YEAR BOOK 2013 - 2014

GOVERNMENT OF PAKISTAN
MINISTRY OF NATIONAL FOOD SECURITYAND RESEARCH
ISLAMABAD

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Message from the Minister
M/o National Food Security and Research

Pakistan is facing the challenge of malnutrition and food security. These include inadequate food availability, lack of access to safe, diverse and nutritious food. Other issues linked with are limited access to clean water, sanitation, health care and inappropriate child feeding and adult dietary choices. Despite being self-sufficient in production of staple foods, livestock and dairy, economic access and utilization persist as the major limiting factors for household-level food and nutrition security. Addressing these challenges, has been identified as an area of prime focus by the Government.

There is no doubt that agriculture and livestock productivity growth contributes to food security and better nutrition. It also has major share in raising incomes, especially countries like Pakistan having an agro-based economy. Our agriculture sector contributes 21.4 % to GDP, employs 45 % of the country's labour force and is the main source of livelihood for 67 % rural population.

In Pakistan, growth in agriculture not only results in enhanced supply of raw material to agro-based industries like textile, sugar, food processing but also generates demand of industrial goods and services. However, agriculture sector experienced stagnancy and during last five years average agricultural growth dropped to only 2.5% per annum. Such level of food production results in food insecurity, under-nutrition and poverty.

Present Government lays high priority to the development of agriculture to play a vital role in boosting national economy and ensuring food and nutritional security. The emphasis is also given on agriculture, livestock research and development priorities with a focus on nutrient dense foods such as fruits, vegetables, legumes and animal source foods.

The year book 2013-14 describes various activities being performed by its various wings and allied departments of Ministry of NFS&R during the year.

Sikandar Hayat Khan Bosan
Minister for National Food Security
and Research (NFS&R)

Message from the Secretary
M/o National Food Security and Research (NFS&R)

Major challenges in the 21st century are increased food and fiber production, a cleaner environment, and renewable energy resources. Pakistan, being a developing country, is facing multi-faceted challenges including energy crisis, food security, and rapid urbanization in the wake of increasing population and the more global phenomenon of climate change.

Food and nutritional security are multi dimensional challenges and require a multi-sector and integrated approach. M/o NFS&R is joining hands with all the stakeholders for bringing change at the grassroots level. In this milieu, The Ministry is committed to ensure food security and better nutrition to our people as enshrined in the constitution. Additionally, to follow the Prime Minister's vision 2025 for Pakistan, the ministry is engaged in provision of support to the provinces, related to international and domestic coordination, upstream and strategic research. Ministry is also in the process ensuring minimum standards for food safety, improved nutrition as well as pest and animal health surveillance.

Improving nutritional diversification through agriculture enhanced focus on high value horticulture, livestock and fisheries has been identified as a main thrust of new "National Food Security Policy" which is currently at its final stages of development. Ministry is also planning to launch a wheat flour fortification programme in collaboration with provincial governments.

The ministry, in pursuance of Rules of Business, 1973 sub-rule (2) of Rule 25, publishes this book on yearly basis. The main purpose is to highlight the activities and functions of its various Wings and departments/organizations during 2013-14 to achieve the goal of food security in the country.

(Seerat Asghar)
Secretary
Ministry of National Food Security and Research (NFS&R)

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Government of Pakistan
Ministry of National Food Security and Research
(Economic Wing)
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INTRODUCTION

Pakistan's natural resource base is very rich and vast, covering various ecological and climatic zones. It offers a great potential for producing all types of food commodities. Diversified agriculture systems across the country have an important role in boosting economic growth. The agro-based entrepreneurs, through exports of raw products such as rice, cotton, fruits, vegetables and semi-processed and processed products such as cotton yarn, cloth, carpets and leather production, provided opportunities to enhance foreign trade.

Reducing poverty, hunger and food insecurity are essential parts of the Millennium Development Goals and are prerequisites for economic development. Food security and economic growth mutually interact and reinforce each other during the development process. A country which cannot produce the required food quantity and has no resources or afford to buy food from the international market to meeting its needs is not a food sovereign state. Food security, thus, becomes a fundamental component of national security which is generally ignored. But it is not the case in Pakistan now as food security is the fundamental agenda of the Government.

There was increase of 4.4% in wheat, 22.8% in rice, 4.3% in sugarcane and 7.3% maize, while cotton has shown decline in production by 2.0% with resultant negative impact on overall agriculture performance for 2013-14.

Food Security and Agriculture demand very comprehensive programs that aim to make measurable and sustainable improvements in agriculture production and resource utilization through instruction and skills improvement in the chain from production, processing and marketing practices till it reaches to the consumer. We have to provide direct technical assistance to farmers through field extension agents to promote changes in attitudes and systems involving various stake holders at provincial and national level.

OVERVIEW

The Ministry of National Food Security and Research (NFS&R) through its attached departments, autonomous organization and boards is focusing to ensure food security. Links between agriculture and food security have long been recognized and there is major shifts in understanding that have led to recognition that agriculture is one of the main contributor to food security. The M/o NFS&R since its inception have been aiming to improve, coordinate and strengthening agricultural research and development in the country.

Functions of M/o NFS&R under Rules of Business,1973

- Economic Coordination and Planning in respect of Food, Economic Planning and Policy making in respect of agriculture.
- Imports and exports control on food grains and foodstuffs, inspection, grading analysis of food grains and foodstuffs, maintenance of standards of quality for import and export and inspection, handling, storage and shipment of rice exports.
- Collection of statistics regarding production, consumption, prices, imports and exports of food grains.
- Coordination with aid and assistance agencies in respect of food sector.
- Pakistan Agricultural Research Council and other Federal agriculture research organizations.
- Food and Agriculture Organization (FAO) of United Nations in respect of food.
- Plant Protection, Pesticide import and standardization, Aerial Spray, Plant Quarantine and Locust control in its international aspect and maintenance of locusts warning organizations.
- Federal Seed Certification and Registration.
- Standardization and import of fertilizer.
- Procurement of food grains, including sugar
    - from abroad;
    - for Federal requirement;
    - for inter-provincial supplies; and
    - for export and storage at ports.

- Grading of agricultural commodities, other than food grains, for exports.
- Administrative control of PASSCO.

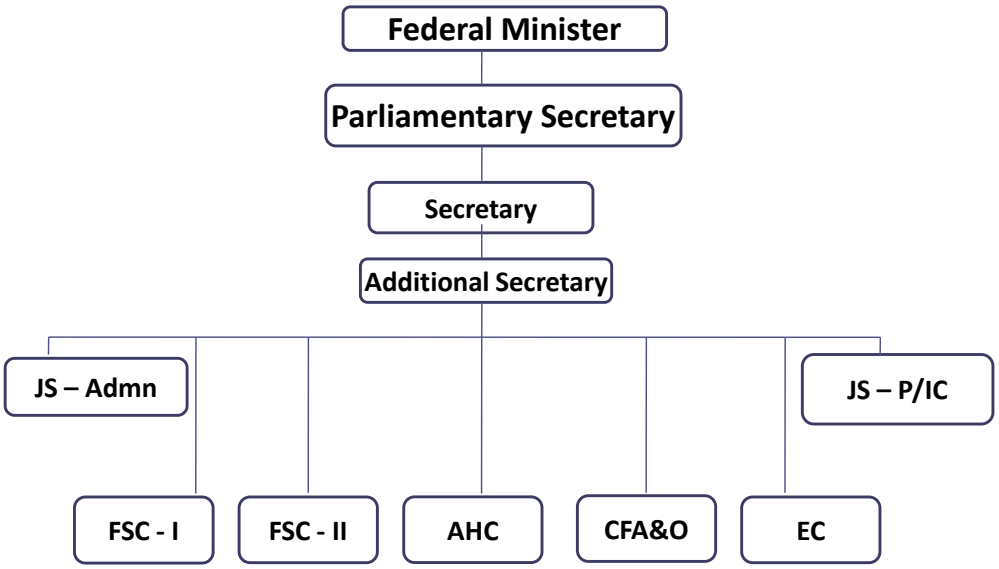
- ❖ Preparation of basic plan for bulk allocation of food grains and foodstuffs.
- ❖ Price stabilization by fixing procurement and issue prices including keeping a watch over the price of food grains and foodstuffs imported from abroad or required for export and those required for inter-provincial supplies.
- ❖ Agricultural Policy Institute.
- ❖ Animal Quarantine Departments, stations and facilities located anywhere in Pakistan.
- ❖ National Veterinary Laboratory, Islamabad.
- ❖ Laboratory for Detection of Drugs Residues in Animal Products at Karachi.
- ❖ Veterinary drugs, vaccines and animal feed additives:

    i. import and export; and
    ii. procurement from abroad for Federal requirements and for inter-provincial supplies.

- Livestock, poultry and livestock products;
    i. Import and export; and
    ii. Laying down national grades.

- Pakistan Dairy Development Company.
- Livestock and Dairy Development Board (LDDB).
- Fisheries Development Board (FDB).
- Pakistan Oilseed Development Board (PODB) (for federal areas only)

Organizational Chart of
Ministry of National Food Security and Research



ATTACHED DEPARTMENTS

1) Agricultural Policy Institute
2) Federal Seed Certification & Registration Department
3) Department of Plant Protection
4) Animal Quarantine Department
5) National Veterinary Laboratory

AUTONOMOUS BODY

Pakistan Agricultural Research Council (PARC)

CORPORATION

Pakistan Agricultural Storage & Services Corporation Limited (PASSCO)

BOARDS

1) Pakistan Oilseed Development Board (PODB)
2) Livestock and Dairy Development Board (LDDB)
3) Fisheries Development Board (FDB)

COMPANY

1) Pakistan Dairy Development Company (PDDC)

CELL

1) Federal Water Management Cell (WMC)

I. PLAN WING

The Plan Wing of Ministry of National Food Security and Research is responsible to coordinate with developmental activities with regard to Food Security through Public Sector Development Programme (PSDP). This Wing analyses the project proposals/PC-I's initiated by the line departments of the Ministry and processes those for approval of the competent forums such as DDWP, CDWP and ECNEC etc as the case may be. Not only it releases the funds on quarterly basis after obtaining approval from the relevant quarters but it is also responsible for monitoring and evaluation of the development projects and submits monthly and annual progress reports to Planning Commission and Finance Division. Funds to the tune of Rs.750.00 million were allocated in PSDP 2013-14 for execution of the following development projects under this Ministry.

1	Research for Agriculture Development Programme
2	National institute of Genomics and Advance Bio-Technology (NIGAB)
3	Pak-China Cooperation for Agricultural Research and Development
4	Indigenization of Hybrid Seed Production for Enhanced Crop Production
5	Special Program for Strengthening of SPS Facilities and Quality Inspection Services in Compliance with WTO-Establishment of an Integrated National Animal & Plant Health Inspection Services (NAPHIS)
6	Up-Gradation and Establishment of Animal Quarantine Stations in Pakistan'
7	Monitoring of Crops through Satellite Technology (Phase-II)
8	Establishment of Horticulture Research Institute, Khuzdar Balochistan
9.	Establishment of Livestock Research Institute, Turbat, Balochistan
10.	Strengthening of Coastal Agriculture Research Station Bhawani Balochistan
11.	National Bio-Saline Agriculture Programme
12.	Establishment of Horticulture Unit for Nursery Fruit Plant and Vegetable Seed Certification System in Pakistan
13.	Animal Quarantine Station Gwadar, Balochistan

The following projects were closed as a result of periodical review due to slow moving based on the evaluation report of the Special Committee:-

i) National Bio-Saline Programme (NABSAP)
ii) Establishment of Animal Quarantine Station, Gwadar
iii) Establishment of Horticulture Unit for Nursery Fruit Plant and Vegetables Seed Certification System in Pakistan

Having approved the following new projects/schemes from the competent forums these have now been proposed for inclusion in next year's PSDP 2014-15.

1	Bovine Spongiform Encephalopathy (BSE-Mad Cow Disease) Surveillance and Capacity Leading to O/E Negligible Risk Country Status for Pakistan.
2	Capacity Development of Agriculture Extension Services In Khyber Pakhtunkhwa Province (PARC)
3	Establishment of Americas Channel Cat Fish (Ictalurus Punctatus) Hatchery at NARC
4	Kitchen Gardening—A way to Safe & Nutritious Vegetables
5	National Pesticides Resides Residues Monitoring System in Pakistan (PARC)
6	Promotion of Olive Cultivation on Commercial Scale in Pakistan
7	Rehabilitation and Strengthening of Summer Agricultural Research Station of PARC
8	Value Addition in Agriculture – Cluster Development Approach
9	Up-gradation of Arid Zone Research Institute (AZRI) D.I.Khan to the Level of Arid Zone Research Centre (AZRC) and Establishment of New Adaptive Research Cum Demonstration Institutes at Seakach, Wana South Waziristan Agency, Miranshah, North Waziristan Agency (FATA), Tank and Matora, Lakki Marwat-Khyber Pakhtunkhwa

Mr. Seerat Asghar, Federal Secretary, Ministry of National Food Security and Research presiding over a high level Meeting to Review the PARC on-going Projects and Achievements for presentation to PM whereas Dr. Iftikhar Ahmad, Chairman PARC, all PARC Members and senior management are also present in the meeting at PARC (HQs). Dte. of PR&P

Mr. Sikandar Hayat Bosan Federal Minister for National Food Security & Research (MNSF&R) addressing Scientists & Other Participants from all over the country at the Occasion of Federal Committee on Agriculture (FCA) Meeting Dte of PR&P

Mr. Seerat Asghar, Federal Secretary, Ministry of National Food Security and Research (MNFS&R) presiding over a high level meeting of on on-going Agri. Research Projects all over the country whereas Dr. Iftikhar Ahmad, Chairman PARC, Dr. M. Azeem Khan, DG NARC and high officials of MNFS&R and attached departments are present in the meeting at Ministry, B-Block, Pak Sectt. Islamabad (Dte. of PR&P)

II. INTERNATIONAL COOPERATION (IC) WING

International Cooperation (IC) Wing deals with participation in international events like World Food Summit, meetings of Food and Agriculture Organization (FAO) of the UN including FAO Conference and FAO Council and its subsidiary bodies, matters relating to World Food Programme (WFP) and IFAD. The Wing also works for seeking assistance in the agriculture sector.

Mr. Seerat Asghar, Federal Secretary in a meeting with WFP Delegation led by Ms. Lola Castro

Interaction and strong collaboration was established with various countries, international agencies and donors to increase food production and ensure sustainable food security. The interaction developed with countries like US and China has resulted in fruitful cooperation in the field of agriculture to promote trade in agricultural commodities and technical and scientific cooperation and collaboration. Unprecedented number of agreements, MoUs and Technical Assistance grants were signed with international agencies. This wing is also responsible to undertake activities related to Joint Economic, Joint Ministerial

Commissions, Pakistan missions abroad and WTO issues. The wing has developed plans for national zero hunger programme in collaboration with FAO, Brazil and other international agencies to ensure food security in the country. The IC wing through department of plant protection has signed the mutual Agreements/MoU with China, Australia, Indonesia and Brazil for technical cooperation and implantation Sanitary and of Phyto-sanitary (SPS) measures to facilitate exports of agricultural produce from Pakistan.

Ambassador of Brazil in Pakistan Alferdo Leoni called on Federal Minister for National Food Security & Research, Sikandar Hayat Khan Bosan in Islamabad on June 12, 2014

Sikandar Hayat Khan Bosan Federal Minister for National Food Security & Research in meeting with a delegation of International Maize and Wheat Improvement Centre (CIMMYT) led by Dr. Thomas A. Lumpkin when the latter called on the Minister.

Sikandar Hayat Khan Bosan Federal Minister for National Food Security & Research in meeting with a delegation of ICARDA (International Centre for Agricultural Research in the Dry Areas) led by its Director General Mahmoud Solh when the latter called on the minister here in Islamabad.

III. ECONOMIC WING

Economic Wing is a the technical arm of this Ministry in terms of its responsibility for maintenance of data bank through imperative annual publications and provision of analytical support in the capacity of economic, trade and investment related issues of the food sector. The Wing collects information regarding Crop Area, Production and other Food Statistics from Federal and Provincial Governments, Pakistan Bureau of Statistics and other departments/agencies, and thereafter performs the function of its compilation, computerization and dissemination in the form of Publications on annual basis.

The Wing is also responsible for issuance of final estimates of about 54 major and minor crops at national and international level. Following two functions under Rules of Business empower Economic Wing:-

- Collection of statistics regarding production, consumption, prices, and imports and exports of grains (Fully)
- Economic Coordination and Planning in respect of food, economic planning and policy making in respect of agriculture (Partially)

Economic Wing published following books during the period under review:-

Agricultural Statistics of Pakistan 2012-13

The publication covers:

- Area, production and yield of major and minor crops including cereals, pulses, oilseeds, condiments, fodder, fruits and vegetables
- Land use statistics
- Use of inputs
- Agricultural credit
- Agricultural mechanization
- Livestock, fisheries and forestry statistics
- Trade statistics
- Prices of agricultural commodities
- Miscellaneous statistics
- Conversion factors

Fruit, Vegetables & Condiments Statistics of Pakistan 2012-13

The Wing released Fruit, Vegetables and Condiments Statistics of Pakistan 2012-13 containing province-wise data for the year 2008-09 to 2012-13. It also contains data on exports, imports (by destination) and wholesale prices which provide updated information for researchers, government functionaries, exporters and all those interested in the issues concerning the agriculture sector.

Crops Area and Production (By Districts) 2010-11 &2011-12

Economic Wing released "Area and Production (By Districts)" during the year. This publication contained latest district-wise data on major/minor crops including condiments, fruit and vegetables for the year 2011-12.

Year Book for Cabinet 2012-13

In pursuance of Rule 25(2) of the Rules of Business, 1973, the Economic Wing published Year Book 2012-13, containing details of activities and achievements of M/o NFS&R, its attached departments and autonomous bodies. The material was collected from all Wings, Departments and Autonomous bodies under the administrative control of M/o NFS&R.

In addition to the above publications, this section was also involved in the following activities.

- Data supplied to IMF, FAO and Prime Minister's Secretariat including other national / international agencies and NGOs.
- Released kharif and rabi estimates of crops at national level for circulation among Federal and Provincial Government Departments/ Autonomous bodies.
- Prepared briefs on prices of Food/Agricultural Commodities for the Secretary, M/o NFS&R.
- Replies of various National Assembly/Senate Questions were prepared.

IV. FOOD WING

Despite being a cereal-surplus country, Pakistan has a sizeable segment of food insecure population. According to the National Nutrition Survey, 2011 conducted by the erstwhile Ministry of Health and UNICEF, our population is food insecure due to:

1. Problems of access to food in remote or disaster stricken areas;

2. Lack of sufficient income to purchase desired calories of food every day; and

3. Unavailability of high quality or adequately nutritious food.

Against this backdrop, the Prime Minister of Pakistan directed the Ministry of National Food Security & Research to aggressively tackle the issue of hunger and malnutrition. While unveiling the first ever National Zero Hunger Action Plan on March 21, 2012, the Prime Minister announced "food security for women and children in the food insecure districts of Pakistan" as his top priority **(Annex – I)**. He directed that the following interventions be carried out immediately in collaboration with international agencies:

i. School feeding program in the most food insecure districts
ii. Nutrition programs for children under five years of age
iii. Nutrition programs for pregnant women and breastfeeding mothers

In pursuance of these directives, a Letter of Intent (LoI) was signed on 21st March, 2012 between the Ministry of National Food Security & Research and the World Food Program in presence of the Prime Minister of Pakistan, whereby the Government of Pakistan agreed to donate 0.5 Million tons of wheat to World Food Program for conversions to high nutrition diets for distribution amongst the above target groups. The cost associated with conversion and distribution of the donated wheat was to be picked up by World Food Program. With this commitment, Pakistan's status has elevated from a recipient of aid for its people to a donor in the eyes of the international community.

In order to address food insecurity/malnutrition, Ministry of National Food Security and Research had donated uptill now an aggregate quantity of 350,000 Metric Tons of wheat to World Food Programme in five installments as per detail mentioned below:

Mr. Seerat Asghar, Federal Secretary, chaired the Meeting "Wheat Review Committee"

Sr.No.	Month	Quantity donated in M/Tons
1	September, 2012	50,000
2.	February, 2013	75,000
3.	October, 2013	75,000
4.	April, 2014	26,000
5.	July, 2014	124,000
Total		**350,000**

Total cost of these donations was borne by the Government of Pakistan.

V. LIVESTOCK WING

Livestock sector occupies an important position in the National Agenda of the economic development. The objective is to exploit potentials of our livestock sector and use it as engine for economic growth and food security for the country. The sector provides net source of foreign earnings, a source of employment generation at rural level, helping to reduce income variability, especially is the only security on crop failure due to any reason. It is central to the livelihood of the rural poor in the country and can play an important role in poverty alleviation derives and can uplift the socioeconomic conditions of our rural masses.

Livestock contribution to agriculture value added stood at 55.9 percent while it contributed 11.8 percent to the national GDP during 2013-14 compared to 55.5 percent and 11.9 percent during the corresponding period last year, respectively. Gross value addition of livestock increased from Rs. 756.3 billion (2012-13) to Rs. 776.5 billion (2013-14), showing an increase of 2.7 percent compared to last year. The livestock population for the last three years is given below.

Livestock Population (Million No)			
Species	**2011-12[1]**	**2012-13[1]**	**2013-14[1]**
Cattle	36.9	38.3	39.7
Buffalo	32.7	33.7	34.6
Sheep	28.4	28.8	29.1
Goat	63.1	64.9	66.6
Camels	1.0	1.0	1.0
Horses	0.4	0.4	0.4
Asses	4.8	4.9	4.9
Mules	0.2	0.2	0.2
Estimated are based on inter census growth rate of Livestock Census 1996 & 2006			

The major products of livestock are milk and meat, the production of which for last three years are given below.

Milk and Meat Production				
Species	**Units**	**2011-12[1]**	**2012-13[1]**	**2013-14[1]**
Milk (Gross Production)	000 Tons	47,859	49,400	50,990
Cow	"	16,741	17,372	18,027
Buffalo	"	29,473	30,350	31,252
Sheep[2]	"	37	37	38
Goat	"	779	801	822
Camel[2]	"	829	840	851
Milk (Human Consumption)[3]	000 Tons	38,617	39,855	41,133
Cow	"	13,393	13,897	14,421
Buffalo	"	23,579	24,280	25,001
Sheep	"	37	37	38
Goat	"	779	801	822
Camel	"	829	840	851
Meat[4]	000 Tons	3,232	3,379	3,531
Beef	"	1,769	1,829	1,887
Mutton	"	629	643	**657**
Poultry meat	"	834	907	**987**

Notes

1. *The figures for milk and meat production for the indicated years are calculated by applying milk production parameters to the projected population of respective years based on the inter census growth rate of livestock census 1996-2006*
2. *The figures for the Milk production for the indicated years are calculated after adding the production of milk from camel and sheep to the figures reported in the livestock census 2006.*
3. *Milk for human consumption is derived by subtracting 20% (15% wastage in transportation and 5% in calf feeding) of the gross milk production of cows and Buffalo.*
4. *The figures for meat production are of red meat and do not include the edible offal's.*

The cattle population showed a growth rate of 3.8%, buffalo 3.0 %, sheep 0.7%, goat 2.3%, camel 0.3% while the production of milk increased by 3.2%, beef 3.45%, mutton 1.6%, poultry meat 8.4 % and eggs 5.0% during 2013-14 as compared to previous year. The production of other livestock products for the last three years is given below.

Estimated Livestock Products Production				
Species	**Units**	**2011-12[1]**	**2012-13[1]**	**2013-14[1]**
Eggs	Million No's	13,144	13,813	14,556
Hides	000 No's	**13,938**	**14,410**	**14,868**
Cattle	"	6,995	7,258	7,532
Buffalo	"	6,842	7,050	7,232
Camels	"	101	102	104
Skins	000 No's	**49,582**	**50,713**	**51,872**
Sheep Skin	"	10,745	10,873	11,001
Goat Skin	"	24,237	24,986	25,664
Fancy Skin	"	14,509	14,854	15,207
Lamb skin	"	3,192	3,229	3,268
Kid skin	"	11,318	11,624	11,939
Wool	000 Tons	43.0	43.6	44.1
Hair	"	23.8	24.4	25.1
Edible Offal's	"	353	363	373
Blood	"	59.8	61.3	62.8
Guts	000 No's	50,089	51,232	52,403
Casings	"	14,832	15,333	15,817
Horns & Hooves	000 Tons	50.9	52.5	54.0
Bones	"	757.5	780.5	802.9
Fats	"	241.7	248.8	255.8
Dung	"	1,071	1,104	1,136
Urine	"	329	338	348
Head & Trotters	"	220.1	226.3	232.3
Ducks, Drakes & Ducklings	Million No's	0.5	0.5	0.5

Notes

1. *The figures for livestock product for the indicated years were calculated by applying production parameters to the projected population of respective years.*

POULTRY

Poultry sector is one of the important and vibrant segments of agriculture in Pakistan. This sector has contributed 1.3 percent in GDP during 2013-14while it's contribution in agriculture and livestock value added stood at 6.1% and 10.8 % respectively. Poultry meat contributes 28.0% of the total meat production in the country. The current investment in Poultry Industry is more than Rs. 200.00 billion. Poultry sector has shown a robust growth @ 8-10 percent annually which reflects its inherent

potential. The poultry value added at current factor cost has increased from Rs. 121.7 billion (2012-13) to 130.7 billion (2013-14) showing an increase of 7.4% as compared to previous year. The production of commercial and rural poultry and products for last three years is given below:

Domestic/Rural & Commercial Poultry				
Type	**Units**	**2011-12[1]**	**2012-13[1]**	**2013-14[1]**
Domestic Poultry	Million No's	79.68	80.87	82.08
Cocks	"	10.10	10.38	10.66
Hens	"	38.09	38.78	39.47
Chicken	"	31.48	31.72	31.95
Eggs[2]	"	3809	3878	3947
Meat	000 Tons	106.51	108.62	110.79
Duck, Drake & Duckling	Million No's	0.54	0.52	0.50
Eggs[2]	"	24.13	23.13	22.17
Meat	000 Tons	0.73	0.70	0.67
Commercial Poultry	Million No's	44.1	47.0	50.1
Layers	"	34.82	37.25	39.86
Broilers	"	597.02	656.72	722.39
Breeding Stock	"	9.25	9.71	10.19
Day Old Chicks	"	623.58	685.94	754.54
Eggs[2]	"	9,281	9,912	10,586
Meat	000 Tons	726.66	797.47	875.24
Day Old Chicks	*Million No's*	655	718	786
Poultry Birds	"	721	785	855
Eggs	"	13,114	13,813	14,556
Poultry Meat	000 Tons	834	907	987

Notes

1. *The figures for the indicated years are statistically calculated using the figures of 2005-06.*
2. *The figures for Eggs (Farming) and Eggs (Desi) are calculated using the poultry parameters for egg production.*

Poultry Development Policy visions sustainable supply of wholesome poultry meat; eggs and value added products to the local and international markets at competitive prices and aimed at facilitating and support private sector-led development for sustainable poultry production. The strategy revolves around Improving regulatory framework; disease control and genetic improvement in rural poultry; hi-

tech poultry production under environmentally – controlled housing; processing and value addition; Improving bio-security; need based research and development and framers training & education. It envisages poultry sectors growth of 15-20% per annum.

LIVESTOCK DEVELOPMENT STRATEGY, POLICY MEASURES & ACHIEVEMENTS

The overall livestock development strategy revolves to foster "private sector-led development with public sector providing enabling environment through policy interventions and play capacity building role to improve livestock husbandry practices". The development strategy for livestock sector revolves on improving per unit animal productivity and moving from subsistence to market oriented and then commercial livestock farming in the country to meet the domestic demand and surplus for export. The objective is to exploit potentials of our livestock sector and use it as engine for economic growth and food security for the country leading to rural population empowerment and rural socioeconomic development / uplift.

The population growth, urbanization, increases in per capita income and export opportunities are fueling the demand of livestock and livestock products. The rise in production cost has increased the retailer's & consumer's price index for milk, yogurt, meat, eggs etc. Livestock Wing with its redefined role continued regulatory measures that included allowing import of high yielding dairy animals, exotic bovine semen and embryos for crossbreeding; allowing import of feed inputs, vaccines at zero rates etc. In order to reduce input costs in livestock / poultry feed production, certain feed ingredients, growth promoters, vitamin premixes have been zero rated. The Government of Pakistan has levied 5 percent duty on import of calf milk replacer / cattle feed premix in the budget for the fiscal year 2014-15. Now calf milk replacer/cattle feed premix can be imported at subsidized duty rates. Duty free facility has been withdrawn. Duty free import of veterinary, dairy and livestock machinery / equipment have been allowed in order to encourage establishment of value added industry in the country.

- Livestock wing provided facilitation for export of live animals and meat. A total of 8,995 buffaloes / cattle and 4,880 sheep/goats were exported for meat purpose during July 2013 to September 30, 2013. ECC of the Cabinet imposed ban on commercial export of live animals with effect from 1st October, 2013.

- Apart from animal exports, 58,730 metric tonnes of meat and meat preparations were exported during 2013-14.The export of meat and meat preparations fetched US$ 177.5 million. This meat was exported from 29 private sector slaughterhouses registered with the Animal Quarantine Department. During same period export facilitation was also provided for livestock by- products like animal casing, bones, horns and hooves, gelatin that fetched US$ 50.0 million.

- Livestock Wing regulated import of superior quality semen and high yielding exotic dairy cattle of Holstein-Friesian & Jersey breeds for genetic improvement of indigenous dairy animals. During 2013-14, 646.8 thousand doses/straws of exotic semen and 7,596 exotic dairy cows were imported. The exotic dairy cows added approximately 144 thousand tones of milk per day in the commercial milk chain / system.

- In order to facilitate dairy farmer, duty free import of calf milk replacer & cattle feed premix was allowed. During 2013-14, 236.9 metric tons of calf milk replacer & 800.7 metric tons of cattle feed premix was imported. Similarly, to promote and encourage value added livestock processing industry in the country, duty free import of machinery for milk, beef, mutton & poultry processing was allowed.

- During 2013-14, the Animal Quarantine Department (AQD) provided quarantine services and issued 32,833 Health Certificates for the export of live animals, mutton, beef, eggs and other livestock products having value of US$ 389.0 million. The AQD generated non-tax revenue of Rs. 45.23 million in 2012-13 as certificate / laboratory examination fee of animal and animal products exported during the year.

Livestock Wing also collaborated with international (Office International Des Epizooties OIE, Food and Agriculture Organization FAO) and regional organizations (South Asian Association of Regional Cooperation SAARC, Economic Cooperation Organization ECO, Animal Production and Health Commission for Asia and the Pacific APHCA, European Union EU) for HRD and capacity building of national and provincial livestock institutions for diagnosis and control of animal diseases. Inter

Provincial Coordination is being done by the Livestock Wing to implement the National Program to Control Foot & Mouth Disease and Peste Des Petitis Ruminant (PPR) disease in Pakistan. This will help to reduce commercial losses in livestock sector due to said diseases.

FUTURE PLANS

The Future Plans include Inter – Provincial Coordination for shifting from subsistence livestock farming to market-oriented and commercial farming covering entire value chain from farm to fork , Coordination to promote value addition livestock industry, diversification of livestock products, entering into global Halal Food Market, Controlling Trans-Boundary Animal Diseases of trade and economic importance through provincial participation (PPR, Zoonotic diseases) & exploring new markets for export of beef, mutton and poultry meat.

Mr. Seerat Asghar, Secretary, M/o NFS&R in a meeting with a Delegation of Saudi Agriculture and Livestock Company (SALIC) led by Mr. Abdull Al-Dubaikhi. Dr. R.H. Usmani, Animal Husbandry Commissioner also present on the occasion.

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NATIONAL VETERINARY LABORATORIES (NVL), ISLAMABAD

National Veterinary Laboratories (NVL) Islamabad is a national institution for service and regulatory support to national livestock wealth with a mission to promote greater productivity and profitability from the livestock industries in Pakistan. These state of the art laboratories are capable of catering needs in advanced applied biotechnology, bacteriology, virology, analytical chemistry, biochemistry, immunology, molecular biology, toxicology, pathology, parasitology and exotic diseases.

The surveillance and diagnostics at NVL remain unique and a strategic facility designed to enable work safely on highly contagious diseases of animals. It houses important national programs on prevention and control of Transboundary Animal Diseases (TADs). This section of the laboratory offers diagnostics and referral work on highly infectious and economically important veterinary diseases in the country. Recent addition of molecular characterization work in this laboratory has started yielding valuable information on virus circulation in the cattle and sheep/ goat population of the country. Such information is becoming very useful for the ongoing efforts for progressive control of Foot and Mouth Disease (FMD) in the country. Similarly, the vaccine quality control (VQC) section played important role to support new initiatives on disease control. This section is becoming increasingly important to cater challenge of quality vaccine supplies to the rapidly transforming dairy and poultry industry and heavy investments in the sector under intensive production systems. The residues and drug analysis facility at NVL remain operational with wide range of sophisticated engineering containments in order to ensure confidence of consumers and exporters in livestock and livestock by-products. The section attained pre-eminence due to its need in scenario of WTO and veterinary public health requirements. Apart from tests requested there was continuous market surveillance for residues and quality estimation of drugs. The information thus generated is useful for the farmers and the provincial and federal governments for regulatory oversight of processors and the manufacturers.

The training and visits of international delegates, federal, provincial and district veterinarians/ internee were catered for ensuring confidence of trade partners and high technology dissemination. It is expected to support process of harmonizing and standardizing the performance of provincial laboratories in terms of disease reporting to maintain an orderly and reliable animal health information system in the country.

ACHIEVEMENTS

During 2013-14, annual allocation to the laboratories was Rs. 17 million. The laboratories maintained staff strength of 46 comprising of 15 technical and 31 ministerial/ support staff. The laboratory analysed 21,742 samples (Table below) compared to 17, 669 analyses during the last year registering an increase of 4037 test (23%). These samples were submitted from the farmers, provincial and territorial livestock departments, development projects, processors and exporters besides the samples from surveillance schemes of veterinary diseases. Arrangements for maintenance of Rinder pest disease & infection free status were kept intact. Keeping in view the economic importance of FMD and PPR (Peste des petits ruminants) in productive animals and its implication on exports; the laboratory continuously provided free of charge diagnostics and supported analyses for FMD progressive control program of Pakistan. Similarly, PPR a disease being the most important limiting factor for sheep and goat farmers in the country was kept at high priority and its diagnostics and surveillance facility was maintained and offered. Information collected from FMD and PPR will be used for policy planning and laying out strategy for their control. During the year, NVL continuously undertook quality testing of imported bird flu vaccines; which helped a reliable supply of quality AI vaccines in the market resultantly supporting the freedom from bird flu.

Residues and drug testing activities are fairly new to the country therefore priority was remained kept high promoting consumers, processors and export partners awareness. This activity is now being widely recognized. Similarly, accreditation of the laboratories was remain a priority; which enabled the laboratory to foresee achieving accreditation under ISO 17025 in 2015. As a national reference and lead laboratory of the country, NVL took part in European Proficiency Testing at Pirbright, UK for FMD (EU-PT 2012 and 2013) and declared as good as 56 European laboratories participating the PT. For 2014, EU-PT is already in process. NVL also took part twice in Regional Proficiency Testing and attained level of satisfactory laboratory analyses. During the year, seven studies performed on the technical aspects were published in national and international scientific and technical journals.

Table. Laboratory Examination and Analyses Offered at NVL During 2013-14.

Area of work	Number of Analyses
Diagnostics and Surveillance	19,320
Vaccine Quality Control	720
Residue and Drug Analyses	1710
Scientific Studies Published	Seven
Total	**21,742**

PART-II DEPARTMENTS OF M/o NFS& R

i. Agriculture Policy Institute (API)

API is an attached department of Ministry of NFS&R, mainly dealing with the analysis of emerging policy issues in agriculture sector. On the evolving of WTO Regime and Regional Trade Agreements in place, the country needed to know/monitor the development of tradable commodities both domestically and internationally and to suggest steps to position the Pakistan Agriculture in the emerging environment. To advise the Government on formulating agriculture policy and to make Pakistani agriculture profitable, competitive and sustainable, the Government of Pakistan extended its role in Agriculture Sector and reconstituted APCom as "Agriculture Policy Institute (API) in December, 2006. The mandate of API is as under:

- ❖ Analyze domestic and international sectoral/commodity-specific policies.
- ❖ Conduct studies on emerging policy issues in crop and livestock sectors (production, consumption, processing, prices, input/output costs, surplus, stock and trade).
- ❖ Examine/estimate production, processing, storage, and marketing costs of agricultural commodities – crops and livestock.
- ❖ Recommend measures to improve export competitiveness of agriculture commodities.
- ❖ Advise on policy adjustments needed for greater efficiency and equity.
- ❖ Analyze the impact of important agricultural policies on producers, consumers, processors, exporters and importers.

Major Achievements During 2013-14

i) Prepared Annual Policy Analysis Reports on Cotton, Sugarcane, Rice and Wheat for 2013-14 Crops

ii) Assisted the Ministry of National Food Security and Research (NFS&R) in preparation of Annual Paper for the meeting of Food Supplies Committee of Defence Planning.

iii) Provided the technical input for the bilateral, multilateral and WTO Agreements and other trade related issues.

iv) Attended regular sessions of the Senate/National Assembly and assisted M/o NFS&R to respond to the Senate/National Assembly Questions.

v) Assisted M/o NFS&R on analysis of Food Security issues and technical input as Briefs/Comments, on various issues/studies/papers/letters, etc.

vi) Published 2 issues of the Pakistan Journal of Agricultural Economics highlighting the merging policy issues in Agriculture Sector.

vii) Drafted the National Wheat Policy for M/o NFS&R, Islamabad 2014.

Special Assignments:

i) A proposal on wheat subsidy programme for Gilgit Baltistan and Balochistan was prepared for the consideration of M/o NFS&R.

ii) Assisted M/o NFS&R in preparation of working papers and minutes for the meeting of the Federal Committee on Agriculture (FCA) for Rabi and Kharif Seasons 2013-14.

iii) Assisted M/o NFS&R in the preparation of replies for the court case on prices of wheat flour in the Supreme Court of Pakistan.

iv) A draft on the subsidies on fertilizer and agriculture credit and consumer subsidy on release of wheat to floor mill from public wheat stocks to ensure food security across the country was prepared for M/o NFS&R.

v) A proposal on wheat subsidy programme was prepared for M/o MNFS&R.

vi) Assisted M/o NFS&R in preparation of production and consumption targets for major food items as directed by the National Price Monitoring Committee, M/o Finance and Revenue.

Meeting on Fertilizer in the Committee Room, Ministry of National Food Security & Research

Way Forward:

i) As per Government directive, the API will continue to prepare Annual Policy Analysis Reports for Cotton, Sugarcane, Rice and Wheat crops.

ii) Assist the MNFS&R in preparation of Annual Report for the meeting of Food Supplies Committee of the Defence Planning.

iii) Regularly provide the technical input for the bilateral, multilateral and WTO agreements and other trade related issues in Agriculture Sector.

iv) Regularly publish the Pakistan Journal of Agricultural Economics highlighting the emerging policy issues in agriculture sector.

v) Attend regular sessions of the Senate/N.A for coverage of agriculture related issues and assist the MNFS&R to respond to the Senate/NA questions.

vi) Monitoring of food prices, food stocks and assist the MNFS&R in the analysis of emerging policy issues in respect of food security in the country.

vii) Any other technical input to the MNFS&R in the form of Briefs/Comments on various studies/papers/letters, etc

viii) Assist the MNFS&R in preparation of working paper and minutes for the meeting of the FCA for each Rabi and Kharif season.

ii. FEDERAL SEED CERTIFICATION & REGISTRATION DEPARTMENT (FSC&RD)

BRIEF ACTIVITIES/ACHIEVEMENTS & FUTURE PLAN OF FSC&RD

Federal Seed Certification & Registration Department (FSC&RD), an attached department of the Ministry of National Food Security and Research. The Department is engaged in providing seed certification and quality cover to both public and private seed sectors, under the Seed Act 1976, through its 28 seed testing laboratories and field offices located in various agro ecological zones of the country.

a. Functioning of Seed Testing Laboratories: 28 seed testing laboratories located at various agro ecological zones in the country are providing seed certification services to public and private seed sector.

b. Registration of new Seed Companies: During the year 2013-14, working paper for registration of 37 new seed companies has been submitted to the M/o National Food Security & Research for the forthcoming 54th meeting of its Working Group. Total numbers of registered seed companies are 766 in the country including 04 public sector and 05 multinational seed companies.

c. Registration of New Varieties of Various Crops: The department continued to take field observations of the candidate varieties and 38 new varieties have been registered during the period under report. So far 651 varieties of different crops and fruits like wheat (136), cotton (125), rice (39), maize (25), barley (10), sugarcane (40), oilseeds (60), pulses (74), fodders (37), fruits (42), flowers (3) and vegetables (60) have been registered.

d. Field Crop Inspection: During the period under report a total of 6,01,210 acres of different crops, offered by the various seed agencies were inspected for certification purposes.

e. Seed Sampling & Testing: A total quantity of 3,89,258 mt seeds of various crops were sampled and tested for purity, germination and seed health purposes during the year 2013-14.

f. New seed legislation

(I) Seed (Amendment) Bill, 2014

- The Seed (Amendment) Bill, 2010 stands lapsed by virtue of Article 76 of the constitution of Islamic Republic of Pakistan. As per advice of the Law Division, the process will have to be initiated de nova strictly in accordance with the constitution and the rules of Business, 1973 made there under.

- Accordingly, the Ministry of National Food Security and Research dated 10-01-2014 has submitted the summary on Seed (Amendment) Bill, 2014 before the Secretary to the Prime Minister of Pakistan for approval and request to dispense with the requirement of placing same, before the Cabinet in terms of rule 16 (2) of the Rules of Business, 1973.
- The Prime Minister has been pleased to desire that matter may be placed before the next meeting of the Cabinet, for considering and approval in terms of rule 27 (5) (a) of the Rules of Business, 1973 made there under;

- The Cabinet considered the summary dated 5th May, 2014 submitted by the Ministry of National Food Security and Research for amendment in Seed Act, 1976 and accorded approval.

- The private sector and multinationals in the absence of Bill find it difficult to undertake local seed production and investment in the seed sector;

(II) Plant Breeders' Rights Bill, 2014

- Pakistan being a member of Word Trade Organization (WTO) has obligation to provide rights to the breeders of new plant varieties under Article 27.3(b) of Trade Related Aspects for Intellectual Property Rights (TRIP's) Agreement.

- The registration of plant varieties and their Distinctness, Uniformity and Stability (DUS) examination is being carried out by the Federal Seed Certification & Registration Department, under the Seed Act,1976; therefore the department took initiative in preparing the draft, Plant

Breeders Rights Bill, in consultation with all stakeholders including the Intellectual Property Organization of Pakistan (IPO). The department also got authorization from the Provincial Assemblies of Punjab, Khyber Pakhtunkhwa, Balochistan and Sindh for making this enactment at the Federal Level.

- Accordingly, the Federal Cabinet in a meeting held on 14th February, 2007 approved the draft of "Plant Breeders Rights Bill" (PBR) and decided that the Plant Breeders Rights Registry will be established in IPO-Pakistan under Cabinet Division to integrate protection of all types of intellectual property rights while DUS examination will be performed by the Federal Seed Certification & Registration Department. The Federal Cabinet gave its approval on 09-09-2009 and the bill was then introduced in the National Assembly Session held on 11th January, 2011, which referred the Bill to the National Assembly Standing Committee on Food and Agriculture. The National Assembly completes its constitutional tenure (2008-13), but the PBR Bill did not come under discussion.

- Since, the Ministry of National Food Security and Research have direct stakes with the Bill, the legislative process of the PBR Bill, 2014 has been accelerated jointly by the Ministry of NFS&R and IPO-Pakistan with the establishment of new Government in 2013 for its early promulgation. After the approval of the Prime Minister, currently the PBR Bill is with the Federal Cabinet for consideration and approval.

g. Seed Quality Control in the Markets: Under the provision of seed act enforcement, a total number of 638 cases with a quantity of 63.56 mt seed of different crops were filed in the different Courts of Law against the seed dealers found selling substandard seeds during 2013-14.

h. Imported seed consignments: A total quantity of 46,660 mt of imported seed of various crops/hybrids (maize, paddy, sunflower, canola, fodders, potato, vegetables etc.) was tested under Seed Truth in Labeling Rules, 1991 at the port of entries i.e. Lahore and Karachi.

i. Seed Health Testing: A total number of 593 seed samples of various crops/vegetables and fruits were tested at the Central Seed Health Testing Laboratory, Islamabad for detection of fungal and viral diseases using latest diagnosis techniques and protocols.

j. Establishment of Fruit Plant Certification System

Fruit production has great potential of value addition but certified and disease free fruit plant were not available. For this purpose, Regional Fruit Plant Nursery testing/certification laboratories have been established with coordination of provincial governments in all provinces to distribute true to type and disease free fruit plants. So far 169 fruit nurseries have been registered for production and distribution of certified fruit plants and 50,000 fruit nursery plants were provided certification coverage to registered nurseries.

B. FUTURE PLANS FOR FSC&RD

Following activities are planned:

- Accreditation of Central Seed Testing Laboratory with assistance of UNIDO.
- Establishment of a Bio-tech lab for testing of GMOs (Genetically Modified Organisms).
- Strengthening of seed quality monitoring system in the market.
- Establishment of Model DUS centre.
- Levy of fee for certification services.
- Involvement of private sector seed companies in all categories of seed production activities i.e. pre-basic, basic and certified seed.
- Registration of seed business for effective monitoring.

Area, Seed Requirement and Seed Availability

for Sowing Rabi 2013-14 and Kharif 2014-15

Crop	Area 000 Ha	Total seed requirement MT	Targeted Seed Requi. MT	Seed Availability (M.T)			
				Public	Private	Imported 2013-14	Total (Loc+Imp)
Wheat	9,045	1,085,400	217,080	76,609	194,642	-	271,251
				7%	18%		25%
Cotton	3,200	40,000	40,000	797	19,887	-	20,684
				2%	50%		52%
Paddy	2,710	42,480	12,744	4,734	41,047	3,841	49,622
				11%	97%	9%	117%
Maize	1,064	31,914	9,574	333	3,541	11,618	15,492
				1%	11%	36%	49%
Pulses	1,337	47,496	9,499	40.61	772	-	812
				0%	2%		2%
Oilseeds	830	10,582	2,116	176	543	1,320	2,039
				2%	5%	12%	19%
Vegetables	254	5,070	5,070	4	-	4,744	4,748
				0%	0%	94%	94%
Fodders	1,942	40,138	40,138	12	7	20,921	20,940
				0%	0%	52%	52%
Potato	149	372,725	74,545	35	29	4,217	4,281
				0%	0%	1%	1%
Total	20,531	1,675,804	410,766	82,741	260,468	46,660	389,869
				5%	16%	3%	23%

Technical Manager, Seed Purity Lab briefing Parliamentary Secretary about Seed Testing Procedures as of International Seed Testing Association (ISTA)

Technical Manager, Seed Purity Lab. briefing Parliamentary Secretary about Documentation in seed testing procedures

Mr. Seerat Asghar, Federal Secretary, M/o National Food Security and Research, in a Meeting with Turkish delegation comprising of Dr. Mete KOMEGAC, President of ECO-Seed Association (ECOSA), Ankara and Mr. Yavuz Batur, Executive of Turk Seed Company, Genta Genel, Istanbul. Mr. Khalid Mahmud Mirza, Joint Secretary - P/IC and Syed Muhammad Nasir Ali, Director General, Federal Seed Certification & registration Department, Islamabad also participated

Turkish Delegation visiting the Seed Germination Testing Lab. (CSTL), FSC & RD, Islamabad

iii. PAKISTAN AGRICULTURAL STORAGE & SERVICES CORPORATION LIMITED (PASSCO)

PASSCO was established in 1973 and commenced its operations in May, 1974. It was registered as a Public Limited Company with an authorized capital of Rs.100 Million and paid-up capital of Rs.30 Million. Secretary, Ministry of National Food Security & Research is the ex-officio Chairman of its Board of Directors and Managing Director, PASSCO is the ex-officio Director of the Board. PASSCO is a self-sustaining concern, applying the standard norms for bench marking entrepreneurial/ commercial performance i.e. profitability, operating efficiency, credit-worthiness, marketing achievements and various prescribed financial parameters. The Corporation has progressively developed strong financial base and resilient functional capacity, over the years. On the directions of the Federal Government, PASSCO is committed to facilitate the Federal Govt. in its quest to ensure national food security by maintaining strategic reserves of different food grain commodities providing the same to deficit provinces including armed forces and maintain international food bank on behalf of Federal Govt. Ensuring implementation of support price to stabilize the prices and extend state welfare to farmer community. Achieve self-sustainability by carrying out agro business activities at own/ in collaboration with national and international organizations.

PASSCO is a primary Government support price maintaining agency of the Federal Government. As a Public Limited Company, within the ambit/ parameters of its Mission, assigned following functions:-

a. Provision of food security at national level, by maintaining *Strategic Reserves* of wheat and other specified commodities.
b. Maintain SAARC Food Bank Reserve Stock.
c. Extend state welfare to farmers by providing support to farmers; stabilize prices by intervening in domestic market.
d. Release wheat to deficit provinces as well as Armed Forces.
e. Undertake import/ export of different food grains when called upon.
f. Construct modern storage facilities for food grains.
g. Assist farmers in cultivation by supplying seeds, fertilizers and other related supplements when called upon.

h. Carry out agro business/ trade activities to achieve sustainability.
i. Other functions as per mandate of PASSCO.

PASSCO during the current year undertaken procurement operation of wheat and related information to the said commodity is provided as under:-

a. Total stocks of 2,026,418 Metric Tons were lying as on 30th June, 2013 with PASSCO that made it possible to effectively meet requirements of the provinces/agencies.
b. PASSCO procured 1,011,290 Metric Tons wheat @Rs.1200/- per 40 Kg to benefit the farmers during 2014. For this a network of purchase centers/ reservoir was established as under:-

Province	**Zones**	**PCs/RVs**
Punjab	09	210
Sindh	01	15
Baluchistan	01	07
KPK	01	01
Total:-	**12**	**233**

Procurement target and achievement thereof is as under:-

Province	**Target (M.Tons)**	**Quantity Procured (M.Tons)**	**%age of Original Target**
Punjab	15,16,500	993,699.450	65.53%
Sindh	56,000	5,950.300	10.63%
Baluchistan	24,000	11,641.100	48.50%
KPK	3,500		-
Total:-	**16,00,000**	**1,011,290.850**	**63.21%**

Special / Extraordinary Measures for Procurement. PASSCO liberally established Purchase Centres including those in the remote areas, to reach the genuine growers/farmers. Following special/extraordinary measures were taken to make the functioning absolutely transparent, efficient and farmer-friendly:-

PASSCO adopted following parameters for issuance of bardana for procurement of wheat:-

(1) Enhances Limit on issue of bardana @ 12 bags per acres instead of 8 bags.
(2) System of verification/validation of farmers.
(3) Documentation/authentication prior to and during the process of procurement (Revenue record/confirmation etc).

Procurement campaign was monitored by the supervisory Committees/Focal persons constituted/detailed by the M/o NFS&R and policy regarding provision of gunny bags to the farmers was fully implemented on the part of PASSCO.

SALIENT ACHIEVEMENTS- 2013-14

a. PASSCO turnover for the Financial Year 2013-14 was Rs.40,244,836,000/-. Profit after tax for the year 2013-14 is Rs.6,303,566,000/-.

b. PASSCO will be enhanced by storage facility of construction of 34 House Type Godowns from own funds is in hand. PC-1 of Project is completed. Project Consultant has been selected. Tender and bidding process is going to be started shortly.

c. PASSCO has initiated a Programmein certified seed production business and initial process has been completed. Further actions are in hand to launch the product in due course of time.

iv. DEPARTMENT OF PLANT PROTECTION

LOCUST SECTION

i). Fortnightly Locust Survey

The routine fortnightly locust survey was carried out in the potential locust breeding areas of Sindh, Punjab and Baluchistan during the last year. During the survey no significant locust activity was observed. Only mature solitary adults with population remaining from 06-25 adults/ hectare were observed at 59 localities of Rahimyar Khan.18 localities of Bahawalpur and 07 localities of Uthal. Maximum population of 25 adults / hectare was recorded at Kakki (275329N-712638E) area of Bahawalpur on 07-09-2013.

ii). Indo-Pak Locust Border Meeting

The locust officers of the Department participated in the monthly Indo. Pak border meeting with Indian counterparts from June to November, 2013 where information on locust survey and control were exchanged between the two countries. Total 05 meetings were held at Munabao/Khokhropar border point during last year.

iii). Pak-Iran Joint Locust Survey Under FAO

21 days Pak. Iran joint locust survey was undertaken under the auspices of FAO by the locust officers of Pakistan and Iran on either side of the Pak. Iran border with effect from 05-04-2014 to 25-04-2014. At the end of the survey a joint survey report was prepared.

iv) SWAC/CRC/CLCPRO Inter-Regional Workshop

SWAC/CRC/CLCPRO inter-regional workshop on the use and improvement of RAMSESv4 and eLocust3 held at Agadir, Morocco from 19-23 May, 2014 organized by the FAO of UNO. One of the designated Desert Locust Information Officers (DLIO) participated in the workshop from Department of Plant Protection.

REGISTRATION SECTION

The following pesticides have been registered/ permitted under different schemes during 01-07-2013 to 30-06-2014

SCHEME	FORM – 1	FORM – 16	FORM – 17	TOTAL
Registered/ Permitted	12	51	62	125

Registration of Formulation & Refilling / Repacking Plants:

Registration section has registered the following formulation and repacking / refilling plants during the same period.

Formulation Plants (Form – 18a)	**Refilling / Repacking Plant (Form – 19a)**	**TOTAL**
03	03	06

Revenue

A revenue of Rs.18,798,020/- was collected through treasury challans on account of registration/import permission, renewal/ revised fee, sample analysis fee and registration of formulation and repacking/refilling plants.

Federal Pesticides & Reference Laboratory.

Analyzed 202 pesticide samples during the report period

PLANT QUARANTINE DIVISION.

The Department of Plant Protection (DPP), the NPPO of Pakistan play its regulatory, advisory and R&D roles as per its mandate in exportation of plant and plants material under the provision of Pakistan Plant Quarantine Act, 1976 and Rule 1967 and the International Standard for Phytosanitary Measures (ISPMs) developed under the WTO-SPS negotiated International Plant Protection Convention (IPPC) of 1997.

The plants and plant materials imported/ exported, examined by the Department for the detection of insect pests and diseases during the year 2013-2014, (Attached as Annexure-I).

To further boost the export of plant and plant materials the septs have been taken by the Department of Plant Protection with trading partners in the light of MOUs signed with different countries.

KINNOW

During November 2013 to April 2014, 226443 MT Kinnow have been exported to Russian Federation, Islamic Republic of Iran, Middle East and other countries of the world.

ISLAMIC REPUBLIC OF IRAN

This year 21028 MT mangoes treated with hot water dip at 45ºC for 75 minutes have been exported to Islamic Republic of Iran as per the agreed MOU between Pakistan and the Islamic Republic of Iran, Issue of fake certification and unfair mean in export of fresh mango fruit from Pakistan to Iran was resolved by mutual understanding.

INDONESIA

Mutual Recognition Agreement (MRA) between Pakistan and Indonesia was signed on 30th August, 2013, both the sides also agreed and grant of pest free area recognition to Kinnow of Sargodha, Punjab Province of Pakistan. This year Pakistan exported 13025 MT citrus to Indonesia.

v. PAKISTAN AGRICULTURAL RESEARCH COUNCIL (PARC)

The achievements of Pakistan Agricultural Research Council during the FY 2013-14 are summarized as under.

PLANT SCIENCES DIVISION

1. Wheat

- **Germplasm development through hybridization**

Crosses: During the reporting period 571 new cross combinations including 31 top crosses have been made for bio-fortification, drought tolerance, disease resistance and quality improvement. Among which about 100 cross combinations were made for Ug99 resistance.

Generation advancement: 923 segregating populations at different filial generations have been maintained and harvested at NARC and planted at SARS Kaghan.

F7 Head Rows: 229 F-7 (10 rows each) populations consisting of 229head rows have been planted and 256 rows have been selected for further screening.

- **Evaluation of international elite lines/nurseries**

6 Observation nurseries and 8 yield trials comprising of 1424 test entries, were assessed for yield potential and other traits of economic importance and 245 selected for using in future wheat breeding program.

- **Evaluation of Station and regional trials**

503 bread wheat lines were tested in one initial evaluation yield trial (IEYT), 5 preliminary, 3 advance yield trials and 2 Regional trials. Out of total lines tested, 167elite lines were selected for advance testing. 10 top yielding lines from advance yield trials were upgraded as advance lines for testing in multi-locational trials. 12 top yielded advance lines from regional trials will be contributed to NWDSN for year 2014-15.In the year 2013-14, twenty advance lines were contributed to NWDSN for screening against various diseases of economic importance.

- **Advance lines tested in Provincial Micro Yield Trial (MYT) and National Uniform Yield trials (NUYT)**

Based on the performance at various stages of testing, four advance bread wheat lines were evaluated in the micro varietal wheat yield trials (rainfed) and two lines were tested in micro varietal wheat yield trials (irrigated) during 2013-14. Two bread wheat advance lines (NR-421 and NR-409) were contributed for 2nd year and two advance lines (NR 413 and NR 419) for first year testing in the National Uniform Wheat Trials (irrigated).One advanced bread wheat line (NR 403) was included in the National Uniform Wheat Trials (Rainfed) were

contributed for 2nd year testing; and four advance bread wheat lines (NR 411, NR 402, NR 407 and NR 439,) were also evaluated in first year testing.

- **Varietal Release**

Drought, heat and rusts (leaf rust, and yellow rust) are the major stresses in Pakistan which cause losses from 30 to 40%. Therefore, varieties with diverse sources of resistance and adaptation are needed to exploit the potential yield and increase wheat production in the country. Climate change may also give rise to new or more virulent races of major wheat diseases and pests. The incidence of the Ug99 race of stem rust in different areas of the world is a potential threat for wheat in Pakistan. More than 90% of the global wheat varieties currently in production are susceptible to this race. The NARC wheat program has released a high yielding, drought and heat tolerant wheat variety "Pakistan 2013" for rainfed areas of the country. This variety carries resistance to wheat rust diseases, particularly Ug99 race of stem rust.

Proposing of candidate line NR 399 (Borlaug 2014) for release

A candidate variety NR 399 (Borlaug 2014) was tested for its yield performance at different locations in NUWYT under both irrigated and rainfed conditions for two years. During the first year of testing (2011-12) under irrigated condition, it was stood fourth on all Pakistan basis (4452 Kg/ha) when yield of both late and normal planting was combined. During 2012-13 under irrigated condition at Pakistan level, it produced 4115 kg/ha in normal planting, 3572 Kg/ha in late planting and 3843 kg/ha when both seeding dates were combined. In both years of test it showed a good performance in late planting. Under rainfed condition, during the second year of testing (2012-13), it produced 3312 Kg/ha at Pakistan level, 3296 Kg/ha in Punjab and 3511 kg/ha in KPK and got 1st, 4th and 1st position, respectively**.**

The advanced line (NR 399) carries desirable resistance against yellow rust, leaf rust and stem rust. Moreover, CIMMYT/ Njoro Kenya disease data showed that it carries resistance against stem rust race of Ug99 which is a potential threat to global wheat production. NR-399 has also desirable quality traits like chapatti making etc. NR 399 was presented for spot examination based on its performance in national, regional and station trials and resistance against rusts. During spot examination conducted by Experts Sub-Committee (ESC) of the Punjab Seed it was cleared.

A high Zn containing potential wheat candidate variety (NR 421)

In Pakistan 5% of the children are at risk of zinc deficiency. Per capita wheat consumption in Pakistan is 124 kg a year, which is among the highest per capita wheat consumption in the world. Average baseline zinc content in Pakistani wheat is 25 PPM. A potential candidate wheat variety (NR 421) developed by Wheat Program, NARC was comparable with high yielding commercial variety in NUYT at its first and second year of testing. It showed the grain Zn content of 39 ppm as compared to the composite local check (25 ppm). It also carries desirable resistance against yellow rust (YR), leaf rust (LR) and stem rust. This

line will be presented for release during next year.

Wheat Drought Tolerance Evaluation

Twenty five wheat genotypes including 15 advanced lines from the wheat program, NARC, i.e. NR-397, NR-441, NR-443, NR-445, NR-448, NR-449, NR-450, NR-451, NR-452, NR-453, NR-454, NR-455, NR-456, NR-458, NR-459 and 10 genotypes from wheat wide crosses i.e. N-249, TH-13, Early Maturity, Webile, Solid stem, K-2, Qazi-11, Dhurabi along with a check variety, Chakwal-50 were assessed for drought tolerance through glasshouse and lab experimentations at NARC. Plants were subjected to drought stress (10% soil moisture) at anthesis stage. Physiological parameters like membrane stability, proline and chlorophyll contents were measured of the control and drought stressed plants. Plants were harvested at physiological maturity. Grain yield like seed numbers and weight per spike and 1000 seeds weights were recorded.

On the basis of high yield potential i.e. seed number & weigh per spike and 1000 seed weight under control and drought stress the wheat advance lines; NR453,NR459 and Wheat Wide Crosses provided genotypes; Early Maturity, Webile, K-2 and Qazi II were found the high yielding. Based on physiological and grain yield data the genotypes; **NR453, NR459 and Early Maturity, Webile and Qazi II** were found to be the best drought tolerant. The information generated on the behavior of different genotypes was shared with the wheat program, NARC for further utilization in their breeding program. The tolerant material has also been placed in NARC gene bank as a source.

Experiments conducted at SARC, Karachi under drought condition the genotypes/accessions/lines AZRC-47, AZRC-48, 11C023, QS3, AZRC-50, TD-1, Tandojam-83, Pirsabak-08, AZRC-50, 11C022, C002, FIS3013 and AARI-11 shows tolerance to drought by considering dry root weight (g) and the value ranges between 0.367 to 0.28g. Whereas the genotypes AZRC-40, AZRC-39, AZRC-37, AZRC-45, Imdad, AZRC-33, AZRC-32, Momal, Punjab-11 and AZRC-44 shows susceptibility to drought and their values range between 0.08 to 0.167g. The value for all the other genotypes remains between 0.08 to 0.167g.

The data reveals that the performance of genotypes AARI-11, AZRC-54, AZRC-47, NARC-11, AZRC-50, Benazir, Hero, Abadgar, AZRC-31, AZRC-51 and TD-1 by considering dry root weight (g) remains highest and ranges between 0.433g to 0.603g. Similarly the genotypes AZRC-39, 11C023, AZRC-40, AZRC-42, AZRC-44, AZRC-43, 11C022, 6C002, FIS3013, Dorabi-11, MPT-09, FSD-08 and Punjab-11 produces minimum dry root weight (g) and the value for them ranges between 0.21g to 0.357g. All other varieties shows average performance and the value for them range between 0.21g to 0.603g.

Finally 3 tolerant and 3 susceptible genotypes will be selected and cross in

accordance to diallel pattern.

Salinity Tolerance Evaluation of Wheat

Ten genotypes of wheat i.e. NR-397, NR-441, NR-443, NR-445, NR-448, NR-449, NR-450, NR-451, NR-452, and NR-453were obtained from Wheat Programme, CSI, NARC for evaluation under 120 mM saline stress conditions in sand culture. Two weeks after germination, seedlings were subjected to saline-stress. After a period of two-week leaf samples were collected and analysed for chlorophyll content, concentration of Na and $K^+$and rate of survival.

Result indicated that genotype **NR-443** had highest K content (55 ppm) as compared to Na content (30 ppm) with elevated K/Na ratio in leaf tissue after exposure to stress condition for a period of two weeks. Survival rate of NR-443 was higher than 80% in 120 mMNaCl stress conditions. In addition, this genotype had higher content of chlorophyll as well in samples. It appears that genotype NR-443 has intrinsic capabilities to withstand saline stress by maintaining high K/Na ratio. Moreover, low Na retention in plant tissue as compared to K content enables the plant to withstand stress.

Wheat Heat Stress Tolerance Evaluation

Fifteen wheat genotypes including advanced lines from the wheat program, **NR-397, NR-441, NR-443, NR-445, NR-448, NR-449, NR-450, NR-451, NR-452, NR-453, NR-454, NR-455, NR-456, NR-458,** and**NR-459**were planted in pots for heat tolerance assessment. Plants of each genotype were grown in natural environment up to anthesis growth stage. At post-anthesis stage, half of the plants (3 pots) of each genotype were kept in natural environment, as control, while three pots of each genotype were exposed to high temperature (40-45°C) in a glass house for 3-4 hrs daily, for 7 consecutive days. After the heat stress treatment, flag leaf was analyzed for proline and chlorophyll content.

Results indicated that on the basis of yield parameters, line **NR-443** and **NR-458** had minimum decrease in grain weight as compared to their control treatment. These lines have highest No. of grain per spike as well. Proline accumulation is a defensive mechanism of adaptation in plants to withstand stress condition, and positive correlation exists between proline content and plant ability to withstand stress. These lines also have optimum prolinecontent (900-1100 ug/g FW) at post anthesis stage. These results showed that line **NR-443** and **NR-458** are comparatively better tolerant to heat stress and are promising lines for breeding programme.

Low input Wheat Evaluation (P-use efficiency)

Ten wheat varieties viz., Bakhtawer, Sarsa-b2, Sonalika9, Inqilab-91, Moripak, Pak-81, Lu-26, Pohtas90, Pasban90 and PSBK-04 were evaluated for P-use efficiency under deficient (20 mg /kg soil) and adequate P (80 mg/kg soil) levels. Seeds were obtained from Wheat Wide Crosses Program Resource person; Dr. QaziMujeeb. Plants shoots were harvested after 45 days of germination and total p-uptake and biomass was recorded. The data revealed variation in shoot, root length; fresh and dry weight and total P uptake at deficient and adequate P supply. The highest shoot dry weight in wheat seedlings under deficient (20 mg /kg soil), was observed in Inqilab 91 followed by Sarsa-b2. Similarly higher P uptake (9.7, 7.8, 7.5 mg g^{-1}) was recorded in LU-26, Inqilab-91 and PSBK-04 respectively at the deficient P supply. Based on the overall performance, the wheat variety **Inqilab-91** was found p- efficient followed by **Sarsa-b2 and LU-26**. Under adequate p-level, Bakhtawer showed higher p-uptake and biomass accumulation. Involvement of genotypes with better P absorption and utilization mechanism in the breeding program could be useful for the plant breeders to evolve wheat genotypes that can perform better on P deficient soils.

Information regarding the genotype having higher p-use efficiency of will be given to NARC gene bank as a source for development of low-input requiring wheat varieties.

- **Crop Management**

Evaluation of different tillage and cropping systems in high rainfall area: Moisture conservation tillage during monsoon and fallow-wheat cropping system are conventional farmer practices in high rainfall area (>500 mm) of Pothwar region. The area receives about 70% of its total annual rainfall in monsoon season (July-September). Intervention was made in traditional farmer practices. Different tillage (Zero-tllage, bed planting and conventional tillage) and cropping systems (fallow-wheat, mung-wheat and maize-wheat) were evaluated at NARC, Islamabad to take advantage of heavy monsoon rainfall by sowing summer crop which replaced the fallow moisture conservation tillage practice. Mung-wheat system proved to be more economical and sustainable cropping system with high annual return under high rainfall condition. It produced wheat yield statistically at par with fallow-wheat system with additional mung crop and recommended for up-scaling. However no concrete conclusion could be made on tillage system due to severe early droughts and lack of suitable bed planter and zero-tillage drill, therefore it needs further investigation

NP fertilizer management for wheat crop in rain-fed ecology:
Wheat crop in rainfed ecology is usually exposed to early drought during months of November and December. Full dose of NP fertilizer application at planting time is a common farmer practice in the area. It is possible that crop might not availed full potential of the applied fertilizer dose due to low soil moisture during early growth stages. In this activity, farmer field trials were conducted in high rainfall (> 500 mm) and low rainfall areas of Pothwar region comprised of various NP fertilizer treatments. No significant differences were observed among various NP fertilizer treatments under both rainfall conditions; however, significant variation in grain yield was noticed among different sites in high rainfall ecologies. It could be concluded that higher NP doses at planting time might not be economical under rainfed conditions.

Legume crop (berseem) integration in traditional rice – wheat system of Punjab: Berseem-rice-wheat crop rotation was evaluated against conventional continuous rice-wheat system for consecutive 3rd years to enhance productivity and soil health. Berseem-rice-wheat improved grain yield (upto 30%) as compared to conventional rice-wheat system. The legume based rotation also helped to improve soil heath, weed control and availability of fodder for livestock in the farming system. The technology is recommended for up-scaling

Adoption of ridge planting of wheat in rice– wheat system of Punjab: Ridge planting of wheat evaluated against conventional flat land broadcast wheat sowing method in rice-wheat system with advantages of increased productivity, water saving, better weed control and other cultural practices. Ridge planting of wheat improved grain yield up to 20% and saved irrigation water (25%) and recommended for up-scaling as compared to conventional rice-wheat system

Sensor based N fertilizer management in Wheat: Nitrogen use efficiency in Pakistan is about 30%. NDVI sensor (Green seeker) was used for in-season fertilizer management of wheat crop. Trial was carried out at NARC using variable N fertilizer treatments (0, 30,60,90,120 and 150 kg/ha). Sensor provided useful indication of nitrogen efficiency at various growth stages of the crop which might be used to improve N use efficiency in wheat crop and enhance productivity.

Effect of Zinc application on yield and wheat grain Zn contents (Wheat biofortification): An average person in Pakistan gets about 60% calories of its daily diet from wheat grain. Human diet in Pakistan is Zn deficient. About 5% of the children are at risk of zinc deficiency. Average baseline zinc content in Pakistani wheat is 25 ppm. Agronomic practices like soil or foliar application of $ZnSO_4$ can enhance wheat Zn contents. An experiment was conducted at NARC, Islamabad that was comprised of different soil and foliar application treatments on wheat crop at various growth stages. Soil and foliar application of $ZnSO_4$ improved wheat grain yield by 14 % as compared to control (no Zinc application). Samples will be tested for Zn contents in wheat grain. According to previous results, foliar application of Zn at booting stage along with soil application at planting improved Zn contents in wheat grain by 15%.

- **Coordination**
  - A total of 126 sets of International Trials/Nurseries that includes 108 (1670 entries) from CIMMYT and 24(615 entries) from ICARDA and were acquired distributed to 22 collaborators in the country to broaden genetic diversity and use in the breeding programs.
  - In National Uniform Wheat Yield Trials (NUWYT), 51 advanced breeding lines were contributed by different wheat research programs in the country. Ninety sets of Wheat Irrigated trials (33 lines and 7 currently grown varieties) and 25 sets of Wheat Rainfed (18 lines and 6 currently grown varieties) of National Uniform Yield Trials were prepared and distributed among 23 collaborators in different agro-ecological zones of the country
  - Under early warning system, 290 bread wheat advance lines were contributed by the breeders from various institutes have been sent to WRI Faisalabad, CCRI Pirsabak, CDRI Karachi, Washington State University USA, University of Minnesota andNjoro Kenya.

2. Cereal System (Rice; Maize, Sorghum, Millet and Fodder Crops)

Germplasm

Eleven sets of 917exotic rice germplasm was acquired from IRRI and evaluated at 9 locations in various ecologies in the country. The promising lines selected from the exotic rice germplasm will be evaluated in adaptability/NUYT trials. About 106 lines of indigenous germplasm of rice (35), maize (42), lucerne (31), sorghum (24) and millet (10) were acquired. On the demand of scientists working on cereal system crops 195 lines comprising of maize (92), lucerne (32), sorghum (24), millet (10), sudangrass (5) and S. S. hybrids (2) distributed.

Rice National Uniform Yield Trials (NUYT)/Adaptability Trials

- Adaptability Trial: Seventy two rice hybrids received from different private seed companies and public sector were evaluated in adaptability trials across the country. Rice hybrid RH-378 produced highest paddy yield of 12.38 tons per hectare. In the current season testing/evaluation of 70 rice hybrids at 11 various locations is in progress.
- NUYT on Candidate Lines of Course Rice: In rice growing season of 2013, 9 lines of course rice were tested in NUYT. Coarse rice line RICC-13122 produced the highest paddy yield (6.99 t ha^{-1}), while RICC-13127 produced lowest paddy yield of 1.58 t ha^{-1}. Eight candidate lines of

course rice have been planted at 8 locations for testing and evaluation in rice growing season 2014.

- NUYT on Candidate Lines of Course Rice: Eleven candidate lines of fine rice were tested in National Uniform Yield Trials across the country during rice growing season 2013. The fine rice line RICF-13112 produced the highest yield of 6.28 tons per hectare, while RICF-13117 resulted in the lowest yield of 3.27 tons per hectare. Twelve fine rice lines at 8 locations are under evaluation during the current season.

Rice Variety/Hybrid Approval through Variety Evaluation Committee (VEC)

- Meeting of Variety Evaluation Committee (VEC) was held on April 7, 2014. Twenty five (25) rice hybrids and one aromatic variety (GA-456) were approved by the VEC committee for commercial cultivation in the country.

Drought Tolerance Evaluation of Rice:

Twelve rice hybrids from the rice program, NARC were assessed for drought tolerance through glass house experimentation. Plants will be grown in pots and water stress was applied by withholding water till temporary wilting appears (leaf rolling ~ 13 % soil moisture) at flowering stage. Physiological & biochemical parameters like chlorophyll, proline and membrane ion-leakage were recorded. Agronomic data agronomic data (panicles/plant, grains/panicle, grain wt/ panicle and grain yield/plant was also recorded. Under drought stress, the rice hybrids; **GSRRFLL-4, GSRRFLL-14 and GSRRFLL-15** performed better having significant higher seeds per spike and showed higher chlorophyll under drought stress.

Maize, Sorghum and Millet (MSM)

- Maize Hybrids: Seventy eight hybrids of maize received from public research institutes and private seed companies were evaluated at various locations both in spring & autumn season. Out of 78 hybrids, Nine Hybrids viz: YH1898, PX12, P1574, HYT1100, FH985, PX13, DK6103, DK9108 & FH949 produced >10 tons ha-1 yield in spring and in autumn, ten hybrids viz: S7720, 40C245, 2468, HYT2055, TM8294, TM8490, OSSK596, 40C253, OSSK602 & OSSK644 gave > 8.5 tons ha-1 yield. In the current season 91 maize hybrids (white & yellow) have been planted for evaluation in three trials at 9-11 locations in spring and autumn season.

- Maize Varietal Trial: comprised of 14 and 10 genotypes evaluated at four and six locations during spring & autumn season respectively. Three newly developed varieties (MTM-1, 7004, E-77) produced < 6.0 ton while

in kharif season, three genotypes viz: Islamabad Gold, EV-77 and MMRI Yellow produced > 4.9 tons/ha grain yield.

- Sorghum: Twenty indigenous hybrids of sorghum evaluated at three locations. Three hybrids (474 x 165, 11 x 89058 & 70 x 89058) produced grain yield of 4.5 to 5.2 tons with stalk yield of 38.8 to 49.4 tons/ha. Twenty lines of sorghum have been planted at 3 locations during the current season.
- Millet: Seven hybrids evaluated at six locations produced maximum grain yield 3450 kg ha-1 followed by EMH685 with 3327 kg ha-1. Ten lines of millet have been planted at 5 locations during Kharif 2014.

Fodder Crops

New Candidates Sorghum Sudangrass hybrids

- Two Sorghum Sudangrass hybrids (NARC Hybrid-2 & NARC Hybrid-4) having yield potential of 20% more than check (Pak-Sudax) across the country. Further, the farmers' field testing results also confirmed 19 and 14 (%) higher yields in "NARC Hybrid-2" and "NARC Hybrid-4" respectively than the check. As another prerequisite of hybrids release; production technology like seed rate, row-spacing, fertilizer trials and sowing dates have also been standardized indicating seed rate of 25 kg ha-1 produced higher green fodder yield (172 t ha-1) in "NARC Hybrid-2" and (159 t ha-1) in "NARC hybrid-4". Row spacing of 30 cm proved its superiority in both the hybrids by producing 167.17 and 169.32 t ha-1green fodder. Fertilizer dose of 60:60 NP at sowing and 75 kg N (ha-1) after each cut was appropriate for getting higher green fodder yields of 161 & 157 t ha-1 respectively in "NARC Hybrid-2" and "NARC hybrid-4". Sowing date of 1st March for Sothern Punjab and 15th March for Pothwar region are appropriate for getting higher fodder production (185-176 t ha-1) in "NARC Hybrid-2" and (179 to 169 t ha-1) in "NARC "NARC hybrid-4". In addition to this 788 kg pure seed of their parents has also been produced for commercial scale hybrid seed production. All other registration formalities like distinctness, uniformity and stability (DUS) have also been completed and proposal writing is in process to release these hybrids for general cultivation in the country.

Adaptability Testing of S.S. Hybrids

- Seventeen (15) exotic and 3 indigenous sorghum sudangrass hybrids contributed by 9 different contributors were evaluated at 10 different locations under adaptability trials in collaboration with FSC&RD. The green fodder yields ranged from 72.41 to 134.77 in four cuttings. On the basis of yield performance 10 S.S. Hybrids producing significantly higher green fodder than check (Pak-Sudax) were recommended for general cultivation.

Germplasm improvement/distribution

- Fodder Research Program maintained and evaluated 843germplasm lines of oats, lucerne, berseem, vetch, sorghum, millet and barley. These germplasm lines were further distributed to fodder scientists of FRI, Sargodha, AARI, Faisalabad, University of Agriculture Faisalabad, NWFP Agriculture University Peshawar, ARI, Tarnab, AZRI, D.I.Khan, ARI, Tandojam, ARI Sariab Quetta, BARS, Kohat, and BARI, Chakwal.
- The oats germplasm was improved through 133 heads to rows selection method from the existing oats germplasm during winter 2013-14. The criteria for selection of these lines wasthe fodder and grain yield and other morphological characteristics like plant height, number of tillers per plants, leaves per tiller, leaf area, fodder availability period, size of spike, number of spikelet per spike and grain size. The most promising three lines of oats and one line of millet were included in NUFYTs for variety development process.

New Candidate Line of Oats "NZ-0034"

- The registration formalities like, application for registration to FSC&RD, DUS, testing under NUYTs, agronomic studies, farmers' field testing and large scale basic seed production of high yielding, late maturing, with more foliage and stiff stemmed of "NZ-0034" has been completed. Proposal writing for VEC is in process and it will be put for release in coming few months.

Dissemination of Production Technology/advisory services to fodder growers

- Improved seed of high yielding varieties of fodder crop (Oats, Maize, Millet, Guar and Mottgrass) was produced, processed (cleaned, graded and packed) and sold through PATCO (Table 1). This activity earned an income of Rs 1.22 million for the organization. Further, with the disbursal of the 22.37 tons seed about an area of 1086 acres was planted under these high yielding fodder crop varieties in the country. In addition to the above advisory services on fodder crops production, problems and their solutions were provided to farmers through lectures, print and electronic media.

Meetings

- Meeting of Cooperative Units of Cereal System (Rice, MSM and Fodder crops) was held on December, 11, 2013 at PARC. Thirty scientists from the relevant federal and provincial coordinated Units/Institutions attended the meeting. National Coordinator (Cereal System) gave a detailed presentation on the current situation of important cereal crops.
- The International Maize and Wheat Improvement Center (CIMMYT), in partnership with Pakistan Agricultural Research Council (PARC)

organized a Maize Working Group meeting from 3-4 February, 2014 for public and private sector Maize Scientists in NARS. The objective was to discuss the collaboration under the Agricultural Innovation Program (AIP) and plan the upcoming activities of maize exotic germplasm (OPV/Hybrid) evaluation. The meeting created a platform to develop shared objectives and priorities for enhancing maize production and productivity in Pakistan. It also provided an opportunity for experience sharing and enhanced synergies among the public and private partners working on maize research and development in Pakistan.

- A meeting on "3Rd Regional Coordination Meeting of ICARDA-SACRP" was attended from 16-22 June, 2014 at Beijing, China. The ongoing research and developments in crops and natural resource managements undertaken in various projects were highlighted by the presenters from collaborative countries. Based on the findings and conclusions highlighted in the presentations, four working groups i.e. Land and Water Management, Food Legume Improvement, Cereal Crops and Integrated Crop-Rangeland-Livestock Systems (ICRLS) were formed. The groups discussed thoroughly the present and future scenario in the areas of their expertise in the region. In forage sector, information regarding the world best collection of oats germplasm at NARC was shared with the participants. The proposed activities under the project "Center of Excellence for Dryland Agriculture in Balochistan" and the following future potential projects were discussed in the meeting.
- Value addition to wool especially for resource poor farmers of higher altitudes.
- Seed production of fodder and pasture crop species.

جناب سکندر حیات یاسن، وفاقی وزیر برائے قومی تحفظ خوراک و تحقیق PARC بینڈ کورٹرز میں 37 ویں بورڈ آف گورنرز کی میٹنگ کی صدارت کر رہے ہیں۔ (اسلام آباد)

3. Oilseed Crops

Germplasm:
The fifteen sunflower germplasm entries (Hybrids) were imported from USA, Europe, Argentina and Australia by private seed companies in collaboration with public sector for adaptability testing in the country. One each entry of sesame and groundnut was received from North Korea and were distributed to coordinating units for their evaluation. Seven spineless safflower exotic entries were also received and were evaluated at NARC. The ninety seven germplasm entries of rapeseed-mustard, groundnut and soybean were provided on the requirement basis to NARS for research and development activities of oilseed crops during 2013-14.

National Uniform Yield Trails 2013-14.

Rapeseed-mustard:
The twenty two rapeseed and fifteen mustard entries were tested at twelve locations during 2013-14. Among rapeseed entries. KN-259 gave higher yield (2351 kg/ha) followed by HBO-5 (2182 Kg/ha) as compared to check Faisal Canola (1943 kg/ha). Among mustard entries EMH-247 gave higher seed yield (2245 kg/ha) followed by KJ-206 (2133 kg/ha) as compared to check Khanpur Raya (1896 kg/ha).

Sunflower:
The sixteen entries received from public and private sector were tested at 16 different locations in the country during spring 2014. The data compilation is in progress.

Sesame:
Ten entries were tested at eight locations during 2013-14. The results revealed that only NS-2 produced higher seed yield (617 kg/ha) as compared to check TS-5 (552 Kg/ha).

Groundnut:
Eight groundnut entries were tested at seven locations in the country. Among the entries BARD-479 (check) produced higher seed yield (2511 kg/ha) followed by the Golden (2434 kg/ha) and PG-1135 (2433 kg/ha)

4. Sugar & Food Legume Crops

Germplasm Acquisition and Distribution (2013-14)
Twenty three lentil nurseries comprising 447 accessions and 26 chickpea (Kabuli) nurseries comprising 400 accessions were received from ICARDA and distributed among cooperative units under NARS
18 accessions of mungbean received from AVRDC distributed to 5 research institutes for further evaluation.

Sugarcane Fuzz

Locally collected sugarcane fuzz from National Sugar and Tropical Horticulture Research Institute (PARC) Thatta were distributed among 4 research institutes and 2 sugar mills as per following/details:

Crops	Acquisition		Distributed to Institutes (Nos)
	No. of Nurseries	No. of Accessions	
Lentil	23	447	10
Chickpea (Kabuli)	26	400	11
Mungbean	-	18	5
Sugarcane Fuzz Local	-	12 Kg	6

National Uniform Yield Trial

i) Food Legume Crops

Rabi 2013-14

NUYT on two food legume crops was conducted in Rabi 2013-14. In chickpea (Desi) 15 entries and in chickpea (Kabuli) 14 entries were tested at 15 locations. In lentil crop 12 entries were evaluated at 17 locations throughout Pakistan. Data is being compiled.

Kharif 2014

In Kharif 2014 Mungbean NUYT with 17 entries is being conducted at 15 locations. Mash trial is also in progress with 5 entries at 12 locations.

In previous NUYT (2012-13) a candidate mungbean variety NCM 257-2 contributed by Pulses Program out yielded all the genotypes in mean seed yield over all the locations. This genotype topped in NUYT for two consecutive years. Maximum yield record was 2300 kg/ha and average yield was 1300-1500 kg/ha as compared to control Chakwal Mung06 700 kg/ha and in NM-II 900 kg/ha.

The results of National uniform yield Trial (NUYT) on Desi and Kabuli chickpea showed a wide range of variation for grain yield between locations and varieties. In Kabuli NUYT, genotype CM 770/06 gave higher mean yield of 1814 kg ha^{-1} as compared to the check Noor-09 (1641 kg/ha) across 11 locations. The results from 13 locations on Desi NUYT revealed significant differences between genotypes ($P<0.05$). The genotype CM 156/05 gave higher mean yield of 2010 kg ha^{-1}. Two lines CMC211S and NCS-0701 contributed by the Pulses Program NARC gave mean grain yields of 1751 and 1200 kg/ha, respectively.

ii) Sugarcane

National Uniform Yield Trial-2012-14

This trial comprised eight sugarcane candidate varieties. The highest cane yield was recorded in candidate sugarcane variety BPTH-804 (126.0 t/ha) followed by Th-719 (118.66 t/ha) and YTTH-55 (114.00 t/ha). Maximum sugar recovery was recorded in the variety NARC-2 (13.04%) followed BPTH-804 (12.96%). Highest sugar yield was produced by sugarcane candidate varieties BPTH-804 (16.33t/ha) and YTTH-55 (14.10t/ha).

Sugar Beet Varietal Evaluation Trial

The experiment consisting of eight sugar beet hybrids was laid out in randomized complete block design with three replications. Two sugar beet varieties California was planted as check. Four rows of eight meters length and 75 cm apart were planted in each replicate. The experiment was planted during October 2013 using seed rate of 2.5 kg ha^{-1}. Fertilizer was applied @ 110-80-80 kg N-P-K ha^{-1}. Weeds were controlled manually. Similar levels and number of irrigation were applied to all the varieties. The data on yield and yield parameters were collected during May 2012.

5. Horticultural Crops

Studies on the Effect of Different Organic Nutrients on Yield of Okra (*Hibiscus esculentus*)

The effects of different organic nutrients on the yield of Rama Krishna Indian hybrid variety of Okra (*Hibiscus esculentus*) have been studied. The data showed that all the treatments have significant effects with respect to days to flowering in comparison with control (47.03 days), whereas, for other treatments it ranges from 32.16 to 37.73 days. Among all the treatments T-1, shows early flowering. The treatment T-3 produces greatest plant height (80.20cm). The treatment T-2 (Biophosphate) produces more number of leaves/plant (18.93), in comparison with control and other treatments. With respect to leaf length and leaf width no significant effect was founds. Longest fruit length (15.81cm) with greatest fruit circumference was produced by the plants treated with T-1. The value for other treatments ranges between 9.75 to 12.99cm and 3.41 to 5.18cm, respectively. Similarly greatest fruit weight was obtained when plants were treated with T-1 i.e. 6.116g. The value for other treatments ranges between 4.55 to 6.016g. The total fruit weight/plant was obtained by the treatment T-1 i.e. 85.45g as compare to other treatments and ranges between 24.98 to 77.5g. It is therefore concluded that all the treatments gave better results, as compared to control.

a. Evaluation of New Crops at IPI Farm, SARC, Karachi

Introduction of exotic and indigenous varieties of crops, fruits, vegetables and ornamental plants for evaluating their potential and suitability under local

conditions is a regular activity of the IPI farm, SARC, PARC Karachi. During the year different accessions, varieties and hybrids of following crops have been evaluated at the farm:

i. Rosella Tea
ii. Bread fruit (*Artocarpus altilis*)
iii. Castor bean (*Ricinus communis L*)
iv. Radish (*Radish sativus* L.)

The salient findings are as follows:

- Rosella tea accessions were received from PGRI, NARC Islamabad for performance evaluation. Accession no. 04-06 has been performing well for growth and floral development as compared to remaining accessions.
- A total of 519 seedlings of Bread fruit have been introduced with main objectives to become substitute/alternate of Wheat as it contains high amounts of starch, fiber and may potentially be used for bread making purpose.
- Three (03) improved varieties of Castor Bean along with a local one were sown in experimental field of IPI. The data regarding growth and yield characters have been collected. The three varieties although have low germination rate as compared to local one, but produced higher number of seeds.

Effect of Nitrogen, Phosphorus and Potassium on Growth and Yield Characteristics of Radish (Radish sativus L.)

A study was carried out to evaluate the influence of different nitrogen levels on growth and yield characters of radish. After compiling the results it was found that an increase in nitrogen levels at 100Kg ha^{-1} and above positively affected the all growth and yield parameters of radish. Control plots, where no fertilizer was applied remained inferior for all characteristics. The root yield (t ha^{-1}) were 45.64, 64.00, 72.60 obtained at 0, 100 and 150Kg ha^{-1} of Nitrogen, respectively.

b. Vertical Farming: An Improved Farming Technique

The vertical farming is a cultivation method of raising vegetables on staked wooden pegs surrounded by net. The seedlings are grown at upward direction on ropes instead of conventional horizontal cultivation. The vegetables of cucurbitaceae and solanaceae families can be grown successfully by using this method.

Vertical Farming

c. Drip Irrigation System for Efficient Water Use

Drip irrigation system is a modern irrigation technique used to supply the desired amount of water in drop form in root zone of crops through plastic pipes and emitters. It was installed on three (03) acres for vegetable production at IPI farm, SARC, PARC Karachi. Three (Pali, Shenshah and Durga) varieties of Hybrid Bitter gourd (*Momordica charantia* L.) were sown. Maximum and minimum germination (82 and 72%) recorded for Pali and Shenshah varieties. Maximum plant height (66 cm) and number of branches (17.0) were recorded.

d. Raised-bed Irrigation System

Application of irrigation water through prevailing traditional methods results into loss of 40-50%. To overcome these losses raised bed planting method is developed for efficient utilization of irrigation water and input saving to increase crop yield.

e. Micro-Catchments: A Modern Technique for Rain water Harvesting

Micro-catchment for water is a successful technique to harvest water. Micro-catchments are especially different nature of basins around the plants with slopes and berms to conserve rain water for long period of time. Micro-catchments were prepared in Coconut, Jojaba and Chiku plants at IPI farm, SARC, PARC, Karachi.

Hybrid Bitter Gourd Plantation on Drip Irrigation System

Raised-Bed Irrigation System

Raised bed preparation

Maize crop grown on raised bed

Micro Catchments

Micro catchments in Coconut

Micro catchments in Jojoba

f. Solar Water Pumping System

A solar panel was installed at IPI Farm, SARC, PARC Karachi under project granted by ICARDA and USAID. The data collected stated that running time of system was 11 hours (from 7am to 5pm). The average discharge is recorded at 1.624 LPS, while, average per day discharge is 64,310L.

6. Tea and High value Crops

During July, 2013, a major change was brought in the mandate of the Institute and in addition to research and development activities on tea, the Institute was entrusted to have a start for the promotion of high value crops i.e. fruits, vegetables and medicinal plants for their commercial production in their specific climatic zones of the areas, It was planned to establish mother fruit orchard, fruits and vegetable nurseries for mass scale propagation and distribution of quality planting materials to growers, develop packages of production and processing technologies for high value crops and training of farming communities for capacity building in the successful cultivation of high value crops and establishment of Display Centre at the Institute for advertisement and sale of NTHRI products. It is encouraging to see the progress made in one year in strengthening of resource base of high value crops, development of production technologies packages for different crops and demonstrating to growers for adoption. Diversification and magnification of activities demands the establishment of well equipped laboratories and field facilities with provision of sufficient qualified staff for efficiently addressing the research and development issues in tea and high value crops.

- Processed one tone of green tea at NTHRI.
- Managed 0.12 million tea y nursery plants.
- Established mother fruit orchard (comprising of 14 fruit species of promising cultivars) on 1.54 acres at NTHRI.
- Purchased 3671 nursery plants of various fruit species from Agric. Research Institutes for distribution among the growers.

- Budded/grafted 5000 rootstock of peach and wild apricot with approved cultivars of apricot, peach, plum and almond for production of true to type fruit plants.

Walnut nursery

Peach rootstock nursery

Mother fruit orchard

Flea seed

Linseed

American saffron

- Raised and managed the nursery of walnut (3000 seedlings), fig (2000 plants), pomegranate (2600 plants).
- Raised nursery of squashes, sweet pepper, cabbage, cauliflower and cucumber as protected cultivation “Natural off season vegetables growing”.
- Sorted /graded for seed production and preserved for pre basic seed in cold storage OPV “Swat-I”.
- Seed will be utilized for experiments, production of seedlings, yield production and sowing for PB Seed during next seasons.
- Produced 13 kg pea seed of Calvary: Dollar , 30 kg Seed of each Radish, turnip and Spinach and 6 kg seed of OPV Swat-I.
- Established Medicinal Herb Garden and following medicinal plants has been collected and planted at NTHRI:
- Cool mint, lavender mint, apple mint, asavi mint, camphor mint, piper mint, mentha peperita, menthe sp., local mint, achilliummellifolium, iculanchoe, thymus serpyllum, hypencum sp., banshfa, plectranthus varigata, plectranthus ambloricus, alovera, lavender, oregano, rosemary. Line seed, Flea seed, Thyme, Saffron (Pakistani & American) and Chamomile.
- Multiply the medicinal herbs i.e. chamomile and thyme for further multiplication at NTHRI as well as on farmers field. Seeds of linseed and flea seed were also multiply
- Established Display Center for advertisement and sale of tea, fruits plants, vegetables seedlings and ornamental plants and availability of broachers on the cultivation of tea and high value crops.

- Supervised one M.Phil, one M.Sc and six B.Sc students from various universities for their research work.
- Awarded Trainings in tea processing, kitchen gardening and cultivation of medicinal herbs.

7. Pest and Disease Management

Crop Diseases

- **National uniform Wheat Yielding Trial (NUWYT)**

National uniform Wheat Yield nursery was comprised of 64 wheat candidate lines to evaluate against all three rust. 12 locations data of leaf, yellow and stem rust indicated that 28 candidate lines were found resistant to leaf and yellow rusts at all the tested in 2013-14. Eleven candidate lines showed their effectiveness against leaf and yellow rusts in 2012-13 and 203-14. Five candidate lines were found resistant to leaf rust and only one to yellow rusts during two consecutive years. Most of the candidate lines showed their ineffectiveness to local stem rust race RRTTF at CDRI, Karachi

- **National Wheat Disease Screening Nursery NWDSN**

National wheat disease screening nursery 2013-14 comprised of 606 wheat lines (104 commercial wheat varieties and 474 breeders advance lines). 186 advance wheat lines were found resistant to leaf and yellow rusts. 142 advanced lines were found resistant to moderate resistant at CDRI, with local rusts race RRTTF. Galaxy 2013 the newly released wheat variety was found susceptible to all three rusts. Pakistan-13, Pirsbak-13, Shahakr-13, Punjab-11 and Faisalabad-08 were found resistant to leaf and yellow rusts but susceptible to stem rust. Aas-11 and Benazir-13 were found resistant to all three rusts. Seher-06 should be replaced with other newly released varieties resistant to rusts.

- **Epidemiology of wheat Rusts**

Wheat rusts trap nurseries comprised of leaf, yellow and stem rusts isogenic lines were planted at 15 locations of the Pakistan. Most of the yellow rust resistant genes were susceptible to prevailing yellow rust pathotypes except *Yr5, Yr10, Yr15* and *Yrsp.* Stem rust was observed in Southern parts of the country. Virulence of *Puccinia graminis* overcame genes for stem rust resistance *Sr5, Sr6, Sr7a, Sr8b, Sr9a, Sr9d, Sr9g, Sr9e, Sr10, Sr11, Sr12, Sr17, Sr18, Sr19, Sr20, Sr21, SrMcN, Sr22, Sr27, Sr28, Sr29, Sr35, Sr36, Sr37* and *SrTmp*. The isogenic lines carrying stem rust resistance genes *Sr24, Sr25, Sr26, Sr30, Sr31, Sr32, Sr33, Sr34, Sr39* and *Sr40* showed resistant. Leaf rust resistant genes *Lr9, Lr19* and *Lr28* were the only two genes gave response as immune and remaining resistant genes were overcome by virulence of *P. triticina.*

Maintenance of rust culture collection

Maintenance of live rust culture collection is one of the most important tasks in wheat rust research. During 2013-14 CDRI Murree isolated, purified and maintained 70 yellow rust, 50 stem rust and 25 leaf rust cultures. These cultures are being used for screening and genetic analysis of host lines and will serve as reference for future analysis.

Maintenance of genetic stocks

Pure differentials and wheat genetic stocks are indispensible for wheat rust research. Soon after reestablishment of Murree glasshouse under WPEP over 2000 wheat land races and rust differentials were acquired for multiplication, maintenance and use from University of Minnesota, Washington State University and National small grain research Facility USDA Aberdeen. These stocks were multiplied under field & glasshouse conditions of CDRI Murree and Islamabad for future research.

Stem rust virulence analysis

After up gradation of Murree facility the race identification work has been addressed more systematically. In 2013-14 forty six isolates collected from wheat from growing areas of Pakistan were analyzed at the CDRI Murree station. Only one race RRTTF virulent to *Sr5, Sr21, Sr7b, Sr11, Sr6, Sr9g,Sr36, Sr30, Sr17, Sr9a, Sr9d, Sr10, SrTmp, Sr38*and *SrMcn* was found among all the samples. The race was avirulent to *Sr9e, Sr8a, Sr24* and *Sr31* and thus did not belong to Ug99 group. A parallel analysis of these samples by the collaborating group at University of Minnesota confirmed the race analysis results.

Yellow Rust virulence analysis

Historically repeated yellow rust epidemics in SAWANA region indicate complexity *Pucciniastriformis*populations in the region. Information about complexity of races/virulence prevailing in the region and their dynamics is critical for the management of this important disease. Very recently evidence for presence of sexual cycle in*P. striformis*populations in the region is provided by Sajid et al. Under these it is became indispensible to monitor yellow rust races prevailing in Pakistan. In 2013-14 CDRI Murree played a vital role in identification of races/virulence of *P. striformis* from wheat growing area of Pakistan. Fourteen yellow rust races were identified among sixty yellow rust samples from all over Pakistan. Complex races with complexity of 9, 10 and 11 were frequent. Virulence for *Yr6, Yr7, Yr8, Yr9, Yr17, Yr27, Yr43, Yr44, YrTr1* and *YrExp2*was common while virulence for *Yr1, Yr5* and *YrSp*was absent. Some of the yellow rust disease samples were also analyzed at Washington State University by the WPEP collaborating scientist.

Leaf rust race analysis

Due to limited availability of the pure seed of leaf rust differentials leaf rust analysis was limited. A set of 40Leaf rust isolates processed at CDRI Murree was dispatched for analysis to University of Minnesota where Kolmer et al.

analyzed them. This analysis showed presence of 8 races namely CCPSL, FHPSQ, MBDSS, MCDSS, PBMQQ, PBPQQ, PGMSL and PHPSQ were isolated among 40 samples. Prior to this seventeen leaf rust disease samples were analyzed at CDRI Murree for their virulence to twelve most important leaf rust genes, as Saher one of the leading mega cultivars of Pakistan, fell susceptible to leaf rust and there was no firsthand information as to what is the genetic base of its resistance to leaf rust. Most of the analyzed samples were from cultivar saher and were virulent to gene Lr16 & Saher but not to *Lr25*which confirmed presence of *Lr16* in saher postulated by Kolmer et. al.

Screening of the Breeders genetic stocks

One thousand three hundred and fifty nine lines consisting of Breeder's genetic stocks, 3rd Base line resistance screening nursery (3rd BRS), national wheat disease screening nursery (NWDSN)and national uniform wheat yield (NUWYT) trial were screened for their resistance to stem rust race RRTTF and the most prevalent yellow rust race 574232 under glasshouse conditions. The material was also screened for stem rust under filed conditions of CDRI Karachi, where epidemic was ensured by supplying viable inoculum from Murree facility. Inoculum was also provided for field screening of this material against yellow rust at CCRI Pirsabak.

In addition to it screened 704 Pakistani wheat land races for their field resistance to yellow rust out of which 201 were resistant at adult plant stage.

- **Chemical Control of Yellow rust**

The control of yellow rust by chemical spray trial was conducted in NARC Field using six varieties. Kirin-95, Sarsabz, TD-1, SKd-1, Moomal 2002 and Morocco in replicated trial Fungicide Folicur430SC was tested for chemical control of rust with the dose 120 ml/acre was used in two sprays in 15 days interval in the field. The plots with fungicide spray showed rust reaction lower than the plots without fungicides. 1000 grain weight was measured in replicated plots. The plot with pre emergence showed best result for controlling the stripe rust.

Spot Blotch

To determine the resistance level against spot blotch disease of wheat, a field screening by artificial inoculation of 64 National Uniform Wheat Yield Trail (NUWYT), 496 National Wheat Diseases Screening Nursery(NWDSN) and 110 commercial wheat varieties against *Bipolaris sorokiniana* was conducted at National Agriculture Research Centre, Islamabad. Out of 64 NUWYT entries 49 entries showed resistance, 13 MR, while one entry (Bahkhar-2000) planted twice in the experiment as check exhibited HS reaction. Out of 496 entries, two entries exhibited HR reaction, 311R, 137 MR, 21 MS, 21 S (the variety Bahkhar-2000) planted the experiment as check and the same showed HS reaction at four lines in the experiment. Out of 110 commercial varieties 94 varieties showed (R). 8 varieties showed moderate resistance (MR). One variety showed moderate susceptibility (MS).Three varieties showed susceptibility (S). Four varieties showed high susceptibility (HS). All the S and HS were exhibited by the same variety Bahkhar-2000 that was replicated in the

trial as check. The two varieties including AZRC-36 and B-1 (N)-9 exhibited HR with zero disease and the all the 454 entries tested in three sets of experiments showed resistance under field conditions can further be exploited in breeding program.

MOLECULAR VARIATION AMONG *BEMESIA* POPULATION IN COTTON GROWING AREAS OF THE PUNJAB AND SINDH.

During 2007-2008 and 2008-2009, the cotton growing areas of the Punjab and Sindh provinces were surveyed and *Bemisia tabaci* populations sampled from cotton fields showing CLCuV infection. The genetic diversity, biotype status of the *B. tabaci* and its association with difference in cotton leaf curl disease incidence across both provinces were assessed by using random amplified polymorphic DNA–polymerase chain reaction and the mitochondrial cytochrome oxidase 1 (mtCOI) gene sequences. Phylogenetic analyses of mtCOI gene sequences congregated Pakistani *B. tabaci* with two genetic groups; Asia II 1(H, M, NA, non B Biotype) and MEAM 1 (B, B2 Biotypes) in the year 2007-2008. However, the 2008-2009 samples fell into three distinctive clusters namely, Asia II 1, Asia II 5 and MEAM 1. This phylogenetic inference revealed that the vast majority of the B. tabaci were Asia II 1(non B biotype) and appeared well established in cotton growing regions of Punjab and Sindh province. This Asia II 1 cluster separated into two subgroups; subgroup A and subgroup B. The subgroup A, showed Pakistani populations shared close relation ship with the Chinese, Indian and previously described Pakistani *B. tabaci* whereas the subgroup B populations with Nepal and Bangladesh populations. MEAM 1 was not detected in Punjab cotton growing areas by RAPD and phylogenetic analysis however identified from few locations of Sindh. Two populations from Pakpatan, Punjab and one from Khairpur, Sindh grouped with Asia II 5 (G biotype) with a high bootstrap support at 99%. The Asia II 5 is a new biotype observed in Pakistan and its presence is already reported in India and Bangladesh. This study is the first evidence of Asia II 5 presence in Punjab and Sindh, hence, the correlation between Asia II 5 and Cotton Leaf Curl Disease is yet unclear. The prevalence of Asia II 1 was sustained in these two year analysis of B. tabaci population from cotton. It seems that the distribution of this genetic group influence the distribution of CLCuD and plays a vital role in the spread of CLCuV all over Punjab and Sindh provinces, Pakistan. The phylogenetic study significantly supported the outcomes of RAPD analysis. The present study, gives the first indication of subsistence of **Asia II 1 on cotton in Sindh** and **presence of Asia II 5 in Pakistan**. This Knowledge will contribute to the development of appropriate strategies with which to manage the disease in Pakistan.

Assessment of Garlic Viruses and their Management.

Indexing of seven varieties (Iranian, Italian, Chinese, MJ-84, JS-1, NARC-09 and Desi) was carried out under natural field conditions at NARC. In the year (2013-14) 1088 plants of all the seven varieties were sown and ELISA tested. After planting/rouging of all visibly infected plants was carried out. Bush

removal and rouging throughout the season was found most effective during the year, as this practice decreases the source of the virus and also saves the work of digging out a much larger plant with an extensive, virus-infection. The double antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) technique is used as a massive analysis system for all garlic planting materials indexing for poty virus antisera namely, *Onion Yellow DwarfVirus* (OYDV). . The comparison of DAS-ELISA results of 2014 indexing showed that the incidence of OYDV was decreased in all varieties but Iranian variety is still showing high incidence. During field observations it was noticed that the hard neck variety cv NARC-09 apparently showed less or no symptoms but by ELISA test the presence of virus was detected confirming latent infection. This monitoring provides information to establish a strategy to raise the phytosanitory quality and the national productivity of garlic.
At present Total 784 Garlic bulbs of healthy plants are available under the project of Assessment of garlic viruses and their management Estimated number of healthy plants from the garlic bulbs will be 7840.

Screening of sunflower material against different diseases under natural field conditions during spring-2014

Sixteen entries of NUSYT were observed for the diseases occurrence during the crop sown in spring 2014. Four diseases Phoma blight, Alternaria leaf spot, charcoal rot and bacterial head rot were found to be prevalent in different intensities. Due the frequent rains and relatively cool weather in the current season the charcoal rot severity was very low. Similarly the other two leaf diseases like Phoma and Alternaria blight was also in traces form. The bacterial head rot disease which was reported as first report from Pakistan during the last year has been observed prominently in mild to severe form on various entries. Among sixteen entries one hybrid exhibited MR reaction while rest were resistant(R) against Phoma disease, whereas all the tested hybrids showed resistant (R) reaction against Alternaria leaf spot. Three entries each exhibited MR and MS reaction against charcoal rot. The maximum bacterial head rot was recorded on two hybrids exhibiting highly susceptible reaction.
In another set eighteen hybrids both local and exotic have been evaluated against the diseases. All the hybrids showed resistant (R) reaction against Alternaria leaf spot while one hybrid each showed MR and MS reaction against Phoma blight whereas rest all showed resistant (R) reaction. In case of Charcoal rot 12 hybrids showed resistant (R) reaction, three MR, two MS and one hybrid showed susceptible (S) reaction. In case of bacterial head rot nine hybrids showed high resistance (HR) four were (R), three were (MR), one hybrid each exhibited MS and HS reaction.
Among eighteen entries of local hybrid set-1, Phoma blight was observed in mild form and five hybrids exhibited resistance (R), while rest of all the entries showed MR reaction. In case of Alternaria one entry exhibited R reaction while rest all showed HR reaction. Charcoal rot was observed on all the entries but only one entry each exhibited MR and MS reaction while rest all showed resistant (R) reaction. Bacterial head rot was also prominent on local hybrids

and five showed HR, three showed R, seven were MR, two hybrids showed susceptibility (S) and only one hybrid showed high susceptibility (HS)
Another local hybrid set-11 having 12 entries has been screened under the same conditions. In case of Phoma disease no entry was found resistant and only one entry showed MS reaction while rest of all showed MR reaction. The Alternaria leaf spot has the least infestation and only one hybrid showed R while rest all exhibited HR reaction. In case of Charcoal rot only one entry exhibited MS rest all were found resistant. The bacterial head rot was also have least infestation on this set and one entry each showed MS and MR reaction, whereas three showed R while rest all showed HR reaction.

Karnal Bunt Diagnostics Services to PASSCO:

In year 2013, more than two hundred wheat crop samples collected / received from the different PASSCO purchase centers including Khanpur and Hifizabad of Punjab province of Pakistan at Crop Diseases Research Institute (CDRI), National Agricultural Research Center, Islamabad for the visual observation and filter wash test for the incidence and distribution of Karnal bunt of wheat. The wheat seed observation test were conducted by observing the 1000 seeds among the sample population to determine the percentage of bunt, while the filter wash test confirms the presence of pathogen (teliospore) in these samples. Under visual observation, no any infected seed were found from the Khanpur wheat crop however the infected seeds were observed (0.001 to 0.003) from the wheat samples of Hafizabad districts. The bunt pathogen (*Tilletia indica*) was found in all the wheat crop samples by filter wash test. This shows a great concern for the country, especially in the context of export potential of the Pakistani wheat. It is an ample need to dug out the areas having free of Karnal Bunt produce from which can be exported after meeting the domestic need of country.

Screening of Wheat elite material for Karnal Bunt (*Tilletia indica)* **at Wheat Wide Crosses, NARC:**
A historical set of Wheat germplasm and more than 2500 wheat elite germplasm were inoculated by Karnal Bunt teliospore inoculums. The reactions for the resistance and susceptible were observed after harvesting the grains.

Diseases Diagnostics Services:
The potato growing areas of Punjab was surveyed to see the incidence and distribution of Golden Cyst Nematode, commonly known as potato cyst nematode. More than 200 soil samples were collected and processed for PCN. The PCN was isolated from 60%-70% soil samples, presenting an alarming situation for this quarantine pathogen, which needs to be addressed for future management and immediate concern for export related commodity, i.e., Potato.

About fourteen soil and root samples of Citrus orchards, collected from different citrus growing areas of Punjab. The most pre dominant nematode, *Tylenchulus semipenetrans* was isolated from the soil and root samples, causing the citrus decline in citrus orchards of Punjab.
Other diagnostics samples were included the turf grass from Baharia Golf City and tobacco samples from Pakistan Tobacco Company limited for the isolation and identification of nematode and fungi. The turf grass was infested with the root knot nematode, *Meloidogyne* sp. and the tobacco plants were infected with *Pythium* sp. simultaneously.

Insect Pest Management

Biological Control

i) Biological observations and predatory potential of immature stages of *Chrysoperla carnea* feeding on *Schizaphis graminum* (Rondani) aphid

Incubation period was 3.5 days and larval duration was 11.9 days with survival rate of 66.6%. Predatory potential was 289.2 (second and third nymphal instars of *S. graminum* aphids per/larva).

ii) Effect of host density on the predatory performance of three larval instars of *Chrysoperla carnea* feeding on *S. graminum* aphid

Prey densities for 1st instar were 10, 15, 20, 25 and 30 aphids and for 2nd instar 10, 20, 30, 40 and 50 and for 3rd instar 15, 30, 45, 60 and 75 per larva. Predatory potential after 24 hour starvation of 1st instar was 7.4, 12, 16.6, 16 and 17, for 2nd 9.0, 17.4, 24.2, 23.1 and 24.5 and for 3rd instar it was 13.0, 24.6, 37.2, 46.6 and 47.4, respectively.

Chrysoperla eggs

Chrysoperla larvae

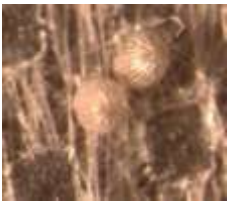
Chrysoperla adults

iii) Biological parameters of *Trichogramma chilonis* reared on three lepidopterous host *Sitotroga cerealella* , *Corcyra cephalonica* and *Helicoverpa armigera* eggs under controlled conditions

Mean parasitism in *S. cearelella* eggs was 88.6% with 90% adult emergence while in *C. cephalonica* eggs the parasitism was 66.2% with adult emergence 63.2 % and the parasitism in *Helicoverpa armigera* eggs was 76.4 with 84.2% dult emergence.

Sitotroga parasitized eggs

C. partellus parasitized eggs



H. armigera parasitized eggs

iv) Biological observations and rate of parasitism by *Cotesia* flavipes reared on *Chilo partellus* larvae under controlled condition (MoU Project)

Developmental duration for *Cotesia* from parasitism to adult emergence was 15-17 days and its adult duration was 40-44 hours. Parasitism was 82.4 % in 3rd instar larvae of *C. partellus*. Mean number of pupae per 3rd instar larvae was 40 pupae/larva with 60 % adult emergence. Parasitism was 66.2 % in 4th instar larvae. Mean number of pupae per 4th instar larvae was 58.0 pupae with 65 % adult emergence. Pupal duration of *Cotesia* was 7-9 days.

v) Developmental duration, survival and predatory potential of *Chrysoperla carnea* larvae *reared* on *Chilo partellus larvae* under controlled conditions

The developmental duration of First instar larvae was1.6 days with 42.4% survival rate, on 2nd instar was2.0 days with 100 percent survival rate and on 3rd instar larvae 3.4 days with 80 percent survival rate. Predatory potential of 1st, 2nd and 3rd instars was 1.0, 2.8 and 5.4 larvae/larva.

Host Plant Resistance against major insect pests

Maize

i. Evaluation of Maize germplasm of MBR-10, Spring 2014

Out of 29 entries, only 4 had 0-5% infestation of shoot fly, only one had 5% stem borer infestation on leaves, armyworm infestation was higher and more than 50% in majority of the entries and the damage caused by cabbage butter fly was lower than 5% in 15 entries. One hundred and fifty healthy and insect free plants were selfed for further advancement.

ii. Evaluation of maize germplasm of MBR-G, Spring 2014

Out of 16 entries, 13 had 0-5% infestation of shoot fly, only 3 had 0-4% stem borer infestation on leaves, armyworm infestation was 0-5% in 5 entries and the damage caused by cabbage butter fly was 0-5% in all entries. Seventy five healthy and insect free plants were selfed for further advancement.

iii. Evaluation of maize germplasm of MBR-C, Spring 2014

Out of 30 entries, 7 had 1-5% infestation of shoot fly, stem borer infestation on leaves was 1-4% in 6 entries, armyworm infestation was higher in all entries and the damage caused by cabbage butter fly was 0-5% in 13 entries. Two hundred and fifty healthy and insect free plants were selfed for further advancement.

iv. Evaluation of Borer Resistant Experimental Varieties

Three experimental varieties were evaluated against stem borer in comparison with 3 positive and 4 negative checks. Least infestation of borer was 2.28% in EV-1120E and 7.5% in EV-1120L which was comparable with positive checks. EV-1110 had higher infestation (16.27%). The negative checks had infestation of 15-25%. EV-1120E and EV-1120L performed well and can be used for approval as variety.

Sugarcane

Nine sugarcane genotypes were evaluated against pyrilla and sugarcane white fly. Maximum infestation of pyrilla was 7.1 and 6.4/leaf in genotypes US-271 and CSSG-239 was and the minimum in US-54 (1.8 /leaf) and CPSG-104 (3.9/leaf). In case of white fly maximum infestation was in CSSG-239 (13.1/leaf) and CP-77-400 (3.5/leaf) and the minimum infestation was 0.2/leaf (US-25) and (0.3 /leaf (US-272).

Wheat

In laboratory 60 different varieties were evaluated against aphid (*Rhopalosiphum maidis*) under different tests. In Seedling Bulk test, 8 varieties showed resistance. In Antixenosis test, 5 showed least preference to aphids. In Tolerance test, 5 had least population of aphids. In Antibiosis test, 30 showed least damage due to aphids. In field trials, with 117 wheat varieties, initially, aphid population was low and increased slowly upto sixth week with slight fluctuation during 4^{th} and 5^{th} week.

Evaluation of Fodder and maize varieties and hybrids against major insect pests

a) Sorghum:

Pest pressure was very high. Shoot fly made dead hearts in all entries. Overall, candidate fodder hybrid 'Sorghum-Sodan Grass hybrid' performed well against all insect pests with lower damage.

b) Maize:

Overall, the promising maize varieties under test (Islamabad Gold and Islamabad White, and maize hybrid (NARC-2704) performed well as compare to other varieties (checks) against stem borer, shoot fly and armyworm.

Stored grain and Bioactive plants

i) Screening of wheat genotypes against *Sitotroga cerealella*

Six wheat genotypes were evaluated for their resistance/susceptibility to Sitotroga cerealella. Maximum weight loss was observed in the genotype Lasani-08 (5.4%) followed by NARC-2009 (4.4%) and NARC-2011 (4.0%).

ii) Insecidal activity of different plant extracts against *Tribolium castaneum*

Three plants parthenium, datura, verbenia were used. Their ethanol leaf extracts were tested for insecticidal activity against Tribolium castaneum. At 10% concentration mortality was 40%, 58.75% and 60% in parthenium, verbenia and datura, respectively after one week of application.

National IPM Programme

A. Management of Cotton Leaf Curl Virus Disease through Integrated Pest Management (IPM) Techniques by adopting Farmer Field School Approach.

This Programme has developed a well trained cadre comprises of 28 Facilitators in improved production of Cotton particularly CLCuV management through FFS approach by organizing a Training of Trainers / Facilitators (TOT/F). These FFS Facilitators were selected from the project districts. The main objective of the training was to develop a well trained cadre of FFS Facilitators in improved production of cotton particularly CLCuV management from district Ghotki Sindh, Bahawalpur, Vehari, Khanewa and Multan Punjab. These facilitators provided season-long technical assistance to 2726 small farmers through Farmer Field School and Participatory learning groups in 60 villages of the project districts. Participatory trials on different sowing dates showed that sowing upto mid May cotton crop was better compared to late planting.

B. Extension of Research Outcomes under ASLP Mango Production to the end users

Modern Nursery Management

During the activities new concept of disease free nursery away from Mango orchard vs traditional practice in orchards were established in specialized infrastructure required for disease free nursery. A total of 400 people benefitted including 50 female participants. Out of 400 people, 50 nurserymen families are willing to adopt ASLP Nursery Management Package and are in continuous with the project team.

Improved Mango Orchard Management

Twenty one integrated research sites are established in Punjab and 11 in Sindh for mango growers to observe, evaluate and adopt the improved management practices developed by ASLP project. More than 200 growers adopt these practices by visiting these sites. More than 1000 growers, extension worker and students were aware in improved practices. The improved practices package includes diseases, pests and nutrient management and other cultural practices on all phenological stages of mango trees starting from growth to harvest of fruits whole cycle. According to a pilot survey around these sites, among the observed 60 growers, canopy management is being adopted by 50% growers, forming ring around the trunk (60%), Bordeaux pasting (70%), scheduled sprays (50%), weed control (40%), soil and water analysis (50%) and floor management by 30 % growers.

The project team benefitted for completing degree research of 06 Ph. D. students, 09 M. Phil., 11 M.Sc. and 09 undergraduate students (internees). Moreover, more than 600 mango growers and extension workers have been trained on the improved orchard management practices.

National Insect Museum

Insect Collection Surveys=10 (Bhara Kahu, Simly Dam, Angoori, Keintla, Khanpur Dam and Wah Garden)

Insect Identification

- **Systematics study of Family Syrphidae (Diptera) of Pakistan**.
  Adults syrphid flies feed on nectar and pollen of flowering plants and are good pollinators, while immature (maggots) are predators and act as bio control agents. During reporting year 05 species and 06 genera are added and now raising 42 species under 26 genera with 11 species as new record for the country.

- **Taxonomic study on family of Curculionidae (Coleoptera) of Pakistan**
  Species of family Curculionidae are of particular interest as agricultural pests of crops, forests and horticultural crops. During reporting year 18 species under 11 genera of 06 subfamilies have been identified, one genus andtwo species are new for Pakistan.

- **Taxonomic study of Family Meloidae (Coleoptera) from Pakistan**
  Blister beetles are important in pharmacology, veterinary and agricultural however, some species feed on the eggs of grasshoppers and are important biological control agents. Uptill now 23 species in 5 genera

under two sub-families have been identified.

- **Systematics of bees from Pakistan**
  Bees are known for their role in pollinationand for producing honey and beeswax. There are nearly 20,000 known species of bees in seven to nine recognized families, in every habitat with flowering plants. Up till know studied specimens reveled 25 species in 14 genera , under four families**.**
- **Taxonomic study on wasps (Hymenoptera: Vespidae) from Pakistan**
  Wasps are important part of the food chain, act as bio control agents for controlling insect population and also cause damage to various ripened fruits such as grapes, pear, and plums etc. Up till now seventy species fewer than three subfamilies have been identified and added to the museum collection. During current year DNA studies of nineteen wasp species (19) from District Mansehra were conducted.

- **Taxonomic studies on family Formicidae from Pakistan**
  Ants play a key role in ecosystems, nutrient cycling, bioticinteractions, symbiosis (facultative and obligate) and also known as predators of many arthropods. A total of 277 specimens belonging to 30 species under 18 genera of 3 subfamilies were studied. Among these 11 species are new records for Pakistan.

Order Neuroptera

- **Taxonomic studies on Neuropterid fauna of Pakistan**
  Commonly knownAnt Lions or Lace Wings): Species under this order are important bio control agents. Few are voracious predators of economic crop pests of our cash crops like sugarcane, cotton rice and wheat. This year one family and four genera have been identified. Up till now the total identified families=08, subfamilies=02, genera=18 and species=06 form Pakistan.
- **Spatial and temporal distribution of Odonata naiads in Potohar Plateau**
  Dragonflies and Damselflies are important predators and act as good bio control agents. This year naiads of four species under two genera of one family have been identified. With this the naiads of twelve species under nine genera of 04 families have been morphologicaly identified. Key for the identified naiads species is under construction.

Wasp *Vespula germanica*

Weevil *Tanymecus chloretis*

Vertebrate Pest Management

a. Assessment of Rodent Contamination in Exportable Food Commodities in Private and Public Sectors

Rodents cause quantitative as well as qualitative losses to stored grains not only by consumption but also by contamination through their filth (feces, urine and hair). Rodent contamination was found in rice collected from 20 markets of Karachi and ranging between 0.06g to 2.05g/250g sample. Rodent containment in pulses ranged between 1.50g to 2.10g in Daal chana; 0.65g to 1.61g in Daal Mung; 0.93g to 1.95g in Daal Masoor; 1.21g to 1.68g in Daal Mash. Trapping success (rat trapped/ nights) revealed high population of Norway rat (*Rattus norvegicus*), 12.5% and roof rat (*Rattus rattus*) 8.6%.

b. Laboratory Studies of *Gliricidia sepium* As a Repellent Against Rice Field Rat (*Bandicota bengalensis*)

Extract of *Gliricidia sepium*, mixed in rice proved a good repellent, by giving 90.90%, 86.65%, 61.20% and 44.20% repellency at 0.1%, 0.5%, 1.0% and 2% concentration, respectively. Paired-Choice trials were carried out to know the relative acceptability of *Gliricidia* mixed rice vs plain rice. The repellency by *Gliricidi*a mixed bait proved highly significant due to less toxicity, for non target animals. Gliricidia may be used to protect crops, stored grains and poultry feed from rodents.

c. Assessment of Losses Due to Rodents in Poultry Farms in the Suburbs of Karachi

Studies of losses due to rodents in the poultry farms in the suburbs revealed that Norway rat (*Rattus norvegicus*) was the predominant species causing colossal losses to poultry products. Rodent population was found on high side in the poultry Sheds, which were mud floored. Kill trapping revealed that 20-25 rats were present in each shed of highly infested poultry houses. Estimates of egg losses only due to rodent feeding in 250 farms of Estate II in Karachi was calculated worth of Rs. 3.6 million /year, while poultry feed loss up to Rs. 160,000/ year. Control trials through application of bait containing brodifacoum (0.005%) gave 72.39% reduction in rodent population.

d. Toxicity of Neem (*Azadirachta indica*) against Red Flour Beetle (*Tribolium castaneum*) Infesting Rodent Poison Baits

Neem seed powder was tested in three (2%, 1% and 0.5%) doses, in comparison with control (plain bait). Mortalities were recorded after 24, 48 and 72 hours. Mortalities were observed at all doses, 100% at 2%, followed by 89% at 1% and 61% at 0.5% in 24 hours; 100% at 1% in 48 hours; 100% at 0.5% in 72 hours. The study is useful in utilizing neem seed powder for the protection of anticoagulant baits from the infestation of red flour beetle (*Tribolium castaneum*).

e. Assessment of Toxicity of Insecticides at Different pH Spray Solution

Toxicity of Profenophos (Organophosphate) and Imidacloprid (Neonicotinoid) were tested by leaf dip and topical bioassay technique on papaya mealybug (*Paracoccus marginatus Williams* and *Granara de Willink*) and tomato mealybugs (*Phenacoccus solenopsis Tinsley*). The findings of study showed that with decreasing pH of spray solution, efficacy of above insecticides improved. The LC50 values for Profenophos were 0.245% and 0.372% by leaf dip and topical bioassay methods respectively. However, LC50 values for Imidacloprid were 0.003% by leaf dip method and 0.004% by topical method. The mortality rate of insects was found to increase with decreasing pH values. It is concluded from the findings of the study that reduction in pH of spray solution can synergize the pesticide and its applied quantity can be reduced.

f. Residual Toxicity of Crude Extract of Ber Leaves (*Ziziphus maritiana Lam.*) Against *Sitophilus oryzae L.* (Coleoptera: curculinoidae)

The toxicity of extracts of Ber leaves was tested using filter paper (7cm diameter) impregnated with 0.5ml of each concentration ranging from 0.06 to 1.0%. Freshly emerged 10 insects (adults) were released in each petridish including control and experimental (water: ethanol). The mortality data were recorded daily up to 13 days after treatment. After recording the mortality data each time new adults were released on the same treated filter paper. The crude extract was found to possess low toxicity against *S. oryzae* with maximum mortality of 60% at 10mg ml^{-1} (w/v) at 5 days after exposure followed by 30, 20, 20, 10% mortality at 5, 2.5, 1.24 and 0.12mg ml-1 after 6, 5, 4, 3 and 2 days of the exposure, respectively. The residual toxicity was found to be dependent on the dose and duration of exposure. Moreover the low toxicity of this extract also leads to less subsequent resistance of pest.

g. Antimicrobial Activity of Some Medicinal Plant against Plant Pathogenic Fungi

This study was planned with the objective to study the antifungal activity of medicinal plants and to determine the efficacy of different chemicals like Chloroform, Acetone, Hexane, Methanol etc to control pathogenic fungi. The leave powder of Neem (Azadirechta indica), Prosopis juliflora, and Calotropis procera has been evaluated for their antifungal activity. Three different concentrations 0.05, 0.10 and 0.15% were made from extracted solution of

these medicinal plants in petroleum ether, methanol and chloroform. Fungi viz., Alternaria alternate, Fusarium oxysporum, Aspergillus flavus and Rhizoctonia solani used as test fungi on Potato Dextrose Agar with different concentration and fungal growth is checked by Zone inhibition method. All chemicals viz., Petroleum ether, Methanol and Chloroform control the growth of fungi @ 0.15% concentration; however among all solvents, chloroform has pronounced antifungal activity toward all the four species @ 0.1% and 0.15% concentration.

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concentration; however among all solvents, chloroform has pronounced antifungal activity toward all the four species @ 0.1% and 0.15% concentration.

Management of rodents at NARC campus:

Field area

Experimental and other field crops were targeted to manage the rodent population. Control strategies comprised of use of fumigants, acute and chronic rodenticidal baits. A total of 8390 burrows were treated. Highest control was achieved in wheat crop where (91%) reduction in burrow activity was achieved on the basis of pre-treatment (3830) and post- treatment number of burrows (350) and high value breeding/experimental lines were prevented from rodent damage.

To control rodents in structures especially in offices, labs, stores, and residential areas, environmentally safe PVC bait stations were installed. Racumin grain bait (slow poison) was used in each bait station. No further damage was reported from the treated area.

Studies on palatability enhancement and effectiveness of zinc phosphide bait to control field rats

To enhance the palatability and effectiveness of zinc phosphide bait series of experiments were conducted in wheat crop and fallow land of NARC. The results are given below:

Results of Multi-Choice Feed Preference Test in Wheat Crop with 2% Cooking Oil as an Additive

This test was performed at the maturity stage of the crop. Wheat, rice, maize and millet in cracked form with the addition of 2% cooking oil as an additive were evaluated. Results of all the six replications on the basis of average daily intake (ADI) indicated that maize was maximum consumed (111.15) g followed by millet (62.8) g, rice (44.51) g & wheat (41.75)g. On the basis of these results, addition of 2% cooking oil in maize have made the texture of bait base more attractive and palatable. Moreover, maize and millet individually or combined in 50:50 ratio if used as bait base in final poisoned bait will produced better results than rice or wheat.

Results of Multi-Choice Feed Preference Test in Fallow Land:

Wheat, rice, maize and millet in cracked form were evaluated in multi-choice feed preference test in two experiments. In first experiment, millet in cracked form was identified as the most preferred one. Overall average daily intake (ADI)/consumption of millet was (31.74) g followed by maize (27.79) g, rice (23.38) g and wheat (14.22) g.

In second experiment again four cereal grains (wheat, rice, maize & millet) in cracked form were evaluated in multi-choice feed preference test to reconfirm the results. Millet in cracked form was identified as the most preferred one this

time also. Overall average daily intake (ADI)/consumption of millet was (54.50) g followed by maize (34.35) g, wheat (20.52) g and rice (15.63) g.

Wild boar management at NARC:

A total of 05 wild boar control operations were carried out during the reporting period. Control strategy includes use of acute and chronic poisons. Acute poison involves the use of poultry bird heads (broiler or layer), and Aldicarb (Timik) as toxicants. The toxicant mixed with peanut butter was inserted (2-3 g) into the buckle cavity of the poultry head. Surface and sub-surface baiting was conducted by using these treated heads. The baiting strategy included the use of heads as piles (10-15 or more) or placing (surface or sub-surface) 1 or 2 heads at equal intervals of distance along the wild boar trails. Pre-baiting for three days was carried out to achieve good results. Racumin (coumatetralyl) a slow poison was used in maize grains. Bait stations were established in maize, sorghum, citrus orchard and along the fence of NARC. Dead bodies were reported by Security department at different locations within and outside NARC campus after one week of each operation. No wild boar damage was reported in the field area of NARC since November, 2013.

8. Food Safety

a. Arsenic and Lead Contents in Rice

Forty five (45) samples of rice grain (rough and fine) collected from REAP (Rice export association of Pakistan), TCP (Trading corporation of Pakistan) and processing mills during December to April. The samples were analyzed for toxic metals (arsenic and lead) contamination. The analysis showed that in all the samples of rough (IRRI) rice type, arsenic and lead content were found within permissible limits of WHO/FAO. However, the lead contents in fine aromatic (Basmati) rice varieties were found at somewhat higher level (0.390$\mu g g^{-1}$).

b. Heavy and Essential Metals in Fresh Liquid Milk Available in Some Area of Karachi, Pakistan

Fifty (50) samples each of fresh milk and UHT processed tetra pack were collected from different locations in Karachi. The fresh milk samples (FMS) were collected from milk shops and UHT processed tetra pack samples (PMS) of various brands from local market. The samples were analyzed for heavy metal concentration. The heavy metals including toxic metals were analyzed on Atomic Absorption Spectrophotometer (AAS). It has been found that the essential metals were found to be very low, where as toxic metal like cadmium was not detected in the samples at ppm level.

9. Environmental Protection

Ecotoxicological Studies

- A study was conducted to investigate the efficiency of aquatic macrophyte i.e. *Nasturtium officinale* for the removal of cadmium from waste water and it's potential in phytoremediation technology. Metal uptake by the plant was dependent upon the concentration of the metal and the duration of exposure. Metal content in plants increased with the increase in metal concentrations in solution and the accumulation in shoots was significantly higher than that in roots. Chlorophyll contents decreased with higher levels of Cd exposure. Moreover, the values of bioconcentration factors as well as the values of translocation factors for Cd removal were greater than one which indicated that the *Nasturtium officinale* is an ideal candidate for phytoremediation of cadmium.
- Collaborated with Grain Quality Testing Lab, NARC for the analysis of Polyphenolic compounds, and antioxidants, in peels of Apple, Citrus, Grapes, Carrot and Pomegranate. Two methods for analysis of Polyphenols on HPLC using reversed phase chromatography were developed one on λ=280nm & λ=370nm. Analyzed 50 samples of Grapes, Carrot and Pomegranate for 14 Polyphenolic antioxidant compounds on HPLC at two different wave lengths. Analyzed 60 samples extracted from Mango, Apple, Citrus peal for thirteen poly-phonologic compounds (antioxidant) on High-Performance Liquid Chromatography with UV detector using C18 column.
- Collected samples from Volta Battery from industrial estate Hattar for monitoring baseline of heavy metal contamination.
- Analyzed water samples collected form I-9/I-10 industrial state. The level of Fecal/Total Coli forms turbidity, Total Dissolved solids and Total suspended salts were found beyond National Environment Quality Standards.
- Water Quality Lab was strengthened by introduction and validation of new parameter viz. Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), oil and grease contents and nitrite analyses. In addition to these parameters, Fecal Coliform, Total Coliform, *E. coli*, hardness, turbidity, pH, Cl^{-1}, Dissolved Oxygen, Free CO_2, HCO_3^{-1}, CO_3^{-2}, NO_3^{-2},SO_4^{-2}, Ca^{+2} and Mg^{+2} are analyzed in the wastewater samples for their aptness for irrigation. Fortnightly analyzed wastewater samples from bioremediation units, NARC and furnished water quality reports.

Bio-remediation

Biorediation of used water at Rose and Yasmine Garden

Site Selection and collection of Baseline data: Several site surveys were performed in order to select the suitable site for construction of Bioremediation facility. By the time several meetings were arranged with CDA official and finally in the Month of March 2014 the site was finalized. The site was again reviewed by the road department of CDA in third week of April 2014 and again

it was asked to move 220 feet away from the Kashmir Highway. The plan was again developed and the work was initiated in the first week of June 2014.

The CDA management also asked to bio-remediate all the discharge of wastewater in rain water drain. The capacity of the site was also increased from the capacity of 0.5 cusec to 4.5.

- Sampling of water and its physio-chemical analysis
- Waste water samples were taken from the inlet stream and analyzed at NIB water quality Lab.)
- Excavation and civil work according to proposed design
  Excavation work was started accordingly, 65 percent excavation has been completed and the rest is in under progress (Section-I)
- Leveling of ponds and placing of Geo-membrane
  Work on leveling of ponds and transfer of surplus excavated soil has been initiated and is under progress.

10. Plant and Animal Genomics

Genetic engineering (GMOs development): Through gene transfer technology, NIGAB is actively involved in the development of new varieties of crops against diseases, salinity and drought, cold stress and to increase the yield and crop productivity. For this purpose, 5 transgenic crops including wheat, groundnut, tomato, maize and potato have been developed at NIGAB.

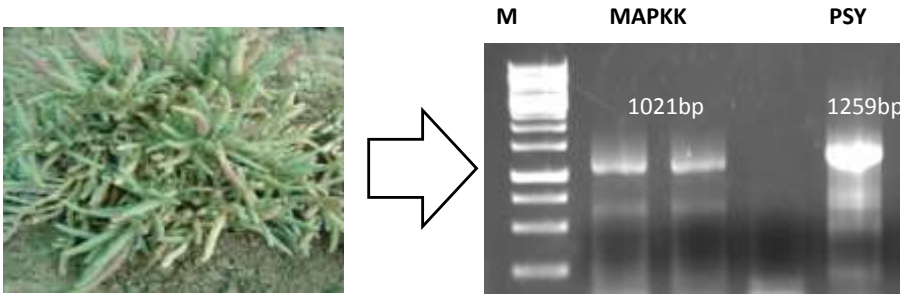
- Bioassay of transgenic rust resistant transgenic wheat lines for Chitinase gene at T5 stage was performed and promising results have been achieved.
- Construct containing EPSPS for herbicide tolerance has been generated.
- Transgenic plants of tomato containing DREB1A gene for cold tolerance tomato has been obtained.
- Maize inbred line was successfully genetically transformed with salinity tolerant gene.
- Salt tolerant transgenic microtubers of Astrix and Sante variety of potato were produced.
- Wheat containing abiotic stress gene is in advanced generation.

Gene isolation and functional characterization

Isolation, cloning, expression and functional characterization of a variety of genes from crop and wild plants have successfully been achieved. These genes include:

- NHX, HKT, phytoene synthase and MAPKK homologs recruited in drought and salinity tolerance in rice and Salicornia.
- Garlic lectin genes conferring insecticidal activity.

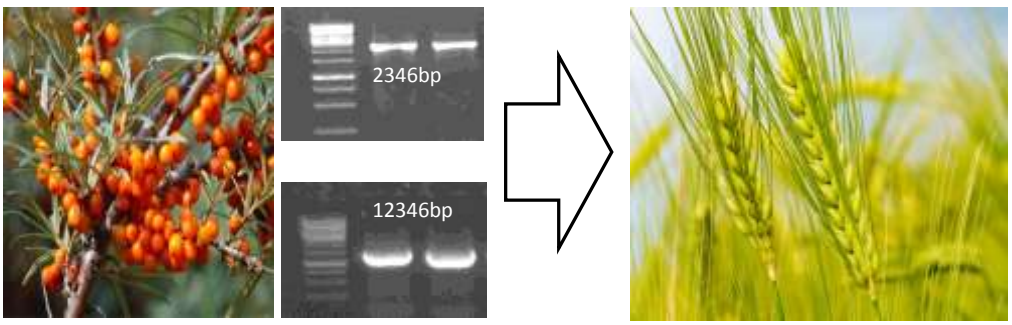
- Isolation of Berberine gene (BBE1) from Berberis vulgaris (local name Sumlu) for cancer research.
- SHATTERPROOF1&2 responsible for shattering resistance in canola.



Salicornia

PCR amplification

Isolation of *MAPKK* and *Phytoene Synthase s*alt stress-responsive transcripts from *Salicornia*; a halophyte



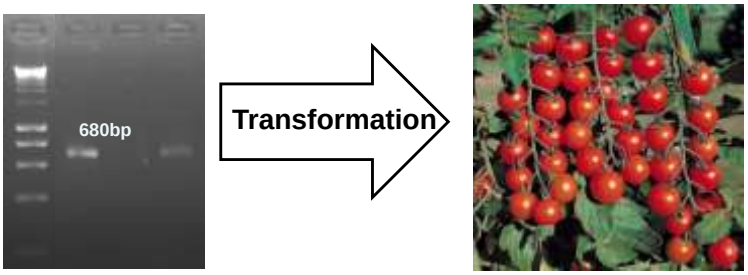
Sea buckthorn plant

Isolated Folate (above) and Ascorbate (below) genes

Wheat plant

Isolation of Folate, Ascorbic acid oxidase genes from Seabuckthorn for value addition in wheat

- HbsAg epitope involved in production of edible vaccine against Hepatitis B virus in plants.
- Isolated folate, lycopene synthase and ascorbate oxidase (vitamins) genes from Seabuckthorn.



Isolation of 2 HbsAg antigens from blood sera

Isolation of HbsAg gene and production of edible vaccine against Hepatitis B virus in tomato

Marker assisted selection

Marker assisted breeding and QTL mapping is another area of research priority.

- Using 500 SSR, STS, SCAR and CAPS markers 20 promising lines of wheat for stem rust resistance have been developed. Moreover, 30 lines have been developed for salt & drought tolerance. These lines are under preliminary yield trials and will be submitted for yield trials at national level next year.
- Developed 21 populations for mapping QTL conferring resistance to wheat rusts and salt stress. Out of these, 02 populations are being used to map QTLs for rust resistance and salt tolerance.

GMOs testing

- NIGAB has been declared as a reference lab for Bt genes detection and expression monitoring system in cotton. In this regard 49 referral samples of cotton varieties from provinces were tested.
- Establishment of *Bt* gene expression profiling in cotton.
- Established Real time PCR system based adulterations detection facility in basmati rice using BADH gene as a marker.

Potential risk for cross resistance development in cotton growing areas of Pakistan

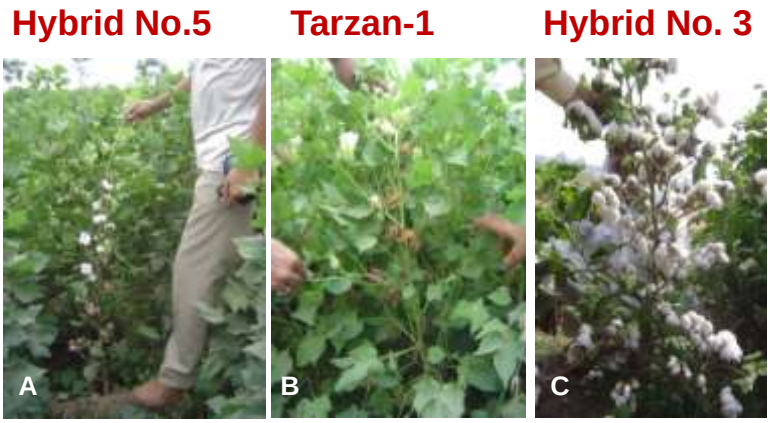
- Determination of Bt gene type and ownership in samples collected from farmer field, research centers of Punjab province
- Detection of Bt gene expression in the collected samples to assess then uniformity of samples before quantification analysis
- Quantification of expression of Cry toxin in Bt cotton genotypes;
- At different growth stages under different drought stress levels maintained in glasshouse

***Performance ofBt* cotton in Pakistan:** A Case Study from Cotton Fields of Sindh Province

- Nine district of Sindh were assessed for insecticidal protein production under natural environment. Bt gene expression was monitored in two different growth stages i.e. 70 and 120 DAS in different plant tissues i.e. leaf and boll. Test for Bt gene type confirmed the presence of only Cry1Ac.
-
- ELISA data revealed the expression trend of Cry1Acgene, maximum concentration of Bt toxin were recorded in leaf tissues followed by boll tissues. Average toxin in leaf at 70 DAS was calculated as 2.434µg/g which was reduced to 1.845µg/g at 120 DAS.
-
- In Pakistani GM cotton most of the individual plants insecticidal toxin was observed very low, furthermore 50% of plants sown in Bt cotton field were found non-Bt. These situation is alarming as it will provoke cross resistance in target pest thus, minimizing the benefit of Bt technology.

Hybrid cotton research

- Production of hybrid cotton is underway at NIGAB to induce high level of Bt toxic protein, increased yield potential and cheaper hybrid seed through ABR system development.
- Ten local lines have been produced for CMS trait. Three promising hybrid lines have been sent to Pakistan Central Cotton Committee (PCCC) for evaluation.



A-B: Heat tolerance comparison between Hybrid-5 & Tarzan-1
C: Typical plant of Hybrid-3

Microbial biotechnology

- NIGAB is leaving no stone unturned to establish the first Pakistani National Culture Collection Centre for newly identified bacteria.

- Besides, Boron and halo-tolerant bacteria as well as pathogenic strains causing Bacterial Leaf Blight in Rice and Cankar in Citrus from Pakistan ecology have also been isolated.
- Many novel strains of bacteria are identified based on 16SrRNA gene sequence. These novel stains are being validated in collaboration with JCM, Japan and KCTC, Korea.

Animal genomics and biotechnology

Genetic improvement of indigenous livestock breeds through gene assisted selection and development of DNA based disease diagnostics, vaccines & therapeutics are the major research areas.

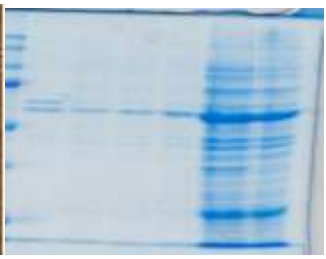
a) Candidate gene analysis of Indigenous livestock breeds for production traits & Disease resistance

- Inflammation of mammary gland (Mastitis) is one of the most prevalent infection diseases of dairy cattle and buffalo, which causes huge economic losses to the dairy industry. Many genes are found to be associated with mastitis such as major histocompatibility complex (MHC), β-defensin, toll like receptors (TLR) etc.
- Genetic polymorphism in bovine β-defensin and toll like receptors (TLR) genes in two high yielding dairy cattle breeds i.e Sahiwal (*Bos indicus*) and Holstein -Friesian (*Bos taurus*) are being studied. Standardization of PCR for genes encoding bovine β-defensin and TLR4 genes fragment were achieved in both Sahiwal and Holstein Friesian cattle. PCR-RFLP analysis shows several DNA banding pattern of β-defensin gene in Sahiwal and Holstein Friesian cattle.
- While in case of TLR4 gene the observed genotype was *aa* in homozygous form in Sahiwal and Holstein Friesian cattle. The resultant genotype found previously more frequent in the healthy animals against udder infection in the dairy cattle. Further work on genomic analysis of β-defensin and TLR4 genes is under process.
- Similarly work on detection of Bovine leukocyte antigen (BoLA) gene polymorphism and their association with Mastitis in Nili-Ravi Buffaloes is also in progress.

b) Recombinant Vaccine development

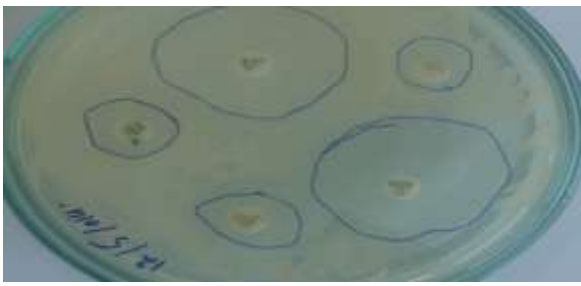
- Cloning of Hypervariable region of hexon gene was achieved and confirmed by PCR and sequencing. Recombinant hexon protein was expressed in BL21 cells and purified by GST tagged columns using GST buffer kit.
- Purified recombinant hexon protein was used for diagnostics and vaccine development.
- Recombinant subunit vaccine of hexon provided 60% protection against Hydropericardium syndrome.

- Use of different Bioinformatics tools showed highest immunogenicity index for Hexon and Penton genes of AAV-4 in poultry.
- An Insilico study was designed for epitope location and Immunogenicity index calculation of nucleoprotein and G1 glycoprotein and nucleoprotein of CCHF virus. Primary, secondary and 3D structure was determined by using online expassy server. Possible B cell epitopes were predicted using online ABCpred server.



c) DNA-based diagnostics of livestock diseases

- Hexon gene based PCR has been successfully standardized for detection of AAV-4 from suspected poultry field samples.
- Recombinant Hexon protein based ELISA has been standardized for detection of AAV-4 from field samples.
- Standardized Lamp PCR for FMD virus detection.
- Identification of drug resistance genes from pathogenic *Escherichia coli* strains in contaminated meat and its products.



Antimicrobial Drug Susceptibility Testing

EFFICIENT SOIL NUTRIENT MANAGEMENT

Improvement of Nitrogen Recovery Efficiency (NRE) by Using Urease and Nitrification Inhibitors

Ordinary urea was amended with Urease and Nitrification inhibitors for improving Nitrogen Recovery Efficiency (NRE) Maximum paddy yield 5048 kg ha^{-1} was obtained with 90 kg N ha^{-1} amended with nitrification inhibitor which was 36% higher than ordinary urea application.NRE increased up to 60% by using amended urea with inhibitors. Nitrification inhibitors also resulted the increase in agronomic efficiency.

Conjunctive use of humic substance and micronutrient as foliar spray

Maximum sugar beet yield and sugar recovery obtained by 101.7 t ha^{-1} and 14 t ha^{-1}, respectively with application of recommended fertilizers (NPK 150-90-100) along with HA (200 mg/l^{-1}) and micronutrient (B 0.05%, Zn 0.1%) sprays. The beet yield increase was 22.6% and 15.8% while sugar yield increase was 25.4 and 6.8% respectively. Maximum beet yield (101.3 t ha-1) and sugar yield (15.0 t ha-1) with the same treatments

Integrated effect of humic acid and Zn on wheat yield and nutrient availability

Integrated effect of humic acid and Zn was evaluated in wheat. It was concluded that combine use of humic acid and Zn significantly increased grain yield of wheat which is 25% more than control. It was 13% higher as compared to Zn application of 10 kg ha-1 alone i.e. without humic acid. Statistically Zn application of 5 kg and 10 kg with 50 kg of humic acid at par with reference to grain yield of wheat. Humic acid application @ 40 kg ha along with Biozote inoculation increased grain yield 16 -27% whereas without biozote inoculation

Integrated Nutrient Management for Cotton Productivity

Integrated Nutrient Management, i.e., N, 225 (75% N from chem. fert. & 25% from FYM); P_2O_5, 80 +K_2O, 70 + Zn, 5 + B, 1 kg ha^{-1}) increased seed cotton yield by 17-25% for Bt and 14-23% for non-Bt cotton over Farmers' Fertilizer Use Practice. The increase in seed cotton yield with INM treatment (where substantial less fertilizers were used), was at par or even little higher compared with increase in yield recorded with recommended dose (*as per Agri. Deptt., Govt. of Punjab*), i.e., N, 400 + P_2O_5, 150 + K_2O, 125 kg ha^{-1} that varied from 16 to 24% for Bt and 12 to 22% for non-Bt cultivars.Inclusion of biozote and

humic acid with chemical fertilizers also helped in increasing crop productivity and reducing the fertilizer use.

Response of Maize to Zn

Zinc application @ 3 kg Zn ha^{-1} increased grain yield of hybrid cultivars from 18% to 21% and local cultivar from 16% to 17%. This increase was almost at par the increase recovered with Zn applied @ 9 kg ha-1 as broadcast. Zinc application also enhanced Zn concentration in leaves and grains of both cultivars.

Soil Salinity

Efficacy of Rhizobacteria in Wheat Crop under Saline Conditions

Efficacy of rhizobacteria having ACC deaminase activity to induce salt tolerance in wheat (cv. NARC-2011) at ECe 8.00 and pH 7.6 was studied. Rhizobacteria strain WM-4 produced maximum dry weight (1.0 g plant-1) closely followed by WPR-51 and WPR-61. Maximum concentration of K (3.4%) and minimum concentration of Na (1.19%) were also observed in WM-4 rhizobium treated plants.

Response of K_2SO_4 foliar application on sunflower yield

K_2SO_4 foliar application (4%) yielded maximum achene yield (4.940 to 6.38g $head^{-1}$) by Cv. SMH-0917 and SMH-0907 that was closely followed by soil application @ 50 kg K_2SO_4 ha^{-1}. 4% K_2SO_4 foliar application lowered two times Na concentration and enhanced K concentration in both the cultivars of sunflower.

Soil Environment

Fungal strains, isolated from contaminated soils, were screened for arsenic tolerance and characterized morphologically. Natural, chemically enhanced Phyto-remedial potential of maize, sorghum and mustard was evaluated for bioremediation of heavy metals polluted soils.Cadmium (Cd), chromium (Cr), lead (Pb), nickel (Ni), copper (Cu) removal capacities of locally available agricultural waste materials, i.e., corn cob, wheat straw, sugarcane bagasse, banana stalk, and saw dust have been evaluated for remediation of polluted water.

Agricultural Water Management Program

Deficit irrigation for limited water resource areas

The water productivity of Sunflower, Wheat and Canola was evaluated under 4 deficit irrigation strategies; I1 (100 % of ETc); I2 (80 % of ETc); I3 (60 % of ETc) and I4 (rainfed). The preliminary results were as follows; the sunflower

crop yield was 3588, 4475, 3094, and 2940 Kg/ha under I_1, I_2, I_3, and I_4 respectively. The water productivity of Sunflower was 12.2 kg/ha/mm under $I_1$and 15.9 kg/ha/mm, and similar under I_3 and I_4. This shows that there is increasing trend of crop yield and the water productivity under 20 % deficit irrigation. The grain yield of Wheat was 6673 kg/ha under I_1, 6030 kg/ha under I_2, 3805 kg/ha under I_3 and 2492 kg/ha under I_4. The water productivity of Wheat was 20.5 kg/ha/mm under I_1, 19.2 kg/ha/mm under I_2, 12.6 kg/ha/mm under I_3 and 14.7 kg/ha/mm under I_4. Results indicate as presented in the Table that the water productivity of Wheat was maximum under full irrigation. However, in limited water resource area, the 6030 kg/ha grain yield and 19.2 kg/ha/mm water productivity can be achieved under 20 % deficit irrigation.
The grain yield of Canola was 1344 kg/ha under I_1, 1151 kg/ha under I_2 and I_3 and 757 kg/ha under I_4. The water productivity of Canola was 5.5, 5.1, 5.5, and 4.4 under I_1, I_2, I_3 and I_4 respectively. The canola crop yield and water productivity was similar under 20 and 40 % deficit irrigation which shows that 40 % deficit irrigation is a better option for the optimum crop yield and water productivity.

Result indicated that there was 20% water saving for optimum Wheat production and 40% water saving for optimum canola production through deficit irrigation management.

Drip Irrigation Systems for Vegetables and Fruit Plants
The drip system technology for orchards vegetables was developed with collaboration of local industries. Low and head drip systems for orchards were demonstrated in arid and semi arid regions of Pakistan. Fruit plants under drip,in southern KPK especially in D.I.Khan was developed. Low head drip system was developed and demonstrated to grow vegetables in tunnels. It was also demonstrated in Pothohar region, hilly and arid areas of KPK for growing fruit plants and vegetables.

Updating GLOF lake inventory of Northern Pakistan
The main objective of the work was to establish an updated inventory and digital database of glacial lakes in context of global warming causing GLOFs hazard in the Himalayan region of Pakistan. Overall, total of 3,044 glacial lakes were identified in the HKH region of Pakistan that cover surface area of about 134.8 km2. Maximum lakes (815) lie in the Indus sub-basin followed by Gilgit River basin (660). The cumulative area of the Gilgit lakes was found higher than that of the Indus lakes indicating presence of large size lakes in the former basin. The four basins of Karakoram Range i.e. Gilgit, Hunza, Shigar and Shyok contribute about 41% to the total lake numbers and lakes area. Out of 3,044 glacial lakes, 36 were classified as potentially dangerous glacial lakes in 10 sub-basins of the Upper Indus basin based on earlier defined criteria.
When compared with the findings of previous lakes inventory of 2001, the current inventory indicated an increase in numbers of glacial lakes in most of

the river basins of the region. Such changes in lakes may be attributed to the faster rate of ice and snow melting possibly caused by effect of global warming in this region. An overall increase in the number lakes was noticed at almost all the elevation ranges of Upper Indus Basin during the last 12-year period. The change in the lakes number of lakes was about 128% within 3,000-3,500 m elevation range, 19.8% within 3,500-4,000 m range and 19.6% within 4,000-4,500 m range during 2001-2013. The project findings would provide base for establishing a monitoring and early warning system, planning and prioritization of disaster mitigation efforts that could save many lives and property in the downstream region.

Risk assessment of Soil erosion in Rawal watershed area

Soil erosion is a major problem effecting agriculture and water resource development in the mountainous region of Pakistan. The risk of soil erosion was investigated in Rawal watershed, Potowar region using Revised Soil Loss Equation (RUSLE) and Geographic Information System (GIS). The watershed characteristics like landcover/landuse, elevation, slopes, basin boundary, drainage network etc. were derived from Landsat ETM 30m image and Digital elevation model (DEM) 30m data was processed in GIS environment. Various factors of Revised Universal Soil Equation (RUSLE) i.e. rainfall erosivity (R), soil erodibility (K), slope length and steepness (LS), cover management (C) and conservation practice factor (P) were determined and final soil erosion risk map was prepared on seasonal and annual basis. Five classes of erosion intensity were developed indicating very low, low, medium, high and very high risk of soil erosion. About 50% of the watershed area was found under very low risk (erosion rate <1 ton/ha/yr) and low risk of soil erosion (1–10 ton/ha/yr) comprising mainly of low lying valleys with scattered range and agriculture land. The high risk zone (30-100 ton/ha/yr) stretches over 16% area in the northern and northeastern parts of the watershed. Very high risk of erosion (>100 ton/ha/yr) possesses minimum coverage of about 7% only. This zone covers about 8.8 squares KM area over steep mountainous slopes mostly in the northeastern parts of the watershed.

More than 60% of the watershed area falls under very low risk of soil erosion during months from October to May. About 4% of the watershed area indicated high risk of soil erosion while 2% area exhibited very high risk of erosion during July and August when monsoon rains are usually at their peak.

Climate variability and change analysis in Upper Indus basin

The spatial and temporal changes in mean maximum temperature had been studied using seasonal climate data of pre and post 2000 periods from 20

meteorological stations in the three Himalayan ranges. The variation in temperature had shown a large influence from topography of the Himalayan mountain region. Mean seasonal temperatures of summer (Apr-Sep) and winter (Oct-Mar) during the two decades (1990-1999 & 2000-2009) vary widely between lowlands in the south and highlands in the north of the region. Mean maximum temperature in the river valleys ranges between 10 ° - 20°C during summer, which drops gradually towards high mountain areas (above 2,500 masl). Temperatures greater than 20° - 30°C were found dominant in the southern parts of the Hindukush and Himalaya Ranges. During winter, most of the central and northern valley, exhibited a temperature range of -10° to 0°C, which dropped to below -40°C mainly in the high mountain areas of the northern and northwestern Karakoram Range. Temperature range of 0°C to 10°C onward was found dominant in the southern valleys of Hindukush and Himalaya.

Rang and Forestry

Potential sites for Runoff water harvesting using GIS and Remote sensing technology

In order to identify potential water harvesting sites using high resolution DEM and ancillary data, the base map layers like of physiography, drainage network, administrative boundaries, locations of towns/villages and infrastructure of D.G.Khan and Rajanpur districts were prepared. A landcover/landuse map was developed using remote sensing data of Landsat ETM+ of the target areas. Major landcover/landuse classes identified were rangeland, open soil/rocks and agriculture land besides minor forest cover. A limited forest cover and plantation exist in patches at various scattered locations in the plains as well as on foot hill slopes. The open soil area along the flood plain can be developed for Rod-kohi agriculture through proper management of flood water in the districts. The physiography map of the study area was generated from Digital elevation model data that exhibited lowlands (<300m Elev.) over 56% and 75% areas in D.G. Khan and Rajanpur districts, respectively. The foothill region (300-700m) consisting mainly of piedmonts plains along Suleiman mountain range exist over 24% area in D.G. Khan and 13% area in Rajanpur districts. The areas under piedmont plains locally called ‘Pachad tract’ possesses high potential for developing spate irrigation system. The Middle mountains (700-2000m) stretch over 20% and 13% areas in the western parts of the D.G. Khan and Rajanpur districts respectively. Rainfall occasionally causes flash floods in this zone which can be used effectively for irrigation purpose through establishing a network of diversion and dispersion structures. The digital

elevation model and land use data will be used for hydrological modeling to assess surface runoff in the watershed areas.

Carbon Sequestration study in rangeland of the Potohar Plateau:

The study was conducted at NARC and Pabbi Hills, Kharian. In Kharian two sites viz. grazed and ungrazed) were selected for experiment. Data for phytomass above and below were collected for carbon pool and was estimated. In grazed site the phytomass in above ground was 0.16 t/ha and in below ground phytomass was 0.10 Mg Cha^{-1} recorded. Similarly for carbon pool in grazed site in above phytomass was 0.08 Mg Cha^{-1} and with below ground phytomass was 0.05 $MgCha^{-1}$ recorded. In un-grazed site the total above ground phytomass was 0.48 Mg $ha^{-1}$with below ground biomass 0.36 $MgCha^{-1}$ recorded. Similarly the carbon pool in ungrazed was 0.24 Mg Cha^{-1} in above ground phytomass with 0.18 Mg Cha^{-1} in below ground phytomass. Hence, the total phytomass in above and below ground was more than the grazed site phtyomasss. Similarly the total carbon pool was also more than grazed in above and below phytomass in district Kharian.

In NARC site the two perennial grass species (*Panicum antidotale*and *Panicum maximum)* were selected for this study. The data was collected for biomass and for carbon pool in below and above in this site. In *Panicum antidotale* the total above ground biomass was 1.28 Mg C $ha^{-1}$with 0.63 Mg C ha^{-1} below ground phytomass recorded. The total carbon pool for *Panicum antidotale* in above ground phytomass was 0.64 $MgCha^{-1}$ with 0.15 $MgCha^{-1}$ in below ground was recorded. Similarly in *Panicum maximum* the above ground phytomass was 1.04 $MgCha^{-1}$ was recorded with 0.28 Mg C ha^{-1} in below biomass. For carbon pool in above ground phtyomass was 0.28 $MgCha^{-1}$ with below ground phytomass 0.52 $MgCha^{-1}$ was recorded in NARC site. Hence, the *Panicum antidotale* gave the highest phytomass in above/ below ground biomass as compared to *Panicum maximum*. Similarly, in case of carbon pool the total carbon pool in above/below phytomass of *Panicum antidotale* was highest as compared to the *Panicum maximum*in NARC site. In *Panicum maximum* as go down the SOC% $MgCha^{-1}$ decrease depth wise, while in *Panicum antidotal* in upper the SOC% $MgCha^{-1}$ was less but more as go down in depth. Similarly in grazed and in un-grazed the SOC % $MgCha^{-1}$ also decreases as go down in depth wise as well as in total carbon $MgCha^{-1}$.

Range Rehabilitation

Rehabilitation and productive use of degraded rangelands was carried out throughsilvo-pastural interventions. Four fodder tree species *Acacia modesta, Leucaen aleucocephala, Morus alba, and Gleditschia* tricanthos were planted along with reseeding of the area with different grass species.

Among the trees *Leucaena leucocephala, Morus alba*proved comparatively better in terms of survival, growth and biomass production. Whereas, among grasses *Cenchrus ciliaris* and *Panicum antidotale* proved more successful.

Honeybee Management for Improved Livelihood & Agricultural Productivity

Beekeeping is a very fascinating occupation. It can be practiced equally by men, women, grown up children and even by physically handicapped and old persons. Over 27,000 families are directly earning their livelihoods from this sector. The investment required is low, and the economic returns are comparatively very high. Beekeeping does not bring any pressure on agriculture land. It produces honey, beeswax, pollen, propolis from the flowers which otherwise dry up in nature and go waste. Beekeeping is a decentralized industry and does not displace persons from their villages. If conditions are favorable, level of beekeeping can be increased to semi-commercial or commercial level.

Though the honeybees are best known for the honey they produce, their economic role in nature is to pollinate hundreds and thousands of flowering plants and assure seed or fruit set. Honeybees thus play very important role in cross pollinating various agricultural and horticultural crops and increase their yield per unit area and improve their quality. Agricultural scientists in America and Europe have estimated that value of the increased crop yields due to honeybee pollination is several times more than the value of the honey and beeswax the honeybees produce.

Influence of honeybee pollination on yield of rapseseed canola *(Brassica napus l.)*

Studies were carried out to determine the role of honeybee on pollination on canola cultivar shiralee during spring crop 2013.Results showed that plants where bees had access produced comparatively more pods per plants, number of seed per pods as compared to without bees, while 1000 seed weight was found non-significant. It is concluded that use of honeybees for *Brassica* yield is useful for pollination. Bees should be moved in *Brassica* field onset of flowering.

AcaricidalActivity of Plant Extracts And Formic Acids on Ectoparasitic Bee Mites

Varroa destructor and *Tropilaelaps clareae* is dangerous pest directly for beekeeping and indirectly for crops that require insect pollination. Acaricides appeared to be effective against *Varroa* and *Tropilaelaps* mites but their application within the hives contaminates the wax and honey. The problems associated with the use of acaricides proved considerable incentive to develop new treatment strategies and screening for potential acaricides to minimize

these problems. Natural products might provide effective solution to the problem of mites.
Toxicity of ethanol extracts of four plants in three concentrations of Thyme, *Thymus vulgaris*, Lemongrass, *Cymbopogon citratus*, Oregano herbs, *Origanium vulgare*, Mint, *Menth alongifolia* and Formic Acid (an organic acid with known efficacy that was used for comparison) against *Varroa destructor* and *Tropilaelaps clareae* infesting honeybee colonies. The mortality was counted after 24 and 48 hrs of treatment and total number of dead mites was recorded. Results showed that formic acid and the highest concentration of tested plant extracts caused effective control of *Varroa* and *Tropilaelaps* mites. All plant extracts showed strong toxicity. However, *Cymbopogon citratus* followed by *Thymus vulgaris* were stronger plant materials in the all tested times and displayed the highest number of mortality. These results suggested that, the application of ethanol extracts of *Cymbopogon citrates* and *Thymus vulgaris* can be suitable alternatives to conventional substances.

Comparative performance of three traps for the control of hornets in honeybee apiaries in Pakistan

Vespa orientalis L. *V. tropica* Beq.,*V. velutina* Vecht., *V. basalis* Smith, and *Vespula germanica* (F.) (Hymenoptera: Vespidae) are social wasps that can cause intense damages in apiaries. The study was conducted to compare three types of traps (Wooden Trap with Plastic Bottle, Wire Gauze Net Trap and Wooden Trap) in combination with three different baits (grapes, fish and meat), and destruction of hornets nesting sites (Mechanical Control) to control the populations of the hornets in apiaries.
The results showed that the use of the Wooden Trap with Plastic Bottle in combination with the grapes as a bait and destruction of hornet's nests was comparatively better. It was a reliable solution for managing hornet population in *A. mellifera* apiaries. Changing of baits after 1-2 days is necessary because the decomposition reduces the total number of wasps captured.

ANIMAL SCIENCES DIVISION

Animal Health Research

Carrier potential of small ruminants in the persistence and transmission of Peste des petits ruminants (PPR) virus (RADP);

- One step PPR virus specific RT-PCR was standardized using F and N genes.
- Real time RT-PCR has been standardized for detection of PPRv in persistently infected healthy animals.
- Evidence of persistent PPRV shedding by recovered goats and sheep was recorded 16 weeks PPR post outbreak. This evidence is supported by HA test and PPRV F gene specific RT-PCR.

Development of models for the control of Peste des petits ruminants (PPR) in Pakistan and PPR vaccine using local isolates. (Nationally Coordinated project ALP-PARC funded)

- Two stakeholders'/awareness workshops were successfully planned and conducted at Coordinating Units in AJK and Gilgit, Baltistan.
- 17 suspected PPR outbreaks were investigated in Punjab, Sindh, KPK, Gilgit Baltistan and AJK. The outbreaks were confirmed by clinical signs, post mortem lesions, epidemiological investigations, HA test, Ic-ELISA RT- PCR and cELISA.
- A massive outbreak of PPR that devastated the desert area of Tharparker, Sindh was confirmed by carrying laboratory investigations including virus isolation. Three PPRV isolates were obtained.
- PPR virus was isolated from camel during outbreak of PPR in sheep and goats in Thar, Sindh. The isolate was confirmed by RT-PCR.
- Five PPR viruses were recovered from PPR outbreaks in different parts of the country on Vero cells. The isolates were confirmed by IcELISA and RT-PCR.
- A local isolate of PPR virus (PAK-fjg-07/NARC4) from AHP repository is being attenuated for the development of PPR vaccine by serial passages on Vero cells. To date 30 serial passages have been completed.
- A survey was conducted in the target tehsils *viz* Tehsil Umerkot in Sindh (6 villages), tehsil Chillas of district Diamer in GB (2 villages) and tehsil Barnala in AJK (5 villages) to estimate the prevalence of PPR.

Improving the diagnostic assay for the control of Warble fly in Pakistan

- Antigen was prepared from first stage larvae of warble fly for the use in ELISA.
- Developed and standardized ELISA for the diagnosis of *hypodermosis* in animals.
- Accurate timing for the treatment and effective control of warble fly infestation was determined.

One Health Concept

- Six provincial surveillance sites were established.
- Two diseases namely Brucellosis and Crimean Congo Hemorrhagic Fever (CCHF) were identified for future work.
- 1,297 serum samples of livestock (cattle/buffalo) origin were tested for Brucellosis and 331 samples were found positive.

- Two training workshops were organized for field veterinarians regarding Surveillance, Awareness, and Reporting of Brucellosis and Crimean Congo Hemorrhagic Fever, where 10 persons participated

National Reference Lab for Poultry Diseases (NRLPD)

Revival of the National Avian Disease Surveillance Network under ALP – PARC funding

- The NRLPD provided nation-wide surveillance and referral diagnostic facilities for avian diseases. In this regard a total of 23326 samples were received from different regions of country for the surveillance of AI and other diseases.
- A total of 179 isolates included AIVs, NDV, AAV, ILTV,ALV, MDV, REV, CAV, IBV, *E.Coli, Slamonella*, Mycoplasma and Pasteurella recovered from the surveillance and referral diagnostic work.
- Three, one day training workshops were arranged at PRI, Rawalpindi, L&DD KPK and NRLPD Islamabad on Poultry Disease Surveillance and Sample Collection

Establishment of Field Epidemiology Laboratory Training Program (FELTP) for joint human/animal disease investigation against avian influenza

- A total of 19 provincial surveillance sites have been set up consisting of Punjab (n=3), Khyber Pakhtunkhwa (n=4), Balochistan (n=2), Sindh (n=4), Azad Jammu and Kashmir (n=3), Gilgit-Baltistan (n=2) and Islamabad (ICT).
- 4273 samples of poultry origin were tested for AIV and 20 H9N2 AIVs were isolated.
- Ten H9N2 AIVs were sequenced for HA and NA genes and cartography experiment was carried out to evaluate immunogenic potential, revealing that more than 6 isolates showed distinct variation in their antigenicity, requiring their including in new vaccines.

Extended regional cooperation on highly pathogenic emerging diseases (HPEDs) in SAARC under FAO project

- Referral diagnosis was extended to commercial farmers and eight public institutions.
- After completing the required capacity building, the NRLPD received preliminary approval after completion of Final Laboratory Assessment for achieving international lab accreditation under ISO-17025:2005 scope.

- 24 H9N2 AIVs have been isolated.

Research on pathogenesis of avian diseases and vaccine development

- Surveillance setup was revived at Provincial Level in VDRL-Abbotabad, -PRI-Karachi,-PRI-Rawalpindi,-VDL, Quetta and VDL, Peshawar.
- Field sampling through collaborating labs in provinces has been started in this regard
- 128 tissues and 140 swabs samples and 300 sera were received from different regions of Pakistan through provincial collaborating units.
- Tissue samples were processed and evaluated for virus isolation through in-vivo inoculation. 6 H9N2 viruses were isolated and sub typed through virus neutralization test.

Animal Nutrition

Evaluation of bio-available phosphorus in indigenous feedstuffs for poultry

- Results of two trials indicated that phytase enzyme supplemented group attained significantly higher weight gain compared to chicks fed non-phytase supplemented diets. Similarly better feed conversion ratio was found in phytase supplemented groups compared to the chicks fed non-supplemented diets.

Comparative evaluation of silage versus hay of oats conserved at bloom stage as basal diet along with concentrate supplement in buffalo calves

- Dry matter (DM) intake of both groups was similar ($p>0.05$). However, 10% higher ($P<0.05$) total body weight gain or average daily weight gain were observed in group A compared to group B. The feed conversion ratio (FCR) was found to be better in group. A compared to group B
- The digestibility of DM, crude protein (CP), crude fibre (CF) and neutral detergent fibre (NDF) was significantly ($P<0.05$) higher in group A compared to group B. It is concluded that oat silage is better than oat hay in terms of weight gain, FCR and nutrient digestibility in buffalo calves of one year age.

Training/extension activities

- Feed Technology Unit (FTU), Animal Nutrition, ASI is operating on commercial basis through PATCO to provide nutritionally balanced and economical feed to the livestock farming communities for different types of animals. Farmers are satisfied and getting improved performance by animals and saving money by feeding PARC feeds.

- During July 2013 to June 2014, 6330 bags of feeds were prepared by FTU and sold to farmers.
- About 200 samples of feed, fodder, silage, grasses, potato, dung, urine and blood from farmers/FAO/students were analyzed for different laboratory tests.

Animal Reproduction

Evaluation of fertility related biomarkers in buffalo semen during peak breeding season

- Progressive motility and mitochondrial transmembrane potential of spermatozoa are positively correlated with *in vivo* field fertility.
- Conception rate from different bulls ranged from 54% to 72%.

Interaction of GnRH and biostimulation during estrus synchronization with CIDR on conception rate in buffalo during low breeding season under field conditions

- Bull x GnRH had a positive effect on fertility of buffaloes after oestrus synchronization with CIDR during low breeding season under field condition.

Characterization of peri-urban dairy production system around Islamabad

- Mostly dairy farmers purchase milking buffaloes from Central Punjab. The average milking buffalo price varies according to the season: high price in summer (Rs.175000 to 225000) and low in autumn (Rs 130,000 to 165,000). Sometimes farmers purchase animals from nearby middlemen (Beoparies) who earns Rs.2500 to 3500/animal.
- 78% farms around Islamabad are on lease. The average lease rate is Rs.495/head/month.
- Each animal is fed 8-9 kg concentrate, 5-6 kg wheat straw and 4-5 kg green fodder. Each animal is given 450 ml oil on fortnightly basis. Milk production of buffaloes averaged 10.45 liters per day.
- Milk is sold either directly to customer where rate differs from farmer to farmers while Dhodhi collects @ 84 rupees per liter.
- Farmers owning animal sheds keep female progeny of high yielding animals for replacement.
- The milk marketing cost is Rs 5 per liter as reported by farmers who are raising animals and also collect milk from other farms.

Training/Extension activities

- Three training courses were conducted for community workers (male and female) from Gilgit, Chitral, Chilas, Hunza and Skardu on Animal production and health (total participants = 47).
- Imparted training to Scientists from Jaba Sheep Farm (Khyber Pakhtoonkhwa) on ultrasonography in sheep
- Offered courses on Animal Reproduction and Genetics to MPhil students from PARC Institute of Advanced Studies in Agriculture (NARC).
- Offered courses on Animal Reproduction and Genetics to Livestock Manager course of TEVTA at NARC.
- Forty DVM internees from Veterinary Faculties of Balochistan (Lasbela University), Sindh (SAU, Tandojam), Azad Jammu and Kashmir (Univ. Poonch, Rawlakoat), Punjab (Lahore, Faisalabad, Jhangand Rawalpindi) and KPK (Peshawar) were given practical training in the latest Animal Reproduction techniques.
- Two M.Phil students completed thesis research in the AR&GP labs

Aquaculture and Fisheries Program

Intensification of fish culture to increase per unit area fish production in farm ponds using different managemental inputs (ALP Funded)

- Inception workshop of ALP Coordinated project was organized by Animal Sciences Division, PARC on 9th January, 2013 at Animal Sciences Institute, NARC, Islamabad. Detailed briefing was given by Coordinator regarding project work plan, project implementation, financial requirement and report writing.
- The areas visited for survey were Ali Pur Chatta, Gujranwala, Hafizabad, Faisalabad, Sheikhupura, Lahore and Attock. Twenty fish farms and fish hatcheries were visited and information was collected regarding the existing fish farming practices in the area. The fish farmers stocked fish @1200/acre according to availability with no or limited feeding.
- The initial data/information was recorded regarding their existing practices there at fish farms. 15 to 20 fish farms and hatcheries were visited during the survey. After collecting the initial data three fish farms were selected for the project at farmers' field.
- Trials were conducted to evaluate the balanced diet on the growth of carps with varying levels of crude protein formulated from locally available feed ingredients in aquaria at AFP. Three artificial diets were formulated based on different crude protein (CP) level i.e. 20 %, 25%

and 30 % CP. The growth performance of all species under treatments having 30% and 25% CP was higher and did not differ from each other.

- Feed containing 25% CP artificial diet level was found to be satisfactory feeding level and have low cost in comparison with rest of the other two treatments.
- The trials were conducted at farmer's field at Ali Pur Chatta, Gujranwala and Faisalabad to evaluate the production performance of carps at various stocking density.
- The experimental design consists of three treatments of stocking densities 1500, 1800, and 2100 fish/acre at Ali Pur Chatta, Gujranwala.
- The species combination stocked in fish ponds of fish were Silver Carp 35%, Rohu 25%, Grass Carp 15%, Mori/Gulfam 20% and additional 5% of channel catfish were added.
- The experimental design consists three treatments of stocking densities 1000 fish/ acre, 1500 fish/ acre and 2000 fish/acre in Faisalabad.
- After 09 months final data were collected at the time of harvesting. The data indicated that the production level was better at high stocking density @ 2100 fish/acre i.e. 2054 kg/acre with artificial feeding followed by stocking density of 1800 fish/acre where production was found to be 1834 kg/acre with 66% increase in the production where as production of 1511 kg was obtained in pond with stocking density of 1500 fingerling/acre
- An experiment was conducted to evaluate the production performance of Tilapia at various stocking densities of 8000 fish/ acre, 10000 fish/ acre and 12000 fish/acre. The production of 4500 kg/acre was achieved at stocking density of 12000 fish/acre followed by 4000 kg/acre at stocking density of 10000 fish/acre, at NARC.

Culture and breeding of ornamental fishes (goldfishes, koi carp and guppies) and feed development for their different developmental stages (RADP Funded)

Dissemination of ornamental fish germplasm to public and private sector

- Germplasm of Shubunkin, Double Tail, Koi carp (orange and white) and High fin Koi carp has been transferred to different farmers, Punjab Fisheries Department, Lahore and Aquaculture and Fisheries Department, University of Veterinary and Animal Sciences, Lahore.
- Display of ornamental fish at FAO KisanMela at NARC, FAO World food Day at NARC and Autumn Festival at Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi. The participants showed enthusiasm and appreciated the efforts of AFP scientists for the development of culture and breeding technology of ornamental fish.

- Successful breeding of ornamental fish (Shubunkin and High fin Koi carp) has been achieved at farmer's farm of Potohar Region (Jand, district Attock) working in collaboration with NARC scientists.
- Culture technology of ornamental fish (Shubunkin and High fin Koi carp) has been transferred to 05 progressive farmers of Potohar Region.
- An amount of Rs 700,000/- has been generated through ornamental fish sale proceed.

Small Ruminant Research

The objective of the project "Study on Production Potential of Different Sheep and Goats for Mutton Production under High Input System" is to improve mutton production through exploitation of their fattening potential.

- Ten Beetal goats were selected and synchronized for estrus through Controlled Internal Drug Release (CIDR) device for crossbreeding with exotic African Boer goat breed at NARC.
- The behavioral and physiological data related to protocol of crossbreeding were collected for estrus synchronization and subsequent crossbreeding
- The body weight measurements recording/analysis was performed to assess the growth trends in the goat flocks
- The ultrasonography data related to the protocol was also collected.
- Under the study progeny of the crosses of native goat with exotic goat the parameters are related to the crossbred progeny, so they require objective measurements on progeny upon their availability from crossbreeding which is currently under progress.
- The goat flock was screened for Brucellosis and parasitic infestations.

Fattening of Male Goats in collaboration with PATCO

- The Small Ruminant Research Section fattened sixty two male goats purchased by PATCO for sale at the occasion of Eid-ul-Azha (2013).
- The PATCO earned Rs. 80000/- profit from the sale of these animals
- Small Ruminant Research Section is trying to disseminate guidance on this fattening intervention to the farmers. This intervention may be profitable for the farmers if they follow the guidelines in this context.

Dairy & Meat Technology

Use of 'natural antimicrobial'to improve keeping quality of yoghurt/dahi

- To extend the shelf-life of yogurt/dahinatamycin was used at 5, 10 and 15 ppm concentration. It was observed that sample without natamycin (control) when stored at room temperature (24-28 oC) spoiled (visible

fungal growth) within 3 days whereas samples with 5, 10 and 15 ppm remained acceptable (no visible fungal growth) up to 5, 7 and 10 days.

- Under another set of trials natamycin was used at same concentrations but treated samples were stored under refrigeration and did not spoil even up to 50 days of observation (all concentrations) whereas the samples without natamycin (control) showed visible mouldgrowth after 21 days of storage thereby clearly demonstrating the efficacy of the preservative to extend shelf-life of the yoghurt.
- 5 ppm concentration of natamycin is enough to extend reasonable shelf-life (5 days at room temperature and beyond 50 days under refrigeration) of yogurt.

Exploiting non-gelatin based stabilizers for improving yogurt/dahi quality — some preliminary results

- Sensory results show that the flavor and taste of yoghurt containing CMC stabilizer were the most desirable being 'liked moderately, both at 0.75 and 1.0 percent level of concentration. However, appearance-wise gelatin containing samples got the highest ranking i.e., more than 'liked moderately' whereas cornstarch containing yogurt was found least desirable one.
- Cornstarch containing samples, both at 0.75 and 1.0 percent level of concentration showed least acceptable appearance but found taste-wise relatively better, particularly at 1.0 percent level whereas flavor-wise CMC and gelatin containing yogurt samples were equal in flavor-ranking.
- On overall acceptance ranking cornstarch containing samples, both at 0.75 and 1.0 percent level of concentration, were found least desirable whereas CMC and gelatin containing samples were found equal in acceptable ranking, the apparent difference being non- significant statistically.

Experiment: Effect of pre-slaughter feed withdrawal on carcass quality of broiler chicken - preliminary findings

- The average carcass dressing percentage among the two feed withdrawal groups (8 and 12 hours) didn't differ significantly which was 60.69 and 61.25 percent respectively.
- The control group (without feed withdrawal) behaved similarly and the dressing was 60.50 percent revealing benefits of feed withdrawal as empty gizzards/crops resulted in mitigation of feed losses taking place during evisceration / dressing process.

Trainings/extension/technical services

- Lectured and organized training on “Value Added Dairy Products Preparation at Household Level” on 6-7th Nov 2013 to 13 participants of “Certificate Course on Animal Health and Production” organized in collaboration with API, NARC and Wild Life Department of the Quaid-i-Azam University, Islamabad under Snow Leopard Friendly Vaccination Program.
- A collaborative study with Directorate of BLPRI on ‘Milk Quality Evaluation of Hilly Camel in Potohar Region’ was carried out and findings were presented in the International Camel Conference which held at the University of Bahawalpur (19-21 Dec 2013).

Poultry and Wildlife

Evolving a new breed of chicken for rural areas of Pakistan (PATCO)

33000 high egg and meat producing chicks produced and distributed throughout the country and an amount of Rs.1779730/- deposited to PATCO during the year 2013-14. One research paper published in Research Journal and one research paper accepted in the journal.

SOCIAL SCIENCES DIVISION

Role of Milk Collection Contract in Improving Milk Production and Marketing in Irrigated Punjab

Milk and meat are two important high value and highly perishable outputs of livestock farming. In Pakistan, at current factor cost, milk worth Rs.1295.4 billion was produced in the country during 2011-12, which is close to the total value of wheat, rice and cotton and their by-products produced in the country. Our national herd consists of 34.6, 39.7, 66.6 and 29.1 million heads of buffaloes, cattle, goats and sheep, respectively, while total milk production accounts 41.3 million tons. About 37% buffaloes and 28.5% of total cattle population is in milk About 70% of buffalo and two-third of cattle farmers are small sized herders by having upto 10 animal heads. Approximately, 80% of the milk is produced in rural, 15% in peri-urban and 5% in urban areas. Punjab and Sindh are major milk producing provinces of Pakistan by producing 25.62 and 9.35 million liters, respectively. Milk production sector is dominated by the small herders. About nearly 5% of the total milk produced is formally marketed in the country whereas a large proportion of milk marketed is disposed off through milkmen. The present study is intended to investigate whether the milk collection contracts (vis-à-vis traditional *gawala* system) have contributed in improving milk production and marketing in the irrigated Punjab or not. Farm level cross section data of 120 livestock farmers was gathered from three districts namely Kasur, Sheikhupura and Vehari (40 from each district) through a formal survey by personal interviews.

On average, there were 13 buffaloes per farm, of which 4 were lactating. The average number of milking animals on contract farms was 8.61 – twice higher that on the non-contracting farms. The average daily milk yield per animal on contracting farms was 7.87 liters compared to 5.82 liters on their counterparts. In this way, total milk production per day on contract producers was almost 3 times higher than non-contract farms. The main reason of higher milk yield and higher number milking animals on contract farms are the initial incentives given by the milk processors to their contracted commercial dairy farms. These incentives include the provision of initial soft loan (to be repaid in the form of continuous milk supply) for purchase of improved breed milking livestock, provision of improved breeding bulls facilities and Semen, the silage making machine on rental basis, and technical services of livestock experts regarding the health and nutrition of milking livestock. Moreover with the start of milk collection centers (milk chilling units) by the major milk processing companies in the remote areas have generated the milk demand in these areas particularly in winter season. The farmers who started marketing their milk to these milk collection centers have gradually improved their milking livestock herd size, and livestock nutrition and management practices. The major milk marketing intermediaries on sample farms were milkmen, supplying to retail shops and milk processing companies with their respective shares as 25.6%, 2.4% and 68.4%. Only 0.45% of the milk is directly sold to the consumers. About 17% of total milk produced on contract farms is domestically consumed therefore; the quantity of milk consumed at home on these farms is significantly higher than their counterparts. The average milk price reported was Rs.44.22/liter with location and marketing agency specific variations. The major problems faced by our dairy industry include small number of commercial dairy farms, low milk yields, poor breeding practices, improper feeding and management practices, weak marketing infrastructure and lack of formal credit support to the producers. Weather variations also generate wide fluctuations in milk yield. It is recommended to adopt improved feed and livestock management practices and some incentives need to be provided to the milk processors so that the contracted milk production system is fast promoted in the country as it directly contributed to improving milk yields and also fast replacement of non-productive animals with the more productive ones in the herd.

An Investigation into the Factors behind the Development of Carrot Production Pocket in Sheikhupura District of Punjab

In Pakistan, the production of crops like cotton, rice and some horticultural crops has recently been spreading in areas which were not specific for the production of these crops. For instance, the production of cotton has been gradually increasing in some regions of Balochistan; new basmati rice growing areas are emerging in mixed cropping belts touching the cotton zone of southern Punjab (i.e. Sahiwal, Okara, etc.); and some pockets of gladiolus flower production have emerged in some parts of AJK. A similar development has been noticed for the emergence of carrot production region in various tehsils of Sheikhupura District. The self development of a crop specific

production region has developed interest of the researchers and policy practitioners to investigate into the factors contributing to its development as no intentional or planned effort from public sector is involved in it. Such study is also important as the area and production of carrots has been slowly increasing in Punjab (i.e. the area and production of carrot increased by 16.5% and 10.9% between 2000-01 to 2011-12) in almost stagnant for the last 5 years. The study in hand is based on a formal survey of 60 carrot growers in Shahkot area of Sheikhupura District.

The sample farmers and farm attributes shows that on average, the farmers were around 40 years old, having 7 years of formal schooling, 24 & 18 years of vegetables and carrots growing experiences respectively. Their average farm size was 17.5 acres, of which 10 acres was owned land. The mean land rent paid for rented-in lands was Rs.37652/acre/year. Loam and sandy loam soils were major soils in the study area. The farmers of the area had access to both canal and tube well waters. Mixed responses have been obtained from sample farmers about the changes in the water table in the area.

In some villages like Kairwala, Keran, Kotwar, Kachi Kothi, Lagar and Tani Chak, 88% to 100% area of the village was planted under carrots during *Rabi* season. It was found that initially, vegetables seed dealers and commission agents convinced the farmers for growing carrots and later on these pioneer farmers convinced other fellow farmers. Sixty percent owners, 78% owners-cum-tenants and 67% tenants reported that they were convinced by fellow farmers for carrot production. The support factors behind the spread of carrot production in the study areas were relatively higher profitability (41.7%), land type suited to carrot production (20%), fitness of carrot farming in the existing rice-wheat cropping system (18.3%) and shorter crop duration (10%). Due to widespread carrot production, wheat followed by sugarcane were the crops mainly replaced with carrots in the area.

Eight carrot varieties namely Global, Nozi Window, Mehrani, Red Desi, Desi, Durga, Anmol and Shakora were reported to be grown by the sample farmers with their respective area as 33.7%, 18.9%, 18.1%, 11.2%, 6.1%, 4.5%, 4.1% and 3.3% of total carrot area on sample farms. Carrot being a labor intensive activity also has generated good employment opportunities in the area. The average cost of carrot production was estimated as Rs.71936/acre including variable costs as Rs.51136/acre. The gross margin and net income from carrot farming were Rs. 196037.30 and Rs.124100.9 per acre, making benefit-cost ratio as Rs. 3.00:1.00. Majority of the carrot growers (72%) self-marketed their output, 13% through beoparies, 10% through contractors and 5% to commission agents. Those who self-marketed their output took their produce to nearby town markets (i.e. Kachi Kothi and Kotwar Mandi) where buyers from outside Sheikhupura purchased their produce. These markets have now became the hub of carrot trading (i.e. single commodity markets) as these are close to their farms and farmers receive timely payments, washing and

cleaning facilities are also available there, low commission has been charged by Arthies and carriage vehicles can easily get into and leave these markets.

The study has provided useful clues about how a specific area has been developed for the production of a commodity initially with the efforts of the seed dealers with the farmers already engaged in vegetable growing for the last many years. Their overtime specialization into carrot production has been attributed to closeness of the markets to their farms, timely payments, availability of washing/cleaning facilities, and easy access/non-congestion of carriage vehicles. The markets like carrot markets of Katchi Kothi and Kotwar Mandi can also serve as production collection centers for the agricultural traders for other fruits & vegetables. The development practitioners and agencies dealing with agricultural market development are suggested to ensure such facilities in other markets so that farmers get the due shares of their efforts.

Pakistan's Value-Added Agricultural Products' Exports Scan Under Pre and Post Trade Liberalization Scenarios

Pakistan is amongst rapidly transforming economies of the world. The analysis of its economic components requires dynamic methods especially in foreign trade sector. The reason is that it links growth and development based on several agreements like trade liberalizations. The reforms are continuous by involving three major sectors i.e. agriculture, industry and services on the basis of their share in the GDP of Pakistan. The agricultural exports of Pakistan have evolved from being commodities to value added agricultural exports. The manufacturing and agro-based industrial sector have quickly developed and significantly contributed in improving economic conditions of the country. The agricultural industry of Pakistan is the most distinguishing with its spillover effects. The trade liberalization scenario of Pakistan exploited its national and regional comparative advantages in agricultural commodities.

Pakistan has a fair comparative advantage in production of wheat, fruits, vegetables & flowers and their value added products. Pakistan exported fruits, fisheries products, tobacco products, rice and livestock products of worth Rs. 20 billions, Rs. 19 billions, Rs. 1.15 billions, Rs. 180 billions and Rs. 10 billion, respectively since last year. The study bears evidence that agricultural trade liberalization has positive impact on GDP of Pakistan and supports the traditional "gains from trade" theory with models who argue that trade not only provides static gains but raises capital accumulation and thus leads to increase per capita output. The empirical results reveal that a long-run relationship exists among value added real agricultural exports and real GDP of Pakistan. Once the agricultural products export market got mature after trade liberalization the demand for value-added agricultural products increased. The countries like US, Canada, Australia and UAE which are also Pak's major trading partners increased demand for value added agricultural products like vegetable oils, processed food, beverages, dairy products and other goods.

The study led to identify trading partners in value-added agricultural products and their trade volumes over the sample period. The study findings portrayed exports of value-added agricultural products pre and post trade liberalization scenarios and escorted future prospects for exports of value added agricultural products in Pakistan. The future prospects, as a result of trade liberalization in the agriculture sector and value added agricultural exports will focus on the total welfare gains. These estimated gains would be accrued only if the agreements and trade negotiations are implemented in its true spirit.

Dynamics of Citrus Area: A Reconnaissance Survey for Kinnow Area in Sargodha

Citrus is one of the main fruit crops which contribute substantially to the national income through foreign exchange. Presently kinnow production is threatened by a number of problems including low productivity and low quality due to diseases and weather conditions. Marketing issues also impacting farm level profitability. To explore the socioeconomic causes of possible orchard uprooting in Sargodha District Social Sciences Research Institute (SSRI) conducted a study through farmers survey and discussion with key informants on current issues of citrus orchards uprooting resulting from farmers disappointments regarding orchard profitability and payments issues from middlemen and kinnow processing factories. Result revealed that at present farmers are facing low farm gate prices even lower than agreed contract price at the time of contracting the orchards by the middle man and kinnow processing factory. The reasons for this as explained by the middleman were low fruit quality due to citrus diseases (citrus scab) and low exports this year. Increasing cost of production and exploitation from market intermediaries and processing factories discourage farm communities and compel them to think alternates for better livelihood. To maintained and increase current acreage citrus in the study area, there is need to add cost effective production technologies, disease free nurseries and use of good agricultural practices in citrus orchard management and marketing structure are essential. For export competitiveness there is also need to meet global standards to increase the exports at high end markets. To maintain and increase the competitiveness of citrus export from Pakistan there is need to provide enabling environment for good agricultural practices ensure reasonable farm gate prices and fair marketing for farmers. As farmers were blaming the exporters that they offer low price of their produce on one hand and on the other hand exporters complain for low international a demand for Pakistan citrus and low international prices. There is dire need to analyze kinnow export unit value in different markets. For establishing an efficient value chain of citrus sub sector to avail the opportunities which have been created by the structural transformation of rural based economies into more urbanized societies and international demand for participants in the citrus value chain. Such opportunities can both increase incomes especially for farmers and create employment in the sector. Several productions and marketing problems at

domestic and foreign markets emerged recently, which need to be carefully investigated.

Analyzing Production and Consumption Trends of Major Animal Based Products and Food Security Implications in Pakistan

Food security of its dwellers is the prime responsibility of both the developing and developed countries of the world. Animal based products are rich source of proteins, vitamins and minerals. In Pakistan, subsistence level livestock farming is quite common as it serves as a good mode of saving, domestic consumption of its products, meeting daily petty cash needs for the consumption of other food items, etc. On the consumers' side, the demand for animal based products is highly price and income elastic. Its consumption is also induced by various factors like the development of processing and preservation facilities, influence of print and electronic media, proliferation of food streets and evening restaurants/refreshment centers in the urban areas, etc. Moreover, the livestock farming sector is virtually free from public interventions like fixation of prices of its products (though some price control is implemented in the form of fixing price of meats in cities, but it is not very effective) government buy-back mechanism, controlling supplies like wheat, etc., therefore, relatively true production enhancing signals are reaching to the farmers. The prime objective of this exercise was to examine the growth trends in the production, consumption, per capita availability and prices of various animal based products in Pakistan. The items considered in this study were beef, mutton and poultry meats. Time series data gathered from different sources like Agricultural Statistics of Pakistan, Pakistan Economic Survey, FAO-STAT has been used for the period from 1980-81 to 2010-11. The semi-log trend function was used to find out the trend and estimate the growth rate.

It was found that the production, consumption, per capita availability and per capita consumption has grown at 1.7, 1.8, 0.6 and 0.7 percent per annum, respectively. The share of beef in red meat production and consumption has remained more than twice higher than mutton during the study period. Across meat types, the annual growth in production, consumption, per capita availability and per capita consumption of beef have been recorded as 1.9%, 1.9%, 0.8% and 0.8%, respectively. Likewise for mutton, the annual growth in production, consumption, per capita availability and per capita consumption were recorded as 0.7%, 0.7%, -0.3% and -0.3%, respectively. For poultry meat, the annual growth in production, consumption, per capita availability and per capita consumption were estimated as 3.5%, 3.7%, 2.4% and 2.4%, respectively. The annual growth in the production, consumption, per capita availability and per capita consumption of eggs were estimated 2.2%, 2.3%, 1.1% and 1.2 % respectively. As a result, the average annual growth in the prices of beef, mutton, poultry meat, milk and eggs were recorded at 4.3%, 4.1%, 3.4% and 3.5%, respectively. The relatively lower growths rates in the per capita availability and per capita consumption of overall meat and its types as well as of eggs than their respective production and consumption growth

rates implies that, because the rate of growth in the production of beef and mutton were lower than the national population growth rate, therefore, the demand for meats and its types are higher than the supplies, which led to more rate of increase in the prices of beef and mutton than the poultry meat and eggs. This calls for enhancing the production of beef and mutton in the country not supporting poultry sector in enhancing animal protein intake in the country but also setting a balance between the prices of beef & mutton vis-à-vis poultry meat in the country. Otherwise, it is likely than short supplies of beef and mutton than the population growth shall generate high price signals for poultry sector making over protein price escalation, which may become out of the purchasing power of common man and the poor sections of the society. The likely implications of such situation will be in the form of widespread protein deficiency in the country and adding to the health bills of the national exchequer.

Turning to milk, the annual growth in production, consumption, per capita availability and per capita consumption of poultry were 2.5%, 2.5%, 1.5% and 1.5%, respectively. The annual growth in the production and consumption of buffalo milk was relatively lower (i.e. 2.3% per annum each) than the cattle milk (i.e. 3.1% per annum each). This has led to relatively less growth in the per capita availability and per capita consumption of buffalo milk (i.e. 1.2% per annum each) than the cattle milk (i.e. 3.1% per annum each). As a result, the average annual growth in the prices of milk was recorded at 3.2%, respectively. The relatively lower growths rates in the per capita availability and per capita consumption of milk than the rate of population growth seems to be the prime reason of high rate of growth in milk prices. Since, the supplies of milk are associated with the proportion of large ruminants' population in lactation as well as per animal milk yield, and both are quite low in Pakistan. Therefore, there is a strong need of maintaining healthy ratio of animals in milk vis-à-vis buffalo/cattle population as well as improving the milk yield per animal through better nutrition and livestock management practices. Otherwise, it may not only lead to induce milk price escalation as well as calcium deficiency (crucial for bones' strength) in country population and poor sections of the society in particular.

Extrapolating the above estimated growth rates under business as usual the annual production and consumption of meats in 2020 shall be 3480 and 2920 thousand tons, respectively. The production and consumption of beef is expected to be 2007 and 1702 thousand tons per annum, respectively in 2020 whereas for mutton the corresponding estimates are 564 and 440 thousand tons per annum, respectively. Similarly, the production and consumption estimates of poultry meat for 2020 are 995 and 917 thousand tons per annum, respectively. Likewise, the production and consumption forecasts of milk for 2020 fall at 57985 and 47140 thousand tons, respectively. This implies that by 2020, the production of beef, mutton and poultry meats shall be little more than the consumption. What shall be the sources of growth even with these given

growth rates is worth investigating because, even under business as usual, much more resources in the form of agricultural land and water for fodder production and other concentrates are needed while the scarcity of both resources is much likely to increase in future. Rangelands development is a promising option for supporting livestock sector in the scenario of shrinking available land and water resources.

Gender Dimensions and Wage Disparities in Vegetable Harvesting in Punjab

Pakistan has great potentials in vegetables production and farmers generally prefer growing vegetables as they are of short duration and low delta crops, however, they are constrained with non-availability of labor at critical times of picking. Despite that the females are generally treated as unskilled workers and are low paid. Literature suggests that rural women contribute more time to vegetable growing than other family members and their participation is more than 26%. The study in hand is based on formal survey of randomly selected 150 rural women (from Faisalabad, Chak Jhumra and Nankana tehsils) engaged in vegetables picking interviewed personally using a pre-designed questionnaire.

Majority of the sample rural female vegetables pickers belonged to non-farm families. Their mean age was about 37 years and had 2.1 years of formal schooling. Their average family size was 6.3 members – ranging from 4 to 15 persons. Their mean household income and expenditures were Rs.10770 and Rs.9291 per month, respectively. In the sample female vegetables picking households, depending upon the family size and number of male earners in the family, 1 to 4 females were engaged in vegetables picking activities. Their average vegetables picking days of employment per season for vegetables picking were 65 – ranging from 23 to 150 days. The average daily earning of males and females from vegetable farming were Rs.333 and Rs.156, respectively. Many females reported that they have to work for up to 12 hours in the field. Majority of the female vegetables pickers contributed in total household income, but did not enjoy any empowerment in household decisions making.

Majority of the female respondents (83%) found doing vegetables picking to fulfill/ support family financial needs. Female respondents also reported earning income from other sources like sewing, knitting, embroidery work, selling milk and working on beauty parlor when there is no vegetable picking activity in the area, in order to support their family income and spending for preparing dowry of their daughters. Majority of the sample women (74%) preferred looking after the children and taking care of household issues instead of vegetables picking. Only 19% considered their wage earnings as important activity.

It was also found that despite majority of the female respondents (86%) were aware about the harmful health effects of pesticides' sprays on vegetables,

they were not using any safety measures. They reported about headache, asthma, eye & skin irrigations, cough and dizziness by working in vegetable fields.

It is suggested that in order to improve wages of rural females on competitive basis, they should be provided training in other more remunerative non-farm activities like stitching for readymade garments, fashion designing, beauty parlors, preparation of value added products of fruits/vegetables. The female vegetables pickers should also be educated about the importance (in terms of disease treatment and long-run health costs) of using safety precautions while working in vegetables fields. The government or extension department may provide protective masks at highly subsidized prices to the female workers working in vegetables and/or cotton fields.

Women Cotton Pickers' Perceptions about Health Hazards of Insecticide/ Pesticide Use in Irrigated Punjab

In Pakistan, cotton crop has special importance from the perspective of largest employment generating crop for both males and females in its production and value chains, and significant source of foreign exchange earnings by exporting textile based products. Cotton picking is primarily a female specific activity in all cotton growing areas of the country. The cotton picking women mostly belong to poor sections of the rural society. Due to heavy spray of pesticides, women cotton pickers are exposed to chronic pesticides poisoning with symptoms ranging from mild headache and skin allergies to cancer of internal organs. The present study was conducted to generate information on to what extent the female labor force engaged in cotton picking is aware about the health hazards of the plant protection chemicals used. For the present study, 150 women cotton pickers were interviewed from Vehari, Bhawalnagr and Sahiwal Districts of Punjab.

The sample women cotton pickers' profile shows that their mean age was about 33 years and had 2.4 years of formal schooling and 10 years of cotton picking experience. Most of them (74%) were married, living in joint families and their average family size was 7.4 members. On average, they spend more than 7 hours daily in the field for cotton picking and pick nearly 30 kg of cotton. The pick and drop facility is provided to them by the landlords. Their average daily earning is around Rs.200 per picker and surprisingly they are quite happy at this level of earnings from cotton picking. They spend this money on daily domestic needs, children' education, purchasing clothes, preparing dowry of adult daughters and other unforeseen expenses. The sample cotton pickers reported the problems like general weakness (54.5%), mental retard (9.90%), cough (8.90%), fatigue (5.90%), eye irritation (5.00%) and Asthma (4.00%). Unfortunately, only 10% women pickers were aware about protective measure (using mask and gloves) to be adopted during cotton picking. However, the use level of protective measures) was almost zero as there is no trend of use of protective measures in the area. About 85% women cotton picker washed their

hand after cotton picking while 77% women reported washing of clothes when reach home after picking.

It is suggested that in order to improve wages of rural females on competitive basis, they should be provided training in other more remunerative activities like stitching for readymade garments, fashion designing, beauty parlors, preparation of value added products of fruits/ vegetables. The female cotton pickers should also be educated about the importance (in terms of disease treatment and long-run health costs) of using safety precautions while working in the fields. The government or extension department may provide masks and gloves at highly subsidized prices to the female cotton pickers in the area. It is also suggested that cotton growers should be persuaded for providing gloves and masks to the female cotton pickers besides providing pick-drop facility to them.

Cost of Production of Sugarcane and its Marketing Issues in Central Punjab

In Pakistan, sugarcane production is hindered by many factors including high production cost such as seed, fertilizers, insecticides and irrigation costs coupled with low return on investment. Marketing issues are also prominent in case of sugarcane which discourage sugarcane production and have strong impact on production performance of each grower. The present study has been designed to estimate cost of sugarcane production across districts and marketing issues faced by farmers to make some policy level recommendations for the improvement in production and marketing systems of Sugarcane. The primary data has been collected from 150 sugarcane growers from Jhang, Faisalabad and Chiniot Districts.

Cost of production analysis indicates that the cost of production of fresh sugarcane crop was Rs.95660/acre, gross margins as Rs.124023/acre and net-income as Rs.28363.3/acre. The total cost of production of an acre of ratoon sugarcane crop was Rs.72173 with gross margin as Rs.121554 and net-income as Rs. 49381. The benefit-cost ratio of producing fresh and ratoon sugarcane crop was estimated Rs. 1.3:1.00 and Rs. 1.7:1.00 respectively. Across sample districts, sugarcane growers of Jhang district were getting relatively higher returns compared to the farmers of Chiniot and Faisalabad districts. This is partly attributed to higher average yield on sample farms (815 mds/acre) from Jhang District than the farms in Faisalabad (750 mds/acre) and Chiniot (746 mds/acre). Its marketing analysis revealed that majority of the farmers (68.7%) sell their produce to mill gate, 25.3% at the procurement centers of the sugar mills and very few (i.e. 8.0%) carry out contract farming. Average price announced by government per mound was Rs. 170 in 2012-13.

The average price received at mill gate was Rs.160/40-kg and Rs.153/40-kg at mill's procurement centers. The average cane weight loss at mill gate during wait in the que was reported as 2.4 mds per 500-mds consignment. Though,

majority of the respondents (87.3%) reported payment through CPR and remaining 12.7% got payments in cash, only 8.7% respondents were satisfied with payment procedure. Overall, about 82% of the total payment was received by the growers and remaining 18% was pending. Time given for remaining payments varies across districts as it was almost 140 days in Jhang district, almost 2 months (60 days) in Chiniot and almost a month (31.5 days) in Faisalabad.

In the light of the study findings it is recommended that to control the production cost of sugarcane, government should reduce the per unit electricity charges especially for farmers growing water intensive crops. For timely payments, CPR system may be changed with on spot cash payment at the time of purchase or transfer of amount to accounts of sugarcane producers. Adoption of government announced rate should be ensured to control exploitation of farmers by *beoparies* and middle men. Public private partnership is necessary to control the monopolistic control of few sugar mills and to induce competition in sugar industry to control prices and farmers exploitation.

An Analysis of the Adoption and Impact of Cultivation of Hybrid Seed of Selected Crops in Pakistan

In Pakistan, seed production and distribution used to be public sector dominated. As a result of more liberal marketing policy of the government initiated in 1994, the role of private seed companies in seed marketing business has significantly increased since mid-1990s. Presently, around 400 seed companies including 4 public sector and 5 multi-nationals are involved in seed business in Pakistan. The fast diffusion of hybrid seeds among small farmers is questioned on two main grounds. First, hybrids' research and seed production is mainly controlled by multi-national companies and they are also marketing this seed in developing countries through the private sector companies. Secondly, the hybrid seeds, though highly productive, but also requires high doses of fertilizers, pesticides, irrigation and other vital inputs. Therefore, the hybrid seed is considerably expensive compared to conventionally breed open pollinated varieties' seed. In this way, the use of hybrid seed becomes beyond the financial capacities of marginal and small sized farmers. Moreover, since the hybrid seeds loss their vigor overtime, therefore, the farmers have to buy new seeds to avoid yield loss. These factors make small farmers' inclusiveness doubtful. How the private sector identifies its client producers of hybrid varieties is the prime objective of this study.

Hybrid Rice

In Sindh province, the pockets of users of rice hybrids were found in Badin, Larkana, Qambar Shahdadkot, Shikarpur and Jacobabad Districts. In Punjab province, similar pockets were identified in Okara, Sheikhupura, Gujranwala and Chiniot Districts. The major role in the development of these pockets was played by the seed dealers, who obtained this seed from multinational seed companies and sold to the rice growers of their respective areas. This is

because these seed dealers were the only supplier of hybrid rice to the farmers. On sample farms, hybrid rice was planted at 50% of total rice area followed by conventional varieties at 22% area. In Sindh and Punjab province, 72% and 31% of total rice area was under hybrid rice varieties, respectively. The conventional rice varieties were found at 16.4% and 25.8% of total rice area in Sindh and Punjab provinces, respectively.

More than 15 rice varieties found planted at sample farms during 2011 and 2012 crop years. The conventional varieties on sample farms were Super Basmati, Supra Basmati, Kernal Basmati, Basmati-385, IRRI-6, IRRI-9, KS-282, DR-82, DR-83, Shandar and Kainat. The hybrid group varieties found on sample farms were Guard-53, Pearl, Pokhraj, Shehenshah, Anmol, Mehrani, Dhaga, Rachna and Winner. In Sindh province, Guard-53 rice was the most popular hybrid rice variety found planted at 51.8% followed by Pokhraj at 12.8% of total rice area during 2011. In 2012, the area under Guard-53 sharply dropped to 30%, while the area under other hybrid rice varieties like Pokhraj, Shehenshah, Pride, Namol and Mehrani found increased. On the other hand, among conventional varieties relatively larger proportionate area was planted under KS-282 by occupying 20.9% of total rice area. In Punjab, hybrid rice varieties found planted at 76.2% of total rice area during 2011. Among hybrid varieties, relatively larger area was planted under Rachna variety (43.14%) followed by Guard-53 (26.4%) and Pokhraj (4.8%).

More than 80% farmers did not like the quality of cooked hybrid rice varieties compared to conventional ones. The mean cost of production of hybrid rice varieties was estimated as Rs.101387/ha including variable and fixed costs as Rs.67622/ha and Rs.33765/ha, respectively. The mean yield of hybrid varieties was 184.2 mds/ha compared to conventional varieties as 118.2 mds/ha. The mean prices obtained by sample farmers were Rs.852/md and Rs.1371/md for hybrid and conventional rice varieties, respectively. The mean gross margin from conventional and hybrid rice varieties were Rs.106933/ha and Rs.89300/ha, respectively. Therefore, the net-income from conventional and hybrid rice varieties were, Rs.60743/ha and Rs.3846/ha, respectively. There were non-significant differences between benefit-cost ratios of hybrid and conventional rice varieties.

The average yield of hybrid and conventional rice varieties in Sindh province were 196.2 mds/ha and 118.5 mds/ha, respectively whereas in Punjab, the corresponding mean yields were 190.2 mds/ha and 117.8 mds/ha, respectively. The mean price received by sample farmers for hybrid and conventional rice varieties in Sindh were Rs.922/mound and Rs.118/mound and in Punjab as Rs.850/md and Rs.1558/md, respectively. The mean gross-revenues from hybrid and conventional rice varieties in Sindh were Rs.180869/hae and Rs.140846/ha and in Punjab as Rs.161765/ha and Rs.183515/ha, respectively. The mean net income from hybrid and conventional rice varieties in Sindh were Rs.59002/ha and Rs.90820/ha, respectively. The mean net-income from hybrid

and conventional rice varieties in Punjab were Rs.38466/ha and Rs.39555/ha, respectively. The benefit cost ratios of hybrid and conventional rice varieties were 0.43 and 0.61, respectively. It can be concluded that cultivation of hybrid rice varieties is not a profitable option for the farmers not only in terms of net-income per ha, but also ever dependence on seed dealers for the seed supplies.

Hybrid Maize

In Pakistan, maize is mainly grown in Punjab and Khyber Pakhtunkhwa provinces. In Punjab, the hybrid maize growing pockets were identified in Chiniot and Okara Districts whereas non hybrid maize growing belt was found in KPK. The major contributors in promoting the cultivation of hybrid maize in these districts are the seed dealers of multinational seed companies. In Punjab, the average farm size of sample hybrid maize growers was 75 acres composed of 36 acres of owned land and remaining was rented in. The soils on sample farmers were mainly clay loam and canal water is main source of irrigation. Nineteen maize varieties found grown on sample farms and all the maize area was planted under hybrid varieties. The relatively more commonly cultivated maize varieties during 2011 were 32B33, 6525, 6142 and 31P41 with their respective shares in total maize area as 37.9%, 17.8%, 8.1% and 7.3%. In year 2012, the varietal composition on sample farms was changed and the area under varieties like 33M15, 67911, P1543, 31L88 and 3443 was increased by 4.7%, 3.4%, 0.9%, 2.3% and 1.9%, respectively. The cooking and eating tests of hybrid maize oil and corn revealed that 61.7% farmers in Punjab tested it in their homes and perceived it better than conventional maize.

The mean cost of production of hybrid maize varieties was estimated as Rs.118189/ha with variable and fixed costs as Rs.76999/ha and Rs.41190/ha, respectively. The mean yield and selling price received by sample farmers were 220mds/ha and Rs.822/md, respectively. The mean gross margins and net-income from hybrid maize production on sample farms were Rs.103834/ha and Rs.48674/ha, respectively making benefit-cost ratio as 0.37. The study concludes that hybrid maize cultivation is more profitable than the production of other crops in the study area during that season.

Hybrid Sunflower

In Pakistan, sunflower fall under non-conventional oilseeds. In late 1990s, sunflower used to be mainly grown in Punjab followed by Sindh, KPK and Balochistan provinces. This composition has been recently changed significantly. The provincial sunflower area composition in Pakistan shows that now Sindh is its major producer followed by Punjab whereas very small area has been planted in KPK and Balochistan province (Government of Pakistan, 2013).

In Sindh, the sunflower hybrids growing pockets were found in Thatta, Badin, Mirpur Khas and Umerkot Districts whereas in Punjab, similar pockets were

present in Lodhran, Vehari and Sialkot Districts. The major contributors in promoting the cultivation of hybrid sunflower were seed dealers and commission agents, but the role of seed dealers was significantly dominant over commission agents as 92.5% sample growers reported purchasing the seed from seed dealers. Only 4 hybrid sunflower varieties were cultivated by the growers. In Sindh hybrid varieties under cultivation were: Hysun-33, Hysun-38, Hysun-39, and S-278. In Punjab only 2 sunflower varieties namely Hysun-33 and S-278 were cultivated and both have occupied 57% of total sunflower area on sample farms during 2011, which was dropped by 6 percentage points during 2012. In Sindh, Hysun-33 was most dominant and cultivated on about 50% area followed by Hysun-39, 37 percent area during 2011. BCR shows that sunflower growers received 0.13 in Sindh and 0.23 in Punjab. Therefore, it is concluded that cultivation of sunflower in Punjab is more profitable than Sindh.

Overall, the total cost of production of hybrid sunflower was estimated as Rs.59193/ha with variable and fixed costs composition as Rs.38414/ha and Rs.20779/ha, respectively. The average yield of hybrid sunflower on sample farms in Punjab and Sindh were 48 mds/ha and 26.5 mds/ha, respectively. The growers of Sindh received higher price Rs. 1989/mds compared to growers of Punjab Rs. 1888/mds. Gross margin and net return of hybrid sunflower were analyzed and found that sunflower growers obtained Rs. 33824/ha of gross margin and Rs. 11772/ha net return from Hybrid sunflower. The comparison between province shows that growers of Punjab received higher gross margin Rs.46860/ha and net return Rs.17073/ha compared to Sindh gross margin Rs. 20563/ha and net return Rs. 6189/ha. Benefit cost analysis is used to determine which option is likely to provide the highest return for a proposed investment. BCR shows that sunflower growers received 0.13 in Sindh and 0.23 in Punjab. Therefore, it is concluded that cultivation of sunflower in Punjab is more profitable than Sindh.

Hybrid Canola

In Sindh, the major pockets of hybrid canola were identified in Mirpurkhas, Benazirabad, Sanghar and Khairpur Districts whereas in Punjab, similar pockets were noticed in Faisalabad, Khanewal, and Jhang Districts. These pockets found developed with the efforts of established by the seed dealers, who purchased seed from multinational companies and distributed among the growers. The hybrid varieties on sample farms were Hyola-43, Hyola-308, Hyola-401 and Pioneer-45J21 and in conventional group, the varieties reported were Sohni Dharti-3024, Tooriya, Local Sarsoon and Khanpur Raya. About 50% of total oilseeds area was planted under hybrid canola during 2011 and 2012 and remaining under conventional varieties making a 50-50 ratio of hybrid-conventional varieties. In Sindh, 5 canola varieties were planted and out of which about 52.4% area was planted under hybrid canola during 2011 and nearly 48% in 2012. Among hybrid canola largest proportion of area was planted under Hyola-43 (20.27 percent) and Hyola-308 (19.58%) during 2011 and area under both Hyola-43 and Hyola-308 decreased up to 16.14% and

12.24%, respectively. The area under other hybrid variety i.e. Hyola-401 increased during the year 2012. In Punjab 6, canola varieties were planted and out of which about 48% area was planted under hybrid canola during 2011, which declined to 42.1% in 2012. Among the conventional varieties' the largest proportionate area was planted under Sohni Dharti-3024 was 16.9% during 2011 which declined to 12.6% in 2012. Canola growers received yield of hybrid canola 50.95 mds/ha compared to conventional rapeseed mustard 57.52 mds/ha. The average selling price of Rs.2186/mds of hybrid canola and Rs.2264/mds of conventional rapeseed mustard. The gross margin was analyzed and found that growers obtained gross margin Rs.91003/ha of conventional rapeseed/mustard and hybrid canola Rs.70752/ha. Benefit-cost ratio shows that conventional rapeseed and mustard obtained BCR 1.79 compared to BCR of hybrid canola 1.32. Thus analysis indicates that hybrid canola was less profitable compared to conventional rapeseed and mustard.

Hybrid Tomato

In Sindh, major hybrid tomato pockets are in Thatta, Badin, and Mirpurkhas Districts, whereas in Punjab, Rahimyar Khan, Bahawalpur, Muzafargarh, Sahiwal, Faisalabad and Sargodha. These pockets were established mainly by the seed dealers and commission agents. Among these two, seed dealers was the major player and majority 91.2% growers purchased seed from seed dealers and remaining purchased from commission agent. The hybrid tomato cultivars were, 1359, 2565, Adventa, Joint, Eaden, Dollar, Anmol, 575, Demand and Avenash. The conventional varieties were PS, class/pop and Peshawari. More than 95% of tomato area was planted under hybrid varieties during 2011 and about same in 2012. The area under conventional tomato varieties was 4.94% during 2011. The higher proportionate area was planted under PS variety during 2011 and 2012. In Sindh, the largest area was planted under varieties 1359 followed by Yaqee variety. In Punjab, 98.79% of total tomatoes area was planted under hybrid tomato during 2012. From the hybrid group, the most popular varieties planted were 2565, 1359, Adventa and Dollar. The conventional tomato varieties' are in decreasing order. The cost of production was analyzed and found that total fixed cost incurred Rs.3234.53/ha and variable costs Rs.132555/ha. The average yield of hybrid tomato was higher Rs.1853 crates/ha compared to conventional varieties 1490 crates/ha. The growers received selling price as Rs.273.73/ create of hybrid and Rs.246.83/ crate of conventional tomato. The net returns Rs.183197/ha, received from hybrid tomato compared to conventional tomato Rs.127897/ha. There is no much variation in BCR in case of hybrid and conventional tomato in Pakistan. BCR of hybrid tomato in Sindh is relatively lower 0.53 compared to BCR is Punjab 0.70. This analysis indicates that adoption of hybrid tomato is less profitable among growers in both provinces.

Hybrid Okra

In Sindh major hybrid okra pockets were identified in Thatta, Tando Allahyar and Sukkur Districts, while in Punjab, similar pockets were found in Muzafargarh, Khanewal, Jhang, Faisalabad and Lahore District. Two hybrid okra varieties are under cultivation i.e. Syngenta-152 and Adventa-802. The conventional varieties were Rama-Krishna, Jalandhari, Juvo, Sabzpari, Durga and Local/unknown. More than 35% of total okra area was planted under hybrid varieties during 2011, which declined by 2.96 percentage points in 2012. The hybrid okra is losing its popularity due to its bigger size, picking and cooking quality compared to conventional varieties. The area under conventional okra was 64.4% in 2011, which increased by 2.96 percentage points in 2012. Seed dealers were the major player of seed supplier and 100% growers purchased seed from them which belongs to various multinational companies. The mean cost of production of okra of hybrid and conventional okra varieties were Rs.329330 and Rs.282548, respectively. The average yield of hybrid okra was higher 542 mds/ha compared to conventional okra 424 mds/ha. The selling price was Rs.1305/md of hybrid and Rs.1595.83/md conventional okra. The gross revenues from hybrid and conventional okra varieties were Rs.707310/ha and Rs.67366/ha, respectively whereas the corresponding net-incomes were Rs.377980/ha and Rs.394818/ha, respectively. The benefit cost ratio shows that conventional okra (1.40) is more profitable per unit of input compared to hybrid okra (1.15). This is due to lower market price of hybrid okra. The above analysis indicates that adoption of hybrid okra was not economically viable for growers compared to conventional okra.

Status of Fruit Farming in Central Valley of Khyber Pakhtunkhwa

Due to diversity in season and variations in altitude, a large number of fruits and vegetables can be suitably grown in KPK. The major fruits grown are apple, followed by peaches, melons, citrus and guava. The inter-provincial fruits yield comparison clearly suggests that KPK have a comparative advantage over Punjab in many fruits. Agro-ecologically, the central valley plains of KPK fall under zone-C of the province, which consists of Peshawar, Mardan, Swabi, Charsadda and Nowshehra. The total cultivated area available in this region is 0.108 million ha, 80% of which is planted under major crops. Besides other fruits, citrus is the prime fruit grown in this region. The prime objective of this study was to examine overtime changes in the cultivation of different fruits in the region.

This study was conducted in four districts of the region namely Charsadda, Nowshera, Mardan and Peshawar. Sixty four fruit orchards growers were formally interviewed during the survey of which 21 were small (upto 12.5 acres), 24 medium (>12.5 to 25 acres), and 19 were large farmers (> 25 acres). The study focused on examining the status and factors affecting fruit orchards of this region and to make policy recommendations for the stakeholders. It was found that on sample farms, the citrus area declined from 50.2 acres to 30.0

acres (40.2%) during last 10 years. The area under stone fruits like peach, plum and apricot declined in the last 10 years from 18.4 acres to 11.3 acres (38.8%), plum from 10.1 acres to 6.6 acres (34.7%) while apricot from 3.4 acres to 1.7 acres (48.6%). On the other hand, a marginal improvement of 4.36% and 1.26% in the area under pear and loquat, respectively.

Majority (59.4%) of the sample farmers reported diseases attacks on fruit orchards as a major problem that decreased the area under fruit orchards. Other farmers reported different reasons that affected the area under fruit orchards such as lower yields (37.5%), marketing of produce (21.9%), high cost of inputs (17.2%), energy crises (12.5%), lack of cold storages (7.8%), lack of capital (10.9%), drought causes (6.2%) and environmental changes (12.5%). The major problems of the production, as perceived by the farmers, in decreasing order of importance were frequent diseases/insects attacks, high input prices, water shortages, adulteration in inputs, and non-availability of credit. It is suggested that agriculture department should regularly disseminate technical-know-how from fruit production (including Integrated Pest Management) to marketing through field days, workshop and other electronic/print media. The government should keep check on price and quality of inputs to put the fruit culture in KP back on track.

Wheat Varietal Diffusion and Yield Updates for Wheat Deficit Areas of Balochistan

Wheat is the prime food commodity produced and consumed all over Pakistan. Punjab and Sindh are its major producers whereas its local production is less than the demands in KPK and Balochistan. Therefore, the eastern provinces (Punjab and Sindh) of the country are net-surplus and western provinces (KPK and Balochistan) are net-deficient in wheat production. After provincial autonomy awarded in 18th amendment, the concerns about enhancing production of prime food commodities aroused in order to ensure provincial food securities as per capita income (or purchasing power) in these food deficient provinces was also comparatively low while majority of the population lives in rural areas. The need for generating information/feedback about the status of wheat varietal adoption, particularly of those developed by provincial and federal research institutions (i.e. ARI & AZRC) was felt in order to mobilize/re-organize resource allocation to agricultural R&D in the province. Therefore, the prime objective of the present exercise was to generate updates about the diffusion status of different varieties developed by institutions like AZRC/ARI in Balochistan. The farm level data was gathered through a formal survey carried out in Districts like Loralai, Killa Saifullah, Pishin and Mastung. These districts were purposively selected to take with account various factors including law and order situation, rural and less wheat production..

Eleven varieties namely Bhakkar-2002, Tajiban-10, Zarghoon, Rakhsana-10, AZRC-1, AZRC-5, AZRC-6, AZRI-96, Zardana-89, NARC-11 and local were found planted at sample farms. Among these, Bhakkar-2002 (32.7%) and

Tajiban 2010 (20.5%) were relatively more widely planted varieties in the study area. The local varieties were planted at 26.6% of total wheat area on sample farms. Though the yield potential of Bhakkar (more than 6 t/ha) was much while the Tijaban-10 (4.5 t/ha), the average yield of Tajiban-10 (18.3 mds/acre) on sample farms was relatively higher than Bhakkar-2002 (17.9 mds/acre).

The prime reason is, perhaps, Bhakkar is for irrigated area whereas due to less water availability in Balochistan, the rainfed area variety Tajiban-2010 performed better. Forty percent of sample wheat growers obtained seed from BARC, 32.2% applied own seed kept from previous crop, 9.6% from a FAO financed project, 6.8% got it from fellow farmers, 6% from seed dealers/shops and 4.4% from R&D departments of Balochistan. The quality of the seed obtained from BARC and FAO project was much better in terms of germination percentage and yield performance compared to other sources. Regarding sowing patterns, 62% of the sample farmers planted wheat within first two weeks of November, 31.4% after 15th November while remaining 6.4% farmers planted in October. Majority of the farmers (67.8%) applied tube well irrigation, 15% applied only rain water and 17% used both tube well and rain waters. Costs and returns statistics shows that total cost of wheat production on sample farms was Rs.28053/acre, gross revenue as Rs.31090/acre and net-income per acre as Rs.3027/acre. The returns per acre on sample farms are much lower than the returns reported by various studies for similar environments in KPK and Punjab. This implies an urgent need of de provinces.

From the above discussion, two important conclusions can be drawn: i) because wheat R&D is quite weak in Balochistan, therefore, both the provincial average and mean yield on sample farms is quite low; ii) the out performance of Tajiban-10 compared to Bhakkar-2002, signifies that indigenously developed varieties can perform better than the varieties of other provinces introduced in Balochistan. Therefore, massive investments in human resource development and other infrastructure (laboratories, gene banks etc.) are needed. Hence, it is recommended to shift financial resources and training program/training slots towards wheat, if Balochistan Government is interested in increasing wheat productivity and the production in the province.

Poverty Alleviation and Economic Growth through Sustainable use of Natural Resources in Noorpur Thal

The improvement in the livelihood of the poor people while conserving natural resources is always a great challenge in rainfed ecologies. The study in hand was conducted to identify real challenges and their possible solutions in land use management and soil conservation for Thal ecology of Punjab. A package of key technological options have been identified which are supported through feasibility and financial analysis of major investment options to achieve the long term development objectives and sustainability goals. It is expected that this

study would be used as reference for planning livelihood improvement strategies in similar other fragile environments of the country

Baseline Survey of Progressive Control of Foot & Mouth Disease Project in Pakistan

Besides contributing 56% to the GDP of agriculture sector, livestock sector in Pakistan is a source of livelihood for millions of small farmers and land less peasants. At the same time the export of live animal and meat products has increased manifold during last decade. Hence, the importance of effectively controlling trade related diseases like FMD, PPR etc., has also enhanced to meet SPS standards. FAO and USAID through a project are supporting government of Pakistan to progressively control Foot and Mouth Disease. Social Sciences Research Institute, NARC has conducted a Baseline Survey of Progressive Control of FMD in Pakistan as a part of the FAO-USAID project to assess the impact of immunization practices being demonstrated for effective control of FMD. It has been revealed that the important causes behind the prevalence of FMD are poor housing, water contamination, congestions at farms, mixing of herds, irregular vaccinations, un-targeted vaccinations and non-observance of bio-safety measures.

Wheat Seed Marketing Systems in Pakistan

Increased production of agricultural crops depends not only on the development of high yielding varieties but also on the efficiency of the national seed systems to ensure that the seeds reach to the farmers. Recognizing the importance of wheat in the economy and realizing limited availability of information regarding adoption of different varieties, seed sources, demand and access to quality seed, across all the provinces and production zones, a national level study was conducted on Wheat Seed Marketing Systems in Pakistan to enrich available data base. Besides providing an over view of the wheat seed development and distribution system, the study provides the empirical evidence on wheat seed use, varietal and source choices, demand and impact at farm level derived from a comprehensive primary data through a national level survey.

Up scaling Strategies and Sustainability Options for Technologies Demonstrated at Different Watershed Project Sites in Rainfed Pothohar, Pakistan

In most of the cases dissemination and technology transfer plans are based on the technical optimum ignoring other aspects important to the farmers. Resultantly most of the interventions resulting in significant yield improvement are not adopted. The return to investment in technology and innovation development is not payable unless the target users participate in the process and ultimately adopt the proven technology. Being one of the development partners, the SSRI has made an effort to develop Up scaling Strategies and Sustainability Options for technologies demonstrated at different Watershed

Project Sites in Rainfed Pothohar, Pakistan based on the experiences and conclusion drawn from researchers and farmers interactions during demonstration and promotion along with evaluation of the individual technologies and structure of local capacity to support these innovation under "Watershed Rehabilitation and Irrigation Improvement in Pakistan: Demonstrating and Disseminating the Best Practices and Technologies to Help Rural Farmers" project.

Trends and Projection of Horticultural Crops in Pakistan

Population of a country directly influences the food requirements. The statistics shows that population of Pakistan is increasing day by day but the pace of agricultural production is not enough to meet the increasing dietary demand of minor crops like pulses and condiment (GoP 2012-13). The importance of horticultural crops in human nutrition is well known. The share of other items (vegetable oils, vegetables, fruits and sweeteners) has substantially increased from 20% in 1970 to 37% in 2006 (Ahmad *et al*., 2010). Thus to meet the local demand of horticulture item there is need to increase the domestic production or other source is to import the food item. The propose of this study is to examine the exports/supply, imports/demand of agricultural commodities (fruits, vegetable,) and projection is done on theses item by the year 2020. Trends showed that if the growth rates of the area of selected commodities remain same than forecasted values showed that area of citrus and mango will increase while apple, banana and grapes will be having downward slopping at the same time. In conclusion keeping in view the ever increasing trend of population and horticultural demand in Pakistan, it is important for the planners and policy makers and other concerned stakeholders to look into the matter that why exports of Pakistani fruit is deteriorating and import is having more volume which dealt burden on our foreign exchange. To maintain the well known position in international market it is important to provide the Pakistani farmers well maintained services to meet the international standards of sanitary and phytosanitary (SPS), because lacking of these standards Pakistan will maintained to loss its share in international market. The country needs to pay special concentration to a very important sector which has the potential of fetching precious foreign exchange.

Analysis of Factors Affecting the Commercial Success of Gladiolus Cultivation in AJK

Floriculture has been identified as a potential business due to divergence of farmers towards high value floral crops and utilization of flowers at social and commercial level. Hence commercial floriculture has emerged inside the country. Gladiolus cultivation in AJK especially Rawalakot district has emerged as a commercial crop for the last six years due to conducive environment. This study was conducted in Rawalakot and Neelum districts of AJK with the objective to analyze factors that have contributed in the commercial success of this newly introduced crop in AJK. A sample of 60 gladiolus growers was

selected particularly those growers who have commercially been growing and marketing gladiolus crop.

Through this study it was tried to investigate the factors played role in commercialization of Gladiolus cultivation in the study area. That four main factors i.e. cost, profit, risk, and socioeconomic features of the farmers were comparatively analyzed for gladiolus and other competing crops. Analyzing the socioeconomic characteristics it was revealed that gladiolus growers were highly educated (i.e. >11 years of schooling). As per previous findings education might be the important socioeconomic factors in adoption of new agricultural technologies. Cultivated land holdings were found small in the research area with average land holdings of 1.27 acres per farmer. The sampled growers cropped gladiolus over an area of 0.32 acres with increased gladiolus area (0.64 acres) this year against previous years. It was found that raising one acre crop of gladiolus cost was Rs.214864, which is about six times greater than maize and fodder cultivation. Seed constituted a major fraction of total variable cost. Seed costs Rs.160000 for growing an acre of gladious crop. Comparing the revenue gladiolus generates a gross margin of Rs.1084190 for an acre of land, about 18 times higher than maize and fodder crops. Higher risk especially sale price fluctuation and other natural hazards are there with the gladiolus crop as compare to lower risks in case of maize and fodder crop. So it was concluded that revenue and socioeconomic characteristics i.e., education level of the farmers and small land holdings are the two factors that encourage the commercialization of this novel crop in the area. On the other hand very high production cost and risk are the other two factors that discourage the commercialization of this novel crop in the area. Three main projects launched during 2007 to 2011 contributed significantly in promotion and commercial success of this crop. USAID funded project, Community Livelihood Rehabilitation Programming and Agribusiness Development Project helped and provided non-refunding financial assistance to the farmers in purchasing inputs for gladiolus cultivation.USAID funded project helped gladiolus farmers in purchasing seed and other inputs on 80:20 cost sharing basis. Under Community Livelihood Rehabilitation Programming farmers were helped in purchasing inputs for gladiolus cultivation on 80:20 cost share bases. Agribusiness Development Project provided non-refunded amount of Rs.125,000/= per farmer for the purchase of gladiolus seed. It is suggested that in order to make any novel crop commercially successful cost and risk must be managed minimized. Agriculture department of AJK can play an important role in provision of quality seed through training the farmers in replication storage and processing of gladiolus seed. Reliable and timely market information could reduce the price volatility aspect.

Agriculture Policy of Azad Jammu and Kashmir

Agriculture in AJK is fundamentally mountain agriculture, which is totally different from plain agriculture. But the course followed by AJK agriculture is

somehow traditionally plain agriculture. The choice of crop enterprise, the type of research undertaken and the strategies followed for promotion and development of agriculture.
This policy document was developed on the request of Director General Agriculture, AJK and was initiated in October 2013 and finalized in May 2014 and is the ever first effort by the department to develop such a policy document by involving Social Sciences Research Institute of PARC.

The main areas encompassed by this document are capacity building, agricultural extension and technology transfer and thematic research agenda. Capacity building of scientists and technical staff is of utmost important in the perspective of structural changes taking place globally and nationally in agricultural sector. To tackle the brain drain in the scientist community changes in the service structure and more opportunities of promotion and career development has been recommended. Also to acknowledge the hard work of the technical support staff one-step up-gradation is suggested. As agricultural extension system play a pivotal role in the transformation, adoption and diffusion of approved tested agricultural technologies from researchers to end user, therefore, need structural changes and innovation. E-agriculture extension system the form services centers have been recommended to upgrade the existing traditional extension system prevailed in AJK.

Exploration of the potential and availing the opportunities existing in the niche due to microclimatic zones, more focus on high value and unconventional agricultural practices is spotlighted to this policy. Organic farming, off-season vegetable production, medicinal plants etc. are the areas that may cause a paradigm shift in agricultural sector by transforming subsistence agriculture into industry, for poverty alleviation and income generation. Availability of good quality seed has always been a concern while quality seed is crucial for enhanced productivity. AJK enjoys a favorable environment for quality seed production of all type. Seed industry at state level in a private sector is one of the policy recommendations made in this document. Soil mapping throughout the State, soil fertility mapping and bioengineering practices for soil conservation are the activities suggested in this policy document. Bringing more land under cultivation by converting culturable waste land into productive land, discouraging housing and other commercial buildings on productive agricultural, land and land reforms have also been kept part of this policy. Mechanized agriculture is the future thrust of the policy and for this purpose terrain agricultural tillage equipment would be introduced.

The establishment of Agricultural Research Institute is pivotal for the development of the sector. The policy document would be hopefully instrumental in the development and promotion of agricultural sector with the aim to reduce poverty and exalt livelihood of the resource poor farming community.

Research for Agricultural Development Program (RADP)

The Research for Agricultural Development Program (RADP) was launched in April 2007, with total cost of Rs. 2963 million for a period of 60 months. Due to overall financial environment in the country, the allocation of financial resources and releases remained far below than those reflected in PC-I. Therefore, by the end of FY 2013-14 the actual expenditure was only Rs.1181.840 million. Due to this factor, the project has been extended up to June, 2015. The project is being implemented by the Pakistan Agricultural Research Council (PARC). Main objectives of the RADP are: to provide timely response to emerging and re-emerging research issues and problems; provide autonomy to PARC to prioritize and implement its research agenda within the main ambits of 22 research themes approved in the project for each sector i.e., Crop Sciences, Natural Resources, Animal Sciences and Social Sciences – with its own implementation mechanism through established PARC system. The other objectives of RADP are to upgrade and strengthen the depleting research infrastructure at various centers of PARC, by supplying latest and state of the art equipment; farm machinery, office equipment; green houses and repair of irrigation system, and old buildings. It also aimed at improving the lab to field mobility of scientists, and update/improve communication links. It has also to cater for the human resource development, and arrange experts in the areas where PARC lacks expertise.

Program Objectives

The broad objectives of "Research for Agricultural Development Program" are: (a) address the current and emerging needs of science based-agriculture development to achieve food security on sustainable basis, poverty reduction, economic efficiency and export competitiveness; (b) serve as a mechanism for timely response to emerging research issues and problems such as pest epidemics for crops and livestock, nutrient deficiency, climate change, etc; (c) maximize productivity per unit of land, water, animal, labor and capital; and (d) move from research output to innovations in terms of products and services suitable for smallholders.

Management Structure

The executing agency of the project/program is PARC. A Project Director has been transferred from PARC main system for the implementation of RADP. The project activities on approved themes / priority areas of each sector i.e. Crop Sciences, Animal Sciences, Natural Resources and Social Sciences are coordinated by respective Member / Incharge of the sector who is authorized / responsible for resource distribution and outcome of that sector. The management committees are:

Program Steering Committee (PSC)

Program Steering Committee (PSC) has been constituted as per approved PC-I for overall supervision of the project implementation. The composition of PSC has been changed with the approval of Secretary, M/o NFS&R because RADP PC-I was prepared in FY 2006-07 and up till now a lot of changes have been occurred at ministerial level. Some positions of the Members of PSC have been eliminated and some new positions have been created. Therefore, it was very necessary that the composition should be changed according to the new positions of Members of PSC to make it more functional and useful while ToRs of the PSC remained unchanged. The PSC during the project has met six times, reviewed the overall progress, provided guidance to resolve operational and financial issues and also authorized technical revision and re-appropriation of funds within overall approved cost and scope of the project.

Program Executive Committee (PEC)

The detailed research plans under the approved themes / activities are prepared by the respective scientists and cleared by PEC based on the recommendation of Technical Division and comments of PIU. The composition of PEC have been changed with the approval of Secretary, M/o NFS&R because RADP PC-I was prepared in FY 2006-07 and up till now a lot of changes have been occurred at ministerial level. Some positions of the Members of PEC have been eliminated and some new positions have been created. Therefore, it was very necessary that the composition should be changed according to the new positions of Members of PEC to make it more functional and useful while ToRs of the PEC remained unchanged. PEC has met 24 times in last seven years (up to May, 2014).

Sub-Projects Progress

By the end of FY 2013-14, more than, one hundred and twenty two (122) research activities/sub-projects were launched. Out of these, 89 sub-projects have completed their life. Sector wise numbers of the approved, ongoing and completed projects are summarized in the table below. The research activities/ projects in operation are reviewed annually by the senior management of PARC, with primary objective to quantify progress/outputs of each of these projects, assesses possible completion/funds utilization and to give directions for speedy achievements of set targets.

Sector Wise Research Projects				
Sr. No.	**Discipline**	**Completed**	**On-going**	**Total**
1	Crop Sciences	46	19	65
2	Natural Resources	16	8	24
3	Animal Sciences	12	3	15
4	Social Sciences	15	3	18
Total		**89**	**33**	**122**

Crop Sciences

In crop sciences number of salt, drought and rust tolerant lines/genotypes of wheat have been identified and their genetic manipulation is under progress. Similarly good hybrid lines of sunflower, canola, tomato, mandarin, and Sudan Sorghum grass available. These hybrids are in pipeline for approval, and commercialization. The case of short duration groundnut line (PG 1158) with maturity periods of 110 days and yield about 3 ton/ha is ready to be presented to Variety Evaluation Committee (VEC). Seed of a couple of oilseed hybrids multiplied and sold to farmers. Technology transfer, seed production and popularization of Lentil variety (Markaz-09) was another success in Potohar region.

The other outputs include fabrication and testing of mango harvesting/pre-cooling and buffalo milking machine, maize dryers, small scale olive extraction unit, turmeric curing and drying machine, vegetable planter and transplanter, PTO driven disk plough developed in collaboration with local manufacturer. Some projects are primarily gathering and putting together useful information on pest control, pest risk analysis and pesticides residue for trade and policy development which are going to suggest new avenues for further research and development as well as policy planning and introducing management interventions. Bioremediation technology of waste water treatment has been recognized at National and International level and passed on to many development agencies.

Social Sciences

Social Sciences projects have done analyses of the commodity value chains citrus, poultry and dairy products, agricultural growth and poverty reduction, food consumption diversity, harvest and post harvest losses, Bt cotton issues at farm level, economy of sugar industry, farmers trainings, demand/supply estimates and projection of meat, scientists capacity building through trainings, strengthening and up scaling of audio visual communication facilities. These

activities have generated very useful information and data set for planning and policy making. At NARC, Pakistan Institute of Advanced Studies in Agriculture (PIASA) with affiliation to Quaid-i-Azam University, Islamabad has been established with enrollment in M. Phil and Ph. D students. One hundred and twenty four students awarded M. Phil degrees, whereas 18 and 16 new students have been enrolled for M. Phil Ph. D program respectively.

Natural Resources

Major focus in Natural Resources is on land and water productivity, water use efficiency through drip and trickle irrigation; watershed management, plant nutrition management, chemical and bio-chemical reclamation of salt affected soils, soil pollutants, their fate and management and modeling for climate change, bio–remediation of sewerage water, and solar desalination of brackish water at domestic level, honey bee lab for analysis for export quality honey, production technologies for developing valuable by products of honey (royal jelly, pollen, propolis and bees wax etc), Beekeeping in Gilgit/Baltistan to make use of high value flora for small farmers, establishment of vermiculture and verimicomposting unit, cultivation of black cumin in Gilgit, conservation of native flora of Cholistan, cultivation of bio-fuel plants on marginal lands, rangeland management and pasture development.

Animal Sciences

Animal scientists have developed state of the art technologies of introducing early puberty and heat synchronization of large ruminants for improved production and reproduction of animals, improved preservation of buffalo and goat semen for enhancing its quality for improved AI. Fattening potential of sheep/goats breeds, Characterization of Avian influenza and FMD viruses and vaccine development, carrier potential of small ruminants of Des Petits Ruminants (PPR), sero-diagnostic and sero-surveillence for the control of warble fly, culture/breeding of ornamental fish, feed formulation and disease control of trout fish in northern areas, and breeding of endangered wild animals have given good results and may enhance production and income of farmers.

Labs Up graduation

The up gradation of infrastructure was given due emphasis for efficient and smooth carrying out of research activities. This included; procurement of demand based scientific equipments, field machinery and office equipment.

Civil Work

In Civil Works component many items of repair and maintenance of existing buildings were carried out by PARC - Works Directorate. Under new construction; Social Science Institute building (SSI), F-type residences at NARC, Laboratory building at MARC, Juglote, Gilgit, Insectary building have been completed. Community Centre/Cafeteria, Livestock Research Lab, and construction of boundary wall at Coastal Agriculture Research Station (CARS) Karachi are the on-going activities.

RADP Workshop

One day RADP workshop was organized on 15 April, 2014 at NARC. The main objective of the workshop was to share the outputs/progress of the program with farmers, researchers, and academia and policy makers. Different technologies of crops, natural resources and animal sciences were also displayed for the participants. Honorable Federal Minister of National Food Security & Research Mr. Sikandar Hayat Khan Bosan was the chief guest of this event. Federal Secretary National Food Security & Research and Joint Secretary (Plan) M/o NFS&R were also attended the workshop. Approximately, 300 participants attended the workshop. Project Director, RADP made a brief presentation about the project activities and progress so far made in various sectors. Chairman PARC Dr. Iftikhar Ahmad in his welcome address briefed about the project profile and its impact on strengthening the National Agricultural Research System (NARS). Director General, NARC Dr. Muhammad Azeem Khan in his vote of thanks address appreciated the financial support of MNFS&R. Honorable Minster and Federal Secretary appreciated the efforts after listening the remarks by the farmers and also urged that the significant technologies of the program must be passed on to the farming communities.

Ex. Sr. Director Planning Dr. Shahida Jamil inaugrating one day workshop of RADP

Secretary M/o NFS&R, Seerat Asghar, visiting the stalls

Mr. Seerat Asghar, Secretary M/o NFS&R, Dr. Iftikhar Ahmad, Chairman PARC and Dr. Azeem Khan, DG NARC visiting the stalls

Mr. Seerat Asghar, Secretary M/o NFS&R, Dr. Iftikhar Ahmad, Chairman PARC and Dr. Azeem Khan, DG NARC visiting the stalls

Inagural Ceremony of Combine Harvestor

Inagural ceermony of combine harvestor was held on 14th May, 2014. Federal Secretary MNFS&R was the chief guest. Combine harvestor has the capacity to harvest 3-4 acres of wheat crop within a hour.

Mr. Seerat Asghar, Secretary M/o National Food Security & Research, inaugurating the new wheat and rice combine harvester at NARC

Seerat Asghar, Secretary M/o NFS&R, Dr. Iftikhar Ahmad, Chairman PARC, Dr. Azeem Khan, D.G NARC, Dr. Nadeem Amjad, Member NRD and other are in group photo at occasion of inaugurating wheat harvesting ceremony

INTER PROVINCIAL COOPERATION

Establishment of Fora at PARC

Established

- Vice Chancellor Forum
- Revived Inter-Provincial Agricultural Research Coordination Committee (IPARCC)

In process

- Inter Ministerial Coordination Committee
- Federation of Farmer's Association
- Women in Agriculture Forum

Signing of MoUs at National Level

Eight MoUs were signed with government, Public Sector & Private Organization to strengthen coordination with stak-holders and other 03 were initiated, along-with coordination/ implementation of already inked 37 MoUs.

PLANNING & DEVELOPMENTDIVISION

Pakistan Agricultural Research Council (PARC) through the Planning & Development Division with its three directorates namely i. Directorate of Project Monitoring & Evaluation (PM&E) ii. Directorate of Competitive Grants & Memorandum of Understanding (CG&MOU) iii. Directorate of Public Sector Development Program (PSDP) is supporting agricultural research by the designing, processing, management & evaluation of development projects funded under a: Public Sector Development Program (PSDP), b: Agricultural Linkages Program (ALP), based upon competitive research grant system and c: Projects funded under Memorandum of Understanding (MOU). PARC since its establishment has been instrumental in providing the much-needed research funding to all components of the National Agriculture Research System (NARS) for the improvement of research and development efforts. PARC through multifarious efforts is also contributing in bringing significant improvement in the agriculture productivity improvement and poverty alleviation. It has been playing significant role in NARS infrastructure improvement and human resource development by availing funding from multilateral donors.

Project Monitoring & Evaluation (PM&E)

Regular project Evaluation/Review is a good management practice and it plays an imperative role in the successful implementation of projects. It aims at providing regular oversight of the implementation of the projects activities and alerts managers about actual & potential projects problems and short comings, before it is too late. In order to know whether or not the projects are on track to achieve projects objectives, it must be monitored during the implementation phase and impact evaluated at mid/end of the project.

Directorate of PM&E in Planning & Development Division (P&D Div.), PARC is responsible to organize and conduct the Evaluation/Review, Monitoring and on-site evaluation of on-going as well as completed projects of PARC funded under different sources. PM&E is also responsible to develop, prepare and update National Agricultural Research Plan and link with five year Development Plan of GOP prepared by the Planning Commission. It also prepares and maintains various data series required for priority setting, plan preparation and resource allocation.

Salient Achievements

- In-house review meetings of twenty four (24) on-going ALP proejcts under Animal Sciences, Natural Resources and Social Sciences Sectors were conducted at PARC Headquarters, Islamabad during the period under reprot. Review reprots of the same were prepared and submitted to all concerned for necessary action.
- Conducted on-site evaluation of five (5) ALP funded on-going projects of Animal Sciences Sector of various institutes/universities at Faisalabad, Peshawar and Khushab. On-site evaluation reports of these projects were prepared and circulated among all concerned for necessary action.
- Physical verification of capital assets purchased as per approved PC-I under the three on-going PSDP funded projects of PARC were carried out during the reporting period at National Agricultural Research Center (NARC). Undertook the activities of transfer of assets to the Host Institutes of two PSDP completed projects at NTHRI, Shinkari, Mansehra, NARC Islamabad alongwith its three other components at AARI Faisalabad, MRS Shujabad and BZU Multan.
- Desk Monitoring on the basis of monthly and quarterly progress reports of seven (7) on-going PSDP funded projects during 2013-14 of PARC continued during the reporting period.
- Twelve (12) briefs and consolidated monthly activities reports in respect of Planning & Development Division, PARC for the year 2013-14 were compiled/prepared. The same were submitted to Director (Technical), Secretary Office, PARC for onward submission to the concerned quarters.

- Director General, P&DD and PSO (PM&E) visited ICIMOD, Nepal on 16th to 20th December 2013 for orientation on Monitoring & Evaluation System. The specific objective of visit was to build RBM&E system for PARC at institution level through which the Council can better monitor & evaluate its five years business plan (2013-2018). A joint effort to establish the proposed result based monitoring & evaluation system for PARC is planned as a result of this visit.
- Organized/Arranged visit of M&E experts of ICIMOD from 15th 23rd April 2014 to establish the Result Based Monitoring & Evaluation Systems for Pakistan Agricultural Research Council (PARC). Developed template of Annual work plan format for Results Based Monitoring &Evaluation at Divisions and Institutes level. Also developed/ compiled data regarding the current and past activities/ progress of three Directorate of P&DD for management information system (MIS) of PARC.
- Developed Logical Framework Analysis (LFA) of commissioned project "Establishment of Provincial Agricultural Research Boards and creation and implementation of transparent and province endorsed "Competitive Grants System" of Agricultural Innovation Program (AIP) project, being a member of M&E team of AIP.
- The Business Plan conceived and prepared in consultation with technical divisions and technical support of FAO consultant. The document finalized after several presentations to various forums and got printed and launched through Minister NFS&R. The document distributed all over international and national donors, policy makers, research system partners and internal system of PARC. Implementation process begun on the document by various actors and being followed up by calling annual work plan of all the Divisions of PARC – formats prepared in consultation with expert from ICIMOD.
- In consultation with ICIMOD expert PARC M & E framework document prepared and finalized in consultation with PARC divisions. The system being made operational with annual planning process as per M&E frame work document prepared. PARC Divisions and organizations being pursued for preparation of their Annual Work Plans on the basis of Business Plan as per uniform format. Divisions and others being supported in preparation of their work plans. Training also planned for institute level personnel in WP preparation. Meetings held with ICIMOD M&E expert to assess progress and difficulties.
- Capacity building project on technical proposal writing for grants under ALP is being executed by PSO, P&DD. Four workshops, one for master trainers and three for provincial scientists. One each for Punjab, Sindh and Balochistan organized with 70 scientists given hands on training in the field.

- RADP project is being supported for its monitoring, evaluation of projects as well as physical verification of capital assets. A number of cases are processed for approval of various forums on weekly basis.

Competitive Grants & Memorandum of Understanding (CG&MOU)

Introduction

The Agricultural Research Endowment Fund was established by the Government of Pakistan in 1999 with an amount of Rs.1.3 billion for Agricultural Linkages Program (ALP). The objective of ALP is to promote and support agricultural research and development activities in accordance with the Pakistan's long term development goals and to promote long term scientific cooperation between Pakistan and the United States in agriculture sector.

Function

PARC is responsible for operation of ALP mainly consist of selection, processing, approval, monitoring, evaluation and coordination of projects. The ALP has its own Board of Directors (BOD) responsible for the fund's program and its financial and managerial policies. The Directorate of Competitive Grants and MOUs Projects, of the division is undertaking following activities:

- Priority setting, invitation and processing of competitive grants and MOU projects for approval;
- Processing of technical and financial reports of competitive grants projects;
- Arrange monitoring, review and evaluation of competitive grants projects and compile the audit and financial reports;
- Undertaking project completion formalities (collection of financial, technical and final reports, arrange audits, final budget settlement and transfer of equipments)

Salient Achievements

- Research priorities for 7th batch of ALP identified by the technical divisions of PARC were considered in 4th meeting of the Inter-provincial Agricultural Research Coordination Committee (IPARCC). The draft procedures/steps involved in processing of ALP projects from short listing to completion stage have been finalized after the approval of competent authority.

Current Status/Progress:

Since the establishment and initiation of ALP in 2000, six batches of ALP has been successfully launched. More than three hundred projects have been completed in various disciplines of agriculture in agriculture research centers/institutes/stations and universities. The 57 projects funded under 6th

batch are currently in operation. The project proposals under 7th batch are in process of appraisal through technical experts/national referees and further processing for approval.

- The 7th batch of ALP projects has been announced to invite preliminary research proposals through advertisement in national newspapers, ALP/PARC website and requested the Heads/ Directors of research institutes and VCs of agricultural universities of NARS for submission of preliminary proposals. The data in respect of preliminary proposals – Six hundred & two (602) received under 7th batch of ALP examined and computerized. The meetings of the review committees of the four sectors (Animal Sciences, Crop Sciences, Natural Resources and Social Sciences) were held for evaluation and short listing of proposals received under 7th batch of ALP. The PIs of short listed projects were requested for development of detailed projects. The detailed projects under 7th batch of ALP provided by the scientists are evaluated and further processed for appraisal.

Completed Projects

313 projects have been completed by June, 30, 2014 in various universities, agricultural research centers, institutes and stations in discipline of plant sciences, natural resources, animal sciences and social sciences. The detail of completed projects (numbers) is as under:

Region and Sector wise Number of ALP Funded Completed Projects as on 30. 06. 2014					
Region/Sector	**ASD**	**PSD**	**NRD**	**SSD**	**Total**
Federal PARC/NARC	16	37	21	4	**78**
PARC (Outstation)	6	8	16	10	**40**
Other Federal	2	25	8		**35**
Punjab	28	32	14	9	**83**
Sindh	7	11	2	3	**23**
Khyber Pakhtunkhwa	5	20	12	1	**38**
Balochistan	2	4	3	1	**10**
FATA		1			**1**
Azad Jammu & Kashmir			1		**1**
NGO/Other	1	1		2	**4**
Total	**67**	**139**	**77**	**30**	**313**
Rs.1078.477 million has been expended to execute these projects.					

On-going Projects

There are 58 projects which are presently implemented at various research institutes and Universities. Out of these 57 were approved under 6th batch of ALP while one project under 5th batch is in operation. The sector region wise detail of on-going projects is given in the table below.

Region and Sector wise Number of On-going Projects (6th Batch) as on July 1, 2014					
Region/Sector	**ASD**	**PSD**	**NRD**	**SSD**	**Total**
Federal (PARC/NARC)	04	06	02	03	**15**
PARC (Outstation)	01	02	01		**04**
Other Federal	-	01	01	-	**02**
Punjab	07	02	01	-	**10**
Sindh	04	-	01	-	**05**
Khyber Pakhtunkhwa	05	02	01	02	**10**
Balochistan	04	02	-	-	**06**
Gilgit Baltistan	02	-	-	-	**02**
FATA (Parachinar)	-	-	01	-	**01**
AJ&K	02	-	-	-	**02**
Total:	**29**	**15**	**08**	**05**	**57**
The total cost of projects under 6th batch as on 01.07.2014 comes to be Rs.321.538 million.					

Newly Approved Projects

During the year July 2013 to June 2014, three meetings; two of Board of Directors (BOD) of ALP and one of Technical Advisory Committee (TAC) were arranged. In the TAC meeting 18 projects proposals were considered for recommendation to the BOD for approval. The 19th meeting of BOD, ALP held on 15th May, 2014 at PARC Headquarters, Islamabad considering the project proposals recommended by TAC, finally approved 18 projects (3 coordinated projects: 02 with 04 components each and one with 03 components). Detail is as follows:

Region/discipline number of newly approved ALP projects				
Region/Discipline	**ASD**	**PSD**	**NRD**	**Total**
NARC, Islamabad	3	-	1	**4**
PARC Outstations	1	1	-	**2**
Punjab	2	2		**4**
Sindh	2	-	1	**3**
Khyber Pakhtunkhwa	2	-	-	**2**
Azad Jammu & Kashmir	1	1	-	**2**
Gilgit Baltistan	0		1	**1**
Total	**11**	**4**	**3**	**18**

7th Batch of ALP

The 7th batch of ALP was announced in October 2013 invited concept papers/ preliminary proposals from scientists all over the country in priority areas identified in consultation of experts from national agricultural research system (NARS). In response about 600 concept papers/preliminary proposals were received. Four evaluation/appraisal committees of animal sciences, plant

sciences, natural resources and social sciences sectors comprising experts from national agricultural research system (NARS) evaluated the preliminary proposals as per approved criteria and shortlisted 167 proposals for inviting detail proposals. Detail given below:

Discipline/region wise number of 7th batch of ALP Projects					
Discipline/Region	**AS**	**PS**	**NR**	**SS**	**Total**
NARC	01	08	05	-	**14**
PARC Outstation	-	07	05	01	**13**
Other Federal	04	05	02	-	**11**
Punjab	30	30	02	07	**69**
Sindh	01	01	-	-	**02**
Khyber Pakhtunkhwa	01	17	07	02	**27**
Balochistan	-	21	03	03	**27**
Gilgit Baltistan	-	04	-	-	**04**
Total	**37**	**93**	**24**	**13**	**167**

New Portfolios under ALP

The following new portfolios have been approved under ALP:

i. Short Term Exchange of Agricultural Scientists and Experts.

ii. Sponsoring of Agricultural Scientists for Presentation of Research Papers in International Seminars, Conferences and Workshops (Travel grants), and Publication of Research papers in International Journals.

MOU Projects

The P&D Division assignment includes appraisal and processing of projects funded under memorandum of understanding (MOU). Budget allocation, extension in duration and declaration of PIs etc. of projects were processed for approval of competent authority of the Council and administrative approval of budget or declaration of PIs accordingly issued through central Secretariat. During the financial year 2013-14 an amount of Rs.152.524 million has been allocated for 19 projects for funding under MOUs. Eight projects have been submitted to the various organizations for consideration and funding under MOUs on approval of the Chairman, PARC.

Public Sector Development Program (PSDP)

Salient Achievements

Preparation of new Development Projects

- Nineteen (19) new projects were prepared by PARC's scientists for processing through PSDP funding.
- Eight (8) new projects were prepared by PARC for execution by the Balochistan Government as per desire.
- All these projects were scrutinized by PSDP Directorate under P&D Division, PARC and processed for approval of competent authority/forum

After submission the new development projects to M/o NFS&R, these were considered by respective authority/forum i.e. DDWP/CDWP as per total cost of the project. Out of submitted projects, eleven (11) projects were considered by CDWP/DDWP and approved accordingly as given below:

- Projects approved by CDWP - 3
- Projects approved by DDWP - 8

The Administrative Approvals were get issued from M/o NFS&R for implementation of approved projects.

Preparation for PSDP

It is an annual exercise being conducted by PSDP Directorate to get budget allocation of PARC projects in PSDP of respective financial year. Efforts were made for getting budget to potential projects of PARC in PSDP 2014-15. An allocation of Rs.930.533 million has been made to fifteen (15) projects of PARC in PSDP 2014-15. Out of fifteen projects, seven (7) are on-going whereas eight (8) new projects have been added in PSDP portfolio of PARC. Out of eight (8) new projects, five (5) projects are approved; one is approved in principle with certain observations whereas two (2) projects are in pipe line.

The Meetings of Project Steering Committee (PSC) of PSDP projects

Most of PSDP projects have Project Steering Committees (PSC) to help in smooth implementation of respective projects. The meetings of PSCs are mandatory to convene at least once a year. The decisions of PSCs meetings were circulated accordingly for better implementation of the project. Accordingly, the PSCs meetings were held as under:

S #	Title of the Project	PSC meetings held on
1	Research for Agricultural Development Program (RADP)	05.08.2013
2	National Institute for Genomics and Advanced Bio-technology (NIGAB)	03.10.2013
3	Pak-China Cooperation for Agricultural Research and Development	04.10.2013
4	Indigenization of Hybrid Seed Production Technology for Enhanced Production of Crops	04.10.2013

Extension of the projects

If on-going projects which not complete approved targets within approved duration, the case for extension in project life within approved cost is processed for approval of Principal Accounting Officer. During the repot period, the cases for extension of following two projects were processed and get approved from Secretary M/o NFS&R and notified accordingly:

- National Institute for Genomics and Advanced Biotechnology (extended upto June, 2015)
- Pak-China Cooperation for Agricultural Research and Development (extended upto June, 2016)

Revision of PSDP funded projects

Due to escalation in cost estimates of civil works and purchase of equipments, the PC-I of on-going project titled, "National Institute for Genomics and Advanced Biotechnology" was revised and submitted to M/o Planning Development & Reforms through M/o NFS&R for approval of competent forum. The project was considered by CDWP in its meeting held on 11.04.2014 and approved in principle with minor observations.

Mr. Sikandar Hayat Khan Bosan, Federal Minister for National Food Security and Research inaugurating PARC developed Silage Baling & Wrapping Machine at NARC. Mr. Saeed Asghar, Federal Secretary MNFSR, Dr. Iftikhar Ahmad, Chairman PARC, Dr. Zahoor A Malik, DG, Dr. M. Azeem Khan, DG NARC and other MNFSR high officials / PARC senior scientists are also present on the occasion (Dte. of PR&P).

وفاقی وزیر برائے قومی غذائی تحفظ و تحقیق سکندر حیات خان بوسن نے NARC میں PARC کی جانب سے تیار کردہ سائلج بیلنگ اینڈ ریپنگ مشین کا افتتاح کر دیا ہے۔ وفاقی سیکرٹری برائے قومی غذائی تحفظ و تحقیق سعید اصغر، چیئرمین PARC ڈاکٹر افتخار احمد ملک، ڈی جی PARC ڈاکٹر زاہور احمد ملک، ڈی جی NARC ڈاکٹر محمد اعظم خان اور دیگر اعلیٰ حکام بھی اس موقع پر موجود ہیں۔ (اسلام آباد)

FINANCE DIVISION

Non-Development Budget

- Budget of Non-development for the year 2014-15 was got approved for Rs. 2345.000 million which is 2.68% above last year budget 2013-14.
- Receipts from own sources were budgeted for Rs. 65.000 million for the year 2013-14 but actual receipts amount Rs. 60.953 million were supplemented to core budget. Against the revised allocation of Rs. 2283.821 million an amount of Rs. 2283.821 million released by Government of Pakistan. Finance Division imposed 30% budgetary cut on total operational budget including hiring and pension amounting to Rs.546.763 million (Other operational Rs.80.598, hiring Rs.139.165 million and Pension Rs.327.000 million) thus the total cut was imposed for Rs.164.029 million which was proposed by the FA's Organization.
- It is pointed that the initially PARC was allocated budget for year 2014-15 worth Rs.2100.000 million by the administrative Ministry out of the total allocation of Ministry of Food Security & Research . This meager allocation was insufficient to cater the requirements of only Pay & Allowance of PARC. Accordingly, an effort was made and a case was initiated to make the PARC allocation realistic one and ultimately the initial allocation raised to Rs.2200.000 million. Even then the allocated budget to PARC was not enough to fulfill the budgetary requirement of the council.
- With the additional budget of Rs.145.000 million, the total budget of Rs.2345.000 for the year 2014-15 was sanctioned from Ministry of Finance.
- 10% Adhoc Relief Allowance-2013 was got approved from Finance Division (Regulation Wing) alongwith grant of pension 10% increase in pension 2013-14 arranged.

Development Budget

- During the year 2013-14 PARC was allocated budget of Rs.510.872 million both for on-going and New Projects.
- Currently PARC PSDP budget has been enhanced to Rs.930.165 million with increase 82.073% as compared to the last year budget.
- The number of the projects was increased 15 as compared to last year seven on-going projects.

ALP Budget

(ALP was created under the Agricultural Research Endowment Fund (AREF) during the year 1999 with sale proceeds of Wheat donated by USA grant for Pakistan.)

- Total 86 On-going ALP projects were operative and release of Rs. 101.343 million was made during the year 2013-14.
- During the year 2013-14 surplus funds of ALP to the tune of Rs.2222.202 million were invested in TDR which fetched interest of Rs.236.600 million by annually. The principal amount has been enhanced from Rs.1300.000 million to Rs. 2222.202 million as a result of investment in Government Schemes. Finance Division, PARC has achieved the target of income at better interest rate as per prevailing fiscal policy announced by Federal Government.

Mr. Sikandar Hayat Khan Bosan, Federal Minister for NFSR, Mr. Seerat Asghar, Federal Secretary (MNFSR) are inspecting newly developed "Hot Water Treatment Plant for Mango", whereas Dr. Iftikhar Ahmad, Chairman PARC, Dr. Nadeem Amjad, Member (NRD) and Dr. M. Azeem Khan, DG NARC briefing the dignitaries about plant at NARC, Islamabad (Dte.of PR&P).

جناب سکندر حیات بوسن، وفاقی وزیر برائے قومی غذائی تحفظ و تحقیق، جناب سیرت اصغر، وفاقی سیکرٹری برائے قومی غذائی تحفظ و تحقیق ۲۰ ٹن کے لئے گرم پانی کے علاج کا پلانٹ کا معائنہ کر رہے ہیں جبکہ ڈاکٹر افتخار احمد، چیئرمین PARC، ڈاکٹر ندیم امجد، ممبر (NRD) اور ڈاکٹر محمد اعظم خان، ڈائریکٹر جنرل NARC اس منصوبہ کے متعلق بریفنگ دے رہے ہیں۔ (اسلام آباد)

Mr. Seerat Asghar, Federal Secretary, Ministry of National Food Security and Research is being briefed by Dr. Iftikhar Ahmad, Chairman PARC and his team about on-going projects at national level, at PARC (HQs) Islamabad (Dte. of PR&P).

vi. PAKISTAN OILSEED DEVELOPMENT BOARD (PODB)

PODB is performing following functions:

- Provide National and International Forum for Coordination and Policy Formulation on Oilseed Sector.
- Establish linkages with the provincial Governments and other stakeholders.
- Formulate and execute projects on oilseeds, edible oil yielding trees and proper utilization of by products.
- Encourage role of private sector.
- Collection of oilseed data from provinces and its compilation for future planning of oilseed policy.
- Launching campaign for proper use of edible oil in collaboration with provinces.
- Perform any other functions as the Federal Government may, from time to time assign it.

During the year 2013-14 various activities enumerated by PODB were as under:

a. Ensured availability of 1,000 ton Sunflower and 40 ton Canola seed for Rabi Season 2013-14 in coordination with Seed Companies Association of Pakistan (SCAP).

b. Initiated work on preparation of a new project titled “National Edible Oil Project (NEOP) and coordinated with all four provinces and Gilgit Baltistan for their consent and inputs/suggestions in preparation of project document.

c. PODB actively participated in National Consultative Conference - Pakistan Vision 2025 and furnished inputs for the Group on Agriculture & Food Security and 11th Five Year Plan.

d. Solicited advice from Law & Justice Division and Cabinet Division on Jurisdiction of restored PODB for “Federal Areas only”.

e. Organized Sunflower Seminar on December 14, 2013 at Multan. Federal Minister for National Food Security & Research presided the Seminar. All Stakeholders of Oilseed Sector attended the Seminar and furnished their technical expertise on sunflower crop.

f. Associated with NARC in holding the Certificate Course on Canola Hybrid Development & Hybrid Seed Production Technology. Technical staff from Agriculture Departments attended the course.

g. Coordinated with provinces regarding production plans on oilseeds crops for Rabi / Kharif season meetings of Federal Committee on Agriculture (FCA).

h. Furnished technical views on Olive development to the Minister of Planning, Development and Reform, Islamabad in a meeting on "Promotion of Olive Cultivation on Commercial Scale in Pakistan" held on 8-4-2014.

i. PODB participated the in the Seminar/Field Day on Canola Hybrid held on 12th March 2014 at NARC.

j. Facilitated Internal Audit for the year 2012-13 conducted by the NFS&R

k. Assisted NFS&R in meeting with Additional Chief Secretary (ACS), Government of Sindh regarding oilpalm plantation in coastal belt of Sindh under technical and financial cooperation of Federal Land Development Authority (FELDA), Malaysia

l. Motivated Olive Growers Association for large scale olive plantation in the country.

VI. Livestock and Dairy Development Board (LDDB)

Livestock and Dairy Development Board was established with the approval of Prime Minister and registered with Security Exchange Commission of Pakistan (SECP) in 2005 as a Government guaranteed company under Section 42 of the Company Ordinance 1984. The Board of Directors of LDDB comprises of fifteen members including six from private sector and nine from public sector. It has 45 General Body Members representing sub-sectors of livestock and all provinces/ regions. The objectives of Livestock and Dairy Development Board (LDDB) are as under:

i. To plan, promote, facilitate and coordinate the accelerated development of and investment in the livestock, poultry and dairy sector in Pakistan

ii. To promote and facilitate and coordinate the accelerated development of and investment in the livestock, poultry and dairy sector in Pakistan.

iii. To promote and facilitate producer owned and controlled organizations for meat, poultry and milk production.

iv. To promote and facilitate the active particular of the private sector in the development of the livestock, poultry and dairy sector.

v. To undertake capacity building of all stakeholders in livestock, poultry and dairy sector.

Salient Achievements:

During the year under report, three PC-IVs were initiated and completed for mega projects previously executed by LDDB. Recovery process and management of PSDP assets was performed with a view to transfer the assets to the provinces for the purpose of continued development of livestock sector. Critical decisions on management, development work and financial approvals were awaited. The Directors were apprised on the matters and two Board of Directors Meetings (BoD) (19^{th} & 20^{th}) were conducted during 2013-14.

A new PC-I on milk & meat supply chain improvements & support to livestock production in federally administered areas having cost of Rs. 58.44 Millions was prepared and was ready to be placed before the DDWP. As guidance to small farmers two videos were prepared on good & bad practices on dairy farming. These videos will be used as training

aid in the farmer's training program. Prime Minister Youth Loan Scheme was welcomed and necessary participation for preparation of training & guidance was made with more than 1000 youth contacted for information exchange and creation of data base with NARC. In addition following concept papers were developed for donor eye–catch and submitted to Plan and IC sections of M/o NFS& R for consideration & funding.

- Yak conservation and poverty reduction through meat marketing altitude Gilgit- Baltistan
- Women empowerment and poverty reduction through milk marketing
- Cattle feed formulation by using local ingredients
- Livestock production and establishment of Yak/Zho farms for organic Meat Production
- Establishment of feedlot fattening farms (yak) for production of quality meat in Gilgit Baltistan
- Support to small scale farmers in high poverty districts
- Two articles were prepared in collaboration with ICIMOD for publication:
- Traditional yak herding in Gilgit-Baltistan high altitudes of Pakistan, Trans-boundary and biodiversity conservation challenge and
- Climate change, innovation and resilience to improve sustainable livelihood in Gilgit- Baltistan

Mr. Seerat Asghar, Secretary, M/o NFS&R, Chaired the 20th Board of Directors Meeting of Livestock and Dairy Development Board,

VII. FISHERIES DEVELOPMENT BOARD (FDB)

Fisheries Development Board (FDB) is set up to provide and maintain a platform for enhancing and promoting fisheries sector in Pakistan, where the participants, professional and intermediaries may discuss issues of common interest, identify new solutions that enhance the efficiency of that sector, initiate development programs, promote regional and global integration and to undertake activities in Pakistan and / or abroad for any or all of the purposes for which the FDB has been established and in pursuance of its objects, which are:

1. Plan, promote facilitate and coordinate with private sector for accelerated development of and investment in the fisheries sector in Pakistan,
2. Promote and facilitate measures to improve the marketing of and also to promote and facilitate producer-owned and controlled organizations for fish, shrimps and marine food products within Pakistan and the export thereof, without indulging in such business,
3. Promote, facilitate and support the development and dissemination of appropriate aquaculture technologies for smallholders in Pakistan, and to undertake capacity building of all stakeholders in the fisheries sector,
4. Promote and facilitate methods for improved aquaculture in order to ensure and enhance human nutrition through the promotion of locally produced fish and shrimps products,
5. Promote aquaculture in Pakistan as primary vehicle for poverty alleviation amongst small and land-less farmers with special emphasis on the empowerment of women, and in doing so:
    a. identify livelihood opportunities and thereby increase income levels through aquaculture activities, and
    b. develop a support system for those engaged in aquaculture production, particularly small scale farmers in rural areas.
6. Provide scholarships to students and professional trainees, including but not limited to the supply of books, stipends, medals, prizes, grants, awards, educational career support, educational loans and other incentives for purposes of the advancement of knowledge, education and literacy both within and outside Pakistan,
7. Provide a platform for research and development relating to objects of the company and in this regard

    a. make available key knowledge tools such as:
        i. a well-equipped library

ii. database and electronic connectivity; and
iii. Website for research publications and interaction.

b. undertake steps for promotion of research such as:
   i. define and support research
   ii. encourage members to conduct research; and
   iii. participate in regional and international research initiatives.

c. undertake any activity for development such as:
   i. arrange funding for supporting research; and
   ii. organize and set of a think tank related to the objects of the company.

d. provide a forum for participation of all concerned and to:
   i. solicit view vis-à-vis the objects of the company; and
   ii. enable discussion / dialogue for promoting quality research, and

Mr. Seerat Asghar, Federal Secretary, M/o National Food Security and Research, Chaired the 17th Board of Director's Meeting of Fisheries Development Board (FDB) (21.02.2014)

8. Conduct, coordinate, facilitate and organize training courses and provide training tools, materials, methodologies and facilities and undertake development projects and training workshops for staff, associates, beneficiaries of member organizations and other deemed appropriate by the company but not to act as a degree awarding institute.

ACHIEVEMENTS

Field trails on Tilapia for demonstration

Fisheries Development Board is supporting Tilapia farming activities in Pakistan for which import of fish seed is being facilitated for private farmers. During the year 2013 about 1500,000 fish seed was imported for private sector tilapia farming. FDB conducted its own field trials for tilapia farming at Mangla dam in Cages.

Commercial fish feed

Two commercial fish feed plants are in operation which have been established in Pakistan in private sector. During the year 2014 one plant has been upgraded to increase its production capacity. Many other investors are looking for the same to tap the opportunity. This has enabled the Pakistan aquaculture sector to flourish in commercial manner on a wider scale.

Promotion of semi intensive carp farming

The predominant aquaculture in Pakistan is based on Carp farming which is a group of six species including Rohu, Thaila, Morakha, Silver carp, Grass carp and Common carp. The existing production of carp farming ranges from 240 kg to 1000 kg per acre. There was a need to enhance productivity per unit area.

Fisheries Development Board is promoting the use of commercial fish feed and use of water aeration in the fish ponds to increase fish production, the preliminary results have shown remarkable progress in production per acre.

Promotion of Cage Fish Farming

Cage fish farming is a new method of fish farming in open water bodies and flowing rivers. It does not require land to build ponds, tube will to supply water or do not involve harvesting cost to collect fish. It is easy to feed and monitor the fish. Fisheries Development Board has established a cage farming in Mangla dam with 40 cages in operation and promoting thistechnology. FDBhas achieved success by demonstrating production of 500/kg fish per cage (16 feet by 16 feet by 6 feet. This technology is much popular in far east countries like Thailand, Malaysia, Philippine etc. and promotion of this technology will provide surplus supplies for local and export markets in addition to provision of livelihood and job opportunity for millions Pakistanis.

Technology Transfer through Training and technical backstopping in the Fisheries and Aquaculture Sector

FDB has started a project entitled Technology Transfer through Training and technical backstopping in the Fisheries and Aquaculture Sector which is support by TVET Reform Support Programme. The aim of the project is to provide training for fish farming, cage farming, net making,

improved fish handling, transportation and marketing methods. Under this project 1000 men, women and transgender will be trained to get their livelihood from the fisheries, aquaculture and allied subsectors. Further, assistance will be provided to prospective trainees in the shape of water quality test kits, fish nets, handling and transportation boxes etc. Water aerators will also be provided to selected fish farmers for testing purposes.

Shrimp Farming Cluster Development Project

FDB has initiated a development project entitled Shrimp Farming Cluster Development with the support of export development fund maintained by Ministry of Commerce, Government of Pakistan. The aim of the project is to promote shrimp farming along the coast of Pakistan in public private partnership. Work has been initiated to select site and partners.

C: REQUIRED INTERVENTIONS FOR THE DEVELOPMENT OF SECTOR:

a. Sector study and resource assessment
b. Technological support for sustainable harvesting of untapped marine resources
c. Capacity building & training in modern techniques of fish handling & processing and marketing.
d. Up-gradation facilities at Karachi, Korangi and Pasni fish harbors with strengthen regulation of its operation
e. Up-gradation of fishing fleet including insulated fish holds
f. Revival of mangroves/ fish breeding grounds
g. Program for Sea ranching
h. Stocking of fresh water bodies.
i. Technical assistance to private sector for coastal aquaculture, shrimp & prawn hatcheries
j. Improved technology of fish feeding/ health, shrimp hatcheries, model farms, cage farming, model markets
k. Direct export of fish from Balochistan
l. Institutional strengthening
m. State land leasing policy
n. Incentives such as credit/ interest free loans
o. Establish marine aquaculture zones in Sindh and Balochistan
p. Establish high potential zones for inland aquaculture of warm and cold water species

ix. Federal Water Management Cell

Federal Water Management Cell (FWMC) was established in 1977 under the Ministry of Food, Agriculture, Livestock and Cooperatives, FWMC was entrusted to ensure adequate water availability to the farmer at farm gate at the right time by solving irrigation water sector problems through formulation of water resources development projects besides agricultural mechanization policies and strategies and land development projects in consultation with the stakeholders. The projects envisaged to bring more lands under irrigation from saved water and get more production helping to country's economy and farmers well being.

After 18th Constitutional Amendment Federal Water Management Cell (FWMC) was restored under M/o National Food Security and Research to deal in matters related to irrigation water management for attaining food security by undertaking land and water productivity projects.

In order to cope with food and fiber requirements of rapidly growing population, an efficient economic and environmentally acceptable integrated approach is needed to arrive at sustainable solutions. Food availability on sustainable basis could be ensured through improved agricultural productivity. Improvement in the current agricultural water use efficiency and conservation practices, both in the rain-fed and irrigated agriculture, is the key within the context to attain and sustain food security in the country.

The detail of activities, program of activities and relevant statistics under-taken by the Federal Water Management Cell during 2013-14 is as follows:

1. PC-I prepared for the project titled "Technical Assistance (TA) Grant for Mini Dams Command Area Development Project in the Potohar Region" has been approved by the CDWP in its meeting held on 2.5.2014

2. Letter of Agreement for Establishment of "ECO Centre for Efficient Utilization of Water for Agriculture" has been forwarded to ECO Secretariat, through M/o Foreign Affairs, for signature/finalization

3. C**o**nsultative meeting with all stakeholders was held on March 5, 2014 under the chairmanship of Federal Minister for NFS&R to

discuss FWMC's concept proposals on National Program for Improvement of Watercourses in Pakistan- Phase-II and National Program for Development of Rodkohi Irrigation System in Pakistan- Phase-I. Representatives of Government of Balochistan and Khyber Pakhtunkhwa consented to participate in the Umbrella project on cost sharing basis. Guidelines for preparation of component PC-I is being prepared for circulation to participating stakeholders.

X. PUBLIC SECTOR DEVELOPMENT PROJECTS (PSDP)

SPECIAL PROGRAMME FOR STRENGTHENING SPS FACILITIES AND QUALITY INSPECTION SERVICES IN COMPLIANCE WITH WTO – ESTABLISHMENT OF NATIONAL ANIMAL AND PLANT HEALTH INSPECTION SERVICE" (NAPHIS)

The NAPHIS project is under execution since 2006-07 and nearing to the stage of fruition, with overall physical / financial progress of 94.8% as on June 30, 2014. It is scheduled to complete by June, 2015. The NAPHIS is basically an umbrella project with an end PC-I objective to establish an Integrated Sanitary & Phytosanitary (SPS) Management System through setting up a National Food Safety, Animal and Plant Health Regulatory Authority. Its physical scope includes: provision of additional lab staff, equipment, staff training / SPS awareness programmes, civil works etc for capacity building of the 7 Agricultural Line Departments/Labs, involved in SPS control measures (inspection, testing and quality certification) for imports/exports of agricultural produce / products.

In addition to its role as Project Implementation Unit - the NAPHIS as a "Think Tank" has contributed a lot in addressing national/international food safety/SPS issues at the policy level SPS meetings, by providing technical/professional input. Its role has been largely recognized both locally and internationally (FAO, UNIDO, CSF, USDA/APHIS (USA), EU etc). The donors have been positive to extend technical / financial support to NAPHIS for the strengthening of National Food Safety and SPS management system. Some of its notable achievements are summarized below:

i) For capacity building, it has provided lab technicians / scientists, vehicles/ logistic support and state of the art lab equipment to the Project component units (department/labs), involved in SPS measures;

ii) Two new lab buildings (15254 sq ft) for Grain Quality Testing Labs (GQTL) - one each at Islamabad, and Karachi have been constructed and are in use while the building for the Virus Secured lab of the National Veterinary Lab (NVL) (8000 sq ft) , Islamabad could not be constructed initially due to non-allocation of land by the PARC, and later on due to paucity of funds.

iii) 4 labs – 2 each of GQTL (Islamabad and Karachi) and Marine Fisheries Department (MFD), Karachi have been accredited/re-

accredited internationally while the case for accreditation of NVL, and Federal Seed Certification and Research Department (FSC & RD) lab is under process with the Pakistan National Accreditation Council (PNAC);

iv) NAPHIS has jointly organized 11 SPS awareness/consultative workshops in collaboration with UNIDO (6), WTO Unit, MINFA (1), FSC & RD (1), SAARC (1), USDA – Mango (1), and US CBEP Safety of veterinary labs (1);

v) The NAPHIS has been designated as National Enquiry Point for SPS issues and Contact Point for Codex Alimentarius Commission;

vi) On NAPHIS initiative, 4 Codex meetings have been approved for financial support through Codex Trust Fund.

vii) Assisted MINFA and M/NFS&R in drafting/finalization of seven SPS MoUs/trade agreements with foreign countries (USA, (Mango export & NAPHIS/APHIS collaboration) Kazakhstan, Australia, Mauritius, Bosnia, Iran and India).

viii) NAPHIS has been instrumental in inspection and approval of 7 slaughter houses in Karachi and Lahore, which are exporting mutton and beef to Middle Eastern countries according to World Animal Health Organization (OIE) standards,

ix) Provided secretarial support for the Afghanistan-Pakistan-USA for Trilateral negotiations and Strategic Dialogues with USA.

x) Instituted regular feedback system for EU Commission/exporters to check confiscation of export consignments of food items, through EU Commission's, e-Window facility.

xi) As a "Think Tank", the NAPHIS has also prepared a number of analytical/technical reports on food safety/SPS issues and assisted in framing various MoUs on SPS issues.

xii) Because of its international recognition, the NAPHIS has attracted sufficient foreign technical assistance / aid which is much more than its' approved PC-I cost of Rs. 415.00 Million. In this context, the UNIDO has termed this project as one of the best

steps taken by the government to address SPS issues and has selected the NAPHIS - as an agency for technical support to enhance its capability in SPS management. This activity is being executed/financed under EU funded Trade Related Technical Assistance (TRTA-II) Programme since January, 2010 to June, 2014. The EU has allocated to NAPHIS **€ 1.107 Million** for strengthening of SPS Management System in the country under which services of an International SPS expert have been provided. Besides, the UNIDO/TRTA-II Programme has supported in acquiring international accreditation of the 4 laboratories – 2 each of GQTL and MFD and also assisted in designing Post Graduate Diploma Courses in Food Safety and Controls in 3 Pakistani universities namely; University of Karachi, University of Vet Sciences, Lahore and Agriculture University, Faisalabad, starting in September 2012.

(xiii) **The United States Department of Agriculture** had earmarked **$ 3.0 Million** for APHIS/NAPHIS collaboration and has identified NAPHIS as an agency for monitoring and intertwining between APHIS (USDA) and NAPHIS. The USDA has also provided two APHIS experts in Animal and Plant Health, to support NAPHIS in its capacity building efforts and US$ 9.00 Million for National Veterinary Lab (NVL) for FMD Control Project (2011-13) – a project which is under execution through FAO – as an executing agency designated by USDA. Moreover, the USDA has committed **$ 25-30 Million** over five years (2011-15) on behalf of the Cooperative Biological Engagement Programme (CB EP) of US Department of Defence and Bio-security Engagement Programme to strengthen veterinary disease surveillance and labs capacity in Pakistan under US-Pakistan-Afghanistan Trilateral Food Security Working Group. In this context, a two days workshop was jointly organized at Islamabad by the NAPHIS and USDA on March 1 – 2, 2011.

The project component units/departments involved in the SPS Management have been strengthened as per PC-I scope. Besides, the NAPHIS has drafted a Bill to set up a National Food Safety / SPS Regulatory Authority with its prime objective to establish an integrated Food Safety/ SPS Management System. The Draft Bill has been submitted to the Cabinet for approval as back on August 30, 2013. It was considered by the Cabinet on May 15, 2014 and M/NFS&R was directed for resubmission of the Bill, after consultation with the M/ Science and

Technology (MoST) and M/ Commerce (MoC). As directed by the Cabinet, the Bill is under process of consultation with the MoST and MoC and likely to be re-submitted soon to the Cabinet, as soon as, it is cleared by the MoST, and MoC, On its approval/enactment by the Parliament, the Bill will provide necessary regulatory framework, ensuring safe food through setting up an integrated SPS management system before closing of the current FY 2014-15.

The prime aim of the proposed regulatory authority is and shall be to efficaciously discharge the functions through an integrated SPS management and official controls system which at present is product based/departmentalized, as it is being performed by various Federal Departments like Department of Plant Protection, Animal Quarantine Department and Marine Fisheries Department but without any coordination. Further, it may be pointed out that the existing laws do not address to the emerging food safety issues. There is, thus, an imperative need to establish the proposed regulatory authority on urgent basis to improve upon and make the existing system more effective and efficient through: (i) integration of dissipated/ departmentalized, and product based functions, (ii) removal of lacunae and weaknesses, (iii) strengthening of existing food safety / SPS management, and (iv) better coordination with the Federal and Provincial government departments/agencies, including international food standards setting bodies/agencies (Codex, IPPC & OIE).

The WTO Member States have already established / are establishing similar regulatory authorities. Pakistan cannot afford to lag behind, if it seeks to become competitive in agro-based international trade. While, preparing the text of the draft Bill, the food safety / SPS management systems enforced in various countries have been objectively reviewed, with a view to harmonize our SPS management and official controls system with international trading partners.

Nevertheless, the National Food Safety, Animal and Plant Health Regulatory Authority when established will be a landmark achievement not only of the NAPHIS project – as an end output, but also of the present Government, as the ultimate aim of the Authority is to ensure "safe food for everyone"

Monitoring of Crops through Satellite Technology Phase-II

The project costing to a total of Rs. 165.739 million was approved by CDWP on 30th April 2009 for a period of four years (June 2013) with administrative approval issued on 16th May 2009. The project period was to terminate on 30th June 2013 but extended for another two years up to 30th June 2015 complete the scope of work especially the foreign Master Programs, Local Training Component and purchase of Satellite Image Processing Soft ware's which could not be accomplished due to short supply of funds. Main objectives/achievements of the project are as under:

1. Objectives and achievements

The basic objectives this program are to further enhance the development of satellite data based agriculture monitoring technology, field testing and its application to cover entire country for additional crops. The main objectives can be summarized as under.

(i) Improvement of Technology

SUPARCO has carried out programs; to further improve the satellite data based crop monitoring technology in coordination with FAO-UN and provincial Crop Reporting Services. Furthermore, technology was applied to make more précised forecasts / estimates on area, yield/production of major crops (wheat, cotton, rice, sugarcane and maize) on country wide scale.

(ii) Timely and reliable crops statistics for Kharif and rabi seasons:

On the basis of the technology /techniques developed by SUAPRCO, the crop estimates on area, yield and production are regularly issued for 6 crops viz. wheat, cotton, rice, sugarcane, maize and potato. These releases are made on 10-20th October for Kharif crops and 1-10th April for Rabi crops. This has transformed the crop monitoring and reporting system in Pakistan. During F.Y. 2013-14, the Kharif crops estimates were issued on 11th October 2013 while those for Rabi Crop (Wheat) were issued on 08th April 2014. The estimates are reproduced as under:

Satellite based Kharif Crops Estimates 2013-14

Cotton Estimates 2013-14			
Province	**Area (000 ha)**	**Yield (Kg/ha)**	**Production (000 bales)**
Punjab	2438.0	667.0	9558.8
Sindh	752.9	784.0	3472.6
Khyber Pakhtunkhwa	6.1	431.0	15.4
Balochistan	39.9	460.0	107.9
Total	**3236.9**	**690.9**	**13154.7**
Sugarcane Estimates 2013-14			
Province	**Area (000 ha)**	**Yield (tons/ha)**	**Production (000 tons)**
Punjab	866.7	56.5	48936.6
Sindh	293.4	50.3	14750.4
Khyber Pakhtunkhwa	118.2	45.3	5356.5
Total	**1278.3**	**54.0**	**69029.4**
Rice Estimates 2013-14			
Province	**Area (000 ha)**	**Yield (tons/ha)**	**Production (000 tons)**
Punjab	1831.7	2036.8	3730.8
Sind	810.3	3203.2	2595.6
Khyber Pakhtunkhwa	64.4	2020.0	130.0
Balochistan	173.1	3651.1	631.9
Total	**2879.4**	**2461.7**	**7088.3**

(11th October 2013)

Satellite based Wheat Crop Estimate for Rabi Season 2013-14 (8th April 2014)			
Province	**Area 000 ha**	**Yield kg/ha**	**Production (000 tons)**
Punjab	6789.0	2806	19049.9
Sindh	1499.0	2782	4170.2
Khyber Pakhtunkhwa	702.9	2020	1419.9
Balochistan	353.0	2210	780.1
Pakistan	**9343.9**	**2721**	**25420.1**

(iii) Capacity Building in Provincial Crop Reporting Services

Satellite image processing laboratories with qualified manpower and equipment have been established & are working at CRS Punjab, KPK and AJ&K while CRS Sindh, Balochistan have labs but not yet recruited the manpower. The recruitment process of project manpower is under progress.

Inauguration Ceremony of Satellite image processing laboratory at CRS HQtr Hyderabad was conducted by Sindh Agriculture Department on 20th May 2014. Secretary Agriculture, Sindh was Chief Guest of the Ceremony. SUPARCO was specially invited in this event where live demonstration of the field data collection, transmission and reception at the Nucleus Laboratory was made in front of huge audience.

03 sets of software ARC GIS 10.2 each for CRS Punjab, CRS KPK and CRS Balochistan were purchase and installed. Besides, hands on training of software operation were also conducted for CRS KPK (31st March – 4th April 2014) and CRS Balochistan (14th – 18th April 2014).

(iv) Training programs

Arrange in-country and expatriate training programs for stakeholders. The target in PC-1 for local training is to train 420 officials of stakeholders during the project life. Up till now, 159 officers, and about 200 field staff of the provincial crop reporting services & CRS AJ&K and GB have been trained under the program at local level. So far the foreign training program is concerned; it includes 06 Master Degree Programs; 30 short training programs in the field of remote sensing, GIS and area, yield/production modeling respectively.

(v) Linkage with FAO

This includes provision of international consultants services on area frame, yield/production modeling and backstopping missions for technical assistance and audits of the satellite data based agriculture monitoring work carried out by SUPARCO. There has been an active coordination with FAO-UN under the program. As already mentioned above, there is a provision of 06 Master Degree Programs and 30 short term trainings abroad in the PC-1 for the stakeholders and

SUPARCO. In this regard, 03 nominations each 01 from CRS Punjab, 01 KPK and 01 from SUPARCO have already been received. The incumbents from CRS Punjab and SUPARCO have secured admission in the fields of "MSc GIS at Portsmouth University and "MSc Agriculture and Environmental Sciences at Newcastle University" UK respectively in the coming Sep 2014 Session. The nominee from CRS KPK has secured admission in the field of, "MS Optical and Image Processing" at RADI, CAS University, China. The case for 30 officials to be trained abroad has been planned in the coming F.Y. 2014-15. All these programs are covered under the head, "Transfer of Technology from expatriate sources" in the PC-1. The aim is to acquire and apply the state of the art satellite data based techniques being used by the developed countries for monitoring agriculture.

(vi) Involvement of stakeholders

- All the stakeholders of the project have been kept actively involved in all activities of the project.
- Pak Met Department has been appreciably cooperating with SUPARCO by providing the weather data and allied services.
- Pakistan Bureau of Statistics (PBS) has been actively onboard on the area frame activities.
- National Fertilizer Development Centre of MNFS&R is providing the fertilizer off take data etc. for use in the yield modeling.
- All the four provincial CRS Departments of Punjab, KPK, Sindh, Balochistan and that of AJ&K have been constantly involved in all activities of the program.

2. Data Sharing

The data on agriculture obtained through this technology is shared with all concerned through issuance of Formal letters to all concerned both at federal and provincial levels by 1-10 April for rabi crops estimates and by 1-10 October for kharif crops estimates containing the procedures followed for these estimates.

(i) Issuance of Monthly Satellite based Crop Monitoring System Bulletin; SUPARCO is issuing a monthly web based crop forecasting bulletin, covering all major developments and issues related to agriculture, and allied disciplines. About 50 hard copies are sent to the relevant quarters including the progressive farmers. For general public and those interested in knowing agriculture status, the bulletin is placed on SUPARCO webpage: www.suparo.gov/pages/pk-scms.asp by 10th of each month. The bulletin also covers horticultural and other than the aforementioned major crops. These include both the autumn and spring crops of maize and potato.

(ii) Monitoring of natural hazards/floods:

Floods 2013 with special reference to agricultural damages were covered through satellite remote sensing & GIS technology. This includes developing daily flood extent maps, estimation of damages to crops, infrastructure, households and economy. SUPARCO also carries out temporal studies and makes reports on follow up recession pattern of floods. The Commission has so far released 5 series of flood reports titled “Pakistan Floods/Rains Rapid Crop Damage Assessment”.

Way Forward

The agriculture sector of Pakistan has a number of challenges resulting in low growth of 2.1% in 2013-14. This is mainly due to slow rate of technological innovations; problems with quality, quantity and timeliness of input supply; limited investment in construction and maintenance of infrastructure; marketing and trade restrictions; pest and livestock disease problems; and limited amounts of credit for agricultural production and processing and the lack of agriculture-specific loan products. The climate change is another important factor in this regard. As a result poverty, food security and food safety remain major issues.

Pakistan needs to continue to build the resilience of the agriculture sector. Climate change projections indicate increased water from higher rainfall, and from runoff from glaciers and snow melt. However, this will be accompanied by greater variability in weather with more frequent extreme events such as flood and drought. Much of the impact of these changes will be on the agriculture sector, which needs mechanisms to cope and adapt.

- Government patronage and commitment for putting agriculture on high growth trajectory
- Mechanisms for coordination with provincial governments and other stakeholders
- Joint strategies for the implementation of innovations through public private partnership
- Finalization and approval of "**Agriculture and Food Security Policy"**
- Concerted efforts to legislate agricultural regulatory laws
- Developing institutional infrastructure for manpower trainings
- Ensuring farm profitability for sustainability of Agriculture sector