidis* and *T. chiloetraeae*, no females were produced. This proves that they are distinct species. Intra-specific crosses involving different populations of *T. chilonis* showed production of large number of females.
- The female production in each cross was more than 75% of the conspecific crosses. This confirms that they are same species. Molecular characterization using ITS-2 region of rDNA have been initiated. Bands of similar molecular weight were obtained during PCR and they show number of base pairs equal to *T. chilonis*. For the analysis of similar band size restriction enzyme analysis was done to further obtain species specific banding pattern. No molecular differences were found by restriction analysis using MnlI endonuclease. However, we hope to get these bands by using other enzymes for which studies are under progress.
- The picture of the distribution of different species is gradually emerging. This study has made it evident that more species of *Trichogramma* exist in Pakistan than known before.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Microscope
- Blower

Project Title: *To develop drought resistant wheat (*Triticum aestivum* L.) genotype under water stress condition.*

Principal Investigator: *Sheikh Muhammad Mujtaba*
Principal Scientific Officer,

Location: Nuclear Institute for Agriculture, P.O.Box 70060, Tandojam, Sindh.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.07</i>
<i>Start Date:</i>	<i>4/26/2002</i>	<i>Fund Released (Rs):</i>	<i>632000</i>
		<i>Fund Utilized (Rs):</i>	<i>498751</i>

Objectives:

- To find out method through suitable field and laboratory screening techniques for identifying drought resistant genotypes.
- To identify the mechanism of adaptation to drought, i.e escape, avoidance and tolerance and the “nature of modification (morphological and physiological) induced in plant, to establish effect of drought on different physiological stage.
- To identify the biochemical and physiological change in resistant and susceptible genotypes.

Achievements/Progress:

- The experiment was conducted at nuclear Institute of Agriculture, Tandojam in pot-house for screening the drought tolerance behavior in wheat (*Triticum aestivum* L.) genotypes/lines.
- Fifty two (52) exotic/local wheat genotypes/lines collected from different research organizations of the country were grown in irrigated sandy clay loam soil filled in eight cemented tanks (10x10 and 3 depth) in pot-house at Nuclear Institute of Agriculture, Tandojam. The seeds were sown in a complete randomized block design. All the wheat genotypes/lines were sown in four cemented tanks under stress condition. In each cemented tank, 13 lines of different wheat genotypes were sown each in a single row. Distance between each row was 0.2 m and 0.06m. A basic dose of urea (70 kg N/ha) and diammonium phosphate (35 kg P₂ O₅/ha) were broadcast and mixed with the surface layer (0-15cm) immediately prior to sowing. Plants in four cemented tanks were subjected to water stress treatment by with holding irrigation water after sowing, whereas plants grown in other four cemented tanks were normally irrigated. Agro-climatic changes like temperature, relative humidity, light intensity and soil moisture content were also recorded.
- On the basis of growth performance of these 52 wheat genotypes under water stress condition, in terms of agronomical parameters like plant height number of spikes/plant, number of tillers/plant, spike length, leaf area/plant, straw and grain weight/plant at final harvest) and osmotic potential were recorded. On the basis of these growth parameters, 29 wheat genotypes/lines viz. AGA, Bucs, C-228, C-591, Chakwal-86 (Check Varieties) CM-24/87,DS-11,ESW-9525, GP-2, GP-7, H-68,HT-29,HT-37, Iqbal, M-172, P-15800, PKV-16 00, QM-4531, QM-4934, RG-24s, ARCs-I, V-7003 V-7004, V-8001, V-8003, V-8004, V-8319, Zardana and ZA-77 were screened out as drought resistant. These genotypes performed well in water stress condition and reduction as compared to control was 11-20% in all mentioned agronomical parameters including yields.
- The reduction in crop growth is a primary effect of every stress in a growth medium, which may be due to different metabolic disturbances in the plant system. With the encouraging results of some wheat genotypes in the present experiment, 52 wheat genotypes/lines have been selected for growing in cemented tanks at Nuclear Institute of Agriculture, Tandojam,

Stress conditions (drought) have been applied to these plants to see their performances in growth upto maturity.

- The experiment is in progress for confirmation of results and identification of genotypes, which can tolerate drought conditions alongwith some markers, which confer drought tolerance. This will ultimately lead to improving yields under stressed conditions.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer with Laser Printer and UPS
- Light meter
- Electronic balance

Project Title: *Exploitation of legume diversity endemic to salt range in the Punjab.*

Principal Investigator: *Dr. Farrukh Javaid*
Asstt. Professor

Location: University of Agriculture, Faisalabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	1.095
<i>Start Date:</i>	4/6/2002	<i>Fund Released (Rs):</i>	421500
		<i>Fund Utilized (Rs):</i>	377870

Objectives:

- Collection, listing and description of wild and weedy relatives of forage legumes from 1066 thousand hectares in Soon Valley (Salt Range) in the Punjab.
- Isolation and characterization of symbiotic Rhizobia from some selected leguminous plants.
- Determination of nutritive value of different legumes for livestock
- Conservation of endangered leguminous plant species through their cultivation and multiplication at farmers fields and botanical gardens.
- Training and education of students for the conservation of natural resources, and maintenance of herbarium and gene banks for the welfare of future generations.

Achievements/Progress:

- Survey of Soon Valley, District Khushab, in the Punjab Province of Pakistan was conducted to explore the legume diversity endemic to it. Nine sites viz. Anga site, Khabeki Site, Sodhi Site, Ucchali Site, Knotty Garden Site, Skasar (vicinity) site, champal site Dape Sharif site and Noshera (vicinity) site were selected keeping in view the topography, soil type, nature of prevailing disturbances, if any, and other related ecological attributes.
- In addition to legumes, the commonly occurring non-leguminous plants and grasses, as well as, sedges were also recorded. Among the leguminous woody species *Acacia modesta* was examined the most commonly found species at almost all the study sites. At Sodhi and Knotty garden sites *Acacia farnesiana* also occurred very commonly and in some habitats it formed mono-species stands. At Khabeki and Sodhi sites *Dalbergia sissoo* also existed commonly in some habitats but it was mostly confined to wet places and along the roadside as natural as well as cultivated plantation.
- Among the herbaceous legumes *Medicago denticulate*, and *Melilotus indica*, were commonly found at all the study sites except the Anga site but during winter season only. Nevertheless *Vicia sativa* was recorded at all the study sites during the mid winter season only. It seems that during the summer season none of the legumes could resist the prevailing high temperature. Among the non-leguminous species *Olea cuspidata* formed good association with *Acacia modesta* at high altitudes. *Zizyphus maritiana* and *Zizyphos numularis* were also recorded commonly occurring trees at almost all the study sites but most frequently at Anga site. Among the shrubs *Dodonaea viscosa*, and *Adhatoda vasica* were recorded occurring very abundantly. These both species to some extent resist the grazing pressure of cattle owned by local people and for fulfilling their fuel needs. As regards grasses they greatly varied in their frequency of occurrence from site to site.
- However, *Saccharum munja*, *Saccharum spontaneum*, *Cynodon dactylon* and *Pennisetum cenchroides* were commonly occurring grasses throughout the valley. Nutritional analysis of leaves, legumes of some woody leguminous plants collected from Soon Valley indicated high protein content in *Acacia nilotica*, greater fat content in *Acacia modesta* while more

energy per unit weight basis was recorded for *Dalbergia sissoo*. Fat content in *Acacia modesta* legumes as well was recorded higher than the pods of remaining two legumes. Lopping of wood for grazing the domestic animals and cutting of woods and shrubs for fuel purpose are the two main disturbances to the entire local vegetation. At some places accidental fires caused due to the carelessness of legal and illegal honey hunters also, sometimes become uncontrollable which wipe out the vegetation from a large area. The subsoil water of the region has fallen very deep and the lakes have completely dried that has resulted in extreme aridity and proving an additional set back to the natural vegetation.

- The inhabitants of Soon Valley seem very eager for the conservation of natural vegetation in general and some endangered leguminous (*Acacia modesta*) and non-leguminous (*Olea cuspidata*) species in particular subject to the provision of some alternate fuel and fodder resource.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer
- Electric balance
- Altimeter
- Lightmeter
- Digital camera

Project Title: *Propagation of sparsely seeded/ seedless kinnow mandarin using cell and tissue culture techniques.*

Principal Investigator: *Dr. Mrs. Nafees Altaf*
Principal Scientific Officer

Location: Nuclear Institute for Agriculture and Biology, P.O.Box 128,
Faisalabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.328</i>
<i>Start Date:</i>	<i>4/4/2002</i>	<i>Fund Released (Rs):</i>	<i>919000</i>
		<i>Fund Utilized (Rs):</i>	<i>658184</i>

Objectives:

- Screening and selection from natural variability for seed-lessness using fruit marker from various orchards of Punjab.
- Clone propagation of selected fruits for seedlessness.

Achievements/Progress:

- Developed 1550 low seeded/seedless clones in field from natural variability. Five clones proved to be seedless (0-1 seed/ fruit)

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Water still
- pH meter
- General Air Conditioner
- Microwave Oven
- Autoclave heating element
- Refrigerator
- Computer

Project Title: *Development and commercialization of mobile seed processing unit.*

Principal Investigator: *Dr. Tanveer Ahmad*
Senior Engineer

Location: Farm Machinery Institute, NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.679</i>
<i>Start Date:</i>	<i>3/29/2002</i>	<i>Fund Released (Rs):</i>	<i>1980000</i>
		<i>Fund Utilized (Rs):</i>	<i>996755</i>

Objectives:

- To adapt mobile seed processing unit.
- To test and evaluate the performance of mobile seed processing unit.
- To demonstrate mobile seed processing unit to end-users.

Achievements/Progress:

- Pure seed is a fundamental input in crop production. Currently, public, multinationals, and private seed companies are hardly meeting certified seed demand by 14% , 18%, 10% and 6%, respectively for wheat, rice maize and mung seed in the country.
- Due to lack of seed processing and storage equipment, seed produced by the farmers and supplied by merchants and local dealers is of low quality. By using good quality seed, crop yield can be increased by 15%-20%. Seed cleaning/grading at farm level is a key factor in quality seed availability.
- The major objective of the project is to adapt/develop a mobile seed-processing unit. The aim is to make available a mobile seed-processing unit to seed companies and farmers with collaboration of local manufacturers either on rental or ownership basis.
- During the second year of the project, seed grader, rectangular aspirator, elevator, and circular aspirators were developed. Initial results are very promising. The FMI Seed Processor developed under ALP funding has a capacity of 2 tons/hour for wheat.
- The machine was displayed and demonstrated on the occasion of 2nd International ALP workshop on 20th April, 2004 The chief guest Mr. James Mosley, Deputy Secretary USDA, Secretary MINFAL, Chairman PARC, DG NARC and participants praised the working of the machine.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Locally made mobile seed processing unit
- Computer and accessories
- Grain moister meter
- Digital camera
- Furniture & fixture

Project Title: *Development of energy efficient wheat thresher.*

Principal Investigator: *Mr. M. Tahir Anwar*
Senior Engineer

Location: Farm Machinery Institute, NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.558</i>
<i>Start Date:</i>	<i>3/29/2002</i>	<i>Fund Released (Rs):</i>	<i>1644000</i>
		<i>Fund Utilized (Rs):</i>	<i>761774</i>

Objectives:

- To study energy requirement of local & imported wheat threshers.
- To extensively evaluate the threshers for varied operating parameters.
- To make changes in the thresher based on test results & extensive field evaluation to confirm the changes.
- To commercialize energy efficient thresher through local industry.

Achievements/Progress:

- Wheat is the staple food of Pakistani people. To secure self-sufficiency in food, wheat production has been placed at high priority in the national agricultural policy. It is grown over an area of 8.1 million ha with production of 18.2 million tons. Almost 80% of the wheat crop is harvested manually and about 95% of the crop is threshed mechanically using locally manufactured threshers.
- Wheat threshers were introduced in the country during early 60s; There are 112,707 threshers working in the country as per 1994 census of Agricultural machinery. Over the period of time, the main emphasis of improvement of this technology was related with the output capacities. As a result of these improvements, the thresher output capacities were improved but no work was done, so far, on the energy requirements of the machine. It has been observed that these threshers are energy inefficient and require more energy (fuel) per unit of output to work with. The earlier studies on thresher performance showed an average fuel consumption of 37.9 L/ha (17.2 L/tonne). As 95% of the total crop is threshed mechanically, it is estimated that about 298 million liters of fuel is used annually for threshing of wheat in the country.
- The comparative study of local and Indian wheat thresher during 2003 harvest showed that though the output of Indian Wheat thresher is low as compared to United Wheat thresher but Indian thresher, on an average, consumed 45% less fuel per hour as compared to United thresher. Whereas, Indian thresher, on an average, used 10% less fuel per tonne of output as compared to local thresher. Further investigations were proposed to confirm the results obtained in this one season. Indian wheat thresher was field tested for its performance during 2004 wheat harvest at Gujranwala and Daska areas.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Locally manufactured wheat thresher
- High capacity Indian wheat thresher

- Torque transducer with display unit
- Fuel consumption meter
- Computer with printer, scanner & data acquisition peripherals

Project Title: *Iron fortification of wheat flour in Pakistan: A step that needs critical evaluation.*

Principal Investigator: *Dr. Masoom Yasinzai*
Professor

Location: Department of Biochemistry, University of Balochistan, Quetta.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.1</i>
<i>Start Date:</i>	<i>4/26/2002</i>	<i>Fund Released (Rs):</i>	<i>420500</i>
		<i>Fund Utilized (Rs):</i>	<i>614401</i>

Objectives:

- To look the level of bio-available iron in whole wheat and the Atta.
- To know the level of phytase enzyme in two types of Atta's and its activity under two different types of processes, especially under the flour mill conditions where its temperature is raised to 92 C in stone mills.
- Estimating the activation of Phyaatase by Khameer state and vice-versa.
- To know the rate of absorption of iron in Pakistani diet, and relate this to the amount of iron contained in the diet.
- To prepare model fortified wheat and study its various characteristics.
- To study the Fe fortification of wheat and the factors affecting its availability through after use surveillance for two years.
- Preparation of booklet/ pamphlet for mass awareness.

Achievements/Progress:

- Government of Pakistan is planning to start the massive program of iron fortification of wheat flour in the fight against anemia. This study is undertaken to investigate some of basic issues in this regard. Overall it includes the finding of the Fe level in different wheat flour types consumed.
- To look into the iron content of the different wheat cultivated around the country and also the overall effect that can be made by the intestinal parasites. Various flour samples including whole-wheat flour obtained from traditional Chakies (Small mills) and the ones obtained from highly mechanized flour mills special, Atta, Fine-Atta Challo-Atta with extraction rates in the range of 72-95%. Choker (Husk) Maidah (super fine flour), were also analyzed for their iron content.
- The analysis of different wheat varieties showed that it contains the iron in the range of 5.8-15.0 mg/100g of wheat . This entire amount of iron is available in the wheat flour obtained from traditional chakies while 50-60% of this available iron is being removed when the outer layers or skin of the grains is scratched off in the form of Choker (Husk) in more mechanized flour mills.
- In addition the wheat flour sample obtained from various regions of Balochistan and Punjab contained varying quantity of the iron, with the later being comparatively rich in iron content. In addition to this the hemoglobin level of the population was screened and the same population was screened for intestinal parasites to establish other reasons of anemia.
- From the results obtained up till now it can be concluded that the wheat flour obtained from traditional chakkies contain enough non-heme iron to cover the needs of up to 1.0 mg/day requirement of an individual while the flour obtained from more mechanized

mills where 50-60% of this available iron is lost as a result of processing, minimizes the chances of the availability of the iron.

- The steps by the Govt. for the fortification of wheat flour from these mechanized mills should be comparatively straightforward and easy as this is going to offer less resistance than fortification programs in the traditional chakkies. Further work on the phytate and phytase enzyme in the various samples is in progress.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Elisa reader & computer

Project Title: *Studies on viral diseases of major pulses crops and identification of resistant sources.*

Principal Investigator: *Dr. Muhammad Bashir*
Principal Scientific Officer

Location: Pulses Program, Crop Sciences Institute, NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.701</i>
<i>Start Date:</i>	<i>3/22/2002</i>	<i>Fund Released (Rs):</i>	<i>2080000</i>
		<i>Fund Utilized (Rs):</i>	<i>1670800</i>

Objectives:

- Conduct survey in pulses growing areas of Pakistan to assess viral disease incidence, distribution and crop losses in major pulse crops such as chickpea, lentil, mungbean and mashbean (urdbean).
- Evaluation of lentil, mung and mash germplasm under greenhouse and field conditions to identify sources of resistance against PSbMY, MYMV and ULCV for including in breeding program to develop disease resistant varieties.
- Development of integrated disease management strategies against, MYMV, ULCV, PSbMY involving host resistance, healthy seed, vector management and cultural practices.

Achievements/Progress:

- During 2003-04, 88 germplasm and breeding lines of mungbean (*Vigna radiata*) were evaluated under field conditions at four locations for resistance against mungbean yellow mosaic virus (MYMV) and urdbean leaf crinkle virus (ULCV). The following ten lines of ; 95013, CI/95-3-140, 9404-19, CI/95-3-20, CI/953-8, CI/94-4-260, CI/94-4-26, CI/94-4-5, C5/95-3-19 and CI/95-3-17 were found Highly Resistant (HR) to MYMY, and 46 lines were Highly Resistant (HR) to ULCV. Out of 88 breeding lines of urdbean, (*Vigna mungo*) screened locations against MYMV and ULCV and ULCV, 28 lines were Highly Resistant (HR) to MYMV and 23 to ULCV.
- Out of 184 lentil breeding lines evaluated at three locations against viruses; 10 lines; 02 KCL-303, 8109/106-10, 4402x 2580/3, 5748 x 270404/4, 8009/5, 273/2 NL 03-04-1, NL-03-2, NL-03-04-7, NL-03-04-9 and NL03-04-9 and NL03-04-10 were Highly Resistant (HR) to viral infection. Twenty-six lines were Resistant (R) with good yield potential.
- One hundred and eighty four chickpea germplasm accessions were evaluated at two locations (NARC and AZRI) against viruses. Eighty-eight and 33 accessions were found Highly Resistant to viral infection under field conditions.
- Fifty breeding lines each of mungbeen and urdbean were screened against ULCV by sap inoculation method under glasshouse conditions. Two lines; NM 2003-02 and NM 2003-04 of mungbean and four of urdbean; 98CM-201, 90CM-035, 90CM-081 and 97CM-512 were found Highly Resistant (HR) to ULCV.
- Seventy-two lentil breeding lines were screened against pea seed-borne mosaic virus (PSbMV) by sap inoculation method under glasshouse conditions, three genotypes; AEL 49/20, NARC 02-2 and 7663/9-5-3 were identified as highly Resistant (HR to PSbMV).
- Out of sixty chickpea breeding lines evaluated against cucumber mosaic virus (CMV) by sap inoculation method under glasshouse conditions, six lines; 92A117, 96A4504, 03A019, 03A012, 96A3249 and 02AG0212 were identified as Highly Resistant (HR) to CMV.

- The seed and mechanical transmission study of chickpea chlorotic dwarf virus (CCDV) in chickpea and that of MYMV in mungbean indicated that both the viruses are not transmitted mechanically and through seed. Seven chemical treatments (neem seed extract/powder, insecticides, mineral oil) were tested for the control of MYMV in mungbean under field conditions. All the treatments were equally effective to reduce MYMV incidence and whitefly population with increase in grain yield when compared with control. Neem seed powder as well extract was proved to be effective in reducing MYMV incidence and whitefly population.
- The effect of row spacing on the MYMV incidence and whitefly (the vector of MYMV) population was studied in mungbean. The effect of wider row spacing (50 cm and 60 cm) was significant on the reduction of MYMV incidence and whitefly population when compared with normal row spacing (30 cm).
- Extensive surveys of mungbean, urdbean, lentil and chickpea crops were conducted to assess the occurrence, distribution and importance of viral diseases in Punjab and NWFP. Around 758 symptomatic samples (showing virus-like symptoms) of mungbean and urdbean, 420 of lentil and 348 of chickpea were collected and tested either DAS-ELISA or TBIA. Variable viral disease incidence was recorded in each crop depending upon virus type and location. Based on surveys it is concluded that MYMV is the most common and destructive virus both in mungbean and urdbean followed by ULCV. PSbMV is important in lentil and CCDV in chickpea. Although, some other viruses such as AMV, BYMV, CMV, BBSV and FBNYV infecting these four major pulse crops were detected in samples collected from farmer fields and research stations, but these viruses are of minor importance. Double antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) or tissue blot immunoassay (TBIA) proved very effective and reliable tests to detect and identify viruses infecting legume crops.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Gel electrophoresis with accessories
- Refrigerated low centrifuge machine
- Oven/ incubator
- Hot plate stirrer
- pH meter with electrodes
- Magnetic stir bars
- Multiscane/ microtiter plate ELISA
- Homogenizer
- Top loading electric digital balance
- Manual top loading balance
- Fixed volume micropipette
- Adjustable volume micropipette
- Multichannel micropipette
- Laser printer
- Scientific calculator
- Liquid nitrogen container
- Hand operated sprayer
- Solo power sprayer
- Mini vacuum desiccator

- Economical stirrer
- Micromixer
- Vortex mixer
- Rapid release pipette pump
- Tflon stir bar retriever
- Spades
- Sickles
- Khurpas
- Display board
- Iron cages for insects rearing
- Wooden cages for insects rearing
- Telephone digital steno set

Project Title: *Management of parasitic weeds in rapeseed and mustard and legume crops in NWFP.*

Principal Investigator: *Dr. Khan Bahadar Marwat*
Chairman

Location: Department of Weed Science, NWFP Agriculture University, Peshawar.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.753</i>
<i>Start Date:</i>	<i>3/23/2002</i>	<i>Fund Released (Rs):</i>	<i>1449000</i>
		<i>Fund Utilized (Rs):</i>	<i>1199278</i>

Objectives:

- To generate the parasitic weed management technology and integrate it with the existing indigenous knowledge of the farmers to form an Integrated Weed Management package for parasitic weeds.
- To quantify the losses caused by parasitic weeds.
- To document the parasitic weeds associated with the major crops of NWFP.
- To transfer the generated technology to the end users.

Achievements/Progress:

- The importance of oilseeds and legumes in the national economy cannot be over emphasized. Similarly onion is one of the most important vegetable crop in the country. These crops face enough competition from the non-parasitic weeds (which can photosynthesize their food). But the competition from the still noxious parasitic weeds that entirely depend upon their host plants for their growth and reproduction by sucking sap from the host through hyphae termed as haustoria's, is worse form of competition. Thus, in infested crops, full yield potential of the genotypes is not going to be exploited due to severe competition. Parasitic weeds are a problem mainly in Malakand Division, infesting Onion, *Brassica* and *Trifolium* and in D.I. Khan Division they parasitize gram (chickpea). The instant project is proposed to explore, develop and disseminate the possible control measures to the growers of Brassica, Onion, Trifolium and Germ (Chickpea) crops in NWFP in addition to determine parasitic weeds flora, and the nature/extent of damage caused by the such weeds.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer, laser printer with accessories
- Power sprayer
- Knapcack sprayers
- Digital camera

Project Title: Investigation of Mechanism for seed dormancy in rice based cropping system.

Principal Investigator: Dr. Gul Hassan
Asstt. Professor

Location: Department of Weed Science, NWFP Agriculture University, Peshawar

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	0.4
<i>Start Date:</i>	3/22/2002	<i>Fund Released (Rs):</i>	248000
		<i>Fund Utilized (Rs):</i>	246938

Objectives:

- To study the dynamics of weed seeds in seed bank of different ecological zones in the rice based cropping system.
- To figure out the dormancy patterns of different weed species in rice involving cropping system.
- To investigate the probable causes of dormancy among different species in the referred cropping system.
- To suggest possible measure(s) to break the dormancy before planting of Rabi crops, as the weed management tactics.

Achievements/Progress:

- Soil samples collection from the rice based cropping system of Pakistan remain continued. The maximum number of seeds germinated from the top 0-10 cm layer of the soil across all the locations. Experiments on wheat and chickpea under zero vs. conventional tillage were continued.
- The second year trials with the previous protocol were laid out in the field. The findings revealed that the density of weeds was lower under zero tillage. Thus, zero tillage could be used as a tactic in weed management and keeping the environment intact. Threshing of the experiments is in progress. Studies were also undertaken on the dormancy breaking chemicals like KNO₃ and GA₃. The findings revealed that different concentrations of the chemicals were instrumental in breaking dormancy in wild oats and curly dock seeds. However, the response was temperature dependent. Isoproturon was discovered as herbicide of choice for use in chickpea, which is an enormous breakthrough. Similarly seeds of the predominant weed species of wheat were collected from the Project area.
- Four students were extended technical guidance and physical facilities to work on their review and special problem research as a part of their B.Sc. (Hons).

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Seed germinator
- Top loading balance
- Dot matrix printer

Project Title: Survey and integrated pest management of cotton insect pests in Balochistan.

Principal Investigator: *Mr. Muhammad Karim Shawani*
Entomologist

Location: Agriculture Research Institute Sariab, Quetta.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.2</i>
<i>Start Date:</i>	<i>3/1/2003</i>	<i>Fund Released (Rs):</i>	<i>707000</i>
		<i>Fund Utilized (Rs):</i>	<i>549730</i>

Objectives:

- Survey, collection and identification of cotton insect pests and their natural enemies.
- To evaluate different varieties of cotton for the insect pests and diseases resistance and their suitability for specific area in the Balochistan.
- To study the biology and population dynamic of bollworms i.e. spotted bollworm and American bollworm. These two insects have been recorded in preliminary survey.
- To find out the most effective insecticide and best time of application of insecticides against different insect pestsof cotton.
- Training of farmers, publication of booklets and leaflets for the dissemination of IPM technology development under this research project.

Achievements/Progress:

- Cotton is a new crop in Balochistan; Mostly farmers are not familiar with this crop. Cotton seeds are being distributed through Agriculture Extension Department, Balochistan since the last few years. The sowing time, irrigation methods and particularly insect and diseases are problems for the farmers. Integrated Pest Management Programme was initiated by the Entomology Section ARI in the previous years. To start a comprehensive IPM programme, it was necessary to get basic pest information.
- In this regard a survey was started from the month of July which was continued till the end of November and thrips, white flies, aphids, spotted boll worm and Heliothis were recorded as the pests of cotton. Many varieties have also been introduced in these years; therefore screening of cotton varieties for tolerance of insect pests at different cotton growing areas was done.
- All varieties were equally preferred by the insects but no severe infestation was recorded for any pest on any of the tested variety. Apart from these experiments few commonly used insecticides in the area were also evaluated for their effectiveness. Confidor 20 SL and Mospilan 20 SP gave significant control followed by Carbosulfan and Monofos as compared with the check plots.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Digital camera
- Reversible AC
- Computer printer + UPS
- Knap sack sprayer

Project Title: **Collection, conservation, evaluation and documentation of horticultural crop germplasm and its wild relatives.**

Principal Investigator: ***Dr. Rashid Anwar***
Director/ CSO

Location: Institute of Agri. Biotechnology and Genetic Resources, NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>3</i>
<i>Start Date:</i>	<i>7/18/2002</i>	<i>Fund Released (Rs):</i>	<i>1112000</i>
		<i>Fund Utilized (Rs):</i>	<i>603895</i>

Objectives:

- Survey and collection of Vitis and its related species germplasm
- Establishment of field genebank at NARC, Islamabad.
- Evaluation of germplasm in collaboration with respective horticultural/agronomists.
- Documentation of genetic resources information and its circulation to horticulturists in the country.

Achievements/Progress:

- One hundred and sixteen (116) samples of different grape species including Vitis vinifera, Vitis labrusca and Vitis Jacquemontii were collected from Northern Areas, NWFP and Azad Jammu and Kashmir during 2002-03. Seventy one (71) samples collected from Northern Areas and NWFP areas including Gilgit, Skardu, Shardu, Shangla, Kohistan, Swat, Peshawar and Mansehra. Whereas, samples were collected in the second phase from different areas of AJK including Muzaffarabad, New-Mirpur, Chapran, Bhimber, Kotli, Bagh and Rawalkot while 27 samples were acquired from different sources. All collection is properly maintained in field. Different valleys of these districts were explored including orchards, farmers' houses, farmers' fields and road sides. The entire Muzaffarabad district was explored, while, Jehlum, valley was explored upto Chakoti and Chinar, whereas, Nelum valley was explored up to Nauseri. It was observed that Vitis Jacquemontii variety was abundantly growing in this area. Vitis vinifera was confined to areas of New Mirpur and Bhimber districts. The collection expedition was arranged during the dormant season. Cuttings were brought to PGRI. Where these were dumped into soil for about one month for callusing. Plants were shifted to the field in February. Plantation was carried out according to the recommended plant to plant and row to row distance. In April, 2004 iron pipes were installed in the field along with iron wires. Also bamboo sticks were inserted into the soil along each plant for stacking. All other cultural practices continued throughout the year and 'Grapes Clonal Repository' was established and maintained.
- Characterization of the grape varieties was done following PGRI descriptors. Data was recorded at young stage for different characters such as form of tip, shoot attitude, color of leaf, size of blade, shape of blade, number of lobes, shape of teeth, length of teeth, length of internodes.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Power sprayer

- UPS
- Epson printer
- Computer (Laptop) and office equipment

Project Title: **In vitro conservation and cryopreservation of plant germplasm of vegetatively propagated crops.**

Principal Investigator: *Dr. Mustafa Sajid*
Senior Scientific Officer

Location: Plant Genetic Resources Institute (PGRI), NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.1</i>
<i>Start Date:</i>	<i>5/15/2002</i>	<i>Fund Released (Rs):</i>	<i>1214000</i>
		<i>Fund Utilized (Rs):</i>	<i>797439</i>

Objectives:

- Acquisition of germplasm cuttings, buds and meristematic tissues of proposed species for in vitro preservation.
- Establishment of rooted cuttings in the green house to serve as the explants source
- Evaluation of hormonal regimes for successful culture establishment and their effect on growth parameters.
- Cry preservation of in vitro propagules of horticultural plant species cultured deterioration and mortality.
- Establishment of rooted cultures in the soil in green house and field conditions under protected cultivation.

Achievements/Progress:

- In vitro technology is a method of choice for conservation of those species, which are vegetatively propagated such as grapes and sugarcane. It is used in conjunction with establishment of field gene bank to serve as the back-up facility for germplasm conservation. Therefore a field gene bank has been established to assemble the biodiversity collected from diverse ecologies of Pakistan and elsewhere. Germplasm was collected from NWFP, AJ&k, Northern areas of Pakistan and it was also acquired from Japan and successfully established in the PGRI premises and also at the Horticulture Program premises in collaboration with the HRP scientists. This facility serves as a long-term source for explants for subsequent in vitro culture establishment.
- During the report period, a number of experiments were conducted to study the in vitro response of plant material to the described treatments in order to augment efforts for the conservation of plant germplasm. In these studies varietal responses of two sugarcane cultivars namely BL4 and Katha were tested for shoot proliferation, root induction, ventilation vs non ventilation and growth retardation. In case of shoot proliferation greater shoot length, shoot mass and shoot number were obtained on MS media containing 4.4 MBAP. On the other hand, Katha gathered less mass, shorter length and fewer shoot numbers when cultured on the liquid media as compared to solid media. Thus liquid media are not recommended universally for better performance of all genotypes.
- The conditions in the bioreactor are different from those of liquid shake cultures, and these differences are in the area of shear and gaseous conditions. The shake flask in partially closed system in which gas exchange is slow and as the culture grows, the O₂ level depletes and CO₂ builds up. In contrast, the bioreactor is supplied with a constant flow of air, which can keep the dissolved O₂ level high and consequently the growth of plants also increases. In bioreactors, the growth was found to be better in the lower compartment of the bioreactor than in the upper compartment.

- In another experiment to study the effect of ventilation on cultures, the vented cultures produced greater shoot mass, shoot number and shoot length as compared to non-vented counterparts for both the varieties.
- In our experiments on root induction, the best rooting response shown by sugarcane varieties was obtained on 1/2 strength MS media containing 1.9 μM IBA among all the auxins used in these studies.
- In the experiment on growth retardation, a linear relationship between the level of osmotica used and the degree of retardation was observed. The retardation effect was found to be the maximum at the highest level of the osmotica used i.e. 4 gm/l of either osmotica.
- These findings will prove helpful in maintaining the sugarcane cultures for long-term conservation.
- In another set of experiments, a number of treatments for dis-infection of several accessions of grapes were also tested for culture establishment. The response was found to be dependent on the duration of the treatment and also on the accession.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Multi Channel motorized peristaltic device
- Environmental chamber
- Peristaltic pump

Project Title: Acquisition screening and utilization of peas germplasm for development of superior cultivars.

Principal Investigator: *Dr. Abdul Ghafoor*
Senior Scientific Officer,

Location: Plant Genetic Resources Institute (PGRI), NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.1</i>
<i>Start Date:</i>	<i>5/15/2002</i>	<i>Fund Released (Rs):</i>	<i>1269000</i>
		<i>Fund Utilized (Rs):</i>	<i>691660</i>

Objectives:

- To identify /produce base material with high yield potential and disease tolerance, i.e powdery mildew and blight.
- Collection and assessment of genetic bio-diversity based on characterization, evaluation and biochemical markers.
- Screening of pea germplasm for powdery mildew and blight to identify resistant sources.
- To identify linkage between qualitative/biochemical markers and quantitative traits for future utilization by the breeders.

Achievements/Progress:

- Pea germplasm collected during two years for preservation and utilization was investigated for biodiversity trend in relation with collecting sites. The study was conducted to investigate the extent of intra-accession variation along with biodiversity for germplasm collected from 28 districts of Pakistan on the basis of agronomic performance that will help in developing future exploration methodologies to preserve maximum genetic diversity for future use of mankind.
- During 2003, 49 accessions were collected locally mostly from Punjab and NWFP with special consideration from farmers fields. On the basis of data recorded for 94 accessions, variance for each trait was computed and then expressed as percent of mean for each character. The variances thus calculated were aggregated for each set of accessions collected and deviation from central point of aggregated variance were taken as an indicator for genetic biodiversity and expressed in terms of percent plant samples differed. The accessions collected from the districts of Chakwal, Dir, Faisalabad, Mingora, Swat, Muzaffarabad, Muzaffargarh, Okara, Attock, Rawalpindi, Narowal, DG Khan, Multan, Vehari, Bahawalpur and Karachi exhibited high magnitude of genetic diversity using 20 samples for intra-accessions variance. The areas where low diversity was observed indicated less representation of these areas although high number of accessions were collected from some of these districts but these could be more or less similar types planted by the farmers. Further it was observed that the areas where peas are traditionally cultivated, less genetic diversity was recorded as compared to those areas where peas are not cultivated so common, In addition 29 accessions of *Pisum Sativum* germplasm was acquired from Nordic genebank, Sweden to enhance genetic resources for future use. Genetic diversity of 145 genotypes of Pea (*Pisum sativum* L.) investigated at phenotypic level with morphological traits, both qualitative and quantitative. Out of 145 accessions, 82 were evaluated at molecular level using SDS-PAGE technique. Thirty morpho-physiological traits were recorded for the whole set of *Pisum* germplasm. Quantitative traits showed significant variance for chlorophyll content, fresh pod width, fresh pod thickness, dry pod width, dry pod thickness, number of pods per plant, 100 seed weight, biomass, grain yield and harvest

index. Among qualitative traits high degree of diversity was observed in dry seed color and hilum color. Spots on dry seed test showed low degree of diversity was observed in dry seed testa showed low degree of diversity.

- Average yield of fresh pods is low as compared to its potential and besides other causes of low yield pathogenic diseases play a major role. Important biotic stresses including powdery mildew and blight. Although later affect less out due to poor cosmetic present it reduces the market value of fresh pods. The disease is gaining importance day by day and could appear in epidemic form in Pakistan. So far no commercial variety has been reported to be resistant to blight in pea, therefore, this study was planned to evaluate pea germplasm for the identification of resistant sources to be included into breeding programme to develop resistant pea cultivars.
- Three hundred and fifty five pea germplasm lines collected from all over the country and acquired from abroad were screened against blight during 2003-04 under artificial inoculation conditions in the green house. Seventy three test entries were free of blight when tested under green house conditions at seedling stage. However 111 lines were rated as resistant and 87 moderately resistant reaction. Other genotypes were susceptible to highly susceptible to blight. Host resistance is the most ideal and cheapest method of controlling pea blight where the biological and chemical control measures are not feasible.
- To estimate diversity at molecular level SDS-PAGE technique was used. SDS-PAGE results showed comparatively significant variations in major bands, although significant variations in minor bands were there. Variations were there in density of some common bands. The electrophoretic banding profile of seed proteins provides a powerful tool for estimating diversity existing in the genotypes. Moreover, this technique is hardly affected by experimental conditions. Genetic diversity revealed by qualitative, quantitative and molecular traits suggest that the significant variations were there in the genotypes. These variations can be used further for producing high yielding hybrids. Moreover, they are helpful in maintaining gene pool of a particular species and desirable traits. Breeding program primarily depends upon genetically diverse genotypes with high yield potential.
- Five accession, viz, 10611, 10639, 10645, 10695 and 10696 were selected for high Chlorophyll contents. Similarly, these selected accessions for various traits are suggested to test under a wide range of environments to confirm their superiority for further utilization. For grain yield and fresh pod traits, the identified accessions need more attention as in Pakistan peas are mostly consumed as green pods, whereas there is a scope for utilization as dry seed in future. Forty-eight accessions have more than 40 pods per plant, whereas only one accession exceeded 150 pods per plant. Five genotypes 10473, 10603, 10607, 10644 and 11114 displayed high grain yield and have maximum harvest index. To conform the yield potential, these accessions are suggested to be tested under a wide range of agro-ecological conditions and should be exploited in breeding high yielding cultivars in pea.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Legume thresher
- Hand sprayer
- Computer
- Book shelf
- Computer table
- Office table set

- Digital camera

Project Title: Study on genetic variation in *Xanthomonas compestris* pv. *oryzae* in relation to resistance in rice.

Principal Investigator: Dr. M. Afzal Akhtar
Principal Scientific Officer

Location: Crop Diseases Research Institute, NARC, Islamabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	4.821
<i>Start Date:</i>	3/21/2002	<i>Fund Released (Rs):</i>	2528000
		<i>Fund Utilized (Rs):</i>	2034289

Objectives:

- The over all aim of these studies is to investigate pathogen city/virulence pattern of the bacterial blight population in order to develop cultivars with long lasting resistance to BB, to characterize bacterial strains on differential host/isogonics lines and through modern molecular techniques.

Achievements/Progress:

- Bacterial blight (BB) is one of the most important diseases of rice in most of rice growing areas of Pakistan due to its high epidemic potential and destructiveness to rice cultivars especially basmati. Survey was done for its incidence and severity in Punjab, Sindh, NWFP, and Balochistan during 2003.
- In Punjab the incidence percentage of bacterial blight ranges from 0-15, 0-1, 15-100, 10-80, 15-55, 5-100, 0-85, 0-40, 25-60 and 50 in Sargodha, Hafizabad, Sheikhpura, Sialkot, Gujranwala, Gujrat, Lahore, Kasur and Mandi Bahudin, respectively and severity ranges from 0-1, 1-5, 1-5, 1-7, 0-5, 0-3, 1-3, 3 in Sargodha, Hafizabad, Sheikhpura, Sialkot, Gujranwala, Gujrat, Lahore, Kasur and Mandi Bahudin, respectively.
- In Sindh the incidence percentage was 15-20, 15-45, 15-65, 15-20, 10-35, 40-45, 10-20 in Larkana, Shikarpur, Dadu, Sukhar, Thatta, Badin, and Jacobabad, respectively and severity was 1, 1, 1-3 and 1-3 in Larkana, Shikarpur, Dadu, Sukhar, Thatta, Badin and Jacobabad respectively. In NWFP the incidence percentage range was 0-40, 0-85 and 0-25 in Lower Dir, Swat and Malakand Agency, respectively whereas severity ranges from 0-3, 0-5 and 0-1 in Lower Dir, Swat and Malakand Agency, respectively.
- In Balochistan the disease incidence percentage was 15-20 in Jafarbad whereas severity was 1. Bacteria isolated from the samples collected were confirmed through biochemical, physiological, hypersensitive and pathogenicity reactions.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Incubator
- Comptuer with accessories
- Thernolyne NUOVA stirring hot plate
- Mechanical Thermostat oven
- Growth Chamber
- Sartorius master seristoploader balance

- Autoclave
- Incubation chamber
- Micropipettes

Project Title: 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 Glps.

Principal Investigator: *Dr. Azra Khanum*
Professor

Location: Dept. of Biological Sciences, University of Arid Agriculture, Murree Road, Rawalpindi.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.473</i>
<i>Start Date:</i>	<i>3/22/2002</i>	<i>Fund Released (Rs):</i>	<i>1676000</i>
		<i>Fund Utilized (Rs):</i>	<i>1461705</i>

Objectives:

- Determination of the functional importance of GLPs in early development.
- Exploration of possible contribution of Glps in alleviation of salinity stress

Achievements/Progress:

- Screening of calli against hygromycin has been done and it was observed that its effective concentration is 75mg/l, Agrobacterium strain, LBA4404 has been transformed with glp gene. Agrobacterium mediated transformation of rice calli is in progress.
- The effect of four stress inducing chemicals i.e phytigel, sodium chloride, sorbitol and mannitol has been observed on regeneration of calli of two rice cultivars and the effect was found to be significant. Regeneration media containing 0.4 percent phytigel gave the best regeneration efficiency for both cultivars. There was a decrease in regeneration potential following increase in sodium chloride levels. In this case, KS-282 showed better response than pakhal. The media containing mannitol and sorbitol also proved itself for increasing regenerating potential. The good regeneration was observed for both cultivars on MI (5:25 for mannitol to sucrose). However, it showed less regeneration compared to regeneration percentage in media containing phytigel, sorbitol and sucrose. Calli induced on media supplemented with sorbitol and sucrose showed excellent regeneration response reaching 100 percent at S2 (10:20 for sorbitol to sucrose), 97.2 percent at S3 (15:15 for sorbitol to sucrose), and 90.9 percent at SI (5:25 for sorbitol to sucrose).
- It was observed that among the four agents capable of inducing water stress-like conditions, phytigel and combinations of sorbitol and sucrose were excellent for enhancing the regeneration potential of the rice calli.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Illuminated incubator
- Thermal cyler & accessories
- Computer/ printer & accessories
- Computer table/ chair

Project Title: Molecular breeding of Kabuli chickpea for Ascochyta blight resistance and high yield potential.

Principal Investigator: Dr. Ahmad Baksh Maher
Senior Scientific Officer

Location: Pulses Program, NARC, Islamabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	2.701
<i>Start Date:</i>	3/22/2002	<i>Fund Released (Rs):</i>	1327000
		<i>Fund Utilized (Rs):</i>	973418

Objectives:

- Under standing of genetic mechanism involved in the inheritance of resistance against blight.
- Development of molecular markers associated with blight resistance.
- Introgression of genes for blight resistance from resistant source into well adapted susceptible cultivars.
- Development of blight resistant varieties through marker assisted selection.

Achievements/Progress:

- Six blight resistant Kabuli genotypes have been identified from exotic germplasm. These genotypes were grown for evaluation of other economically important traits. Five extreme genotypes, 3 resistant (Balkasar, Dasht and ILC-482) and 2 susceptible (Punjab-1 and ICCV2), were inter-crossed to develop 4 hybrid populations to produce inbred lines for marker identification. The F4 populations of the hybrids, PUNJAB-1 XBALKASAR, PUNJAB-1 X ILC 482, DASHT X ICCV@ AND BALKASAR X PUNJAB-1 are growing in the field for development of F4 derived F5 families. The five parents were used for study of DNA polymorphism using Operson random primers. A total of 30 primers were screened which showed polymorphic bands in the parents. The band profile of two primers, OPP9, OPC14, showed that a single major band was missing in susceptible parents. Whereas an additional band was present in the band profile of susceptible parents obtained from OPC5 primer. The linkage of these bands with resistance or susceptibility will be investigated using inbred lines.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Digital science electrophoresis
- Micro centrifuge refrigerated
- Portable balance
- Water bath
- Visible and Uv visible spectrophotometer
- Power supply
- Refrigerated centrifuge machine
- Freezer
- Micro pippets

- High speed orbital shaker
- Personal microcentrifuge
- pH meter
- Liquid N container
- Books
- Tanita baby scale

Project Title: **Increasing production of Kabuli chickpea for its import substitution.**

Principal Investigator: *Dr. Muhammad Afzal*
 Director

Location: Pulses Research Institute, Ayub Agricultural Research Institute, Faisalabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.328</i>
<i>Start Date:</i>	<i>4/6/2002</i>	<i>Fund Released (Rs):</i>	<i>733500</i>
		<i>Fund Utilized (Rs):</i>	<i>730297</i>

Objectives:

- Screening/testing of ICARDA lines for introduction of blight resistance varieties of Kabuli gram for raising successful crop in Pothowar areas.
- Introgression of kabuli and desi types of chickpeas for the development of bold seeded, high yielding, widely adapted, diseases resistant varieties of kabuli gram suitable for rain fed areas of Pothowar and irrigated areas.
- - Dissemination of kabuli chickpea varieties and package of its production practices for promotion of kabuli gram production in Pothowar areas, rice-growing area and as intercrop in September planted sugarcane

Achievements/Progress:

- During the year 2002-2006 new and 129 existing accessions were evaluated at Pulses Research Institute, Faisalabad. Out of 206 new accessions only 9 performed normal/showed tolerance against root-rot. The 9 tolerant accessions were crossed with the high yielding local material during 2003-04.
- During the year 2003, 26 new accessions were received from ICARDA. These were sown in October, 2003 for evaluation. The crop is in progress and results will be incorporated upon harvesting. Twelve cross combinations made during 2002-03 were sown as FI during the month of October, 2003. The FI generation is in the field and data will be recorded during the season. For creation of variability 14 cross combinations have been sown during the year 2003-04. The crop is in progress and results will be compiled after harvesting the crop. In Rice-based areas i.e. Sheikhpura, Gujranwala, Sialkot and Narowal, 23 demonstration trials were sown at Farmers fields and at research farm whereas, 18 demonstration plots intercropped in Sugarcane have been sown. The crop is under progress.
- Frequent visits at Farmers fields are under way for proper guidance of growers. Contacts for Farmers days in Rice-based and Sugarcane intercropped areas are also under process.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Seed bed planter
- Plot thrasher
- Peter engine
- Cultivator
- Computer with accessories

Project Title: Pathobiology of Foliar Spots of Wheat and their Integrated Management.

Principal Investigator: Mrs. Shamim Iftikhar
Senior Scientific Officer

Location: IPEP, NARC, Islamabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	4.069
<i>Start Date:</i>	7/1/2003	<i>Fund Released (Rs):</i>	1703000
		<i>Fund Utilized (Rs):</i>	854434

Objectives:

- Assessment of distribution, incidence and severity of foliar diseases of wheat in different agro-ecological zones of Pakistan.
- To understand variability in the pathogen causing foliar disease in relation to resistance in host.
- Identification of new source of multiple disease resistance with other promising traits.
- Devise an integrated strategy for foliar disease management.
- Enhance Pakistani research knowledge base across the disciplines of this project.

Achievements/Progress:

- At seedling stage *Alternaria alternate*, *Drechselera spicifer*, *Curvularia lunata*, *Pyrenophora tritici-repentis* and *Biopolaris sorokiniana* were isolated from different surveyed locations of Punjab, NWFP and Barani areas.
- *Biopolaris sorokiniana*, *Alternaria alternate* and *Pyrenophora Tritici-repentis* were isolated at booting stage from different locations of Punjab, NWFP, Barani area, Swat and Kalam area and Skardu valley.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Growth chamber with light and humidly
- Water distillation unit glass
- Top load balance
- Gel electrophoreses unit mini (Ver)
- Gel electrophoreses unit mini (Hort.)
- Power supply
- pH meter
- Gyromixer
- Waterbath shaker
- Refrigerator
- Hot plate with stirrer
- Colony counter
- Microwave
- Photocopier
- Computer PIV with accessories

- Laser printer
- Scanner
- Field camera

Project Title: Evaluation and incorporation of new genetic diversity in Pakistani wheats for stripe (yellow) rust resistance.

Principal Investigator: *Dr. Iftikhar Ahmad*
Dy. Director General

Location: IPEP, NARC, Islamabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	3
<i>Start Date:</i>	7/1/2003	<i>Fund Released (Rs):</i>	1126000
		<i>Fund Utilized (Rs):</i>	542296

Objectives:

- Survey and gather pathogen virulence in Pakistan.
- Acquisition of novel wheat genetic stocks and their parents for conducting stripes rust screening in the seedling and adult plant stage in Pakistan.
- Identify stable genetic stocks from the test germplasm and seed increase.
- Transfer resistant gene/s from the novel sources into some leading Pakistani varieties.
- Screening of segregating populations of the crosses, selecting desired derivatives, and stabilizing them by maize mediated double haploid protocol.
- Develop a genome based partial monosomic analysis population for subsequently facilitating gene localization on wheat chromosomes.
- Transfer of resistant stable advanced genetic stocks to wheat breeding programs.

Achievements/Progress:

- In Pakistan virulence is present for the genes Yr 1, Yr 6, Yr 7, Yr 8, Yr 9, Yr 11, Yr 12, Yr 17, Yr 18, Yr SK, genes, while no virulence was found against Yr8, Yr10, Yr26, and Yr SP. So this inoculum can be used to identify new gene from new sources. While leading commercial varieties Inqilab, and MH-97 showed Moderately Susceptible to Susceptible reactions at all the locations.
- While farmer fields survey showed that in northern areas local white was major cultivate variety, this variety showed susceptible reaction in all the surveyed areas of Northern areas. While Inqilab showed moderately Susceptible to Susceptible reactions in Chakwal.
- As a result of screening resistant germplasm, was found in wild crosses accessions. These lines are included in the Elite-I and Elite-II sets which are crossed with leading Pakistani varieties to have F1s. This material along with their parents will be available for screening in the next project year.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Furniture with fixture
- Computer system P-IV with printer

Project Title: Identification of sources of resistance to Karnal bunt disease of wheat.

Principal Investigator: *Mr. Javed Iqbal Mirza*
Scientific Officer

Location: CDRI, Sunny Bank, Murree Substation, Murree.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	2.54
<i>Start Date:</i>	7/3/2003	<i>Fund Released (Rs):</i>	824500
		<i>Fund Utilized (Rs):</i>	345696

Objectives:

- Identification of Karnal bunt disease resistance sources.
- Making available Karnal bunt resistant germplasm to breeders.

Achievements/Progress:

- Teliospores of karnal bunt require particular conditions to germinate. Certain protocols were tried but most of the protocols mentioned by earlier workers did not work. Dormancy in the *Tellitia indica* isolates can be broken by treating them with liquid nitrogen at pH 9. Time of surface sterilization is very critical in spore germination. Isolates obtained so far are available for screening purpose.
- Karnal bunt disease has spread to the major wheat growing areas of Punjab and NWFP. The disease mostly affects varieties Inqilab-91, MH97 and Wattan, which are main wheat varieties in Punjab. It is thus very important to introduce varieties with genetic resistance against the disease.
- Fields to collect more inoculums for screening purpose in future are identified. Moreover, hot spots to test and deploy finally evolved germplasm are identified.
- Seed of the wild grasses available with PGRI is acquired and is available for screening and reference purpose.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Furniture and fixture
- Computer PIV with accessories

Project Title: Investigation on barley yellow dwarf virus (BYDV) in wheat crop in Pakistan.

Principal Investigator: Dr. Shahid Hameed
Scientific Officer

Location: CDRI, NARC, Islamabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	3.892
<i>Start Date:</i>	1/1/2004	<i>Fund Released (Rs):</i>	2020000
		<i>Fund Utilized (Rs):</i>	357590

Objectives:

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

Achievements/Progress:

- Survey of Punjab and NWFP was carried out and 550 samples of wheat barley and oats were collected for the identification of different strains of BYDV.
- For detection of BYDV strains, initially 56 leaf samples of wheat, barley and oats from plants with BYDV like symptoms collected from experimental plots of NARC and suburbs was tested using local polyclonal antiserum and BYDV-PAV (Finance) by DAS & DAC-ELISA.
- Overall infection was 35.07% & 17% using BYDV local & French antiserum. In wheat 34.2% and 26.8% infection was observed using local & French antiserum respectively. In oats and barley 40% & 73.3% infection was using local & French antiserum respectively.
- Transmission of BYDV was carried out on oats using bud cherry oat aphid (R.Padi). Typical symptoms i.e. Redding and stunting was observed.
- Two aphids species has been identified from oats namely bud cherry oat aphid (R.padi) and green bug (S. graminum). Both of them were transferred on healthy wheat for rearing.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Adjustable volume digital pipettes
- Power supply
- Multiwell plate washer/ Dispenser
- Gel electrophoresis apparatus (Hor)
- Gel electrophoresis apparatus (Ver)
- Gel electrophoresis apparatus (Mini)
- Glass plate coating
- PCR machine
- Motor for pestle
- Computer laptop with accessories
- Books
- 1 Liter with silvered glass liner, blue enamated steel jackets and vended cap.

Project Title: Assessment of Suitable Sealant material (s) for increasing the gas-tightness of Public Sector warehouses and Tarpaulins used for covering the open-stacks (ganjees).

Principal Investigator: Syed. Asim Rehan Kazmi
Senior Scientific Officer

Location: GSRI, Southern Zone Agriculture Research Centre (SARC), Karachi Code No. 75270.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	5.258
<i>Start Date:</i>	5/1/2003	<i>Fund Released (Rs):</i>	1523000
		<i>Fund Utilized (Rs):</i>	363305

Objectives:

- Identify and evaluate suitable material to attain minimum gas-tightness in existing house-type and binishell warehouse (godown structures).
- To test the candidate material under laboratory and field conditions for effect on retention of phosphine gas.
- To design and demonstrate the most economical treatment/ method for the application of candidate materials.
- To prepare and test gas-tight, waterproof and fireproof tarpaulins under laboratory and field conditions for open storage (ganjees) fumigation.

Achievements/Progress:

- Public sector grain storage warehouses particularly “BINISHELL” type structures are not suitable for fumigation with Phosphine (ALP3) gas. Three sealants i.e. ZSG-12/99, ZSAC-10/55 and ZSP-1191, manufactured locally, have been tested in laboratory for increasing the gas-tightness of BINISHELL.
- Under laboratory conditions the sealants were applied onto small earthen pots from inside, outside and both sides with control set kept untreated. These highly porous pots when injected with 1500 ppm of 1-3 weeks at room temperature of 25+5c compared to control. Variations/drop in gas concentration was recorded using automatic phosphine detection meter (range0-2000 ppm)
- Performance of the sealant materials in high temperature 50-55c is being evaluated under controlled conditions within Welkin-type Environmental Chambers.

Equipments Purchased:

Following equipments have been procured for the project’s activities out of Agricultural Research Endowment Fund (AREF).

- Phosphine detection meter
- Methyl bromide detector
- Computer with laser printer
- Scanner
- PC-Cam

Project Title: Sustainable Cropping Patterns for Pothowar Plateau.

Principal Investigator: *Dr. Shahbaz Ahmad*
Professor

Location: Department of Agronomy, University of Arid Agriculture, Rawalpindi.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>3.036</i>
<i>Start Date:</i>	<i>5/1/2003</i>	<i>Fund Released (Rs):</i>	<i>801000</i>
		<i>Fund Utilized (Rs):</i>	<i>85861</i>

Objectives:

- Identification of cropping patterns for efficient soil moisture and fertility use under rainfed conditions.
- Identification of the most ruminative cropping pattern under rainfed conditions.
- Demonstration and popularization of the best cropping pattern to the farmers.

Achievements/Progress:

- During the period under report, the work was started according to the project objectives. As included in the plan of work, the experiments were laid out at five locations i.e. University of Arid Agriculture, Rawalpindi (UAAR), National Agricultural Research Centre, Islamabad (NARC), Barani agricultural Research Institute, Chakwal (BARI), Barani Agricultural Research Station, Fateh Jang (BARS) and Groundnut Research Station, Attock (GRS). At all the locations, the experiments comprise of ten cropping patterns replicated three times. The plot size at NARC and BARI is 15 x 10 m² and at UAAR, and GRS it is 10 x 6 m². This variation in plot size is due to the availability of land. The plots have been sprayed with anti-termite chemical to avoid any damage by termite.
- Different crops have been planted and data have been gathered according to the work plan. During Kharif-2003, the crops planted were Sunflower+Mungbean, Mungbean were planted during spring -2004. Groundnut was planted in April- 2004.
- Data were gathered on the yield and yield components of all the crops. The performances of the individual crops have been significant at different locations. The best yields have been obtained at UAAR/NARC and the lowest yields have been observed at GRS. Sunflower planted during Kharif-2003 and Spring-2004 was a failure at GRS that can be attributed to the variation in the climate and availability of soil moisture.
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- Data on soil moisture content is being gathered by gravimetric method at fortnight intervals continuously in each plot at all the locations. Rainfall data from all the locations is also gathered to calculate water use efficiency.
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- Soil samples have been collected from the planted plots at three stages i.e. before fertilizer application, after fertilizer application and after harvesting. These soil samples are analyzed for Nitrogen, phosphorus and potassium determination.
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- The facility to analyze the soil samples for NPK determination has been established in the department of agronomy. The required equipments, glassware and chemicals have been arranged. For potassium determinations, the samples are prepared in the agronomy laboratory and then analyzed in the UAAR central laboratory using the flame photometer.
- The post-graduate students have been trained to analyze the soil samples.

-
- Six post-graduate students are working on their theses in the project. The synopses of their studies have been approved. Two of these in the final stages of their theses completion. The titles of the theses of these students are as under:
 - 1. Yield and Quality of Maize and Millets under Varying Environments
 - 2. Feasibility of Intercropping Mungbean in sunflower under Rained Conditions
 - 3. Yield and Quality of Wheat under Different Rained Conditions
 - 4. Fodder Yield of Oats under different Rainfall Conditions
 - 5. Response of Canola Pertaining to Rainfall and Temperature Variation
 - 6. Yield and Quality of Groundnut as Influenced by Varying Environment
- These students are working on the individual crops looking at different aspects like yield and yield components, quality parameters, water use efficiency, soil fertility dynamics and economic analysis.
-
- The fixed assets provided in project budget have been purchased and are being used for the project activities.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Moisture tester
- Soil augers
- Balance
- Soil sampling cans etc.
- Computers with accessories
- Printers
- Scanner
- Webcam
- Fax machine
- Office table
- Office chair
- Wooden almirah
- Carpet
- Filing cabinet
- Computer table
- Computer chair
- Visiting chairs
- Center table
- Air conditioner

Project Title: Introduction of soft fruit (strawberry, black berry, rasp berry, black currant) in the potential areas of Pakistan for economic returns.

Principal Investigator: *Dr. Khalid Mahmood Qureshi*
Senior Scientific Officer

Location: IFHC, NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>4</i>
<i>Start Date:</i>	<i>7/1/2003</i>	<i>Fund Released (Rs):</i>	<i>2057000</i>
		<i>Fund Utilized (Rs):</i>	<i>856225</i>

Objectives:

- The primary objective of the programme is the introduction of improved exotic planting material of soft fruits.
- To select the best adapted one to local climate soil and biotic condition for commercial exploitation.
- To develop appropriate production technology.
- To established plants nursery for production of pedigree plants.

Achievements/Progress:

- Survey was carried out for identification, selection and collection of germplasm. During survey strawberry, black berry, raspberry varieties were collected from Mingora, Peshawar, Murree and Islamabad surrounding areas.
- Plants were planted in green house and open field conditions and are being maintained for research purpose and multiplication at NARC. Data regarding vegetative and reproductive growth are being collected. Four strawberry varieties were selected for experimental trial to observe the effects of environmental factors on growth behavior of cultivars.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Refrigerator
- Top loaded balance
- Kitchen balance
- Refractometer
- Vernior caliper
- Horticultural coloured card
- Thermometer
- Fiber glass tunnel/ shade hou
- Thermohygrometer (Digital)
- Computer P-IV and accessories
- Photo copier
- Cycle
- Camera
- Computer table
- Computer chair

- Office steel cabinet
- Book shelf
- Office chairs

Project Title: Mutation breeding for high grain yield, improved quality and earliness in non-aromatic rice (*Oryza sativa* L).

Principal Investigator: *Mr. Abdul Wahid Baloch*
Principal Scientific Officer

Location: Nuclear Institute of Agriculture, P.O. Box 70060, Tandojam, Sindh.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.112</i>
<i>Start Date:</i>	<i>8/1/2003</i>	<i>Fund Released (Rs):</i>	<i>326000</i>
		<i>Fund Utilized (Rs):</i>	<i>179519</i>

Objectives:

- To evolve new rice varieties with i) Early maturity ii) Superior grain quality iii) High yield and iv) tolerant to biotic and abiotic stresses.

Achievements/Progress:

- Based on sensitivity data. 1000 seeds of each variety were irradiated. The plants were inspected to identify effects of somatic mutations. Two panicles of each surviving plant were harvested and maintained separately in 2003 for recording the number of survived seeds per dose, plant height (cm), number of productive tillers, panicle length (cm, number of fertile grains per panicle, number of sterile grains per panicle, total number of grains per panicle, fertility % per panicle.
- The effective dose for inducing chlorophyll mutations was 200 Gy and the rice variety Sarshar had the maximum number of mutations followed by Shua-92 and IR8. The highest frequency of chlorophyll mutation was that of albina types followed by strait types. The seeds from each panicle harvested in the M1 generation were sown in separate plots in the M2 generation in 2004. High yielding mutant plants with early maturity, fine grain and compact plant type will be selected in M2 Generation.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Moisture meter
- Single plant thresher
- Computer P-IV
- Printer Laser Jet
- Scanner
- Furniture for computer
- Top balance
- Pedestal fan for winnowing

Project Title: **Production of doubled haploids wheat with longer coleoptile.**

Principal Investigator: *Dr. Fida Muhammad*
 Associate Professor

Location: Department of Plant Breeding, NWFP Agriculture University, Peshawar.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.859</i>
<i>Start Date:</i>	<i>8/1/2003</i>	<i>Fund Released (Rs):</i>	<i>857000</i>
		<i>Fund Utilized (Rs):</i>	<i>626286</i>

Objectives:

- To enhance wheat production in the province by utilizing agricultural land more efficiently. The exotic and indigenous wheat varieties will be hybridized to develop high yielding wheat cultivars for specific environment.
- Develop wheat genotypes with longer coleoptiles.
- Determine the narrow-sense heritability of coleoptiles length.
- Determine genotypic and phenotypic correlations of coleoptiles length with yield components.

Achievements/Progress:

- Seedling emergence in wheat crop is hindered when wheat is seeded relatively deep in search of moisture for germination. The problem occurs in sandy soil under rain fed conditions where water filters down quickly to the lower zone.
- The objectives of this project include: heritability estimation of coleoptiles length and develop doubled haploid wheat with longer coleoptiles through intergeneric hybridization between segregating wheat and maize. Sequential plantings of indigenous and exotic wheat lines were carried out during November/December 2003 to ensure pollen availability for hybridization. About 500 heads of wheat were hybridized to get F1 seed. By the end of May 2004, some segregating wheat material was planted at Kaghan and Kalam to use them for doubled haploid production. About 400 heads were emasculated and pollinated with maize pollens both at Kaghan and Kalam.
- By the middle of August 2004, haploid embryos will be excised and cultured in aseptic conditions. Haploid plants will be treated with colchicines to double their chromosome number. This project will yield homozygous wheat lines with longer coleoptile.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Microscope (Lieca)
- Micro pipette gilson (1000-5000 ml)
- Computer
- Furniture & fixture

Project Title: Control of phytopathogenic microorganisms by bacteriocins from indigenous strains.

Principal Investigator: *Dr. Sheikh Ajaz Rasool*
Senior Professor

Location: Department of Microbiology, University of Karachi, Karachi-75270.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.133</i>
<i>Start Date:</i>	<i>7/1/2003</i>	<i>Fund Released (Rs):</i>	<i>1247500</i>
		<i>Fund Utilized (Rs):</i>	<i>595374</i>

Objectives:

- Isolation & identification of the pathogenic organisms (from different diseased fruits, vegetables)
- Bacteriocin production potential of the isolated strains against the isolated and other standard phytopathogenic bacterial strains.
- Genetic determination location monitoring experiments for positioning the bacteriocin regulating genes by curing experiments.
- Plasmid isolation and characterization by mini-prep method and agarose-gel electrophoresis.
- Purification (partial) and characterization of the representative bacteriocin preparation w.p.r. to molecular weight/sizing etc.
- Technology development for mass application.

Achievements/Progress:

- Seven strains and *Xanthomonas oryzae* NAI, *Xanthomonas oryzae* NA2, *Xanthomonas citri* NA3, *Pseudomonas andropogonis* NA4, *Erwinia* NA5, *Agrobacterium* sp. NA6 and *Agrobacterium* sp. NA7 were isolated from diseased fruits, vegetables and soil near onion and pepper rhizosphere. They were identified on the basis of morphological, cultural and biochemical characteristics.
- The identification was confirmed by using API 20 E and API 20 NE kits. All seven isolates were checked for antibacterial activity against phytopathogenic bacteria whereby only three i.e. *Erwinia* NA5, *Agrobacterium* sp. NA6 and *Agrobacterium* sp. NA7 were found to produce bacteriocins. Their bacteriocins are designated as Erwiniocin NA5, Agrocin NA6 and Agrocin NA7 respectively.
- So far all three isolates have shown narrow spectrum of antibacterial activity i.e. killing only closely related strains. However, staphylococin Bac 188 (from) nonphytopathogenic strain, showed broad spectrum of antibacterial activity i.e. killing all tested phytopathogens.
- After further detailed study of these bacteriocins we could be able to use them as effective tools in microbial antagonism and plant defense against phytopathogens responsible for a number of diseases in fruits, vegetables and crops.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Colored printer laser
- Digital camera

- Digital pipette (1-5 ml)
- Digital pipette (10-200 ml)

Project Title: Conservation and sustainable utilization of agro-biodiversity of under-utilized crops.

Principal Investigator: *Dr. Zahoor Ahmad*
Principal Scientific Officer

Location: Plant Genetic Resources Institute (PGRI), NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.896</i>
<i>Start Date:</i>	<i>7/1/2003</i>	<i>Fund Released (Rs):</i>	<i>637000</i>
		<i>Fund Utilized (Rs):</i>	<i>418298</i>

Objectives:

- To expand germplasm collections of underutilized crops (upto 10 species)
- Evaluation of collected germplasm (10 to 50) for various morphological and agronomic traits.
- To increase the yield of under utilized crops through selection/ breeding and substantially increasing the income of small farmers.
- To open up marginal lands by cultivating underutilized crops.

Achievements/Progress:

- Eight hundred and seventy nine accessions belonging to *Cyamopsis tetragonoloba*, *Mentha* species, *Plantago ovata*, *Ricinus cummunis*, *Hibiscus cannabinus*, *Sesamum indicum*, *Trigonella foenum graceum*, *Linum usitatissimum*, *Nigella sativa* and *Vigna unguiculata* were collected from various parts of Punjab, NWFP, Sindh and Azad Kashmir. Thirty accessions of *Sesamum indicum* were imported from Japan.
- Most of the germplasm collected was evaluated for agronomic, morphological character and biodiversity was evaluated at total seed storage protein using SDS-PAGE electrophoresis. The passport data of collected material has been compiled and material has been conserved as active and base collection in the gene bank.
- Seventy-one accessions of *Vigna unguiculata* (L.) Walpers collected from Pakistan were evaluated for agronomic traits and analyzed for biodiversity within each district. The differences proved its validity in substantiating the postulated regions of diversity or gene centres.
- Migrations of landraces into new regions, followed by some degree of contamination by mixture or out crossing with other landraces were observed that might be due to frequent exchange of germplasm or transportation of grains from one place to others. The areas with a high level of stress are expected to present tolerance to environmental stresses, but homogeneous mixtures that needs less extensive sampling for genetic resources conservation purposes. The study confirmed the existence of a wealth of phenotypic divergence in the local cowpea germplasm and identified pure-lines are suggested to be utilized in crop improvement through simple selection or using in hybrid program. The variation appears attributable to different districts without influence that how frequently area was explored.
- Further collecting missions to main cowpea areas with greater diversity could concentrate efforts on sampling as many geographically and ecologically distinct areas as possible, rather than collecting extensively from fields close to motor able roads. The germplasm with high mean values along with medium to high genetic variance should be exploited through simple selection. During screening one hundred accessions of Cowpea germplasm against

seed borne viruses, the accession Nos. 27087, 27086,27074,27096,27089 and 27025 were observed more susceptible to viral symptoms. The most important and of world wide spread seed borne viruses of cowpea are black eye cowpea mosaic (BICMV) and cowpea aphid borne mosaic (CABMV) poty viruses. Losses caused by BICMV depend upon virus strain and genotype interaction. A yield loss of 32 to 80% was reported when cowpea was infected with mixed infection of cucumber mosaic virus (CMV) and BICMV. The BICMV when occurs in mixed infection with CMV, it causes very severe infection due to synergistic effect. Cowpea entries 27087,27086,27074,27089 and 27025 were observed more susceptible to viral symptoms. ELISA system worked well both in case of CABMV and CMV and results were reliable. Out of eighty-one samples tested for CABMV, fifteen samples were found positive for CABMV. Samples from entries 27096, 27094, 27084,27052,27018,27011 and 27106 were mild while two others (27086 and 27161) were moderate in reaction against CABMV antiserum. In case of CMV antiserum, all samples were negative showing all samples were free of CMV infections.

- Thirty accessions of Sesame germplasm imported from Japan of diverse origin were evaluated for qualitative (flower color and growth vigor) and quantitative traits (days to first flowering. Plant height, pod length and width, days to maturity and grain yield). High variance in plant height, days to flower, days to maturity, seed colors, and yield per plant and 100-seed weight was observed indicating the potential to improve the yield. Low diversity for total seed storage protein was observed.
- Two hundred and fifty one progenies isolated from fifty one accession fo Guar (*Cyamopsis tetragonoloba*) were evaluated for nine qualitative descriptors viz: plant type, plant color, pigmentation, hairiness, flower color, immature pod color, disease incidence, mature pod color and maturity pattern. For plant height accession PAK98179 was proved to be best which grew up to 176.8cm. Two accessions PAK98140 and 98146 showed high branch-bearing plants, which ranged between 25.8-28. Chlorophyll content was observed to be high in three accessions PAK98125, PAK98256, and PAK98126, which had 54.3-59.3mg of chlorophyll. As for days to 50% flowering three accessions PAK98256, PAK98144 AND PAK98258 ranged 140.2-150.4 days (5 months) for days to maturity while PAK98149 and PAK98176 mature late in 200 days (6-months 20 days) as compared to other accessions. Maximum pod length recorded in accession PAK98134, which was 6.004cm. Where as highest pod width was recorded in three accessions PAK98130, PAK98154 and PAK98179, which ranged between 6.00-6.11mm. Ten seeds/pods were calculated as highest number in seven accessions i-e PAK98134, PAK98154, PAK98090, PAK98176, PAK98139, PAK98138, and PAK98133. Range 36.04-39g was considered as best regarding 1000 seed weight 98126 showed 36.04g and 1000 seed of 98127 weighed 39g. Genetic diversity of guar germplasm revealed by SDS-PAGE analysis showed no intra and inter accessions variation.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Digital camera
- Scanner
- UPS
- Power sprayer
- Top loading baby balance
- Seed cleaner
- Moisture tester

- Field implements
- Single row drill
- Sicken rotary for weeding etc.

Project Title: **Studies on mycotoxins in corn.**

Principal Investigator: **Dr. Yasmin Ahmad**
 Principal Scientific Officer

Location: IPEP, NARC, Islamabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	2.5
<i>Start Date:</i>	8/1/2003	<i>Fund Released (Rs):</i>	1131000
		<i>Fund Utilized (Rs):</i>	901076

Objectives:

- Survey and mapping for the incidence of mycotoxin producing fungi in corn grains under storage and field conditions.
- To determine the incidence of mycotoxins in corn stalks.
- Isolation and characterization of mycotoxins.
- Developing strategies for the management of identified mycotoxins.

Achievements/Progress:

- Survey for the incidence of mycotoxin producing fungi in corn grains under storage and field conditions were conducted in different areas (Nowshera, Mardan, Swabi, Charsada, Peshawar, Kohat and Bannu) of NWFP. For the isolation of mycotoxin producing fungi seed samples were surface sterilized for 2 min in 1% sodium hypochlorite. Seeds were plated on potato dextrose agar (PDA) plates.
- After four days fungal colonies were observed. Pathogens viz., fusarium moniliforme, Fusarium graminearum, Aspergillus flavus and A. niger were identified, and characterized. Moreover, different strains of F. moniliforme and A. flavus were also isolated. No any toxin was observed in corn samples collected from different areas (Janangira Swabi, Malangi, Peshawar and Khoshab) and analyzed for fusarium toxins (fumonisins).

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Kit for deeting mycotoxins
- Camera (Nikon) with zoom & other accessories
- Microwave oven
- Pipette set
- Wilef mill
- Fridge
- Top coading balance
- Vorlex mixer with variable speed
- Incubator with 32 liter capacity
- Computer
- Laser printer
- Scanner
- Removable hard disk
- Chairs

- Computer table
- Book shelf
- Cabinets
- Wall racks

Project Title: **Planning, Coordination, Monitoring and Dissemination of Technology on Management of Indian Crested Porcupine, *Hystrix indica*, in Pakistan.**

Principal Investigator: *Mr. Abdul Aziz Khan*
Director

Location: Plant Protection, CSD, PARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>0.618</i>
<i>Start Date:</i>	<i>9/1/2003</i>	<i>Fund Released (Rs):</i>	<i>120000</i>
		<i>Fund Utilized (Rs):</i>	<i>0</i>

Objectives:

- To plan, coordinate and monitor the three subject activity components for smooth implementation of the project.
- To identify uniform parameters of data collection, methods, materials and analysis of results/ data.
- To conduct annual planning meetings and reviews to monitor the progress of all components.
- To organize training and workshops for the stakeholders to disseminate developed technologies for the management of porcupine and publish literature.

Achievements/Progress:

- Exchanged the information on the design of traps, snares and materials were made to all the components and in-country suppliers were identified. Data sheets on damage and bait consumption were finalized.
- Planning meetings and reviews of progress were made specifically related to selection of experimental locations, on site progress and bottlenecks if any. Completed selection of locations in Tarbela-Mangla Watershed, Sindh, Balochistan and central Punjab. Porcupine damage to vegetables, fruits and trees in Sindh and Balochistan was assessed by way of interviewing farmers.
- Farmers training on porcupine damage prevention methods was conducted in Punjab (Component-III) and in Balochistan (Component-IV). Fifty five research publication/documents were distributed to P.I's of other three components. In-country and abroad contacts were established with institutes and scientific societies to procure literature and to up-date knowledge on different aspects of porcupines.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer P-IV with media accessories
- Laser printer, scanner, voltage regulator

Project Title: **Investigations on Indian Crested Porcupine, *Hystrix indica*, Damage to Forest Flora and Development of Prevention Practices in Tarbela-Mangla Watershed Areas.**

Principal Investigator: *Dr. Iftikhar Hussain*
Senior Scientific Officer

Location: VPCL, NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.866</i>
<i>Start Date:</i>	<i>7/1/2003</i>	<i>Fund Released (Rs):</i>	<i>1141000</i>
		<i>Fund Utilized (Rs):</i>	<i>576519</i>

Objectives:

- To quantify porcupine damage to tree stockings, trees, surface vegetative cover (plant communities) and crops.
- To study reproductive biology, population structure (distribution, density etc.), behavior and food habit preferences, energy budgeting and seasonality.
- To develop environment friendly and sustainable management strategies to prevent porcupine infestations and damage.
- To train forest staff and stakeholders (farmers) on the management of porcupine damage.

Achievements/Progress:

- The study was carried out in plantations of six forest ranges (Abbottabad, Hawaiilian, Sherwan, Batagram, balakot, Ghari Habibullah) in Tarbela watershed Management Project area. Survey of forest plantations covering an area of 80 ha indicated that Pinus sp. Below the age of six years was the most preferred plant for porcupine, with an average damage of 38.1% to < 1 year old plantation and 24% to 1-6 year old plantations. The damage to the adult plants was negligible, only pertaining to partial debarkation of roots and stems.
- The analysis of 78 samples of faecal materials revealed that a local grass *Desmostachea* sp. was dominant in the diet of porcupine, with highest frequency of occurrence (75%) and proportion (59.15%). The other two dominant plant species were *Cedrela* and *Pinus* with frequencies of their occurrence above 30% and proportions at 18-20%. It was important to note that there were only vegetative parts of *Desmostachea* and *Pinus* sp. while only seed parts were observed for the other plant species recorded (i.e. *Cedrela* sp. *Treexacum* sp. *Mulberry*, *Dietyros lotus* and wheat).
- No porcupine was captured in any of the 55 body-snares (made of 2mm and 3mm cabled wire) tested during this study period. The reasons for the failure of the snares could be attributed to neophobic behaviour of porcupine as well as larger and irregular openings of the porcupines' dense under the rocks.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Radio telemetry apparatus with antennae
- Bait pellets machine
- Computer P-IV with complete multimedia and accessories

- Laser Printer
- Scanner

Project Title: **Biology and Management of Porcupine, *Hytrix indica* in Central Punjab.**

Principal Investigator: *Dr. Afsar Mian*
Dean

Location: Faculty of Sciences, University of Arid Agriculture, Rawalpindi.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.094</i>
<i>Start Date:</i>	<i>7/1/2003</i>	<i>Fund Released (Rs):</i>	<i>727000</i>
		<i>Fund Utilized (Rs):</i>	<i>0</i>

Objectives:

- To quantify porcupine damage to tree stockings, trees, surface vegetative cover (plant communities) and crops.
- To study reproductive biology, population structure (distribution, density etc.) behavior and food habit preferences, energy budgeting and seasonality.
- To develop environment friendly and sustainable management strategies to prevent porcupine infestations and damage.
- To train forest and irrigation staff and stakeholders (farmers) on the management of porcupine damage.

Achievements/Progress:

- The project though started in July 2003, yet it could not be lifted from ground till recruitment of Research Fellow in November 2003. The staff has been trained and acclimatized to the research and the area. Twenty three visits have been conducted, covering Attock, Rawalpindi, Chakwal, Khushab, Mianwali, Bhakkar, Layyah and Bahawalpur districts, falling in four agro-ecological regions of central Punjab, i.e., rain fed Pothar belt, irrigated forest plantation, embankments of drainage and link canals and desert.
- The information has been collected from the farmers of different areas to develop a general synopsis of the distribution of porcupine and damage caused to vegetation. The general survey of the area suggests that porcupine uses the mud hillocks, raised embankments and/or hilly slopes for its burrowing activity, while the associated plains/ agricultural fields are exploited as the foraging grounds.
- The burrow density has been used as an index of relative density of the porcupine population. An overall density of 0.56/hac has been recorded for the total tract, with the highest density for rainfed Pothar belt (0.95/hac), followed by canal embankments (0.83), irrigated plantations (0.21) and the lowest for desert tracts (0.13).
- Random sampling of different tracts and crops has been undertaken for damage estimates. The present estimates suggest a damage of 61.4% to the nursery plantation of *Bombax* sp. in Kindian Planatation, followed by groundnut (20.2%), wheat (8.5%), irrigated forest plantation (8.4%), and minimum damage has been caused to the onion crop (2.7%). The damage is significantly higher in the periphery (10.0+0.6) as compared with the centre (6.9+0.6) of the field. There are evidences to suggest that the damage decreases with the distance of the fields/ plantation from the embankments/ hills.
- The studies on the stomach contents and faecal pallet analysis suggest that the two routs of studying the food of the animal are not significantly different, and hence any of these can be used for such studies. The stomach contents contain reasonably large pieces, which can be identified macroscopically, while the faecal pallets contain small pieces, identifiable

microscopically. The species is totally herbivore and depends on a wide variety of plants species, adjusting its diet with the seasons and geographical location. The species appears to have wide base of its food and 26 species have been identified from the stomach and faecal pallets analyzed, under the present study. The species, like, *Prosopis juliflora*, *Zea mays*, *Arachus hypogea*, *Triticum aestivum* and *Hordeum vulgare* are more frequently consumed. The two sexes do not appear to be significantly different in selection of their food.

- All 17 individuals trapped were adults, while two young were dug out from a burrow, suggesting that the adults come out for foraging and the young is nursed in burrowed for a longer duration. There is a normal 1:1 sex ratio in adult population, as exhibited by the trapped animals. The morphometric characters analyzed under the present study suggest that this population is not significantly different from those reported previously.
- The reproductive anatomy of male and female have been studied. The testes are abdominal and the resting penis is posteriorly directed. The female has a biramous uterus. Maximum of two fetus have been recovered, one from each uterus. There are two pairs of nipples and the lactation nipples are larger and more visible than the non-lactating one's. The sizes of the testes, ovaries and the number and size of the follicles in the ovary has been recorded. Farmers have been using different techniques for the control of the animals in different area, including, snares, leg traps, hunting with dogs, shooting, etc, with different degree of success.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer P-IV with complete multimedia and accessories
- Scanner
- Laser printer
- Radio telemetry receiver with antenna

Project Title: **Developmental Biology, Feeding Pattern and Management Strategy against Indian Crested Porcupine (*Hystrix Indica*) in Sindh and Balochistan Provinces.**

Principal Investigator: ***Mr. Amjad Pervez***
Senior Scientific Officer

Location: VPCI, Southern Zone Agriculture Research Centre (SARC), Karachi University, Karachi.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.962</i>
<i>Start Date:</i>	<i>7/1/2003</i>	<i>Fund Released (Rs):</i>	<i>1091300</i>
		<i>Fund Utilized (Rs):</i>	<i>770058</i>

Objectives:

- To enhance the productivity of agricultural and forestry system of Sindh and Balochistan provinces.
- To quantify porcupine damage to tree stocking, surface vegetation cover and crops in Sindh and Balochistan provinces.
- To study reproductive biology, behavior and food habit preferences, energy budgeting and seasonality.

Achievements/Progress:

- The project was lunched in July, 2003 with main objective to gain in depth knowledge related to breeding biology, litter size, gestation period and post-natal developmental study of newly born young under out-door enclosure at VPCI/SARC premises. During the first year of laboratory study two births were recorded having litter size of 1 and 2. Newly born young weighed 350 gms.
- To ascertain food preference study of Indian crested porcupine (*Hystrix indica*) various combinations were tested for various cereal grains under no choice and paired choice test. Under no-choice, mean daily bait intake of black gram was recorded the highest i.e. 520.00+42016 gms/animals followed by sorghum (413.33+25.51 gm). Millet was the least preferred cereal bait and its intake was recorded 265.00 + 35.87 gms.
- Under paired choice test, various combinations were tested and remaining choices are in progress. Following bait combinations have been tested:
 - Wheat vs Rice
 - Wheat vs Millet
 - Wheat vs Black gram
 - Rice vs Black gram
 - Barley vs Black gram
- Under wheat vs rive combinations, rice was preferred , (60.65%) over wheat (39.35%), while in case of wheat vs millet choice test, millet was preferred more (61.98%) over wheat (38.02%). Same trend was observed in wheat vs black gram combination. Under rice vs black gram choice test, rice was preferred over black gram (50.12% and 49.88% respectively) while in barley vs black gram, the preference trend was in favour of black gram (53.97%). To undertake porcupine damage and its management techniques, following sites were selected in Sindh province.
 - I.Makli, Thatta
 - II.Pir Patho, Thatta

- III.Jokhio Farm, Bin Qasim Town
- Like-wise in Balochistan, following study sites were marked based on thorough survey and farmer's interview.
- I.Hanna valley, Zarghoon
- II.Muslim Bagh
- III.Mastung
- Porcupine damage to vegetable, fruit and crops was found very severe ranging from 5-10% in the selected areas. In Balochistan wild pistachio tree were main victim of porcupine.
- Three one day farmers field days were arranged one in Sindh and two in Balochistan related to porcupine management techniques that will prove cost effective. The training programmes were arranged in collaboration with Deptt. of Agricultural Research and Area Development Program UNDP/FAO. Farmers were trained related to porcupine biology and it management strategy.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Automatic pellet formation machine
- Block formation machine
- Office computer
- Live cages, live traps and scanner
- Lab. Furniture and fixture
- Porcupine rearing enclosures

Project Title: **Quantification of maize yield losses from leaf blights and improving maize populations for grain yield and leaf blight resistance.**

Principal Investigator: ***Dr. Hidayat-ur-Rehman***
 Professor

Location: PBG, NWFP Agriculture University, Peshawar.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.173</i>
<i>Start Date:</i>	<i>7/1/2003</i>	<i>Fund Released (Rs):</i>	<i>880000</i>
		<i>Fund Utilized (Rs):</i>	<i>563097</i>

Objectives:

- Improve the existing maize germplasm for resistance to leaf blights and yield potential and therefore, enhance maize crop productivity in the maize growing belt of Pakistan in general and NWFP in particular.
- Obtain an estimate of the yield losses caused by leaf blights in maize growing belt of Peshawar and Swat valleys of NWFP.
- Determine the relationship between disease severity and grain yield loss caused by leaf blight.
- Develop yield loss models for estimating potential losses caused by leaf blight.
- Adopt an effective maize breeding methodology for improving yield and disease resistance to leaf blights.
- Quantify the expected gains in resistance to leaf blights using S1 family selection.
- Develop maize populations having stay characters for dual use as green fodder for livestock.
- Increase the research capability of the institution by establishing foundation for long term maize breeding programs.

Achievements/Progress:

- The preliminary data collection regarding the survey of farmers maize fields for disease prevalence and maize population improvement scheme was undertaken. The nature of work involves breeding of maize populations for improved yield, increased level of disease tolerance accompanied with other desirable attributes.
- As breeding efforts are extended over several years and selection cycles, therefore upon the completion of just one selection cycle, valid conclusions can not be drawn at such an initial stage. In spite of these limitations, our observations from the one year results are encouraging. We have been able to quantify the relative efficiency of the powdered form inoculum in inducing epiphytotic conditions for leaf blight disease under the agro-climatic conditions of Peshawar.
- The information obtained through surveys of farmers maize fields are considerably helpful in formulating maize breeding strategies and necessitates emphasis on breeding strategies and necessitates emphasis on breeding maize varieties with increased level of tolerance to stalk rot and leaf blight. The changing trend towards growing spring season maize crop for green roasting is indeed a sign of new avenues in maize marketing for maize crop producers.
- More surveys of the farmers maize fields in Swat, Dir and Peshawar valleys are needed to further quantify/validate these observations and draw valid conclusions.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Shaking water bath
- Top loading analytical balance
- Micropipette gilson
- Magnetic stirrer with hot plate
- Water still + deionizer
- Freezer
- Grain moisture testers
- Computer
- Pentium IV + Laser Printer+ UPS
- Furniture and fixture

Project Title: **Integrated Nematode Disease Management (INDM) in some cereals, fruits and vegetables of Pakistan.**

Principal Investigator: **Dr. Shahina Fayyaz**
 Officer Incharge

Location: National Nematological Research Centre, University of Karachi, Karachi.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	3.435
<i>Start Date:</i>	5/1/2003	<i>Fund Released (Rs):</i>	2121000
		<i>Fund Utilized (Rs):</i>	1659610

Objectives:

- Nematode investigation of cereal, fruit and vegetable crops of Pakistan for the preparation of locality wise map indicating the nematode problem in different regions of Sindh, Punjab and N.W.F.P.
- Survey, taxonomy and morphology of nematodes associated with economically important cereal crop (rice and maize), sugarcane, vegetable, (tomato, potato) and fruit (Citrus, banana and coconut).
- Estimation if damage caused by nematodes to these important crops.
- To educate and train researchers and the extentionists for the identification of nematode problem in the field through a series of lectures and practical demonstration at NNRC.
- Chemical, biological and other methods of control will be demonstrated at the NNRC.

Achievements/Progress:

- The losses caused due to plant parasitic nematodes on various crops stress upon the demand of their suitable management. Practices do exist that can be used to manage nematodes successfully in poor resource farming systems to achieve sustainable crop production.
- The use of these practices or the choice of practices will vary according to different systems and environments; the combination or intergration of a number of practices will have the most beneficial effect, as no single management practice is complete in itself. A need-based integration of at least two or more of any feasible practices can be adapted to achieve better yield both in respect of quality.
- The present strategy demands the development of such nematode management practices, which should be simple, easily adaptable to field conditions and highly effective against nematodes with minimum effort and expenditure without having any adverse effect on the environment.
- The present study concludes that taxonomical studies on plant and soil nematodes should be undertaken on a priority basis so that the identification work may be completed at the earliest.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Lab. Colony units
- Environmental control chamber for nematode cultural
- PCR equipment for nematode identification through chemical method

- Compound Nikon microscope with cerira attachment
- Furniture and fixture
- high speed printer

Project Title: Development of heat tolerant wheat varieties.

Principal Investigator: *Dr. Muhammad Aqil Khan*
Director

Location: Wheat Research Institute, AARI, Faisalabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	2.955
<i>Start Date:</i>	10/1/2003	<i>Fund Released (Rs):</i>	1555000
		<i>Fund Utilized (Rs):</i>	200921

Objectives:

- Screening and testing of wheat germplasm for heat tolerance and disease resistance.
- Incorporating of genes for heat tolerance into commercial and high yielding varieties.
- Testing of heat tolerant lines/ varieties at farmer's field/ Govt. Agri. Farms.

Achievements/Progress:

- In the first year of the project, 442 wheat lines differing in heat tolerance available at Wheat Research Institute Faisalabad (WRI) were planted in the field conditions in two sets on Dec. 1st 2003. Keeping plot size 1m and 0.3 X 0.3m within the rows. One set was planted as a control under normal conditions while other was planted under tunnel facility available at WRI, Faisalabad. At the time of heading high temperature stress was provided. The temperature was recorded three times a day for both sets. Data for heading and maturity were also recorded. At the time of maturity 25 randomly selected spikes were harvested from each entry. Data for following yield parameters were recorded to determine the performance of each entry.
 - 1. Grain yield
 - 2. Total no of grains
 - 3. 1000 grain weight
 - 4. No. of grains/Spike
- After analyzing the data 20 varieties were observed to be potential heat tolerant.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Wheat plot thresher
- Single head thresher
- Electronic weighing balance
- High temperature screening facility
- Water tank
- Rehabilitation of water supply system

NATURAL RESOURCES

NATURAL RESOURCES

BACKGROUND

ALP Secretariat received 125 preliminary proposals relating to natural resources for funding under the 1st batch. In process of preliminary appraisal 28 proposals were short listed for the invitation of detailed projects and 97 proposals which were not up to the standard were dropped. Finally, 23 projects costing Rs.67.097million were approved by the Board of Director (BOD) of ALP for funding to conduct the research in different disciplines:

For instance, seven projects on management of salt affected soil and brackish water in Pakistan, four projects on soil fertility monitoring and management in rice-wheat system and three projects on recycling of organic wastes for sustainable crop productivity.

There are also three projects on use of nitrogen fixing, plant growth promoting rhizobacteria (PGPR) for development of bio fertilizer for crops on economic importance and two projects on diagnosis and remedial measures of micro-nutrient deficiencies in fruit plants of economic importance in Pakistan. The region wise detail of the on-going projects is summarized as under:

S.No	<i>Region</i>	<i>Projects</i>
1	<i>PARC/NARC</i>	<i>7</i>
2	<i>PUNJAB</i>	<i>5</i>
3	<i>SINDH</i>	<i>1</i>
4	<i>NWFP</i>	<i>4</i>
5	<i>BALOCHISTAN</i>	<i>2</i>
6	<i>AJK</i>	<i>1</i>
	<i>OTHER FEDERAL</i>	<i>3</i>
	<i>TOTAL</i>	<i>23</i>

IMPLEMENTATION STATUS

Out of 23 approved projects 20 are in operation since last two years while the following three projects are still in process of agreement.

- *Use of nitrogen fixing, plant growth promoting rhizobacteria (PGPR) for development of biofertilizer for crops on economic importance.(Component-I ,Soil Biology, NARC, Islamabad)*
- *Use of nitrogen fixing, plant growth promoting rhizobacteria (PGPR) for development of biofertilizer for crops on economic importance.(Component-II, Biofertilizer Division, NIBGE, Faisalabad)*
- *Use of nitrogen fixing, plant growth promoting rhizobacteria (PGPR) for development of biofertilizer for crops on economic importance. (Component-III, Quaid-e-Azam University, Islamabad)*

FINANCIAL STATUS

So far an amount of Rs.28.178 million has been released against the overall total cost of Rs.67.097 million in respects of approved projects. Till now overall expenditure of Rs.19.238 million has been incurred as reported by the PIs of the projects.

MONITORING & EVALUATION

The Chairman, PARC/BOD of ALP has reviewed the 1st year progress of the projects located at NARC, while the progress of other projects located outside Islamabad were reviewed/evaluated by the CSO/In charge, Natural Resources Division, PARC. The second review of the projects by the Chairman, PARC/BOD of ALP is schedule to be organized in the next year.

However, on site evaluation of on-going projects is underway. The out comes of the evaluation will be published soon after its completion.

Currently, most of the projects have completed two years of their life span .The annual progress reports of the projects shows that significant task has been completed and the outcomes are very encouraging /cheering. The salient achievements of these projects have been complied in subsequent chapters of this annual report.

Project Title: **Diagnosis and Remedial Measures of Micro-Nutrient Deficiencies in Fruit Plants of Economic Importance in Pakistan (AARI-Faisalabad).**

Principal Investigator: ***Dr. Muhammad Ibrahim***
Agri. Chemist (Soil)

Location: Soil Chemistry Section, Ayub Agricultural Research Institute, Jang Road, Faisalabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.337</i>
<i>Start Date:</i>	<i>3/21/2002</i>	<i>Fund Released (Rs):</i>	<i>1562500</i>
		<i>Fund Utilized (Rs):</i>	<i>920855</i>

Objectives:

- To investigate the existing status of micronutrients in soils and plants, to find out their deficiency and to delineate the deficient areas.
- To monitor the improvement in quantity (yield) and quality (size, sugars and acidity) parameters with the application of these micronutrients.

Achievements/Progress:

- In Pakistan large area is under orchard/fruit plant. The major fruit plants being grown are of citrus, mango, guava and datepalm. Work on micronutrients (copper, boron, iron, manganese and zinc) has been done more on field crops than orchards.
- The work done on orchards in Pakistan is limited to certain plants or areas on small scale, which do provide useful information but can not be generalized for wide spread recommendations. The project was designed to address the problem, investigates the status of micronutrient and find their deficiency for citrus and mango in Punjab.
- After the start of the project in March, 2002, survey of citrus orchards at Sargodha district and mango orchards at Multan district was completed during 2002 and soil and plant tissue collected were analysed. In March, 2003, eight field experiments were established, 2 on citrus at Kot Momin and 2 at Bhalwal while 2 on mango at Jhoke Vaince, Multan and 2 at Shujahabad. These experiments are in progress. Micronutrients (applied through soil and foliar to mango) and fertilizer were applied according to treatments during March, 2004. Citrus fruits are on the trees and will be picked up during January, 2005. While the mango orchards at village Alampur were harvested during June, 2004. Yield data were recorded which showed no response of applied micronutrients through soil as well as through foliage. The yield varied from 19.4 to 35.3 kg/tree in soil application experiment and it varied in foliar application experiment from 21.8 to 48.7 kg/tree in various treatments. The application of micronutrients did not effect the quality of mango as the quality parameters like TSS, pH, vitamin C, sugar, acidity and pulp % remained almost similar in all the treatments.
- The analysis work (leaves samples analysed for P and B) shows the citrus orchards deficient in P (9%) and B (13%) as well as mango orchards are deficient in P (10%) and B (27%).

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Card of Atomic Absorption (1)

- Deep Freezer (1)
- Laser Printer (1)
- Scanner (1)
- Computer Hard Disk (1)
- Power Spray Machine (Moveable) (1)
- Power Spray Pump (Portable) (2)

Project Title: **Diagnosis and Remedial Measures of Micro-Nutrient Deficiencies in Fruit Plants of Economic Importance in Pakistan (ARI-Sariab, Quetta).**

Principal Investigator: **Mr. Muhammad Idrees**
Director (Vegetable Seed Production)

Location: Agriculture Research Institute, Sariab, Quetta.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	1.563
<i>Start Date:</i>	3/1/2003	<i>Fund Released (Rs):</i>	485000
		<i>Fund Utilized (Rs):</i>	480186

Objectives:

- To investigate the existing status of micronutrients in soils and plants, to find out their deficiency and to delineate the deficient areas.
- To monitor the improvement in quantity (yield) and quality (size, sugars and acidity) parameters with the application of these micronutrients.

Achievements/Progress:

- Following activities were conducted under the project:
- Site Selection: Three districts (Quetta, Pishin and Mastung) of Balochistan were selected for carrying out project activities.
- Farmers/Growers Interviews: Growers and farmers were interviewed according to the proforma, developed to get a pre-requisite of nutrition and past activities carried out in the orchards.
- Soil Samples Collection: Profile/composite soil samples were collected prior to application of any input. Soil samples thus procured were processed to carry out detail analysis.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer with Accessories (1)
- pH/EC Meter 4 type (1)
- Compression Spring balance (1)
- Power Spray Pump (1)
- Professional Camera (1)

Project Title: **Assessment of Nutritional Potential and Performance of Range Species in Balochistan.**

Principal Investigator: **Dr. Muhammad Islam**
 Senior Scientific Officer

Location: Arid Zone Research Center, Brewery Road, Quetta.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	1.933
<i>Start Date:</i>	3/22/2002	<i>Fund Released (Rs):</i>	1507000
		<i>Fund Utilized (Rs):</i>	1241544

Objectives:

- To describe the chemical composition of native promising grasses, shrubs and trees relative to the nutrition requirement of small ruminants.
- To determine the seasonal variation in the concentration of non-protein nitrogen to describe actual amounts of protein instead of crude protein and the concentration of primary and secondary anti-nutritional components.
- To establish multi-purpose native and exotic range germplasm source.
- To evaluate and monitor the performance of potential range germplasm for adaptability and growth in different ecological zones.

Achievements/Progress:

- Performance of Exotic and Native Shrub Species:
- Trials on evaluation of adaptability, productivity, and chemical composition of native and exotic grasses, shrubs, and trees are under progress. The experiments were conducted in Quetta, Tomagh (Loralai) and Nushki areas. Separate trials on grasses, shrubs, and trees were conducted. Seven exotic and five native shrub species were planted during early spring of 2003 in pits. Ecological, agronomic and nutritive characteristics of these species are under evaluation. Fourteen grass species (native & exotic) were tested at AZRC, Quetta. Four tree species were tested at Tomagh (Loralai) under water harvesting structures and with the addition of supplemental irrigation.
- *Haloxylon persicum*, the white saxaoul or ghada tree, is a tall desert shrub/small tree, 2-6 m tall. It is native of the sandy desert wadis of the Middle East and Central Asia. Seeds were obtained from Uzbekistan and initial agronomic and ecological trials are underway at AZRC and data regarding plant survival, plant height and standing biomass was recorded. The survival percentage was 94 and the surviving seedlings attain average height of 52 cm at the end of the growing season. During the end of 2004, the seedling attained a mean height of 79 cm and dry biomass production of 362 kg/ha. *Haloxylon persicum* survived under the drought conditions of Balochistan. This species has the potential in Chagai and Kharan deserts of Balochistan for sand dune fixation and forage production for sheep and camels.
- *Salsola vermiculata* commonly called saltwort is an exotic Mediterranean arid zone fodder species. Forage and wood productivity of *S. vermiculata* was determined at AZRC field where forage production ranged from 100 to 413 kg/ha and wood production from 130 to 327 kg/ha.
- Only seven species of native and exotic grasses out of 14 were germinated and survived. Due to low rainfall the trial was irrigated. *Panicum antidotale* produced highest forage production compared to other grass species. Some grass species are showing potential for raising as a pasture crop in monsoon rainfall areas of Balochistan.

- All the exotic shrub species produced higher forage and wood production as compared to native shrub species. At Tomagh, the experimental plots received sufficient runoff water from winter and monsoon rains and all shrub species showed excellent growth.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- GPS (1 set)
- Soil Sampling Equipment (1)
- Computer with Printer (1)
- Scanner (1)
- Steel wire
- Donkey pump (1)
- Stabilizer (1)

Project Title: Optimal Tillage Practices for Wheat-Fallow and Chickpea-Fallow Rotations in Southern NWFP.

Principal Investigator: *Dr. Muhammad Jamal Khan*
Professor/Chairman

Location: Department of Water Management, NWFP Agricultural University, Peshawar.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.5</i>
<i>Start Date:</i>	<i>3/21/2002</i>	<i>Fund Released (Rs):</i>	<i>1917000</i>
		<i>Fund Utilized (Rs):</i>	<i>1619765</i>

Objectives:

- Effect of different tillage practices on soil moisture conservation, weed control and crop establishment under wheat-fallow, chickpea-fallow rotation in the Southern region of NWFP.
- Document yields and yield components of wheat and chickpea crops under experimentation.
- Effect of different tillage practices on physical properties of soils under wheat/ chickpea rotation.
- Selection of optimal tillage package for dissemination to the growers in collaboration with Agricultural Extension Department.

Achievements/Progress:

- Five tillage treatments, No Till (NT), Chisel plough once and Tine type cultivator twice (CPTC2), Disc Harrow once and Tine type cultivator twice (DHTC2), Mould board plough once and Tine type cultivator twice (MBTC2) and Tine type cultivator three times (TC3) are being used at Karak site under sandy loam soil condition. At D. I. Khan under silty clay soil condition in Roth Kohi area, tillage experiments are being conducted with Disc Harrow once and Tine type cultivator three times (DHTC3), Disc plow once and Tine type cultivator three times (DPTC3), Chisel plow once and Tine type cultivator three times (CPTC3), Mold board plough once and Tin type cultivator three times (MBTC3) and Tine type cultivator four times (TC4) and Farmer's practices Disc harrow once and Tine type cultivator once (DHTC1). Wheat and chickpea were sown during October and November 2003 at both sites respectively. Data related to moisture content, bulk density, soil strength, germination, weeds and plant height and number of branches and yield were collected.
- Based on second year data, in sandy loam soil at Karak research site the wheat grains yield ranged from 2038 to 2551 kg/ha. Maximum yield was attained by MBTC2 (2551 kg/ha) followed by TC3 (2524 kg/ha), while the minimum yield was recorded for NT (2038 kg/ha). In chickpea plot the yield ranged from 1739 to 2139 kg/ha, where maximum grain yield was obtained by CPTC2 (2139 kg/ha) followed by TC3 (1925 kg/ha), while the minimum grain was recorded for NT (1739 kg/ha).
- In silty clay soil at D. I. Khan research site the wheat grain yield ranged from 2733 to 3298 kg/ha where maximum yield was attained by DPTC3 (3298 kg/ha) followed by DHTC1 (Farmer Practices) (3089 kg/ha), while minimum yields was recorded for TC4 (2733 kg/ha). In chickpea plot the grain yield ranged from 2453 to 2884 kg/ha with maximum yield obtained by CPTC3 (2884 kg/ha) followed by TC4 (2736 kg/ha), while minimum yield was recorded for DPTC3 (2453 kg/ha). The study is still continued and final recommendation will be made after completion of the project.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer (2)
- Double Ring Infiltrometer with Accessories (Main Set 2, Subset 6)
- Soil Sampling Equipment and Accessories (1 set)
- Digital Balance (2)
- Hand Penetrometer (2)
- Motorcycles (2)
- Electric Ovens (2)

Project Title: Soil fertility monitoring and management in cotton-wheat (NARC, Islamabad).

Principal Investigator: *Dr. A. Rashid*
Chief Scientific Officer

Location: LRRP, INRES, NARC, Islamabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	2.7
<i>Start Date:</i>	3/21/2002	<i>Fund Released (Rs):</i>	1743000
		<i>Fund Utilized (Rs):</i>	1549667

Objectives:

- Investigate the nature, extent, severity and spatial variability of nutrient disorder in cotton-wheat system.
- Develop nutrient management strategies for enhancing and sustaining crop productivity.

Achievements/Progress:

- Nutrient Indexing Survey:
- Statistical analysis of nutrient indexing data (wheat leave and associated soil sample, i.e., N, P, K, B, and Zn) of Vehari district was completed while in Rhaim Yar Khan district extensive nutrient indexing of wheat crop was carried out. Wheat plant analysis and soil testing of Vehari district indicated that 60% soil were deficient in P, 13% in K, 41% in Zn and 47% in B. Application of these nutrients on deficient soils would help to increase the crop productivity.
- Cotton-Wheat Field Experiments to Develop Nutrient Management Strategies:
- Diagnostic plant tissue samples of wheat (sown in December 2003) were collected and analyzed for macro- (N, P, and K) and micronutrients (Zn and B). Soil physical properties, i.e., bulk density, total porosity, and saturated hydraulic conductivity were determined during wheat 2003- 2004. Recorded grain and straw yield of wheat experiment harvested in April 2004.
- Analysis of cotton (2003) plant components, i.e., sticks, leaves, lent, and boll capsule, carried out. After harvesting wheat, cotton was sown in May 2004, on the same permanent layout, at all experimental sites.
- The results showed that the balanced nutrient management increased wheat grain yield from 18 to 35% as compared with farmer's practice. Levels of increase in grain yield with integrated nutrient management (25% N substituted with FYM) were comparable with balanced nutrient management as these varied from 20-35%. Concentration of N, P, Zn, and B in grain and straw increased in balanced and integrated nutrient management as compared to farmer's practices. The total uptake of P by wheat crop varied from 9.3 to 15.0 kg/ha, lowest uptake being with farmer's practice and the highest with integrated nutrient management. Zinc and B uptake by crop varied between 80-120 g/ha and 13-29 g/ha.
- Soil bulk density of 0-15 cm depths varied from 1.36 to 1.48 Mg M-3 and of 15-30 cm depth 1.56 to 1.68 Mg M-3. Similarly, total soil porosity ranged between 48 and 44% of surface soils and 41-37% of sub-soils. Saturated hydraulic conductivity was 305 to 445 mm day-1 of surface soil.
- As a result the integrated use of fertilizer N and manure N increased soil available P, plant nutrient concentration, crop yield and nutrient uptake (N, P, B, Zn) over farmers' fertilizer use practice.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Centrifuge (1)
- Analytical Balance (1)
- Muffle Furnance (1)
- Vortex Shaker (1)
- Digital Electric Burette
- Research Equipment and Machinery

Project Title: Soil Fertility Monitoring and Management in major Cropping Systems of AJK (AJK, Muzaffarabad).

Principal Investigator: Dr. Muhammd Bashir Butt
Soil Chemist

Location: Department of Agriculture, Gojra, Muzaffarabad, AJ&K.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	1.15
<i>Start Date:</i>	3/21/2002	<i>Fund Released (Rs):</i>	1002000
		<i>Fund Utilized (Rs):</i>	905526

Objectives:

- Investigate the nature, extent, severity and spatial variability of nutrient disorder in major cropping system of AJK.
- Determine nutrient management strategies for improving crop yield and sustaining soil productivity.
- Determine nutrient management practices for crops for maximum productivity without deteriorating the soil resources base.

Achievements/Progress:

- Nutrient indexing of maize crop was carried out in district Muzaffarabad and Kotli. One hundred sites were selected randomly in each district where maize is grown. Soil and plants samples from these selected sites were collected during 2002 for nutrient indexing. Similarly, for wheat crop nutrient indexing samples were collected from 187 sites in district Kotli at two depths. Data regarding physico chemical properties (soil texture, pH value, macro and micro nutrient status) of soil was recorded. The nutrient indexing results have shown great deficiency of macro as well as micronutrient throughout the cropped area. This is the logical output of very low fertilizer use.
- Based on the results of nutrient indexing fertilizer research experiment, “Maize crop response to NPK and Zn application under barani conditions” were conducted during 2002 at three locations.
- The fertilizer experiments, on maize crop have shown significant differences among various treatments. The highest yield was obtained with full dose of NPK alongwith Zn application.
- Two types of fertilizer research experiment for wheat crops were also conducted to see the most optimum fertilizer requirement under rainfed conditions. The macronutrient experiments were conducted at four locations, while three experiments on micronutrients were conducted. The crop was harvested and the yield and other data recorded to infer the results.

Equipments Purchased:

Following equipments have been procured for the project’s activities out of Agricultural Research Endowment Fund (AREF).

- Computer with Printer (1)
- Water distillation Still (1)
- pH Meter (Cyberscan 500) (1)

Project Title: **Soil Fertility Monitoring and Management in Dryland Cropping Systems of Balochistan (AZRC, Quetta).**

Principal Investigator: *Mr. Ahmad Sami Ullah*
Senior Scientific Officer

Location: Arid Zone Research Centre, P..O Box 63, Quetta.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.15</i>
<i>Start Date:</i>	<i>3/21/2002</i>	<i>Fund Released (Rs):</i>	<i>980500</i>
		<i>Fund Utilized (Rs):</i>	<i>815362</i>

Objectives:

- Investigate the nature, extent, and severity of nutrient disorders in major dry land cropping systems of Balochistan.
- Develop soil fertility maps delineating nutrient status/disorders in the study area and cropping system.
- Workout nutrient management strategies for wheat under khushkaba, sailaba/ water harvesting/ supplemental irrigation.

Achievements/Progress:

- Soil and plant samples were collected for nutrient indexing study in major dry areas of Balochistan. Their macro and micro nutrient analysis was carried out at NARC. The pH, electric conductivity, organic matter %, Calcium Carbonate (CaCO₃) %, Phosphorus and soil texture test at AZRC, Quetta shows, pH: 7.9-8.7, Calcium Carbonate: 8 - 33.5% and organic matter: 0.59 - 1.3%. The results of the last two season trials reveal that the fertilizer response in dry land is not so simple and do need lot of efforts, on farm presence and punctuality. Micronutrients (Zn & B) performed well in the presence of nitrogen and phosphorous in sorghum. Whereas, nitrogen and phosphorous responded well when they were applied alone or in the combined form in mash
- The initial soil fertility map of the area, which shows potential dryland farming areas, soil and plant samplings and soil series of the area, has been developed. The detail map will be prepared after finalization of the results.
- Five soil fertility trials on wheat were planted in the residual moisture on farmers fields, but after emergence due to the environmental changes the grass-hopper multiplied in the Rarkan valley and its surrounding districts (Musa Khail and Lorallai) completely destroyed the wheat crop.
- To get maximum information about the dry land sailaba farming system, experiment also designed for the Kharif (2004) legumes, and experiments by applying various treatments of fertilizer on sorghum, mung and mash were conducted.
- The following three papers were presented in 10th Congress of Soil Science, held in Tandojam:
 - i.Dryland Cropping System and Nutrient Indexing of Rarkan Valley in Highland Balochistan.
 - ii.Response of Fertilizer on Sorghum for Fodder Production under Rainfed Conditions of Rarkan (Distt. Barkhan) Balochistan.
 - iii.Potential of Chemical Fertilizers in Dry land Crop Production System of Rarkan-Barkhan, Balochistan.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer with Printer and Scanner (1)
- Digital camera (1)
- Reaper (1)

Project Title: **Soil Fertility Monitoring and Management in Rice-Wheat System (NARC, Islamabad).**

Principal Investigator: *Dr. Fayyaz Hussain*
 Senior Scientific Officer

Location: LRRP, INRES, NARC, Islamabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2</i>
<i>Start Date:</i>	<i>4/6/2002</i>	<i>Fund Released (Rs):</i>	<i>1442000</i>
		<i>Fund Utilized (Rs):</i>	<i>1199319</i>

Objectives:

- Investigate the nature, extent, severity and spatial variability of nutrient disorder in rice wheat system.
- To improve and sustain soil fertility as well as crop productivity in rice wheat system.

Achievements/Progress:

- Field experiments on rice-wheat (wheat crop followed by rice crop) were conducted on two locations i.e. Kala Shah Kaku and Sadhokee. In these studies wheat response to phosphorus and potassium application, wheat response to Zinc and Boron application, rice response to phosphorus and potassium application, and rice response to Zinc and Boron application was studied. Yield parameters of wheat were recorded at harvest. Paddy and straw samples were collected for analysis of Phosphorus, Potassium, Zinc and Boron.
- Graded doses of phosphorus increased the wheat yield. The % increases due to direct application of P doses ranged from 8% to 30% at both experimental locations. Because the experiment were initiated from the reporting wheat crop therefore, residual and cumulative effect will be reported after getting the data from ongoing rice crop and after that wheat crop. The chemical analysis in progress.
- Integrated use of Zinc and Boron fertilizer increased the grain yield and straw a yield as compared to the alone application of Zinc and Boron alone. This response is due to direct application of Zinc and Boron. Residual and cumulative effect will be reported after getting the data from ongoing rice crop and after that wheat crop. The chemical analysis of grain and straw samples is in progress.
- The study reveal that the integrated use of Phosphorus, Potassium, Zinc and Boron fertilizer increased the grain yield, straw yield, agronomic efficiency and P, K, Zn and B uptake of rice and wheat.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- pH Conductivity meter (1)
- Moisture meter (1)
- Plant Grinder (1)
- Top Load Balance (1)

Project Title: **Recycling of Organic Wastes for Sustainable Crop Productivity (Uni of Agri..Faisalabad).**

Principal Investigator: ***Dr. Muhammad Arshad***
 Professor

Location: Deptt. of Soil & Environmental Sciences, University of Agriculture,
 Faisalabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.013</i>
<i>Start Date:</i>	<i>3/21/2002</i>	<i>Fund Released (Rs):</i>	<i>1489500</i>
		<i>Fund Utilized (Rs):</i>	<i>1211882</i>

Objectives:

- Assessment of organic wastes materials in quantitative and qualitative from and their variability in space and time.
- Isolation and identification of effective microorganisms to enhance process of composting (in term of time and quality of compost).
- Test and evaluate selected effective microorganisms to document their effectivity in term of composting process (time and quality) and enrichment.
- Formulation of bio- fertilizer for selected crop.
- Development of composting technology transfer modules for selected ecologies.

Achievements/Progress:

- Organic waste (mainly fruit and vegetable waste material) was collected from various fruit and vegetable market, restaurants and juice shops. The material was processed for composting by optimizing the incubation conditions. Juice was extracted from the collected materials with the help of extraction machine. After extraction, material was placed in the oven for drying at 55oC for 24 hours. The oven-dried material was chopped into finer particle with the help of grinder. The ground material was transferred to a composter and water was added to it and incubated for seven days with constant stirring. Composted material can be converted into an effective organic biofertilizer by blending it with nutrients and/or biologically active substances (L-tryptophane which is an established precursor of auxin).
- Research trials, were conducted to see the effect of compost-based biofertilizer on maize (pot trials), recycling of organic waste enriched with chemical fertilizer and L-TRP for improving growth and yields of maize (field trials), effect of compost and chemical fertilizer on growth and yield of wheat (field trials).
- Results revealed that the effectiveness of the compost enriched with mineral nutrients and/or biologically active substances (an auxin precursor, L-TRP) for improving the growth and yields of maize crop under wirehouse (pot experiment) and field conditions. It was found that band application of compost enriched either with N or L-TRP significantly affected the growth and yield of maize, compared with control. However, combined application of compost enriched with both N and L-TRP was more affective in improving the growth and yield of maize than their sole applications.
- Enriched compost with 50% N fertilizer showed more promising results under both pot and field conditions causing improvements in plant height, fresh biomass, fresh cob weight, 1000-grain weight and grain yield compared to control. In general, application of enriched compost saved about 25% of recommended N fertilizer without compromising on yield. The

novelty of this approach is that the enriched compost was applied just @ 250 kg ha⁻¹ as organic/biofertilizer. The compost was not used as a source of organic matter, which are usually applied in tonnes.

- Results also revealed that application of compost enriched with N and L-TRP significantly increased the plant height, fresh biomass, fresh cob weight, 1000-grain weight and grain yield of maize in pot and field experiments, respectively, compared to untreated control.
- The results of these trials are highly encouraging and very much in support of the validity of the project hypothesis. It is highly likely that by using the composting technology and blending with Biologically Active Substances (BAS) and inoculation with Effective Microorganisms (EM)/ Plant Growth Promoting Rhizobacteria (PGPR), the organic waste material could be converted into a useful biofertilizer. The work is in progress to develop a biofertilizer, nutritionally balanced, as well as a rich source of BAS and an excellent carrier of PGPR.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Fermenting unit
- Deep freezer

Project Title: **Recycling of Organic Wastes for Sustainable Crop Productivity (Arid Agri. Uni , RWP).**

Principal Investigator: ***Dr. Mushtaq Ahmed Khan***
Dean

Location: Department of Crop & Soil Science, University of Arid Agriculture,
Rawalpindi.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>1.642</i>
<i>Start Date:</i>	<i>3/21/2002</i>	<i>Fund Released (Rs):</i>	<i>1011000</i>
		<i>Fund Utilized (Rs):</i>	<i>831013</i>

Objectives:

- Assessment of organic wastes materials in quantitative and qualitative form and their variability in space and time.
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- Isolation and identification of effective microorganisms to enhance process of composting (in term of time and quality of composts).
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- Test and evaluate selected effective microorganisms to document their effectivity in term of composting process (time and quality) and enrichment.
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- Formulation of bio- fertilizer for selected crop.
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- Development of composting technology transfer modules for selected ecologies.

Achievements/Progress:

- During the period 2003-04, survey of 383 poultry farms in two tehsils of Rawalpindi i.e. Kotli Sattian and Gujar Khan and four tehsils of district Chackwal namely Talagang, Choa Saidan Shah, Kalar Kahar and tehsil Chakwal was carried out. Approximately 4694t/annum of poultry litter were being produced from the surveyed area in Chakwal and Rawalpindi. The farmers in Chakwal were using poultry litter for a long time and they were well aware of its effects on crop. It was being used in brick kiln as a source of fuel and in fishing ponds to increase fungal and vegetative growth that ultimately served as a source of food for fish.
- In order to see the effects of poultry litter application on maize and wheat yield, six field studies were carried out in the research area of the University of Arid Agriculture Rawalpindi. In first study, residual effects of poultry litter applied in maize 2002 were studied on wheat 2002. In second study that involved growing of wheat in winter 2002, different doses of poultry litter ranging from 5t/ha to 35 t/ha were applied to the crop and compared with the treatments receiving recommended doses of N and P. In third study, effects of poultry litter application on maize (“Agaiti”) 2003 were studied under rainfed conditions. In fourth study, maize variety “Agaiti” (2003) was sown in the plots where previously wheat (2002) had been sown to see the residual effects of poultry litter. In fifth study, wheat (2003) was sown to see the residual effects of poultry litter applied in maize 2003. In sixth study wheat was sown in winter 2003 to see the effects of poultry litter application under rainfed conditions.
- It was found that application of poultry litter had significant effect on the macro and micronutrient content and organic matter of soil. Similarly initial analysis of poultry samples

obtained from the experiment in which different storage methods of poultry litter were being studied, it was found that microbial population was quite variable in different methods and it could be responsible for different decomposition rates in different types of storage.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Nitrogen Digestion & Distillation Apparatus (1)
- Shaker Orbital (1)
- Water Distillation Apparatus (1)
- pH Meter (1)
- Vortex Mixer (1)
- Micropipette (1)
- Computer (1)

Project Title: Recycling of Organic Wastes for Sustainable Crop Productivity (NWFP-Agri. Uni. Peshawar)

Principal Investigator: Dr. Zahir Shah
Associate Professor

Location: Department of Soil & Environmental Sciences, NWFP Agriculture University, Peshawar.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	1.642
<i>Start Date:</i>	3/21/2002	<i>Fund Released (Rs):</i>	1188000
		<i>Fund Utilized (Rs):</i>	1138218

Objectives:

- Assessment of organic wastes materials in quantitative and qualitative form and their variability in space and time.
- Isolation and identification of effective microorganisms to enhance process of composting (in term of time and quality of compost).
- Test and evaluate selected effective microorganisms to document their effectively in term of composting process (time and quality) and enrichment.
- Formulation of bio- fertilizer for selected crop.
- Development of composting technology transfer modules for transfer to farming community in selected ecologies.

Achievements/Progress:

- The quantitative and qualitative assessments of various municipal, industrials, and farm solid wastes in NWFP were completed. Also assessed the influence of selected wastes on microbial activities and N mineralization in soil. Work on composting has begun to test and identify the effective microbes responsible for expediting the process of composting. Three out of four M. Sc. (Hons) students involved in the project have successfully completed their degrees and one is in the process of completion. Seven B. Sc. (Hons) students assigned small projects (special problems) related to this project, have all been successful.
- It was observed that the amount of municipal solid waste (MSW) produced varied greatly from location to location and from house to house within the same locality. The data revealed that on average about 0.24 kg of MSW is produced per person per day in the residential area of Peshawar, which is equivalent to about 845 tons per day for Peshawar. It was also observed that the MSW contain variable amounts of major nutrients (%), such as N (2.33), P (0.10), K (1.34), and micro-nutrients (\square g g-1) Zn (36.63), Cu (27.05), Fe (834.98), Mn (130.11), and toxic metals (\square g g-1), such as Ni (66.01), Cd (2.76), Pb (41.92), and Cr (58.40). These results suggested that huge amount of MSW is produced in Peshawar but it is not used for any meaningful purpose despite the fact that it has large reserves of essential elements.
- It was estimated that a total of about 33967 tons of industrial solid wastes (ISW) is produced annually from a total of 377 industrial units in NWFP. It was, however, observed that most of the ISW are either re-processed for producing another product or used as animal feed or as manure on agricultural lands. The nutrient concentration varied greatly from product to product and industry to industry. Among the major nutrients in ISW, on average, K was found in highest concentration (2.5%), followed by N (1.99%) and P (0.33%). Similarly among micronutrients, the amount of Fe was highest (638 \square g g-1) followed by Mn (158

□g), Ni (55 □g), Zn (34 □g), and Cu (0.17 □g). Among the toxic metals, Ni was found in highest concentration (55 □g) followed by Pb (19 □g g-1), Cr (12 □g) and Cd (0.6 □g). These results suggested that huge amount of ISW is produced annually in NWFP but they are being used for meaningful purposes. However, they can also be used as manure on agricultural lands with careful management as they contain large reserves of essential major and minor nutrients.

- The amount of farm wastes produced varied from location to location. On average, the estimated amount of various farm wastes produced per year in NWFP were 5.19 m.t wheat straw, 1.80 m.t maize stover, 0.18 m.t. rice straw, 0.87 m.t sugarcane bagasse, 0.007 m.t tobacco stalks and 3.37 m.t of FYM with common uses as fodder, fuel or manure. On average, the maximum concentration of 1.02% N was found in maize stover followed by 0.74% N in FYM and 0.72% N in wheat straw. Phosphorus concentration was highest in FYM (0.13%P) and K in rice straw (1.35%). The concentrations of all the three micronutrients (Zn 59 mg, Fe 1476 mg, Mn 476 mg kg-1) were highest in FYM. Among the toxic metals, Ni was highest (42 mg kg-1) in FYM, Cd in FYM and maize stover about 4 mg kg-1 in each and Pb was almost equal (24-29 mg kg-1) in 5 out of 6 farm wastes. These results suggested that most of the farm wastes contain considerable amounts of N and K as well as Fe but low amounts of P and other micronutrients or toxic metals.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer, Printer, N Distillation Accessories (one set each)
- Lab Equipments:
 - - (Shaker/Mixer/Grinder/Composting Bins) (one set each)
 - - Desiccators (3 Nos.)

Project Title: Impact of sewage wastes (effluent and sludge) on soil properties and quality of vegetables.

Principal Investigator: *Dr. Muhammad Qasim Khan*
Chairman

Location: Department of Soil Science, Gomal University, D.I.Khan.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	4.153
<i>Start Date:</i>	7/1/2003	<i>Fund Released (Rs):</i>	1820000
		<i>Fund Utilized (Rs):</i>	730900

Objectives:

- To evaluate the quality of sewage waste (effluent and sludge) of different sewerage channels of D. I. Khan city and Zafarabad town being used as a source of irrigation/fertilizer for vegetable crops.
- To determine the quality of soil and vegetables being treated with sewage wastes.
- To investigate about the quality of soil and vegetables as affected by different levels of sewage wastes application.
- To propose a most suitable dose/concentration of sewage waste which could be used by the farmers for raising improved quality of vegetables.

Achievements/Progress:

- The effluents and sludge were collected from the selected sewerage channels (Chah Mughal Wala, Jhok Dhap Wali and Army Farm). Soil samples were collected from different location from the fields being irrigated with the sewage waste. These were then analyzed for physico-chemical characteristics and pathogenic organisms.
- The pH value of the effluent ranged from 8.21 to 8.40 while EC varied from 1.96 to 2.86 dS/m, it was rich in organic matter (3.28 to 4.30%), NPK (2.38 to 2.69%, 55 to 64 ppm and 45 to 60 ppm, respectively) in all micronutrients. Sewage sludge had the pH ranging from 7.6 to 8.0, EC varied from 2.10 to 2.28 dS/m while % organic matter from 14 to 15%. It had sufficient amount of NPK (1.40 to 1.60%, 60 to 75 ppm and 350 to 370 ppm, respectively) and micro nutrients (Cl varied from 667.34 to 730 ppm, Fe 680 to 800 ppm, Cu 12.0 to 18.0 ppm, Ni 300 to 370 ppm and Zn 290 to 370 ppm)
- Analysis of the soil showed that it was alkaline in nature having pH value of 8.0 to 8.4, low in organic matter (1.03 to 1.31%) and macro and micro nutrients content (N 0.051 to 0.065%, P 15 to 20 ppm, K 255 to 280 ppm, CI 370 to 470 ppm, Fe 91 to 114 ppm, Mn 106 to 126 ppm, Cd 1.5 to 5 ppm and Zn 20 to 30 ppm).
- The dominant bacteria specie isolated from the effluents was *Basillus cereus*, from the sludge it was *Bacillus magatarrium* while the soil was dominated by *Proteus rettgi*.
- Species of fungi, which were isolated from sewage effluents, were *Schizophyllum commune*, *Penicillium vermiculatum* and *Mucor hiemalis*, while the sludge had *Mortierella rostaфинiskii*, *Bremia*, *Penicillum vermiculatum* and *Molassezia furfur*. The sewage treated soil contained *Scopuariopsis brevicaulis*, *Aspergillus flavis*, *Bremia*, *Mucor hiemalis*, *Candida albican* nd *Molassezia furfur*.
- It was observed that the major and minor nutrient elements as well as heavy metal content of the sewage wastes of D. I. Khan were not high enough to be cause of concern for harmful effect on soil. However, their high Sodium and Carbonate content may be of concern in raising soil pH in the long run.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Cathode lamps for atomic absorption spectrophotometer
- Flame photometer
- Air Conditioner
- Computer P-IV
- HP Laserjt Printer 1200
- Epson Dot matrix printer
- Scanner HP
- CD Writer
- Voltage Stabilizer
- Furniture & Fixture

Project Title: National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan.(Component 1: NIAB, Faisalabad)

Principal Investigator: *Dr. Zahoor Aslam*
Coordinator

Location: Saline Agriculture Farmers Participatory Development Project in Pakistan, NIAB, Faisalabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>4.017</i>
<i>Start Date:</i>	<i>8/1/2003</i>	<i>Fund Released (Rs):</i>	<i>1276000</i>
		<i>Fund Utilized (Rs):</i>	<i>0</i>

Objectives:

- Generation of comprehensive technology for economic utilization of salt affected soils and brackish water with the production of appropriate crops/plants species.
- Ensuring short and long term income for the farmers of salt affected lands through popularization and dissemination of selected package of technology by appropriate means.
- To reverse environmental degradation and improve soil health enhancing the value of waste lands.

Achievements/Progress:

- The following activities were started under the project:
- Screening of stress tolerant germplasm of plant genotypes viz: *Desmanthus illionensis*, *Accacia saligna*, *Azadirachta indica* and *Accacia ampliceps*.
- Initiation of agroforestry experiments on studying the effects of planting methods and soil amendments on growth of *Accacia nilotica*, *Accacia ampliceps* and *Casurina glauca*.
- Documentation on initial testing of Sulfurous Acid Generator completed.
- To improve animal health care facilities, oil adjuvanted immunopotentiator haemmorrhagic septicemia was prepared and injected to animals on various livestock farms. Blood samples of vaccinated animals were collected for determination of antibody titer in serum. Antibody titer of vaccinated animals was higher than the unvaccinated animals. Same vaccine was also injected to calves and they were challenged with live culture. All the 4 calves resist the challenge with live culture.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Centrifuge machine
- Porometer
- Spectrophotometer
- Hot plates with magnetic stirrer
- Laptop

Project Title: National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan. (Component 2: SSRI, Pindi Bhattian)

Principal Investigator: *Dr. Nazir Hussain*
Agriculture Chemist

Location: Soil Salinity Research Institute, Pindi Bhattian.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>3.19</i>
<i>Start Date:</i>	<i>5/1/2003</i>	<i>Fund Released (Rs):</i>	<i>1834000</i>
		<i>Fund Utilized (Rs):</i>	<i>1297928</i>

Objectives:

- Generation of comprehensive technology for economic utilization of salt affected soils and brackish waters with the production of crops (wheat, rice, and medicinal crops) and fruit trees (guava, jamin, ber) at 10 different sites.
- Ensuring short and long-term income for the owners of salt affected lands through demonstration of 5-10 acres and dissemination in the project area.
- To reverse environmental degradation and improve soil health by growing crops, forest trees and fruit plants. The soil health will be monitored after the harvest of each crop.

Achievements/Progress:

- The project activities were started in May, 2003 to manage the salt affected soils - brackish water - crop (cereal and fodder) trees (forest and fruit) as an integrated system so that short, medium and long term income is ensured to the owners of such lands.
- During first year of the project, 5 sites of 4-5 acres of salt affected soils were established (one in Sheikhpura, one in Gujranwala and 3 in Hafizabad districts) for reclamation and crop production. Gypsum was applied in 2-3 acres at each site and crops were sown. The respective mean yield of rice and wheat crops was 2.41 – 2.84 and 2.69 – 3.25 t ha⁻¹. A gradual improvement in soil health was recorded. Parameters of EC, pH and SAR reached almost nearer to the normal values. Guava, jamin and eucalyptus plants were also planted successfully through improvement technology.
- Data of four research trials indicated that compost prepared from crop residues (at the rate of 10 to 20 t ha⁻¹) could successfully be used for reclamation of saline/sodic soils. One experiment was conducted to evolve technology for the usage of brackish water. The preliminary data indicated that bad effects of brackish water (EC=2.48 dSm⁻¹, SAR=16.46 and RSC=3.6 me L⁻¹) can be avoided if 10% additional water is applied as leaching requirement or added after application of gypsum in the required amount.
- Fifty acres barren land was rehabilitated under the activity of supervised reclamation. The mean yield of paddy and wheat recorded at 5 different localities were 2.5 to 3.4 and 3.2 to 3.6 t ha⁻¹ respectively.
- A comprehensive brochure has been prepared and printed for distribution among the farmers.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Electrical Conductivity Meter (1)
- pH meter (1)
- Spectrophotometer (1)
- Furniture & Fixture

Project Title: National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan. (Component 3: UA, Faisalabad)

Principal Investigator: *Dr. Javid Akhtar*
Associate Professor

Location: Department of Soil Sciences, University of Agriculture, Faisalabad.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>4.287</i>
<i>Start Date:</i>	<i>8/1/2003</i>	<i>Fund Released (Rs):</i>	<i>1842000</i>
		<i>Fund Utilized (Rs):</i>	<i>1123243</i>

Objectives:

- Generation of comprehensive technology for economic utilization of salt affected soils and brackish water with the production of appropriate crops/plants species.
- Ensuring short and long term income for the farmers of salt affected lands through popularization and dissemination of selected package of technology by appropriate means.
- To reverse environmental degradation and improve soil health enhancing the value of waste lands.

Achievements/Progress:

- The project is being conducted to generate a comprehensive technology for economic utilization of salt-affected soils and brackish waters with the production of wheat/fodder and to increase the income of farmer through the utilization of salt-affected soils. Therefore, different genotypes of barley and wheat were initially screened in the green house of Saline Agriculture Research Centre, University of Agriculture, Faisalabad before their cultivation, testing at the farmer's field. In the green house studies, salt tolerant wheat genotypes SARC-5 performed better compared to the other genotypes while SARC-5, V02-2 & V02-A and SARC-1 had good growth/yield under saline and drought conditions. These selected genotypes along with some already selected material, then cultivated in the salt-affected soil under different set of treatments, at two sites are in district Faisalabad village 126 R. B, Pharang and 2nd in district T. T. Singh village 286 G. B.
- The comparison of wheat genotypes under moderate and high salinity conditions revealed that SARC varieties proved better compared to the recommended variety. However, at low salinity approved variety (Inqlab) was better due to its capability to grow under normal soil. These experiments demonstrated the better performance of SARC genotypes. The existing varieties of barley were also tested in the salt-affected farmer's fields and barley variety Haider-93 performed better compared to the other varieties.
- To test the brackish water use for wheat and barely, experiments were also conducted at both sites and it was found that combined use of canal water and brackish water proved much better compared to use of brackish water alone.
- The results revealed that even though this was the first year of the project in the farmer's field, the results of testing the saline agriculture technology are very promising and have a good demonstration value for the farmer's of the project area.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- pH Meter
- Conductivity meter
- Soil Sampling Kit/Soil Extraction System
- Computer P-IV
- Laser Printer/Scanner, UPS
- Table & Chair

Project Title: National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan. (Component 4: SALU, Khairpur)

Principal Investigator: *Dr. Abdul Razak Mahar*
Associate Professor

Location: Department of Botany, Shah Abdul Latif University, Khairpur.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>3.513</i>
<i>Start Date:</i>	<i>7/1/2003</i>	<i>Fund Released (Rs):</i>	<i>1945000</i>
		<i>Fund Utilized (Rs):</i>	<i>1382777</i>

Objectives:

- To generate the salt affected soils for re-using for the production of different crops for human being and livestock.
- Re-use of brackish water and analysis of salt affected soils at various affected areas will be brought under this system.
- To encourage and train farmers to actively adopt the new approach for short and long terms income.

Achievements/Progress:

- The sites of the salt-affected land were selected, leveled and prepared for cropping. Field trials were carried out in Khairpur and Hyderabad districts.
- Performance of five selected wheat (*Triticum aestivum* L.) cultivars along with a local variety as a check were studied during 2003-04 at Shah Abdul Latif University (SALU), District Khairpur. The experiment was conducted at three different sites having salinity of 4, 6.5 and 7.8 dSm⁻¹ respectively. SALU1a produced taller plants while significantly long spikes with more seeds per spike and higher grain weight were produced by SALU2. Site-I, which had low salinity, produced taller plant ($P < 0.05$), more spike and significantly higher grains. While the lowest values for all the parameters were recorded at site-III, which was due to higher salinity. Salt tolerance ranking based on grain weight was SALU2 > SALU1a > TJ-83 > SALU1b > SALU3 > SALU4. The study suggests that at higher salinity (Site-III), SALU2 have the potential of producing economic yields while at low salinity (Site-I), SALU1a, SALU 1b and local variety are equally effective.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- pH meter
- EC meter
- Shaking machine
- Refrigerator
- Microwave oven
- Water distillation unit
- Soil sampling kit
- Water quality checker
- Digital lab. Balance

- Hydrometer
- Camera
- Air conditioner
- Computer, printer & scanner
- Furniture & Fixture

Project Title: National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan. (Component 5: NWFP Agriculture University, Peshawar)

Principal Investigator: *Dr. Izhar-ul-Haq*
Professor

Location: Department of Soil & Environmental Sciences, NWFP Agriculture University, Peshawar.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>3.094</i>
<i>Start Date:</i>	<i>7/1/2003</i>	<i>Fund Released (Rs):</i>	<i>1788000</i>
		<i>Fund Utilized (Rs):</i>	<i>1023964</i>

Objectives:

- Generation of comprehensive technology for economic utilization of salt affected soils and brackish waters with the production of appropriate crops/plants species.
- Ensuring short and long-term income for the farmers of salt affected lands through popularization and dissemination of selected package of technology by appropriate means.
- To reverse environmental degradation and improve soil health enhancing the value of wastelands.

Achievements/Progress:

- To generate technology for reclamation of saline and sodic soils and economically utilize less productive and waste lands by growing salt tolerant cereal, sugar and fruit crops and to improve soil health, experiments were conducted at various sites on farmer's fields in Charsadda, Mardan and Swabi districts of NWFP during the crop year 2003-2004.
- The crop yield data obtained from experiment "effect of amendments application on yield of wheat crop and improvement of salt affected soil" indicated that wheat yield was significantly increased in saline sodic conditions by application of amendments such as gypsum, manure and press mud. Of these amendments gypsum was found most effective in increasing the crop yield to an extent of 26% over control compared to the other two organic amendments. Gypsum was also found better in reclaiming the soil with regards to soil pH and gypsum requirement as it reduced both these parameters to the tune of 5-16% and 49-77% respectively. Conjunctive use of these amendments was found superior to their application alone.
- Ten wheat lines such as SR-2, SR-4, SR-7, SR-19, SR-20, SR-22, SR-23, SR-24, SR-25 and SR-40 were evaluated in an experiment "to evaluate the performance of these wheat lines in saline sodic environment". The results showed that out of 10 wheat lines, SR-40 gave the maximum average yield of 2494 kg/ha followed by SR-19 giving a yield of 2383 kg/ha. Minimum yield of 1767 kg/ha was obtained by SR-24. Salt tolerant varieties have an edge over non-tolerant varieties under more saline field conditions. This suggests that selection of the most salt tolerant wheat varieties in addition to the use of improved planting techniques and proper nutrition are important factors for achieving improved yields.
- Six treatments consisting of control, 25%, 50%, 75%, 100% and 200% of the recommended rate of FYM (20 tons per hectare) were used in another experiment "to study the performance of sugar beet crop in saline-sodic environment". The results showed that farm yard manure application helps in amelioration of the soil physical properties such as porosity, bulk density, permeability etc. providing better environment for seed germination coupled with supplying nutrients for crop growth.

- The quality of irrigation water samples of 25 selected tube-wells operating in Charsadda and Mardan districts was assessed so far. The quality of water of the tube-wells was found satisfactory for irrigation with little management, would be needed especially on soils of fine to medium texture.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Ion-Selective Meter along with one Electrode each of Sodium & Chlorine ions (1 set)
- Computer with printer & scanner (1 set)
- Digital camera (1)

Project Title: National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan. (Component 6: ARI, Quetta)

Principal Investigator: *Mr. Shahjahan Khan*
Deputy Director

Location: Soil Fertility Section, ARI, Sariab, Quetta.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.930</i>
<i>Start Date:</i>	<i>8/1/2003</i>	<i>Fund Released (Rs):</i>	<i>1226000</i>
		<i>Fund Utilized (Rs):</i>	<i>627657</i>

Objectives:

- Generation of comprehensive technology for economic utilization of salt affected soils and brackish water with the production of appropriate crops/plants species.
- Ensuring short and long term income for the farmers of salt affected lands through popularization and dissemination of selected package of technology by appropriate means.
- To reverse environmental degradation and improve soil health enhancing the value of waste lands.

Achievements/Progress:

- The following experiments were initiated and data recorded:
- Effect of Sulphur on the Yield and Growth of Onion Crop in Salt Affected Soils: The crop was sown from 25th April to 5th May 2004 in Nohsar, Muslakh and Panjpai areas.
- Effect of Sulphur on the Yield and Growth of Tomato Crop in Salt Affected Soils: Crop was sown from 25th April to 5th May 2004 in Nohsar, Muslakh and Panjpai.
- Effect of Sulphur on the Yield and Growth of Sorghum as Fodder Crop in Salt Affected Soils: Crop was sown in June 2004 in Nohsar, Muslakh and Panjpai.
- Use of Chemical Amendments for Reclamation of Saline Sodic Soil (Rice): Rice (Super Basmati) was sown in June 2004 in Nasirabad area.
- Use of Gypsum as an Ameliorant of Brackish Ground Water: Rice (IRRI-6) was sown in June 2004 in Nasirabad area.
- Data/parameter regarding mortality, height and growth of the plant, physico-chemical characteristics of the soil, yield, soil improvements (Salinity, Sodicity and Fertility), socio-economic impact being recorded will, be analysed. The experiments are still ongoing.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer (P-IV) with accessories (1)
- UPS (1)
- Laser jet Printer HP (1)
- Voltage Stabilizer (1)
- TSS Meter(1)
- Power Sprayer (1)
- Soil Conductivity Meter (1)
- Pipette 10 ml (2)

- Pipette 20 ml (2)
- Spring Balance (1)

Project Title: National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan. (Component 7: NARC, Islamabad)

Principal Investigator: Dr. M. Salim
CSO/DDG

Location: INRES, NARC, Islamabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	3.993
<i>Start Date:</i>	7/1/2003	<i>Fund Released (Rs):</i>	1924000
		<i>Fund Utilized (Rs):</i>	1139530

Objectives:

- Generation of comprehensive technology for economic utilization of salt affected soils and brackish waters with the production of appropriate crops/plants species.
- Ensuring short and long-term income for the farmers of salt affected lands through popularization and dissemination of selected package of technology by appropriate means.
- To reverse environmental degradation and improve soil health enhancing the value of wastelands.

Achievements/Progress:

- The overall coordination, supervision and management of the coordinated project having seven components including NARC unit is being carried out by NARC. The applied research as well as dissemination of technology is being carried out in the farmers' fields located in various parts of the county.
- The experimental studies were started during September 2003 at Pind Dadan Khan area as well as at Tehsil Sahiwal, Distt. Sargodha, simultaneously. Two sites were selected at village Haranpur of Tehsil Pind Dadan Khan. One of the fields was selected for brackish water irrigation while second irrigated with river water brought from tube well bored on the bank of river Jhelum (Fresh Water). Twelve varieties of Mustard were selected to screen out salt tolerant ones. Out of different varieties tested, Sultan raya was found to be early maturing with maximum number of pods and yield. Variety 19-H ranked next to Sultan raya.
- In Sargodha, three sites were selected at village Chohal, located on Farooqa Road, Rakh Sahiwal and Chak 105 Janoobi. At two of the three sites (village Chohal and Rakh Sahiwal) the crop failed to germinate due to untimely rains. However, at third site (Chak 105 Janoobi) it was a success. The results of the experiment are similar to those at Pind Dadan Khan. Chemical analysis of plant material is in progress.
- During February 2004, fruit tree plantation was carried out in different fields of same experimental areas. Initially Ber, Guava (two varieties) and Falsa were transplanted at Rakh Sahiwal and Pind Dadan Khan sites. Various doses of gypsum and farm yard manure were applied at the time of transplantation. Fruit tree nursery was purchased from Pattoki and transported to the experimental sites. Experiment is in progress.
- Castor bean was tested for its salt tolerance in a highly saline sodic soil at Jalalpur Kanghra, Jhang Road, Tehsil Sahiwal. Two gypsum levels were selected i.e. 4 ton and 8 ton gypsum per hectare as treatments. The experiment is in progress.
- A solution culture experiment was conducted using 5 salinity levels to test the performance of salt tolerant and sensitive varieties of mustard. Seeds of castor bean were obtained from

AZRI, Bahawalpur. Data on the agronomic parameters as well as ion concentration were considered. Sultan raya proved better adaptation for the salt affected areas.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Portable pH meter
- Portable pH meter (1)
- EC meter (1)
- Ion meter (1)
- Lap top computer (1)
- Digital camera (1)
- Telephone set (4)

SOCIAL SCIENCES

SOCIAL SCIENCES

BACKGROUND

ALP Secretariat received 39 preliminary proposals relating to social sciences for funding under the 1st batch. In process of preliminary appraisal 21 proposals were short listed for the invitation of detailed projects and 18 proposals which were not up to the standard were dropped. Finally, 7 projects costing Rs.14.281million were approved by the Board of Director (BOD) of ALP for funding to conduct the research in different disciplines:

For instance, there is one project on WTO Trade Liberalization to study the existing situation in domestic market & international arena and to pinpoint adverse effects of liberalization if any and suggest ways and means to minimize such effects. To recommend policy prescriptions in line with the WTO trade liberalization. There are also projects on:

- *To study marketing systems of selected fruits & vegetables in Punjab and Sindh and to determine the technical and socio-economic constraints in the marketing system.*
- *To determine the profitable and efficient production packages for various vegetables.*
- *The economic valuation of Indus delta mangrove ecosystem.*
- *Farmers' capacity building through information technology in Pakistan.*

The region wise detail of the on-going projects is summarized as under:

S.No	Region	Projects
1	<i>PARC/NARC</i>	2
2	<i>PUNJAB</i>	2
3	<i>SINDH</i>	2
4	<i>NWFP</i>	1
	TOTAL	7

IMPLEMENTAION STATUS

Out of 7 approved projects five projects are in their 3rd year of operation while the following two projects have been completed.

- *The economic valuation of Indus delta mangrove ecosystem.*(Sindh Development Studies Center (SDSC) University of Sindh, Jamshoro)
- *Structure, conduct and performance of the marketing system, margins, and seasonal price variation of selected fruits and vegetables in Sindh. A co- integration analysis.*(TTI, AERU, Agriculture Research Institute, Tandojam, Sindh.)

FINANCIAL STATUS

So far an amount of Rs.7.250 million has been released against the overall total cost of Rs.14.281 million in respects of approved projects. Till now overall expenditure of Rs.5.485 million has been incurred as reported by the PIs of the projects.

MONITORING & EVALUATION

The Chairman, PARC/BOD of ALP has reviewed the 1st year progress of the projects located at NARC, while the progress of other projects located outside Islamabad were reviewed/evaluated by the CSO/In charge, Social Sciences Division, PARC. The second review of the projects by the Chairman, PARC/BOD of ALP is schedule to be organized in the next year.

However, on site evaluation of four on-going and two completed projects have been completed and evaluation of remaining projects is underway. The out comes of the evaluation will be published soon after its completion.

Currently, most of the projects have completed two years of their life span .The annual progress reports of the projects shows that significant task has been completed and the outcomes are very encouraging /cheering. The salient achievements of these projects have been compiled in subsequent chapters of this annual report.

Project Title: WTO trade liberalization move: Implications for Pakistan's agriculture with special reference to sustainable development, poverty alleviation and environmental concerns.

Principal Investigator: *Dr. Anwar F. Chishti*
Associate Professor

Location: Department of Agri. Economics, NWFP Agriculture University, Peshawar.

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>3.00</i>
<i>Start Date:</i>	<i>4/3/2002</i>	<i>Fund Released (Rs):</i>	<i>2036500</i>
		<i>Fund Utilized (Rs):</i>	<i>1862753</i>

Objectives:

- To study the existing situation in domestic market, covering various GoP's programmes/policies with specific reference to (a) domestic production support, (b) foreign export trade, and (c) import of agricultural commodities, processed products and inputs and supplies meant for use in agricultural production.
- To study the existing situation on international arena, covering programmes and policies being pursued in the world global market, in general, and adopted by Pakistan's trading partners, in particular.
- To analyze the implications of reducing and phasing out of protection of agriculture in domestic market and liberalization trade at international level for total and agrarian economy through estimating and working out welfare effects for various stakeholders including producers, consumers, traders, government and society at large.
- To find out, in addition, implications of liberalization for sustained development of agriculture, alleviation of poverty and environmental safety and preservation.
- To pinpoint adverse effects of liberalization if any and suggest ways and means to minimize such effects.
- To recommend policy prescriptions in line with the WTO trade liberalization move, and based on findings of the study.

Achievements/Progress:

The preliminary findings of the project are as under:

- The Agreement on agriculture, signed in 1994, set specific numerical targets for reduction in support and protection to the agriculture sector, but such reduction targets were to be achieved during the first phase going to expire in December 2004. Resumption of new multilateral negotiations for setting targets for further reductions in support has been agreed on August 1, 2004. It is high time to suggest that Pakistan be ready for adjustments and more substantial improvements in world trade in the second phase of WTO's trade liberalization to be enacted during the post-2004 period. In the new negotiations, Pakistani negotiators need to put more emphasis on efforts aimed at to open the world's "Developed Economies" through elimination of export subsidies and domestic supports in practice in developed economies than to get protection for Pakistan's own domestic economy.
- In order to meet the challenges of incoming WTO regime, Pakistan needs to be cost-efficient so that its products are available at competitive prices in the world markets. With a view to lowering cost and adding value to product, the following steps are suggested:

- (i) getting higher output per unit area/input used
 - (ii) Checking/controlling losses & damages
 - (iii) Improving post-harvest/post-production operations
 - (iv) Diversification/intercropping
 - (v) Employing cost-efficient production techniques
 - (vi) Adding value through processing, quality improvement
 - (vii) Production of organic products/high value crops
 - (viii) Expanding demand: creating niche market; selling through brands, and user-friendly packaging
- Besides lowering cost, Pakistan needs to improve and update its products quality and packaging in accordance with the desire and demand of international customers. For this purpose, the following steps would be helpful:
 - Step 1: Consult Codex Alimentarius Commission (CAC), on website WWW.codexalimentarius.net for various quality concerns.
 - Step 2: For quality concerns specific to Plant and animal health areas, consult International Plant Protection Convention (IPPC) & International Office of Epizootics (OIE) through CAC's website already referred;
 - Step 3: For other quality concerns not covered by the CAC, IPPC & OIE, consult other international organizations open to all WTO member countries;
 - Step 4: For higher food standards developed by US, EU, Japan and other OECD member countries, consult their respective websites on quality, specifically for standards adopted for packaging and labeling by Pakistan's trading partners.
 - Following research papers and seminar proceedings were published:
 - "WTO, Quality and Quality Improvements: Pros& Cons and Actions Needed" in Quality and Productivity in the Post WTO Scenario, PIQC's E-publication, Pakistan Institute of Quality Control, Lahore.
 - *"WTO's Trade Liberalization, Agricultural Growth and Poverty Alleviation in Pakistan", Pakistan Development Review, 40:4 Part II (Winter 2001), PIDE, Islamabad.*
 - *"The WTO's Trade Liberalization: Implications for Poverty Alleviation and Sustained Agricultural Development", proceedings of workshop on Poverty Alleviation Through Sustainable Agricultural Development arranged by AUP at Bara Gali, July/2001.*
 - *"WTO's Trade Liberalization Programme and Deregulation of Pakistan's Agricultural Markets". Proceedings of National Seminar on "Deregulation of Agricultural prices" held on 20 October 2001 at University of Agriculture Faisalabad.*

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer with accessories 4 Nos.

Project Title: **Structure, conduct and performance of the marketing system, margins, and seasonal price variation of selected fruits and vegetables in Sindh. A cointegration analysis.**

Principal Investigator: ***Dr. Ali Muhammad Khushk***
Sr. Scientific Officer

Location: TTI, AERU, Agriculture Research Institute, Tandojam, Sindh.

<i>Duration (Months):</i>	24	<i>Total Cost (million):</i>	2.500
<i>Start Date:</i>	4/3/2002	<i>Fund Released (Rs):</i>	2095000
		<i>Fund Utilized (Rs):</i>	2095000

Objectives:

- Study the existing structure, conduct and performance of the marketing systems of selected fruits & vegetables in Punjab and Sindh.
- Determine the technical and socio-economic constraints in the marketing system which have an impact on the expansion of its production and marketing in Punjab and Sindh.
- Quantify the market margins of producers and other market intermediaries; and assess ways and means to improve the producer's share and consumer's surplus in Punjab and Sindh.
- Assess the perceptions of rural and urban consumers and selected consumers groups in Punjab and Sindh.
- Develop policy recommendations for efficient marketing system to safeguard the interest of producers as well as consumers and to enhance out put and export of fruit & vegetable.

Achievements/Progress:

- In Pakistan, marketing of fruits and vegetables is becoming more important because quantity of these commodities is expanding as the urban population is growing. Increasing in international trade makes more complicated marketing systems. Marketing functions including grading, packing and information are important to facilitate exports. Processing is another issue associated with the exports of fruits and vegetables in the country.
- The main purpose of the study is to conduct detailed investigation of fruits and vegetables marketing systems in Pakistan. This study has been carried out through a primary survey of fruit and vegetable growers and market intermediaries in assembly, wholesale and terminal markets of Sindh and Punjab provinces. Data on mango and guava was collected from both provinces, whereas, data on citrus was collected from Punjab province and data on date was collected from Sindh province. Whereas in case of vegetables primary data on onion and tomato was collected from both provinces, data on potato was collected from Punjab province and data on chilies was collected from Sindh province. A combination of analytical techniques was used to assess the efficiency of fruit and vegetable marketing system in Pakistan. The most common techniques used in this study are market margin analysis, price correlation coefficient analysis and market integration analysis.
- The empirical investigation revealed that in the horticulture sector, resources are not optimally allocated, which is reflected by the fact that producers achieve low yield as compared to the potential yields. The lack of capital and limited access to institutional credit leads producers to limit the use of chemical fertilizer, sprays to control insects and pests and labour inputs in fruit orchards. In such conditions producers adopt a strategy of contracting out their orchards at the flowering stage. This is due to the fact that the contract system provides economic advantages to the producers. It is also apparent that producers face great

difficulties in marketing their own produce. In assembly and particularly in wholesale markets they are treated as temporary clients without access to the credit and other facilities extended to contractors. Without adequate access to market information they also face high price uncertainties. Lack of capital and non-accessibility of institutional credit leads producer to rely on relatively high cost informal credit sources and advances from fruit contractors. By not marketing their own produce they do not benefit from seasonal price variation, particularly in early and late season.

- Despite the present environment in which growers are operating, characterized by lack of information, non availability of institutional credit, little research and extension support and the biased treatment from commission agents, the investigation indicated the producers receive a fruit and vegetable than most other crops. Growers are attracted towards fruit and vegetable cultivation because of its relatively low capital and labour use.
- The analysis of the marketing system revealed that fruits and vegetables markets are not perfectly competitive, but it is sufficiently competitive to prevent market traders from reaping excessive margins. A large number of buyers and sellers participate and none is able to corner exclusive access to large supplies. There is a competition at each stage of the marketing chain. No strong evidence was found of collusion among market agencies with prices at each stage normally set by supply and demand factors, and no evidence was found that market intermediaries are able to manipulate prices. Spread of information regarding quantity and price is rapid amongst all agencies other than producers.
- The efficiency of the marketing system has been examined by correlation coefficient and market integration analysis. The findings from the analysis revealed that price formation of fruits and vegetables in one wholesale market is not related for similar quantity and quality in other wholesale markets, or at least that there is no evidence that they are related. The scarcity of transport cost and non-availability of price information are the major causes of weak integration of markets which affects the efficiency of the marketing system.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer 2 sets
- Printers 2 sets
- Stabilizers 2 Nos

Project Title: **Determination of profitability and efficient production packages for various vegetables.**

Principal Investigator: *Dr. Bashir Ahmad*
 Vice Chancellor

Location: Department of Farm Management, University of Agriculture, Faisalabad

<i>Duration (Months):</i>	<i>36</i>	<i>Total Cost (million):</i>	<i>2.500</i>
<i>Start Date:</i>	<i>4/18/2002</i>	<i>Fund Released (Rs):</i>	<i>1260500</i>
		<i>Fund Utilized (Rs):</i>	<i>869446</i>

Objectives:

- To ascertain extent of adoption of various practices followed by the farmers in the production of various vegetables.
- To determine the cost structure gross income and profitability of cultivation of various vegetables.
- To identify and prioritize the major constraints in the cultivation of different vegetables.
- To identify the improved farm practices for obtaining high yield of various vegetables.

Achievements/Progress:

Three research reports of Tinda Gourd, Bitter Gourd and Muskmelon have been published.

- The estimated tinda yield per acre in Khanewal (1589.6 kg) was statistically lower as compared to that in Layyah (2692.8 kg). However, it was found that tinda growers of Khanewal received a higher price compared to those in Layyah. Total cost per acre was statistically higher in Layyah (Rs.6399.62) compared to that in Khanewal (Rs.5592.34). Cost per 40 kg was statistically low in Layyah (Rs.95.2) and high in Khanewal (Rs.140.8). But net returns per 40 kg were estimated higher in Khanewal (Rs.76) than those in Layyah (Rs.10.40). Net returns per 40 kg were reported to be negative in low yielders of the selected districts (Rs.-28.8 in Layyah and Rs.-12.8 in Khanewal). Cost per 40 kg was Rs.128.80 and 248.00 on the low yielders, whereas it was estimated as Rs. 75.20 and 101.60 on the high yielders in Layyah and Khanewal respectively. Better land preparation and plant protection measures, timely sowing and efficient use of labour for weeding/hoeing were the factors responsible for higher yield in the high yield category of sample districts.
- The yield of Bitter Gourd was 2763 and 2974 kgs per acre in Faisalabad and Rahim Yar Khan Districts respectively. Gross income per acre estimated to be higher in Rahim Yar Khan (Rs.21603.13) than that of Faisalabad (Rs. 19537.27). The respondents of R. Y. Khan district applied more inputs to their crops as compared to Faisalabad. Therefore, total cost per acre was found higher in R. Y. Khan (Rs. 14802.91) and lower in Faisalabad (Rs. 12505.01). Gross margin per 40 kg was significantly higher in Faisalabad (Rs.141.08). The respondents of Faisalabad obtained higher net returns per 40 kg (Rs. 101.78) than those of R.Y.Khan (Rs.91.46). The high yielders of Faisalabad obtained higher yield compared to the low yielders mainly because of the difference in quantity of manure, amount of nitrogen and phosphorus and use of sprays. Net returns per kg and 40 kg of the low yielders were significantly lower compared to those of the high yielders in Faisalabad and R. Y. Khan. The results of the study concluded that quantity of manure, fertilizer and labor used for controlling weeds and earthing up played a significant role on the farms that experienced high bitter gourd yield.

- The yield per acre of the respondents of R.Y. Khan (3337.30 kg) was statistically higher as compared to that of Bahawalpur (2908.57 kg). Gross income was estimated to be higher in R. Y. Khan (Rs. 15718.68) than Bahawalpur (Rs. 12157.82). The respondents of R. Y. Khan district applied more inputs to their crop as compared to Bahawalpur district. Therefore, total cost per acre was found higher in R. Y. Khan (Rs. 10878.01) and lower in Bahawalpur (Rs. 9514.77). Gross margin per 40 kg was significantly higher in R. Y. Khan (Rs. 83.20) compared to that in Bahawalpur (Rs. 64.80). The respondents of R. Y. Khan obtained higher net returns per 40 kg (Rs. 58) than those of Bahawalpur (Rs. 36.40). The high yielders of R. Y. Khan and Bahawalpur obtained higher yield compared to the low yielders mainly because of the difference in land preparation quantity of manure, amount of nitrogen and phosphorus and use of sprays. The results of the study suggest that the farmers should allocate more area to Chichawatni variety by applying optimum quantities of nitrogen, phosphorus, potassium, manure, irrigation and proper weeding.

Three research reports of Economics of Growing Radish, Carrot and Potato are under preparation. Salient findings of the studies are:

- The yield per acre of radish in Sheikhpura (6535 kg) was statistically higher as compared to that of Sahiwal (5331 kg). Gross income per acre was estimated to be higher in Sheikhpura (Rs. 15372.42) than that of Sahiwal (Rs. 11844.37). The respondents of Sheikhpura district applied more inputs to their crop as compared to Faisalabad. Therefore, total cost per acre was found higher in Sheikhpura (Rs.105753.82) and lower in Sahiwal (Rs.9800.09). Gross margin per 40 kg was significantly higher in Sheikhpura (Rs. 37.28) compared to that in Sahiwal (Rs. 32.13). The respondents of Sheikhpura obtained higher net returns per 40 kg (Rs.29.36) than those of Sahiwal (Rs. 14.67). The results of the study concluded that quantity of seed, fertilizer, irrigation and labor used for controlling weeds played a significant role on the farms that experienced high radish yield.
- The yield of carrot per acre was statistically far higher in Sheikhpura (8010.00kg) as compared to that in Kasur (6516.80kg). Total cost per acre was found higher in Kasur (Rs.12874.00) and a little bit lower in Sheikhpura (Rs. 12571.95). Nevertheless, gross income and gross margin per acre were estimated higher in Kasur (Rs. 12874.00 and 9103.92) than those in Sheikhpura (Rs. 16981.20 and 6296.56) because of the high price of the produce in Kasur. Gross margin per 40 kg was significantly higher in Kasur (Rs. 56.00) compared to that in Sheikhpura (Rs.30.80). The respondents of Kasur obtained higher net returns per 40 kg (Rs. 46.40) than those of sheikhpura (Rs. 65.80). It is concluded that the farmers' access to certified seed, better land preparation, recommended dose of seed and fertilizer and availability of credit are the major factors that can enhance the carrot produce.
- The yield per acre was statistically higher in Okara (8396.80 kg) than that in Kasur (7971352). Total cost per acre was estimated as Rs. 26601.05 and 31608.37 in Okara and Kasur respectively. High cost in Kasur was the result of irrational use of fertilizer and irrigation and high price of seed. However, gross income and gross margin per acre were statistically higher in Okara (Rs. 24938.50 and 1054.63 respectively) and negative gross margin per acre was estimated for Kasur (Rs.-7789.77). Positive gross margin per kg and negative net returns per kg were found in Okara (Rs. 0.12 and -0.20) while the above were negative in Kasur (Rs.-0.98 and -1.44). It is concluded from the study that farmers could enhance potato yield per acre if recommended seed, FYM and particularly fertilizer are applied for potato crop.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer P-IV (2)
- Laser Printer
- Dot matrix printer
- Scanner

Project Title: **Application of farm planning models to analyze the choice of oilseed crops at regional and national levels.**

Principal Investigator: **Dr. Khalid Mahmood**
 Sr. Scientific Officer

Location: SSI, NARC, Islamabad.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	3.000
<i>Start Date:</i>	8/13/2002	<i>Fund Released (Rs):</i>	795000
		<i>Fund Utilized (Rs):</i>	611000

Objectives:

- To establish farm typologies for the construction of representative farm models for different agro-ecological regions;
- To elicit the importance given to a range of objectives by a representative sample of farmers in the representative oilseed growing farming systems of Pakistan ;
- To explore the systems relations and resource allocation patterns among prevailing and alternative oilseed crops in the major cropping zones;
- To build linear programming and Multiple Criteria Decision Making Models (MCDM) to analyze the economic implications of the adjustments of alternative oilseed crops in different production systems of Pakistan;
- To analyze the impact of improved technologies of alternative oilseed crops on the allocation of farm resources for different systems at regional and national levels; and
- To draw implications from the study for research, extension and government policy with regard to the new oilseed crops.

Achievements/Progress:

The Technical progress made so far under the project is as follows:

- Prototype Model has been constructed for major cropping zones.
- Secondary data of nine oilseeds crops (i.e. Cotton, Rapeseed and Mustard, Groundnut, Sesmum, Linseed, Castroseed, Soybean, Sunflower and Safflower) for last thirty years from 1969-70 to 1987-88, was analyzed. Five year averages were estimated on yields and area allocation to different oilseed crops.
- A comprehensive review was carried out to synthesize oilseed development approaches adopted from national and regional perspectives. Approaches adopted in India and China was also reviewed to understand most relevant experiences of our neighborhood.
- A questionnaire was designed for primary data collection on oilseed crops in the selected districts of all the agro-ecological zones of Pakistan.
- The project progress was at a slow pace due to some financial issues. An other up-set to the project was the placement of original PI and architect with FAO in November, 2003 and taking over by Dr. Tariq Hassan, SSO as its new P.I. who was a Sociologist. However, he did work and made some progress according to his capacity and within the limits of financial system. On transfer of Dr. Tariq to Training Institute, Dr. Khalid Mahmood Aujala, Dy. Director, SSD was declared as its new P.I.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer (4)
- Laptop (1)
- Laser printer (1)
- Office table (1)
- Computer table (1)
- Office chair (1)
- Computer chair (2)
- Book racks (2)
- Guest chairs (4)
- Telephone set (2)
- Fan heater

Project Title: **The economic valuation of Indus delta mangrove ecosystem.**

Principal Investigator: *Dr. Abida Taherani*
 Director

Location: Sindh Development Studies Center (SDSC) University of Sindh, Jamshoro.

<i>Duration (Months):</i>	24	<i>Total Cost (million):</i>	0.580
<i>Start Date:</i>	4/27/2002	<i>Fund Released (Rs):</i>	343000
		<i>Fund Utilized (Rs):</i>	326000

Objectives:

- To determine economic values for the mangrove forest products so that true economic value /price could be passed on to consumers (communities personnel);
- To identify and assess the key determinants of Total Economic Value (TEV) of the mangrove ecosystem;
- To identify various environmental benefits of mangrove forest that would help understand the importance to sustainable management of the mangrove resources;
- To establish an understanding of the role of environmental valuation in preventing consequent over exploitation or excessive degradation of the mangrove that results from its under-valuation.

Achievements/Progress:

- The study indicates that there is a positive relationship between the growth rate of mangrove forests & flora and funa with the quantity of fresh water available for the mangrove forests.
- The urban drainage to sea especially in Karachi works as a fertilizer for mangroves, it also operates as a source of sweet water that is needed for the growth of mangrove forests.
- People complained about the lack of interest and cooperation by the public sector for the growth of mangroves. The fisherman also complained that there were no facilities available for them to seek loans for expanding the sweet fishing in the area. Although, Pakistan Fisher Folk Forum (PFFF) did exist for the purpose but its performance was inadequate.
- The estimated economic values of the following direct and indirect products – both marketed and non- marketed – of the Indus delta mangrove ecosystem are as follows:
 - Fuel wood (from Mangrove Trees) is Rs.45.6 million per year
 - Timber (from Mangrove Trees) is Rs.28.4 million per year
 - Fodder (from Mangrove Trees) for Camel Browsing is Rs.88 and for buffalo grazing is Rs.28.8 million per year
 - Honey (from Mangrove Trees) is Rs. 517.5 million per year
 - Fisheries (Mangrove Dependent)
 - Shrimps Rs. 4.225 million per year
 - Finfish Rs. 780.0 million per year
 - Crabs Rs. 120.0 million per year
- The minimum economic value of selected products of Indus Delta Mangrove ecosystem is Rs. 1612.525 million per year.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Computer P-IV

Project Title: Identification and analysis of technology transfer for sustained growth in agriculture as used by extension in Sindh, Pakistan.

Principal Investigator: Dr. S. S. Bukhari
Associate Professor

Location: Department of Agri. Education, Extn. & Short Courses, Sindh Agriculture University Tandojam, Sindh.

<i>Duration (Months):</i>	36	<i>Total Cost (million):</i>	0.500
<i>Start Date:</i>	1/1/2003	<i>Fund Released (Rs):</i>	276000
		<i>Fund Utilized (Rs):</i>	80000

Objectives:

- Assess the technology transfer process/package for sustained growth as used by the Extension Department in Sindh.
- Assess the impact of various sources of information employed in dissemination of information.
- Identify and determine the technology transfer gaps/ constraints between research generators and users as faced by Extension Department.
- Develop a technology transfer model based on information gathered through the project for Extension in Sindh.
- Suggest recommendations that help address the problems/ constraints of the farming community and their solutions at various levels for their consideration and application.

Achievements/Progress:

- Review of literature has been completed.
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- Questionnaire have been developed for data collection which relates to demographic information, extension activities and opinion survey from agricultural researchers, extension agents and farming community.

Equipments Purchased:

Following equipments have been procured for the project's activities out of Agricultural Research Endowment Fund (AREF).

- Compute & Office Equipment