LIST OF COMPLETED SUB-PROJECTS UNDER RADP (MAY-2016)

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
	CROPS SCIENCES				
1	Intra and inter-specific variation of oilseed brassicas using biochemical and molecular markers. **Dr. Ashiq Rabbani, PSO, IABGR, NARC**	6.770	1.07.2007 to 30.12.2010	• Collect indigenous germplasm of different Brassica species and their wild relatives from diverse ecologies of Pakistan • Select promising lines having high yield potential, bold seeds, higher oil contents, lower levels of erucic acid glucosinolates, and resistant to insect pests (aphids). • Fingerprint and discover species-specific biochemical and molecular markers for the identification of improved cultivars and germplasm accessions of oilseed Brassicas.	• Acquired 2040 germplasm from abroad and 525 from Pakistan and increased the PGRP gene bank pool from 1424 to 4000. Seed of 931 accessions acquired from abroad regenerated and evaluated 395 brasica lines. • 22 elite lines of oilseed group and 13 vegetable type identified and seed multiplied. • 15 lines identified for high yield, oil content, low level of erucic acid glucosinolates. • Screening for drought tolerance of 300 accessions. • 2 aphid resistant lines of brasica and 3 non-shattering lines of canola also identified. • The identified lines handed over to breeders for use in their breeding program. • Biochemical analysis of 30 cultivars and 375 local collections of 4 oilseed varieties conducted. SSR and RAPD analysis for 30 cultivars conducted for DNA profiling.

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2	Marker assisted selection & genomic studies on stress tolerance in wheat and rice. **Dr. Ghulam Muhmmad Ali**	71.785	1.07.2007 30.06.2012	• Screening of wheat and rice germplasm to identify sources of resistance for salt tolerance • Gene tagging for indirect selection using molecular markers • Human resource development.	Genome specific SSR markers identified. Genomic studies on wheat and rice using micro satellite DNA markers (SSRs) conducted. Transgenic wheat and rice for drought and slat tolerance identified. Various new genotypes identified as source of tolerance to Salinity, drought and heat and used in breeding programmes.
3	Development of Sunflower and Canola hybrids and Canola Type Mustard Varieties. **Dr. Akbar Shah, Director, CSI, NARC**	28.536	1.07.2007 to 30.06.2011	**Sunflower** • Strengthening the research capabilities of oilseed research program • Development of inbred lines (A, B & R) using conventional and non-conventional methods with good general and specific combining abilities • Development of F_1 hybrid with high yield potential and oil contents. **Canola** • Development of inbred lines (A, B & R) of Canola rapeseed • Development of canola hybrids with higher yield potential and wider adaptability • Development of canola quality mustard cultivars suitable for dry and hot areas	• • 39 inbred lines were planted for purification and seed multiplication. • 20 different hybrid combinations were produced. • During autumn, 2011 SMH-0925 produced higher seed yield of 2619 kg/ha than Hysun-33. Ohte promising hybrids were SMH-1005 and SMH-1001. During spring, 2012, SMH-1101, SMH-0932, SMH-0916, SMH-0934, SMH-1006 and SMH-1002 were promising hybrids and produced maximum higher yield than both check hybrids. • In NUYT, SMH-0907 and SMH-0927 produced comparable yield with Hysun-33 and NK-S-278 (checks). • In on-farm research trials, performance of the local hybrid (SMH-0917) was comparable with

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					commercial hybrids at some of the locations, ie. at Zafarwal, Arifwala and Kasur. At NARC, local hybrid, SMH-0907 produced maximum seed yield of 4607 kg/ha, followed by SMH-0917, SMH-0942, Hysun-33 and NK-S-278 with 4304, 3996 and 3922 kg/ha, respectively. • A total of 1.8 ton hybrid seed of two potential hybrids (SMH-0907 and SMH-0917) was produced during spring 2012. • Research trials on plant population and N fertilizer requirements were also conducted to develop package for their production technology. • Data on required morphological characters were recorded on both potential hybrids and their parent lines.
4	Development of sorghum-sudan grass hybrids for high forage yield and quality characters. **Mr. Ashiq Hussain, PSO, CSI, NARC**	5.044	1.07.2007 to 31.12.2010	• Acqusition of sorghum and sudan grass germplasm and its evaluation for agronomic and quality characters • Utilization of available lines in hybrid combination and identification of fodder type more present lines. • Evaluation of improved S.S. hybrids under various agro-ecological conditions of the country	• Four plots of parents (A, B, & R) of the two promising hybrid shave been planted at NARC, Islamabad and Arifwala, Sahiwal for purification/maintenance purposes. Pure seed production for about 10 acres is expected which will be utilized for hybrids development in spring 2013 at different locations in the country. • Nine plots have been planted for

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					development of two hybrids at 7 different locations, crossing work is in progress and seed produced of these hybrids (NARC hybrid-2 and NARC hybrid – 4) will be utilized for adaptability, agronomic trials, demonstration and also for registration purposes. • To see the potential of the promising hybrids an adaptability trials comprising of 12 indigenous and exotic hybrids is in progress at 9 different locations around the country. Data collected at NARC showed that "NARC hybrids-2 and NARC hybrids-4 were among the top yielding hybrids by producing 128 & 120 t ha^{-1} green fodder yield in 3 cuttings whereas it was 104 t ha^{-1} in check. • To devise the production technology of the newly developed hybrids agronomic trials like seed rate, row-spacing and fertilizer trials is being executed at NARC Islamabad. Data indicated that seed rate of 25 kg ha^{-1} produced higher green fodder yield (147.78 t ha^{-1}) in NARC hybrid^{-2} whereas in NARC hybrid-4 it was higher in seed rate of 30 kg ha-1 but at par with seed rates of 25 kg ha^{-1}.

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					Row spacing of 30 cm proved its superiority in both the hybrids by producing 138 and 151 t ha^{-1} green fodder in 3 cuttings. Fertilizer dose of 60:60 NP at sowing and 60 kg N (Ha^{-1}) after each cut was suitable for getting higher green fodder yield in both the hybrids. • Registration activities of the promising hybrids with FSC&RD are well in progress. IN this regard revised application for registration has been submitted. DUS data for 1st year hs been provided and for 2nd year seed has been provided to FS&RD. • Multiplication / maintenance work of two most promising S. S. hybrids (NARC hybrid-2 and NARC huybrid-4) during summer 2012, at nine locations in the country at private as well as at public farms also provided us an opportunity to promote the developed hybrids through public private partnership to introduce it to fodder growers.
5	Identification/Selection of parental lines and hybrid development in tomato **(PGRP) Dr. Abdul Ghafoor, PSO, IABGR, NARC**	3.232	1.10.2007 to 30.09.2011	• Enhancement of tomato genetic resource through collection and acquisition • Evaluation and characterization of tomato germplasm for fruit yield, fruit	• Accessions acquired 700. Half of these including SDS-PAGE (450) and SSR analysis (39 genotypes) evaluated. • Seventeen (17) selected parents

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				texture, quality and shelf-life for investigation of genetic diversity and identification of high yielding genotypes • Biochemical and molecular analyses of tomato germplasm for investigation of genetic diversity • Identification of tomato parental lines to strengthen the existing ones (available with vegetable program)	crossed resulting in 130 hybrids, among these 4 were promising.
	Identification/Selection of parental lines and hybrid development in tomato **(Vegetable) Mr. Muhammad Farooq Chaudhry, PSO, HRI, NARC**	1.934	1.10.2007 to 30.09.2012	• Evaluation / seed multiplication of tomato germplasm • Determination of combining ability of parental lines • Determination of tomato hybrids • Evaluation/ comparison of locally developed hybrids	• Germplasm collected/multiplied – 33. • Hybrids developed -17 • **Four (4) combinations found promising with** yield potential comparable to commercial hybrids. • Parental lines selected / multiplied – 11.
6	Characterization of sugarcane germplasm for flowering ability **(NARC Unit) Dr. Muhammad Zubair, PSO, CSI, NARC**	5.768	01-4.2008 to 30-3.2011	• Determine Flowering time, duration and intensity of sugarcane germplasm under natural and controlled conditions • Study the effect of nutrition on flowering efficiency of sugarcane lines	• 260 germplasm planted at 3 locations to determine flowering ability. 46 flowered with intensity of 1-100 at Charra Pani (HSF 240 gave 100%). • 2 nutrition experiments planted under controlled conditions of photoperiod and Chemical treatment with three types of growth regulators for flowering efficiency. • Baseline information generated for breeders for sugarcane varieties
	Characterization of sugarcane germplasm for flowering ability **(Thatta Unit) Mr. Salah-ud-din Junejo, SSO, NSCRI, Thatta**	4.260	01-4.2008 to 30-3.2011		

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					development. Dependence on imported fuzz will be reduced. • At **Thatta** station 450 lines were sown in winter and harvested fuzz of 180 lines which flowered. • Fuzz to be used for breeding etc at Thatta station to evolve new varieties.
7	Securing some key biotic stress resistances in wheat verities of Pakistan around Gene and vertical Development strategies with emphasis on recombination breeding aided by molecular technologies **Dr. Abdul Mujeeb Kazi, ICARDA Country Office, NARC**	39.925	30.06.2008 to 29-06.2011	• To generate varieties resistant to all 3 types of rusts. • Production of varieties with Powdery mildew and Karnal bunt resistance • Incorporation of BYDV and Aphid resistance to elite Pakistani cultivars.	• More than 6000 germplasm brought in and tested for various traits and used for breeding purposes • Genomic/allelic diversity created, protective boundaries developed with efficient system of integration using novel techniques. A conduit to national and international partnerships exists. • Translocations e.g. transfer of S.R gene for Ug 99 resistance in Pakistan's wheat varieties of wheat with added yield and stress components. • Varietal candidates developed Ug99 = local (Kazi-9 and Kazi-11) 7 lines being increased by ICARDA. Leaf rust, yellow rust, kernel Bunt (Kazi 1-12 and Kazi 13) for CCRI, BARI, RARI, NIA and AZRC). • Drought and yr (BARI-Kazi -114 to Kazi 119).
	Development of new Pakistani Wheat verities tolerant to key a biotic stresses project **Dr. Abdul Mujeeb Kazi, ICARDA Country Office, NARC**	39.501	30.06.2008 to 29-06.2011	• To generate varieties resistant to drought. • Production of varieties with salinity tolerance • Incorporation of heat resistance to elite Pakistani cultivars.	

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8	Genetic Manipulation for Induction of Resistance against Fungal Disease and Potato seed Production **Dr. Iqbal Hussain, SO, PBP, NARC**	14.820	01.07.2009 to 30.06.2012	▪ Preparation of source materials for seed production and genetic transformation. ▪ Virus free seed production ▪ Introduction of chitinase gene in potato through Agrobacterium medicated transformation. ▪ Molecular analysis of transgenic plants ▪ Pathogenesity test	• Through tissue culture produced 25,000 nucleus seed and 100,000 pre basic seed at NARC. • Produced certified 5000 in vitro potato plants of variety Santeny and Kroda. • Putative transgenic plants containing Chitinase gene (RCG-3) were obtained on selection media. • Molecular analysis (PCR) revealed that the presence of 680-bp segment of hygromycin gene and 823 bp of of Chitnase gene.
9	Improvement of Groundnut for short duration and yield in rain fed wheat cropping system **Malik Shah Nawaz, SSO, Oilseed, CSI, NARC**	2.850	01.07.2009 to 30.06.2012	• To develop short duration and high yielding groundnut varieties fitting in the wheat cropping system under rainfed conditions. • Objective to reduce duration from 170-190 to 110-120 days to avail period and moisture after wheat.	Approved by the Variety Evaluation Committee as "Pothowar". Maturity 110-112 days (Normal 170-180 days) PG-1058 (ICRIST material)**.** With the introduction of short duration variety, almost one year fallow period associated with groundnut will be reduced. 10-15% of acreage will be increased. Row to row spacing: 30cm**.** Plant to plant spacing: 10cm. Average Yield: 2683-3000 kg/ha. Check BARD-92 2450 kg/ha**.** Sowing: on set of monsoon rains. Planting of wheat crop on time possible.
10	Development of Bt Transgenic and colored cotton in Pakistan in collaboration with China, **Dr. Yousaf Zafar, CSO, NIGAB**	20.395	1-5-09 To 01-06-09	• Introduction and field trials of colored (organic) cotton in different ecologies of Pakistan. • Introgression of Bt gene into locally	• 950 kg seeds of Bt & colored cotton (5-genotypes) and 08 drip irrigation systems were imported and installed at eight locations in Sindh

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	Dr. Ahmad Bakhsh Mahar, CSI, NARC			adapted and commercially released cotton cultivars. • To develop public private and / or private – private partnership for dissemination of seed to farmers.	and Punjab. • Many Chinese experts visited for expert advice on hybrids testing/development, installation and testing of drip system and collaborative program development with Pvt sector of Pakistan. After trial best adapted cultivars of Bt / colored cotton selected for cultivation and multiplication in Pakistan.
11	Accelrated Development of Hybrid Wheat, Rice, Cotton, Sunflower, Non Shattering Canola, Maize and Use of Innovative Technologies, **Dr. Ahmed Baksh Mahar, PSO, CSI, NARC**	80.725	01-12-09 to 30-06-12	• Determination of specific and general combining abilities of elite inbred/pure lines for selection of good combiners. • Accelerated development of CMS inbred liens (A & B lines) through hybrid embryo rescue technique and Development of R lines. • Development of hybrids and technology for hybrid seed production on commercial scale. • Dissemination of locally developed hybrid seed with management technology.	• 22 low cost tunnels fabricated at CSI NARC, staff and support services acquired. • 136 Elite inbred germplasm lines of maize, rice, cotton, sunflower, canola acquired from China. • **Cotton**: 65 hybrid combinations developed, 5 high yielding were selected. 64 acres planted for hybrid seed production, 2000 kg hybrid seed of 5 combination produced. • Five hybrids handed over to AGC and planted at 100 acres. • **Wheat**: 96 cross combinations developed, 6 hybrids selected. • BAU 9403 identified as chemical hybridizing agent, 15 acres block planted at NARC. • **Rice:** One potential hybrid identified, 6 acres hybridization

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					block at Mardan produced 1000 kg hybrid seed. • **Maize:** 47 white and 58 yellow cross combinations developed for compatibility. 185 white and 395 yellow cross combination developed for evaluation with yield 5420 to 6444 kg. 500 kg seed produced of NARC – 2704 hybrid.
12	Intervention for the Management of Mycotoxin in Maize and Groundnut Component-II (Detection and Management Strategies) **Dr. Yasmin Ahmed, PSO, IPEP, NARC**	3.690	01.04.2009 to 31.03.2012	• To study / evaluate mycotoxine management practices including drying with dryer.	Mapped the incidence of mycotoxin producing fungi in groundnut at market and consumer level and proposed management strategies. Survey for the incidence of mycotoxin producing fungi in groundnut in Pothowar, Punjab and KPK showed the presence of seven fungi vis., A. flavus, A. niger, F. graminearum, F. oxysporum, Penicillium, Trichoderma and Alteranaria in 50 groundnut market/storage centers. Solarization recuded soil born pests (22.5%), fungal diseases (58.9%), nematodes (91%). Technology package dissemination will help farmers to boost their crop production free of mycotoxins. A mobile flat dryer has been developed/adapted for drying groundnut, maize and ear corn. Dryer is capable to dry 2 tons of ground from 24% moisture content to 14 % in 2-1/2
	Intervention for the Management of Mycotoxin in Maize and Groundnut Component-I (Mobile Flat-Bed Dryer) **Dr. Munir Ahmad, CSO, ABEI, (FMI), NARC**	2.869		• To adapt and evaluate drying technology (mobile flat-bed dryer) for maize and groundnut. • To perform the cost analysis of maize an groundnut drying using this technology • To demonstrate and disseminate this technology among the maize and groundnut growers.	

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					hours. The cost of drying ground nut was estimated Rs. 1.4/kg. On average dryer took 10 hours to dry 4.0 tons autumn ear corn from 29% moisture content to 20%. The cost of drying was estimated about Rs. 1.9/kg. On average dryer took 4 hours to drop the moisture content of 1.25tons maize grains from 35% to 14% during the months of November-December.
13	Pilot project for Adoption of Water Saving Cultivation Pot, **Dr.Syed Ijaz Hussain Shah, Director HRI, NARC**	3.900	01-07-07 to 30-06-09	• Testing of 20,000 Cultivation Pots at NARC, AZRC, Quetta, Tarnab, Peshawar, AZRI, Bahawalpur and CARS, Karachi	• Water saving pots to increase survival and plant establishment during critical period of water need tested in all the provinces. Japanese technology did not work in our climatic conditions.
14	"Evaluation of Locally Developed Mandarin Hybrids in Potential Citrus Growing Areas" NARC Unit **Mr. Mukhtar Ahmed, SSO, Fruit Crop Research Programme, HRI, NARC**	3.139	01.04.2008 to 31.03.2011	• Testing the adaptability/evaluation of mandarin hybrid for early maturity of crop • Development of seedless mandarin hybrids.	The hybrids are: Hybrids – Kinnow x Salutiana & Kinnow x Mussambi. Four hybrids selected (NARC-05-06, NARC-05-14, NARC-05-17, and NARC-05-18). Root stock of sour orange was used. Physical characteristics of fruits (number of fruits/tree, fruit weight, rind thickness, number of seed/fruit) and physiochemical characteristics (fruit color, TSS %, acidity %, pH, total sugar %) completed. Five hundred plants of NARC-05-17 and NARC-05-18 were grafted on citrus rootstock (sour orange). Out of 500 grafted plants, 300 plants are ready for transplanting in the

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					field. Organolapthis tests are completed.
15	Sustainability & Improvement of Tea Production **Mr. Abdul Waheed, SSO, NTRI (PARC), Shinkiari, Mansehra.**	10.729	01.07.2009 to 30.06.2011	▪ To select elite tea bushes from mixed seed population at NTRI and farmers fields on the basis of phenotypic characters under different climatic zone i.e. Battal, Battagram and Swat for maximum production. ▪ Evaluate rooting ability, survival %age and growth performance of the selected tea bushes in the nursery at different agro-ecological zones. ▪ Determine the nutritional requirements and suitable intercropping system for tea under different agro-ecological conditions	Indigenous germplasm of 3 clones of tea form Unilever acquired for cultivation. Experiments on 64 elite tea bushes conducted. Progeny garden of 12 cultivars established.
16	Kitchen Gardening at Internally Displaced Person Camps, ***Mr. Derawadan, SSO, PARC Research Station, Mardan.***	3.364	01-06-09 To 30-06-11	• To enable IDPs to grow vegetables at house hold level. • Capacity building of target communities • To resolve the problem of drainage and harvest rain & used water for kitchen gardening & other plantation • To resolve the sanitation problem specially related to bad smell of toilets.	In emergency after conflict in Swat the issues of IDP`s in the camps were assessed. IDPs trained with the techniques to grow their own vegetables for sustenance of life at camps, later on at door steps of returned IDPs in Swat and Bunir. Provided seeds, hand tools kits, fertilizer to IDP families. Established 600 demonstration plots in conflict areas and provided 35 on farm trainings.
17	Ginger and Turmeric: Introduction, Acquisition, Kitchen gardening and Farm Production Technology **Dr. Ghulam Mustafa Sajid, PSO,**	2.975	01.07.2009 to 30.06.2012	▪ Ginger and turmeric germplasm acquisition, collection and multiplication. ▪ Establishment of demonstration scale	• 14 ginger and turmeric lines from Sri Lanka, China acquired. • These lines are under cultivation in green house and open field for

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	PGRP, IABGR, NARC			plantations, characterization of germplasm and development of production technology and introduction as kitchen gardening ▪ In vitro culture establishment of the ginger and turmeric germplasm, their maintenance and small scale micropropagation using in vitro technology	multiplication. More than 300 ginger plants prepared in clay and plastic pots. Growth is good in clay pots for kitchen gardening. 2 training imparted for private farms and 2 for general public. Package of technology to develop with plants for farmers and kitchen gardens. • In-vitro culture established in lab, micro propagation to start on standardization of technique. Upto 10,000 low cost plants to produce per year through invitro-culture.
18	Fabrication of Liquid Bio-Herbicide Processing Unit **Dr. Yousaf Hayat, PSO, EBI, NARC, Islamabad**	2.320	01.11.2009 to 30.06.2010	• To develop the low cost inputs at farmer level to get relief of sky – high prices of synthetic herbicide. • To develop pilot processing units at NARC and across the country at small farmers level (herbicide). • To develop pollution free environment and organic agricultural production to meet the WTO standards for export that is free from herbicidal residual effect.	Fabrication of the bio-herbicide processing completed and installed at NARC. Bio-herbicide produced (200 liters) was sold through PATCO for organic farming.
19	Pest risk analysis of Rice, Mango, Citrus, Dates **(NARC) Dr. Ghulam Jillani, CSO, IPEP, NARC**	12.253	1.07.2007 to 30.06.2010	• To undertake pest risk analysis based on pest distribution mapping biological limiting factors, agro-ecological, and metrological data and risk management options in specific areas. • To provide necessary information on	• Geographic mapping of major insect pests of citrus and mango carried out. Proposed alternate strategy for persistent pest specific to citrus and mango e.g. Citrus syla management strategy given, export issue of mango fruit fly, khappra in

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				Pest Risk Analysis and to demonstrate measures to be taken to enhance exports of agricultural products through implementation of international standards for sanitary and phyto-sanitary measures (ISPM) • To educate concerned stakeholders regarding Pest Risk Analysis and World Trade Organization (WTO) with regard to International Trade.	rice addressed through effective management strategies. Application of IPM models of fruit fly and other insect pests based on their intensification developed for different crop ecologies. A number of pests identified and removed from risk list of USA for Pakistan.
	Pest risk analysis of Rice, Mango, Citrus, Dates (**SARC**) **Dr. Mubarik Ahmed, SARC**	12.054	1.07.2007 to 30.06.2010		• PRA of mango is completed, report prepared and submitted. Rice work is also done and report is prepared and being submitted. Dates preliminary survey done and no further work is conducted due to law and order situation and non-availability of vehicle. • PI will also prepare a presentation for negotiation with other countries for export of these commodities. • A number of pests removed from risk list of USA for Pakistan. • Management options will also be given for various stages of rice processing. • Final report not submitted. Decision be made about further work to address weak areas as project stands completed.
20	Development & Improvement of Mass Production Techniques of Insect Bio-control Agents **Dr.**	27.401	01.01.2008 to 30.06.2011	• To improve the potential Mass-Rearing techniques of Trichogramma sp and its hosts under laboratory conditions	Established infrastructure and facilities (insectar-biologial control labs.) for rearing the bio-control agents and their

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	Ehsan-Ul-Haq, PSO, IPMP,IPEP, NARC			through investigations on different biological parameters • To develop / evaluate efficient rearing techniques of Chrysoperla, Coccinellid, Aphidius spp. and their hosts. • Training and Transfer of Insect Bio-Control technologies to the end users	insect hosts. Various factitious and natural hosts for rearing of parasidioids and predators were evaluated and experiments were conducted on different biological parameters of locally selected strains of Chrysoperla carnea, Aphidus colemni, Coccinellid spp. And Trichogrramma chilnois. Thirty two agricultural graduates from different institutes were trained in rearing techniques of insect bio-control agents and their hosts. Technical assistance/advisory services provided to Shah Taj Sugar mills, Phalia Sugar Mills, Ramzan Sugar Mills, and Patoki Sugar Mills, Agriculture Dept. Northern Areas & AJK.
21	Fabrication of liquid bio-pesticide and micro nutrient formulation unit **Mr. Azhar Javed, NARC** (Dr. Banaras Raja, PSO, CSI, NARC – looking after operations)	0.870	01.06.2009 to 30.05.2010	• To develop a low cost inputs at farmer level to get relief of sky-high prices of synthetic pesticides. • To develop pilot processing units at NARC and across the country at small farmers level (Pesticide). • To develop pollution free environment and organic agricultural production to meet the WTO standards for export that is free from pesticide residual effect.	• Plant fabricated at BARD yard NARC and is in production. • Two organic pesticides and plant nutrients developed. • **Products need standardization.** • **Production and marketing strategy on self sustained and continued basis to be developed.**
22	Biological Control of Major Cotton Pests including mealy bug in Pakistan **Dr. Wasim Ahmed Gilani, PSO, IPEP, NARC.**	4.255	01.07.2009 to 30.06.2012	▪ Conduct studies on the effectiveness and repellency of bio-pesticides against mealy bug and their natural enemies on cotton and other preferred host plants	Collected 19 bioactive plants with pest control properties from Multan and Islamabad. Extracts of all the plants prepared in petroleum ether, Acetone

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				under local environmental conditions. ▪ Role of use of bio-pesticides in IPM of the mealy bug sharing knowledge with CABI. ▪ Train farmers and extension workers on application of bio-pesticide for controlling mealy bugs on cotton and other plants and promotion of this product on large scale.	and Ethanol. Through lab studies identified three plants having bioactivity agasint mealy bug.
23	Transfer of Rodent Control Technologies through Commercialization and Service in the Province of Sindh. **Dr. Amjad Parvez, SSO/Director, VPCI, SARC, Karachi.**	7.166	01.07.2009 to 30.06.2012	• To work out strategy and implementation action plan for rodent bait commercialization in urban and rural situation, through service provision to farmers and general Public. • Dissemination of rodent control technologies through multi-disciplinary approaches (demonstration at Farmers, field School, Farmer gathering, video session) so that PARC developed rodent bait technologies be adopted by at least 75% of target groups. • To commercialize PARC developed rat bait technologies to end-users through on-site demonstration, farmers field school and their motivation to increase crop yield at least 5-20%.	PARC rat bait technology for the rodent pest management in urban and rural areas of Sindh disseminated. Rodent control survey conducted to ascertain pest infestation and services cost was conducted in 12 food processing and trading companies, 5 hospitals (public and private), 4 pharmaceutical companies, 2 hotels, Karachi fish harbor, Jinnah international airport (precision engineering complex) and port Qasim authority (FAP terminal). The Patent process is also completed.
24	Integrated Management of American Bollworm Helicoverpa armigera (Hubner) on Cotton-Wheat in Southern Punjab. **Mr. Attah-Ullah Khan, SSO, IPP**	4.534	01.01.2008 to 30.12.2010	• To find out the most vulnerable stage and time to break life cycle for effective management of H. armigera • To evaluate insect growth regulators, selective insecticides, bio-botanical pest	Predatory potential of natural enemy C. carnea studied at egg larval stages. Spinosad pesticide found most effective. IPM conducted against Armigera in tomato crop gave better

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	Station, Multan			controlling material, light - and sex pheromones traps for conservation of bio-control agents • To develop and demonstrate model for IPM of H. armigera in Gram, Wheat, Tomato and Brinjal	results compared to farmer`s practices.
25	Fate of pesticide residues in cotton agro-ecosystem and their impact on human health and livestock **Dr. Karam Ahad, SSO IPEP, NARC**	6.843	1.1-2008 to 31.12.2010	• To investigate the occurrences and magnitude of pesticide residues in soil, water, fodder, cottonseed cake and dairy milk in Multan Division • To evaluate human health (Applicators, Pickers) implications associated with pesticides by analyzing their blood samples for biochemical parameters like reproductive hormones and Cholinesterase activity	investigated the occurrence and magnitude of pesticide residue in soil, water, feed/fodder and dairy milk in Multan division. Both pre and post cotton season vegetable, feed and milk samples were containing pesticide residue above the FAO/WHO Codex MRLs. Muscular weakness, skin burns, breathing difficulty and coughing nausea and vomiting were more common amongst spary applicatiors while headache and muscular weakness were quite high among cotton pickers. The pesticide exposure causes endocrine dysfunction, significantly elevated serum FSH and serum testostorne and decreases prolactin levels in the cotton farmers. It is associated with disturbance in the thyroid and reproductive hormone levels in agricultural works.
26	Development of Picking and Pre-cooling Technology for Mangoes. **Dr. Muslim Abbas Zaidi, ABEI, NARC**	6.527	1.07.2007 to 30.06.2011	• To survey the current practices for mango picking and pre-cooling in the country and farmer's interest about the machine	The mechanized mango harvesting would save labor 60 to 70%, speed up the work rate and especially improve the quality of fruit for international

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				• To design and develop a technology for mechanical picking and pre-cooling of mango. • To test and evaluate performance of the developed machine and to demonstrate it to farmers/mango growers.	market. The operational cost of this machine is RS. 500/hours and can pick about 7 tons of mangoes a day. It has its own diesel engine of 20 hp to operate it and can be pulled by tractor.
27	Development of milking machine for water buffaloes and indigenization of milking machine for cows. **Dr. Jandool Khan, P. Engineer, ABEI, NARC**	3.015	1.07.2007 to 30.06.2011	• To develop mechanical milking machine for water buffaloes • To indigenize the milking machine for cows • To test and evaluate the performance of these machines • To commercialize the machine among progressive dairy farmers by involving local industry, print media and Internet technology	developed a portable milking machine for buffaloes and cows. Average milk yield 0.807 litters/minutes for single cluster. Five developed machines purchased by farmers.
28	Adoption and Commercialization of a Small-Scale Olive Oil Extraction Unit, **Mr. Liaqat Ali Shahid, Principal Engineer, ABEI, NARC**	6.800	01-07-09 To 30-06-12	▪ Performance evaluation and modification of available small-scale olive oil extraction technology. ▪ To indigenize the potentially feasible small-scale olive oil extraction technology through local machinery manufacturing industry. • To conduct extensive field demonstrations with the help of stakeholder for commercial adaptation of indigenized technology in the country.	Efforts at national and provincial level are underway to increase the olive production. Increase in olive production will demand mechanized oil extraction machine at community level. Movable and compact machine. Process up to 40 kg of olive per hour. Processing costs is low and affordable by most of the farmers. Oil recovery varies from 10 to 22% of processed fresh fruit and depends on fruit variety, maturity level and harvest time. Machine demonstration carried out at different farm locations in Punjab and Khyber Pakhtunkhwa.

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
29	Neelibar Agricultural Research & Training Station Burewala, **Mr. Riazuddin, SSO, Incharge Station, Burewala**	9.035	01-10-09 to 30-06-10	• Establishment of camp office for Neelibar (Burewala) Station • Demarcation and preparation of Experimental land. • Designing and implementation of pilot experiments	• The station at Burewala has been established on 77 acres, Land demarcated and prepared for experiments (25 acres). • Boundary of Station covered with barbed wire, tube well installed and electricity provided. Implement/machinery shed constructed. • Work on crop, livestock, horticulture and farm machinery experiments started. Crops and horticulture plants planted. 2 acres of Jathropha garden established. Research studies started on pomegranate, ber figcitrus, castor, Jatropha, neam. Sukhchain, and other fruit plants. Workshop/conferences for trainers organized. . • Project completed from RADP. Further plan to be proposed by Technical Division.
30	Establishment of Pakistan Agricultural Research Council Station at Sakrand, Shaheed Benazir Bhuttoabad District **Com-I: Mr. Fateh Khan Nizamani, PSO, Sakrand.**	2.725	01.10.2009 to 30.06.2010	• To establish a multiple crop research station for conducting g applied research in the farmer fields. • To survey, identify and rehabilitate plant and animal species in desert and river eco systems. • To develop and transfer the improved technologies for efficient use of	• Station established at Sakrand, work started on various crops. Surveys conducted on crop, livestock production of the area. • Improved technologies (Chinese and local wheat varieties) being tested in the farmers' fields at various locations. Banana Nursery

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
				available source of land, water and germplasm	produced by tissue culture lab NARC arrived and distributed among farmers for plantation. • New technologies of drip irrigation for wheat and other crops introduced with the help of Chinese experts. • Project completed from RADP, further action to be taken by Technical Division.
31	Establishment of Microbial Bio-resource laboratories: National Culture Collection of Pakistan (NCCP), **Dr. Iftikhar Ahmed, SSO/NIGAB, NARC**	2.006	1-10-11 to 30-9-12	• To collect and preserve the microbial genetic resources from Pakistani ecology. • To conduct research for the identification of economically beneficial strains. • To establish a data base comprising all the information required for genetic resources of useful and pathogenic micro organisms. • To distribute the economically important strains to scientific community for research or utilization in industrial process as a regular activity of the NCCP after its establishment and recognition at national and / or international level.	PARC/NARC took an initiative to start working on identification, systematic/taxonomy and preservation of economically important bacterial strains from Pakistan and establish microbial bio recourse repository. More than 500 indigenous beneficial microbial strains were collected which include plant growth promoting Rhizobacteria, Halo tolerant, boron and heavy metal tolerant strains and Pathogenic strains. More than 15 candidate NOVEL strains were identified. Two novel species of bacteria has been descrived and validated by International Committee of Systematics in Prokaryotes (ICSP).

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
32	Development of Sorghum Sudangrass hybrids for high forage yield and quality characters (2nd Phase) **Dr. M. Shafiq Zahid, PSO, Fodder Program, NARC**	1.934	01-01-12 to 31-12-14	• To maintain, purify and multiply the desirable parental lines of S.S. hybrids under various ecologies. • To see the fodder yield potential of best performing S. S. Hybrids in various agro-climatic zones. • Refinement of production technology of S.S. hybrids under various environments. • To register developed hybrids with FSC&RD and promote its introduction to fodder growers through public private partnership.	Acquired 24 CMS (A&B) sorghum lines and 16 Sudan grass. Two hybrids (NARC-2 and NARC-4) out yielded imported seed. The average green fodder field of two NARC hybrids (NARC Hybrid-2 & NARC Hybrid-4) was recorded 115.42 t/ha and 108.73 t/ha respectively, compared with 103.63 t/ha of check. These hybrids have potential to produce 26 and 23 percent more fodder yield than the standard one "Pak-Sudax". Production technology of sorghum Sudan grass developed. National and multi-national seed companies were involved in different activities to monitor it production and viability. More than 700 kg seed of A, B & R lines have been purified, sufficient to raise hybrid seed on commercial level over an area of more than 100 acres. More than 800 kg hybrid seed has also been produced for promotional and hybrid release purpose. Variety Evaluation Committee approved two Sorghum Sudan grass hybrids (NARC SS-hybrid and NARC-Shahtaj) approving during the month of October 2015.
33	Development of sunflower and canola hybrid and canola type mustrard varieties (Second Phase),	5.675	01-01-12 to 31-12-14	• Completion of field requirements for registration/approval of local sunflower and canola hybrids and mustard	Approved by the Variety Evaluation Committee (VEC) as "PARC Canola Hybrid". PARC Canola Hybrid (CRH-

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
	Dr. Muhammad Ayub Khan, CSI, NARC			varieties developed during first phase of the project. • Maintain purity and identity of parent lines of potential local sunflower and canola hybrids and mustard varieties. • Seed production of potential sunflower and canola hybrids and mustard varieties for demonstration and promotion.	40/10) is developed by Oilseed Research Program, NARC, Islamabad using CMS-Restorer system with an objective to increase per unit production of canola crop in the country. PARC canola hybrid is well adaptive to our local environment in Pothowar and Khyber Pakhtunkhwa (KPK) and has shown consistently better yield performance. Average seed yield of PARC canola hybrid is 2194 kg ha^{-1} while potential seed yield was 3182 kg ha^{-1}. The PARC canola hybrid was planted on 10 thousand acres on farmer's field during 2014-15 with the help of National Rural Support Program (NRSP). With the help of PATCO, more than 50 tons of PARC canola hybrid seeds are produced and sold to farmers at less market price (Rs. 500/kg) as compared with market rate of 1500/kg for commercial hybrids. • Locally developed sunflower hybrid PARSUN-03 was approved in the Variety Evaluation Committee meeting held on 15th May 2013. On average SMH-0917 (PARSUN-3) produces 1780 kg/ha seed yield compared to commercial imported hybrids, Hysun-33 and NK-S-278 with 1833 and 1733 kg/ha. Demo

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					plots were conducted in Punjab and Sindh with the collaboration of private seed companies. SMH-0907 (PARSUN-3) recommended by the Variety Evaluation Committee for Registration. Two ton hybrid seed of Sunflower Hybrid (PARSUN-3 & SMG-0917) produced and distributed among farmers on 50% less price than imported hybrid seed.
34	Strengthening of National Insect Museum (NIM), **Dr. Muhammad Ather Rafi, PSO, NIM, IPEP, NARC**	3.00	1-2-12 to 31-1-14	• To strengthen and improve the existing housing facilities in National Insect Museum, NARC. • To explore the insect fauna of Pakistan in different ecological zones with special reference to agriculture importance. • To provide online access to generated knowledge.	surveys were conducted in Punjab (16 districts), Khyber Pakhtunkhwa (13 districts), Gigit Baltistan (4 Districts) and Azad Jammu & Kashmir (2 districts). Fifteen thousand insect specimens collected. Thirty seven new records explored. Online database of National Insect Museum developed (www.nidp.org) and linked with PARC website.
35	Genetic diversity analysis of brassica oilseeds and adaptability testing of elite lines at different ecologies (follow up project) **Dr. M. Ashiq Rabbani, IABGR, NARC**	2.855	1-1-12 to 31-12-14	• Regeneration of germplasm for conservation and distribution to user communities. • Evaluation and identification of promising genotypes having high yield potential, bold seeds, higher oil contents, lower levels of erucic acid and glucosinolates, and resistant to shattering and aphdis.	• Diverse genetic resources are vital for maintaining an efficient and sustainable farming industry, as they allow development of cultivars to cope with new demands. During first six months of RADP sub-project, 25 accessions of indigenous germplasm were collected from Thall area and

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
				• Seed multiplication and multi-locations testing of elite lines in comparision with improved cultivars and germplasm accessions of brassica oilseeds.	added to PGRP gene-bank. These contained Brasica juncea, B. napus and B. rapa (campestris) and Eruca sativa). A total of 380 accessions of oilseed brassica (from Canada, China, USA) were regenerated, allotted proper accession numbers and conserved in PGRP gene-bank for storage and future use. • Two field experiments were conducted during present investigation. Around 86 accessions of canola rapeseed were evaluated for agro-morphological traits in the first experiment, while 100 accessions of Eruca sativa were used in 2nd experiment. A considerable level of polymorphism was observed among different accessions of two crucifer species for most of the phenotypic traits. Diverse genotypes having high yield potential, bold seeds, higher oil contents, low levels of erucic acid and glucosinolates, and resistant to aphids and shattering in comparison with check lines/cultivars are being identified

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					for use in future breeding programs/varietal development. • Ten selected accessions of canola rapeseed (high yielding and bold seeded), three non-shattering juncea canola genotypes, and one promising line of Eruca sativa (Taramira) have been multiplied at IABGR for further use at farmers' field as well as in breeding programs during next cropping season. Seed samples of these selected lines, canola rapeseed and Eruca sativa germplasm have been sent to NIFA for oil /protein content determination, fatty acid profiles and lucosinolates analysis. • A total of 108 SSR primer pairs were screened using two improved cultivars of Brassica carinata and most informative markers were identified for further use. After initial screening, DNA profiling of 60 accessions of Brassica carinata was carried out using 52 SSR markers for diversity analysis. SSR markers analysis will help us in cultivars discrimination, variety protection, and marker assisted breeding.

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
36	Effect of levelling practices on crop productivity in farmers field in the districts of Punjgoor, Khuzdar and Lasbela, Balochistan, **Mr. Saeed Ahmad, SO, CARI, Lasbella**	25.550	01-10-12 to 30-9-15	• Formulate a complete package of land levelling technology that produce more at less cost. • Establish an effective and viable linkage among researchers, extension agents and farmers for timely adoption of new technology. • Demonstrate laser land levelling technology in farmers' fields to improve water and crop productivity. • Build the capacity of stakeholders including machinery manufacturers, farmers technicians and extension agents.	• Farmers of the Bela, Khuzdar guided by the Agriculture Engineer regarding the Land Levelling. 16 farmers Land Levelled and unlevelled recorded at Bela Winder. • 35 farmers levelled and unlevelled recorded for the levelling purpose in the next quarter. • Guidelines regarding levelling practices increased the income of the farmers up to 15% and decreased the wastage of water resources and expenditure occurred on the tube wells etc.
37	Seed Production and Popularization of lentil variety, Markaz-2009, **Dr. Asghar Ali, PSO, Pulses Program, CSI, NARC**	2.215	01-10-12 to 30-09-14	• To produce quality seed of newly released lentil variety Markza-09 at limited scale at NARC and farmer's field with the involvement of a seed company Seed and Services International, Islamabad (SSI). The company is already working in the Pothowar regions.	NARC released lentil variety (Markaz-2009) introduced among farming communities in five districts of Pothowar region (Rawalpindi, Jhelum, Attock, Gujrat, Chakwal) on an area of 100 acres. On average famers yield from Markaz-2009 was 12 m/acre as compared with local variety of 4 m/acre. Production technology of lentil was also introduced among farming communities.
38	Making NARC campus Rodent Free through operational research, **Shahid Munir, SSO, VPMP/IPEP/NARC**	1.639	1-10-11 to 31-3-2013	• To evaluate and determine different operational parameters for area-based rodent control campaign. • To test and evaluate different rodent control practices as to be adopted by the concerned programmes/institutes	A total of 18611 burrows were treated with fumigation and rodenticies. Overall 80 to 90% reduction in burrow activity.

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
				at NARC or by the farmers in the barani areas. • Budget analysis of cost-return of the campaing.	
39	Determination of the severity of HLB and CTV in citrus growing areas of Punjab and KPK, **Dr. Shahid Hameed, SSO, IPEP, NARC**	2.847	1-10-11 to 30-9-13	• To gain a better understanding of the current status of citrus greening and virus disease occurrence in the citrus growing regions of Pakistan. • To establish the genomic variability among the selected isolates of HLB and CTV using molecular methods.	Major growing areas of Punjab and Khyber Pakhtunkhwa were surveyed. Citrus Tristeza Virus (CTV) disease was prevalent in all the surveyed areas. In Punjab incidence of CTV range 10-40% while in KPK 16-50%.
40	Management of Viruses infecting Garlic in Pakistan, **Talat Shaheen Gilani, SSO,IPEP, NARC**	2.189	1-10-11 to 30-9-2013	• Assessment of distribution, incidence and severity of viral diseases of Garlic in selected agro-ecological zones of Pakistan. • Identification of new sources of disease resistance against viruses. • Indexing of virus free Garlic variety/varieties at NARC Islamabad and Summer Research Station, Kaghan	Surveys of four locations in Punjab and eight locations in Khyber Pukhtunkhawa were conducted for assessment. In Punjab % infection recorded 33.44% through DAS ELISA against OYDV. Highest 90% infection was recorded in Swabi. Identification and indexing of garlic germplasm carried out at NARC field for seven varieties. Different degrees of infection was recorded. Sowing of virus free ELISA tested cloves can reduce the infection.
41	Acquisition and Improvement of Mushroom Production Technology in Pakistan **Mr. Umer Iqbal, SSO, CSI, NARC, Islamabad**	6.056	01.11.2009 to 31.10.2012	• Acquisition and collection of genetic resources to broaden the genetic base of mushrooms. • Improvement of mushroom production technology for commercially grown mushrooms.	Cultures of button, oyster, reshi, Chinese and shiitake mushroom were collected from various sources (China, Japan, Belgium and United Kingdom). Hybrid strains of oyster and button mushroom was produced from

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
				• Development of indigenous spawn production facilities for cultivable mushrooms. • Improvement of post-harvest technology for mushrooms. • Training and development of human resources in mushroom cultivation.	commercial farming. Button and oyster mushroom produced and fresh and dried mushroom sold through PATCO. Package of technology developed.
42	On Farm Research & Development for Improved Drying, Grading, Packing, Branding and Marketing of Dates in District Khairpur **Dr. Ali Muhammad, Director (TTI, PARC) ARI, Tandojam**	29.530	01.11.2009 to 31.10.2012	• Development and demonstration of harvesting, drying, grading and packaging facilities for value addition of dates • Gender based on – farm capacity building of growers in the overall value chain of dates • Identification and establishment of potential market channels linking them with the growers.	• Social mobilization of Date growers and other stakeholder were done. A gas/solar date dryer and a solar date dryer were installed at Hussainablad and Chhudaho villages of District Khaipur in collaboration with KCS and WADO. The growers who processed their dates in solar house reported that quality of dates is better than the dates dried by conventional methods. It was recorded that dates become dried with in 4 days and the colour of dates remain unchanged. The dates quality and colour was attractive than dates proceed in solar house and by conventional methods. The training programs on "Date Plam Orchard Management" and "value addition and brand development" were organized in the project area.
43	Establishment of Botanical Garden for Cultivation of wild plants of	4.055	01-01-12 to 31-12-	• Introducing new value added crops from wild plants resources	• Land preparation, weed clearing, land levelling, irrigation channels

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
	Pakistan to introduce non-conventional crops in cultivation for value addition, **Dr. Rubina Akhtar, PSO, IABGR, NARC.**		14	• Setting up display wild plant farm for education, research, aesthetic value and cultivation requirement of wild plants in agriculture. • Ex situ conservation of plant diversity through seed preservation in gene bank and living collection of plants in botanical garden	done. Landscape design prepared. Seed sowing for spring planting done. • Bulbs and cuttings grown for spring season according to the requirement of plant species. • Sub project closed on the recommendations of Technical Division.
44	Extraction and analysis of essential oil from rose, jasmine and aromatic herbs, **Dr. Muhammad Naeem Ullah, PSO, IABGR, NARC**	3.73	01-02-12 to 31-1-14	• To identify best varieties of rose, jasmine, mint, lemongrass and rosemary with high essential oil contents. • Optimization of essential oil extraction methods. • To analyze bioactive compounds in different medicinal plants.	Acquired rose, mint, lemongrass and rosemary germplasm. Hydro-distillation method for essential oil extraction proved to be better than solvent extraction. Determined the antioxidant potential of rosemary, mint and lemongrass. Determined seasonal variation in total phenols, flavonoids, anti-oxidant and anti-mirobial activity in lemongrass.
45	Evaluation of Locally Developed Mandarin Hybrids in Potential Citrus Growing Areas (Phase-II) **Mr. Mukhtar Ahmed, SSO, Fruit Crop Research Programme, HRI, NARC**	0.892	1.7.2012 to 30-6-14	• Testing / evaluation and selection of mandarin hybrids in citrus growing area for early maturity. • Propagation of selected hybrids.	The hybrids are: Hybrids – Kinnow x Salutiana & Kinnow x Mussambi. Four hybrids selected (NARC-05-06, NARC-05-14, NARC-05-17, and NARC-05-18). Root stock of sour orange was used. Physical characteristics of fruits (number of fruits / tree, fruit weight, rind thickness, number of seed/fruit) and physiochemical characteristics (fruit color, TSS %, acidity%, pH, total sugar%) completed. Five hundred plants of NARC-05-17 and NARC-05-

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					18 were grafted on citrus rootstock (sour orange). Out of 500 grafted plants, 300 plants are ready for transplating in the field. Organolapthis tests are completed.
46	Establishment of R&D facilities of National Institute of Bio-Remediation: **Dr. M. Ashiq, Director NIB, NARC**	31.146	01-4-10 to 31-3-13	• Establishment of analytical facilities. • Development /validation of waste water analytical techniques at NIB. • Collection, characterization and establishment of indigenous microbial bank and aquatic plant nursery for use in bioremediation at national level. • Generation of awareness through seminars and imparting training at provincial level through workshops. • Development of manpower skill and expertise.	Established water quality lap for monitoring of used water (sewerage water). Analyzed water samples from different places throughout the country. Comparative surveys were conducted and collected indigenous aquatic plant species for bioremidiataion. 0.7 million gallon used water per day from NARC and Chak Shahzad is reclaimed to irrigate 400 acres through high efficiency irrigation system and 240 acres of land through flood irrigation. Bioremediation technology scaled up in various parts of the country.
47	Development and evaluation of a turmeric curing and drying technology, **Dr. Hafiz Sultan Mahmood, Assistant Agri. Engineer, ABEI, NARC**	2.800	01-02-12 to 31-01-14	• To develop a suitable turmeric curing and drying technology • To evaluate the performance of this technology in turmeric growing areas. • To perform the cost analysis and to demonstrate this technology to turmeric growers and local manufacturers.	Developed and evaluated Turmeric Curing and Drying Technology. Some Facts: – Cultivated Area: 5647 ha – Total Production: 57238 ton (Fresh) – Average Yield: 10-14 tons/ha (Fresh) – Kasur District major Turmeric production Area – At harvest time 80% moisture (December-January)

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					– Sun drying common take 25-35 days and quality is also deteriorated. – Turmeric Dryer – Drying Capacity: 600-1000 kg – Drying Temperature: 55-60 oC. – Drying Time: 30-34 hours. Turmeric dryer was demonstrated among farmers in Kasur. ABEI, NARC will provide technical assistance to interested manufactures.
48	Development and Evaluation of a PTO driven disk plow, **Shabir Ahmad Kalwar, P.E. ABEI, NARC**	4.980	1-3-12 to 28-02-14	• Development of PTO driven disk plow • Performance evaluation of powered disk plow in the field. • Demonstration of new machine to the local manuyfactures, farmers, extension workers, and NGO	After combine harvesting most of the paddy fields are wet with anchored stubbles and some un-burnt loose straw present. Due to tires slippage tractors have difficulties to pull implements generally used for land preparation. To overcome this problem farmers have adopted to use 3-5 times disk harrow with two times cultivator and planking then manually broad casting of wheat seed. It has increased the cost up to Rs. 17290/hectare (7000/acre). In this situation the disk harrow penetrates only 3-4 inches deep and hardpan further closer to the top soil. When irrigation applied, water remains for longer period in the field within root zones and in case of rain, situation further worsen and wheat crop became yellowish and gives low yields against

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					its potential.The 2nd prototype machine was brought back from Daska to NARC and tested in wet fields to check its performance to use it for puddling as cheaper option than present practices. Finalized technical parameters & manufacturing drawings on the basis of machine testing at farmers field near Daska and at NARC. Small scale demonstration arranged to the selected manufacturers and progressive farmers at farmers field to get feedback before commercialization. To make machine for all season and for every soil from standing water (Puddling) to hard soil the 3rd prototype machine fabricated at the workshop of united Agro engineers Daska. It shows excellent performance and worked at desired depth especially in rice-wheat field conditions. It also shows performance in standing water and hard soil conditions. A new implement designed and fabricated by Agricultural & Biological Engineering Institute, National Agricultural Research Centre, Islamabad with the help of a collaborative manufacturer M/S United Agro Engineers, Daska; in which tractor transmit power through PTO shaft to rotate disks instead of pulling

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					through rear tires. These disks penetrate more than 20cm (8 inches) and also helps tractor in to forward motion with complete mixing of stubbles and residues just in one pass. It also enables farmers to use drill machine. This new machine is the combination of two (disk harrow and rotavator) and their cost is Rs. 300,000/both as compared Powered disk about Rs.120,000/ (when commercialized). This machine is suitable for all kind of fields in any cropping system and can be revolt especially in land preparation practices in terms of cost reduction, increased field capacity and efficiency, maintain land leveling, ensure better yield due to good root penetration, evenly distributes soil nutrients throughout the soil, destroys pests shelters and disrupts their lifecycles, control weeds and better way to aerate the soil. Results showed that yield increased between 790-988 kg/ha (8 to10 monds/acre) and land preparation cost reduced from Rs. 17290 to 4940 per hectare (Rs.7000 to 2000/acre).
49	Investigation of Factors causing low head rice recovery, **Dr. Tanveer Ahmad, PE, ABEI, NARC**	2.750	1-2-12 to 31-1-14	• To assess the factors affecting low head rice recovery for combine harvested paddy. • To identify the practices (such as	Results indicate that manual paddy harvested gave highest head rice recovery (60.66%), followed by head feeding combines (58.10%),

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
				drying, storage and rice milling) causing low head rice recovery for long grain rice.	conventional combines (56.92%) and village level sheller (48.4%) respectively. The results also indicate that crop condition also influenced head rice recovery. Healthy paddy samples gave best recovery (51-55%), medium crop gave better recovery (48-50%), while stress/weak paddy gave poor head rice recovery (40%).
50	Evaluation and commercialization of mango picking and desapping machine, **Dr. Muslim Abbas Zaidi, ABEI, NARC**	3.12	1-3-12 to 30-09-12	• To test and evaluate the performance of new version machine and to demonstrate it to farmers/mango growers in Punjab and Sindh. • To commercialize mangoes picking machine involving local industries arranging field demonstrations.	• Conducted preliminary testing of the machines at ABEI and make it perfect for field work for coming season. • Commissioned the machine in the field and field tested at Mustafabad 30 km from Hyderabad, Sindh. • Arranged a number of field demonstrations in district Thatta (Mustafa Farm), Tando Allah Yar (Junaid Haider Shah Farm), Rahim Yar Khan (Jamal Din Wali, Makhdoom Farm), Multan (Lutfabad, Major Tariq Farm) and Zahid Bokhari Farm at Bhawalpur road. A number of mango growers and stakeholder were present and they appreciated the efforts made by PARC to solve the problem of mango picking and desapping.

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51	Development and evaluation of vegetable planter and transplanter, **Dr. Muslim Abbas Zaidi, ABEI, NARC**	3.00	1-3-12 to 28-2-14	• To design and develop a vegetable planter at AEEI initially focusing on pea planting, • To indigenize the imported vegetable transplanter through local manufacturer. • To evaluate the performance of the developed machines at farmers fields. • To demonstrate the technology to the stakeholders by conducting extensive field days/demonstrations.	Designed and developed vegetable planter for pea and okra. Testing and modification of planter in the light of field results like redesigning of riggers, redesigning of bed shaper, main frame and drive system have been completed.
52	Production and propagation of quality deciduous fruit plants in MARC, Gilgit and Rawal watershed at Satrameel, Islambad (MARC – Comp) **Mr. M. Din, SSO, MARC, Juglote, Gilgit** Production and propagation of quality deciduous fruit plants in MARC, Gilgit and Rawal watershed at Satrameel, Islambad, **Mr. M. Saleem Pomee, SO, WRRI, NARC**	7.610	1-2-10 to 30-6-13 24-2-10 to 23-2-13	▪ Develop research based package of technology on production of quality deciduous fruit plants, Hamalyan roses and medicinal herbs. ▪ Enhanced income of farmers through introduction and supply of certified quality fruit germplasm and medicinal herbs for commercial cultivation. ▪ Improved livelihood of population through supply of high yielding and disease resistant fruit and medicinal cultivars.	Introduced quality cultivators of deciduous fruits in Juglote, Gilgit. Increased and maintained the new germplasm of grapes, peach, almond, apple, cherry, apricot. Introduced new techniques of grafting by reducing one year life cycle in production of grafted plants in the regions. Produced twelve thousand grafted plants and supplied to growers.
53	Antioxidant potential and bioavailability of poilyphenols extracted from fruits and vegetables for functional foods preparation, Mr. **Muhammad Naeem Safdar, SSO, FSPDI, NARC**	3.20	1-3-13 to 30-9-15	▪ Total polyphenol contents in strawberries, organs , grapefruits, mulberry, apricots, plum apricot, guava, beetroots and carrots will be known. ▪ Antioxidant potential of phenolic compounds and bioavailability will be quantified	Functional fruit bars containing different levels of mango, kinnow, pomegranate extracts were developed and standardized. One hundred and forty functional fruit bars containing 1%, 2% and 3% mango/kinnow/pomegranate peel extracts were prepared and analyzed

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				▪ Functional foods will be produced by fortification/supplementation of extracted antioxidants in different food recipes ▪ Food industries in private sector would be able to produce functional foods for special groups i.e. diabetic, heart patients etc.	for 36hysic-chemical and microbial quality parameters. Storage studies of 90 functional fruit bars containing 1%, 2% and 3% mango & kinnow peel extracts were carried out at refrigerated temperature for 36hysic-chemical, microbiological parameters as well as for sensory attributes at one month intervals. The storage studies of functional fruit bars for three months storage revealed that the product remained satisfactory for three months.
54	Cultivation and evaluation of Salicornia crop in Coastal areas of Sindh, **Mr. Fateh Khan Nizamani, PSO, SARC, Karachi University**		1-6-13 to 31-5-16	▪ To evaluate the salicornia in comparison to local halophyte species for oil production and utilization. ▪ To develop suitable agronomic cultural practices for Salicornia in marginal lands ▪ To study the potential of salicornia as animal fodder cultivated under sea and brackish water ▪ To evaluate the socio-economic benefits of growing salicornia on marginal lands ▪ Capacity building of local farmers on salicornia growing technology.	Salicornia seed broad casted in standing water, planted at ridges and planted in Wattar condition (by Chungi) failed to germinate. Up to 10% germination of the salicornia seed was noted only where the seed was broad casted in the dry soil beds. Sub-project closed on the recommendation of Technical Division.
55	Establishment of mother blocks, fruit plant nurseries of high value crops and seedlings / seed production of economically important vegetable in district	7.00	1-10-13 to 30-9-15	▪ Establishment of mother blocks of promising hilly fruit species at NTHRI. ▪ Production of nursery plants of hilly fruit species. ▪ Human resource development.	Peach: 2500 plants (Florida King and Early Grande). Apricot: 2500 plants (Badami, Castle Bright and Swat Selection) Plum: 2300 plants (Fazal

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
	Mansehra, **Dr. F. S. Hamid, Director, NTHRI, Mansehra**			▪ Establishment of display centre. ▪ Seed production in field and nursery management of high value off season vegetables crops at NTHRI.	Manani, Au-Producer) Almond: 2000 plants (Lajawab, Karishma) Walnut:1500 plants (Local Chattar) Fig: 1300 plants (Sawari Black) Pomegranate: 2200 plants (Tarnab Gulabi) Twelve thousand peach rootstock seedlings available for budding and grafting ,Nursery of fig var. Sawari (3200 plants & pomegranate Var. Tarnab Gulabi (11000 plants) for the growers are available. Walnut (3500 seedlings and new nursery of 300 peach rootstock with Almond variety Karishma ready. Budded 600 Peach rootstock with apricot varieties Badami. Castle Bright and Swat Selection. Stool beds of apple (MM-106, MM-111 and M-26) Pear (Quince) and Cherry collected for multiplication. Managed the Kiwi plants with 90 % survival at NTHRI. Managed the Mother Fruit Orchard (188 plants of different spp.) at NTHRI and installed Drip Irrigation System. **Vegetables:** Produced off seasons vegetables i.e., cucumber, tomato and chilies. Produced

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					more than 50,000 seedlings of onion OPV's Swat-I . Planted onion (3 varieties) for production of pre basic seeds . Raised 5000 tomato seedling through cuttings under tunnels for off season production. Introduced new crop broccoli both as seasonal and off seasonal production. Identified some best hybrids suitable for local area. Introduced new technology for nursery raising in plastic trays among the farmers for vegetables production. Produced seed (½ kg – 25 kg) of different vegetables and disbursed among the different Institute for research purposes. Checked different insecticides, fungicides for recommendation of vegetables growers. Collected and planted different medicinal plants. Fruits & vegetable certificate has been issued on March 16, 2015 by Seed certification Department (Min. FSR GOP, Islamabad).
56	Establishment of model facility of wastewater treatment through bioremediation at Rose & Jasmine garden Islambad, **Mr. Yousaf Riaz, Director NIB, NARC**	7.675	30-9-14 to 30-5-15	• To demonstrate PARC interventions, awareness generation and enhance public to public institutional partnership in bioremediation. • To utilize the waste water through eco-friendly measures for multiple gardening models and afforestation on sustainable basis.	Model facility of wastewater treatment through Bioremediation at Rose & Jasmine Garden, Islamabad was established. Treatment of 4.5 cusec of sewerage water per day is possible for green belt establishment. Various aquatic plants both submerged and floating were introduced to detoxify

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					the sewerage water by removing various types of pollutants i.e. heavy metals, organic and inorganic contaminants, detergents, pesticides, oils, human and animal excreta. Five thousand fruit and ornamental plants were planted. Honorable president of Pakistan Mr. Mamnoon Hussain inaugurated the bioremediation model at Rose and Jasmine garden Islamabad on 14th October 2015.
57	Commercialization of wheat straw chopper in combine harvested wheat fields in southern Punjab, **Mr. Zulfiqar Ali, PSO, ABEI, NARC**	1.550	1-6-14 to 31-5-15	▪ To conserve the combine harvested wheat straw by up scaling the wheat straw chopper cum blower in the wheat growing areas of the southern Punjab. ▪ To perform the cost analysis of the machine.	Demonstrate wheat straw chopper in Southern Punjab in order to maximize the farmer's income with a reliable machine. The machine was operated at three sites in Multan area. A large number of farmers, manufacturers, farm machinery service providers, officials of line departments, Director AMRI, Multan, NGOS and other stakeholders participated in the demonstrations. Farmers appreciated the effort made by PARC in introducing this technology in the area. Although, the wheat straw chopper has been adopted in North and Central Punjab, but adoption of this technology is slow in Southern Punjab.

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
	NATURAL RESOURCES				
58	Development of Bio Fertilizer Processing Plant; Mr. Abdul Waheed Zafar, P. Engineer, ABEI, **(Dr. Banaras Raja-looking after the operations) NARC**	2.186	01-04-09 to 31-03-10	• To develop pilot Bio-fertilizer processing unit and install at NARC	A prototype Bio-fertilizer processing unit designed and manufactured from a private manufacture. The unit installed at NARC and operational for production of compost/bio-fertilizer.
59	Plant Nutrition Management for Sustained Crop Production in Northern Areas of Pakistan, **Mr. Sher Ahmed, SSO, MARC, Juglote, Gilgit**	5.960	01-06-09 To 30-05-12	• Develop research-based package of technology on integrated plant nutrient management. • Improve the fruit yield for major fruits of the areas. • Observe the effect of different input levels on the yield and quality of fruits.	Constructed Soil testing Lab building and equipped with latest equipments. Soil sampling of various representative sites in Gilgit, Diamer, Astore and Ghizar districts were carried out. About 300 sites were sampled and analyzed for fertility status and physio-chemical characteristics. Majority of the sites were deficient in essential plant nutrients. 100% samples were deficient in nitrogen, 80% in phosphorous and 65% in Potash. Among the micronutrients, Fe was deficient in only 5% soil samples, Zn deficient in 92% samples and CU deficient in 10% samples. For soil organic matter, 36% samples were deficient, 38% marginal and 26% adequate in soil organic matter. Four major fruit species (Apricot, Almond, Cheery, Apple) were selected for nutrient experiments. All the fruit species showed better yields by the application of required nutrients. Nutrient recommendations were made

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					based on field experiments for apricot, almond, cherry and apple.
60	A strategic approach of chemical and biological reclamation of salt affected soils in southern zone of N.W.F.P **Dr. Abdul Rashid, PSO, AZRI-D.I. Khan.**	5.468	01.07.2007 to 30.06.2011	• Rehabilitation of degraded soils through physical methods, chemical amendments and introduction of salt tolerant plants. • To develop sustainable and economically viable technology for use of waste lands for agricultural production	Salt affected soil can be reclaimed on sustainable basis with different strategies of soil reclamation. Deep tillage, use of organic manures and gypsum application proved very effective in improvement of soil condition. Joint application of gypsum with organic manures was found superior than gypsum alone in soil reclamation and yield increase in wheat and rice. Salt affected soil can efficiently be utilized with the introduction of slat tolerant grass species and fruit trees of falsa and guava. Two promising lines of barley and one for wheat are in pipeline for variety evolution best suited for salt affected areas. Kallar grass proved successful for fodder production in salt affected soil where other crops failed to survive. Highest fodder yield of 53322 kg/ha annually in four cuts was obtained when kallar grass planted at 50 cm row spacing. Combined application of farm yard manure, press mud and gypsum increased the falsa and guava yield. Residual effect of soil amendment on the yield of rice sown after wheat in salt affected soil with

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					seven different soil amendment (Control, deep, tillage, FYM 20 t/ha, Gypsum 100%, Deep tillage+FRM, Deep tillage+Gypsum, FYM+Gypsum) indicate that soil inputs significantly increased the paddy yield than control. The paddy yield ranged 2867 to 3924 kg/ha. Highest yield 3924 kg/ha was obtained with the treatment of 100 gypsum application+deep tillage. Lowest paddy yield 2867 kg/ha was obtained from control. pH of the soil reduced from 8.3 to 7.9, electrical conductivity (ECe dSm-1) from 4.25 to 1.50 and sodium adsorption ratio (SAR) from 17.20 to 5.00. Effect of gypsum and organic manures on yield of wheat in salt affected soil with six treatments (control, Mungbean straw 10 t/ha, FYM 10 t/ha, Gypsum 100%, Gypsum 100%+Mungbean straw, Gypsum 100%+FYM) indicate highest wheat yield 4287 kg/ha with 100% gypsum+FYM compared with control of 2537 kg/ha. Maximum decrease was also observed in electrical conductivity and soil adsorption ratio in the joint treatment of gypsum plus farm yard manure. Six wheat genotypes and four varieties were evaluated in field condition for salt tolerance. Grain yield

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					ranged 3041 kg/ha to 4205 kg/ha. AZRI (DN)-S1 gave highest grain yield of 4206 kg/ha. This genotype is under further testing in National Uniform Yield Trials. Five promising selected barley lines from previous trials evaluated for slat tolerance in field conditions and compared with local check. Grain yield data ranged 3794 to 5091 kg/ha. The highest grain yield of 5091 kg/ha was obtained from Entry-2, Entry-4 stood second with a grain yield of 4900 kg/ha.
61	Establishment of Pakistan Agricultural Research Council Station at Sakrand, Shaheed Benazir Bhuttoabad District **Copm-II (of Sr. No. 33): Dr. Sher Muhammad, Director (Organic Farming) NARC**	5.400	01-10-09 to 30-9-2010	• To fabricate / establish two bio fertilizer plants in Sakrand and Sanghar	• Two fertilizer plants fabricated for installation at Sakrand and Sanghar. • Production of fertilizers with consistent/tested quality to start. There is no progress despite review by Technical Division and actions proposed.
62	Evaluation & resource conservation technologies for improving water productivity in rice-wheat cropping system. **Mr. Qurban Hussain, PSO, WRRI, NARC**	5.311	01.10.2007 to 30.09.2011	• Evaluation of different cultivation practices for water use efficiency under rice-wheat cropping system • Evaluation of different irrigation strategies for water use efficiency for rice crop • Improving water productivity by identifying water efficient cultivation practices and irrigation management	Experiments were conducted at Kala Shah Kaku, Muridke and Faisalabad. Crop water requirement for wheat and rice crop was determined as 383 and 600 mm respectively. Double zero tillage increased water productivity by 28% for Basmati rice as compared to conventional method. Direct seeding increased water productivity by 18% for Basmati rice as compared to

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
				strategies for rice-wheat cropping system.	conventional method. Saturation and alternate wetting and drying irrigation strategies for rice increased water productivity by 22 and 19% respectively for Basmati rice. Bed planting with hybrid rice using mechanized process in district Kasur on farmers field saved 35% water as compared to conventional method. Paddy yield of 5.5 t/ha were same under both the bed and conventional planting methods. Whereas, at Faisalabad, hybrid rice on bed saved 25% water with 15% increase in yield. Zero tillage and bed planting under wheat crop increased water productivity by 16 and 11% respectively.
63	Water Productivity and Application Efficiency Evaluation under Trickle Irrigation System in Stress Environment of D.I Khan **Engr. Noman Latif, D.I.Khan.**	4.407	01.10.2007 to 30.09.2010	• To enhance water productivity under different irrigation management strategies through trickle irrigation. • To evaluate irrigation efficiency and uniformity of locally developed micro sprinkler and micro-tube emitters under different pressure heads. • To develop irrigation management strategies of trickle irrigation systems for improving water productivity in stress environment.	Rod Kohi (Spate irrigated) areas selected for installation and testing of drip irrigation systems.Twenty one acres farm were provided with drip irrigation as: o Pir Iqbal Farm, Musazai 3 acres o Nawaz Farm, Khuti 3 acres o Giloti Model Fram 5 acres o Muazam Fram 3 acres o Artesian Well Area Daraban 5 acres o Gomal University 1 acre o ARI, Ratta Kulachi 1 acre o In-Situ Experimental Area,

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					D.I.Khan 1 acre Experiments were conducted on various vegetables and fruits under different irrigation systems and water saving recorded with Trickle Irrigation Systems.
64	People Centred Agro-Based Research & Demonstration Centre; **Mr. Zaheer ul Ikram, PSO/Dir (Trg), PARC**	10.655	01-01-09 to 31-12-12	• To enable people of the program area communities to make the best use of natural resources through integrated agro-based interventions and capacity building to combat poverty. • Organic farming to be propagated through the provision of appropriate tools and skills; agriculture products and knowledge to be demonstrated along with training and capacity building to maximize the potential of the programme area. • Model of public private partnership for research providing a platform for scientists for experimentation and research in a mountainous environment and landscape, and • Provide learning opportunities to students in order for the enrichment of neglected and marginalized communities.	• Agro based Research and Demonstration Centre launched at Chattar Plain, Distt. Mansehra. • Survey of the area, preparation of land and installation of PARC and other technologies started. • The technologies started include; rain water harvesting and storage, fish pond using rain water, sheep rearing, organic tunnel farming, and mushroom cultivation. • Community workshops organized, rural families mobilised and (male/ female and youth) trained. • Prominent scholars visited the project activities. • Partnership with NGO-KIRAT established. • Project reviewed by Committee, but final report still awaited to decide its fate.
65	Conservation of native flora of Cholistan through rejuvenation technique. **Mr. Mumtaz Hussain,**	5.995	01.07.2009 to 30.06.2012	• To conserve and restore ecological balance of Cholistan desert by conservation of biodiversity through the	Cholistan desert extends over an area of 2.6 million ha having harsh climatic conditions. The total population of

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
	SO, AZRI, Bahawalpur			establishment of more productive pasture. • To develop sustainable pasture-livestock farming system by increasing desert land productivity on regular basis through the use of locally available resources, which can lead to profitable farming, sound pastoral development and environmental protection. • To optimize economic gains by effective pasture improvement and livestock development, this will ultimately support poverty alleviation.	Cholistan desert is 1.6 million, and their livelihoods mainly depends on livestock. Experiments were conducted to select drought tolerant grasses, shrubs and trees to conserve the native flora of Cholistan and make the desert more productive and green. Fifteen native and exotic grass species evaluated and found that *Panicum maximum* produced the highest fodder yield of 46.3 t/ha followed by *Panicum antidotale*, *Cenchrus ciliaris* and *Chloris gayana*. Five desert grasses (*Lasiurus sindicus*, *Panicum antidotale*, *Cenchrus ciliaris*, other local grasses) propagated through seeds, stubbles and cuttings on sand dunes of Cholistan on an area of 26 acres. Four desert shrubs (*Calligonum polygonoides*, *Haloxylon salicornicum*, *Zizphus nummulaia*, *Leptadenia pyrotechnica*) and four desert trees (*Ziziphus mauritiana*, *Prosopis cineraria*, *Tamarix aphylla*, *Salvadora oleoides*, *Acacia* species) were planted on nine acres on sand dunes. Seeds of grasses, shrubs and trees were collected for further re-seeding. Seedlings of desert plants were also provided to farmers and NGOs for plantation.

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
66-a	Cultivation of Biofuel Plants on Marginal Lands in Pakistan **Dr. Rukhsana Anjum, Director AZRI, Bahawalpur**	4.220	01-07-09 to 30.06.2012	• To cultivate the selected bio fuel plant species/varieties on marginal lands and develop appropriate protocol for propagation of these plants. • To investigate the oil potential of important non-edible oil plant species grown in Pakistan • To develop an appropriate package of technology for promising bio fuel plants and introduce it among the farmers	**Umerkot:** Germplasm/seeds of three varieties Jatropha curcas viz. (Indian, Thai, Malaysian) acquired from a private company at Karachi. These varieties were tested under nursery conditions. March is the best time for nursery planting, maximum germination 90-93% was found in Thai variety. Flat bed method proved best result and it is cheaper and less laborious than polythene bags and iron tray and earthen pots). Black ripen seed 92% germination followed by half yellow 85% and green 50% germination. Filed experiments indicate that planting density (2.15 x 3.0 m), irrigation at 15 days interval and fertilizer (60-60-60) NPK proved excellent results. Seed yield of 1596 kg/ha, 1320 kg/ha and 1109 kg/ha of Thai, Malaysian and Indian varieties was recorded. Extraction of oil from three varieties was recorded 33%, 29% and 28% from Thai, Malaysian and India variety, respectively. A comparative study of four varieties of Castor bean viz (Nangar Parker, Mithi, DS-30 and local check) was evaluated. Nangar Parkar variety performed better in all growth parameters. Three acres land covered

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					with various experiments of J. curcas and castor bean crops at AZRI farm. Nursery of 15000 plants of J. curcas raised. Ten acres of marginal land covered with J. curcas plantation at different locations on farmers' field. Three hundred kg seed of J. curcas and 150 kg seed of castor bean collected. **Karachi :** Ten acres of Jatropha planted on farmers' field / Govt. farmers from the raised nursery at SARC. About 50 acres castor bean planted from seed on marginal land at Gulam Qader Palejo farm near on National Highway near Gharo. The best sowing of jatropha nursery starts from March while best time of plantation in field in Sindh found pre monsoon in the month of June. The cutting of Jatropha taken from top, middle and bottom was tested and best sprouting in bottom cutting was observed followed by middle and top. **Bahawalpur:** Procured germplasm of Jatropha curcase from six different sources. Raised plants of Pnogamia pinnata (Sukh chain) from the locally available seed. Seed of Ricinus communis (Castorbean) was procured from Ayub Agricultural Research Institute, Faisalabad for its successful

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					multiplication at AZRI, Bahawalpur. Seed has been multiplied large scale and is being sold to the local farmers. A large scale bio fuel nursery was established at AZRI, Bahawalpur and made fully functional by raising more than 36,500 plants of biofuel species including Jatropha curcas from Australia, India, Thailand, Malaysia, Africa. More than 28,000 plants of Jatropha and 8,500 plants of Castor and Sukh Chane transplanted on 5 acres at AZRI farm, Bahawalpur and 4 acres at Cholistan farm. Vegetative propagation is relatively faster with higher success rate. The best sowing time identified is March and September during the year. **Dera Ismail Khan:** July sowing of Caster bean gave more yield 225.47 g/plant as compared to early sowing during June that in turn produced 153.85 g/plant. Sowing of Jatropha curcas during the month of April is more suitable time with 20 days irrigation interval and plant population of 1250 plants/ha.

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
66-b	Cultivation of Biofuel Plants on Marginal Lands in Pakistan **Mr. Ghulam Shabir Bohio, Director AZRI, Umerkot.**	2.496	01-07.2009 to 30.06.2012	• To cultivate the selected bio fuel plant species/varieties on marginal lands and develop appropriate protocol for propagation of these plants. • To investigate the oil potential of important non-edible oil plant species grown in Pakistan. • To develop an appropriate package of technology for promising bio fuel plants and introduce it among the farmers.	• Nursery blocks of Jatropha, castor and Sukhchain planted. • Thailand variety of Jatropha performed better and 12 acre were sown at farmer field, 10000 plants ready for transfer. • Four varieties of castor bean evaluated. • 500 plants Sukhchain planted at AZRI. • Oil extraction to be done for potential analysis.
66-c	Cultivation of Biofuel Plants on Marginal Lands in Pakistan **Dr. Rehmat Ullah Khan, Director AZRI, D.I. Khan.**	2.496	1-7.2009 to 30.06.2012	• To cultivate the selected bio-fuel plant species/varieties on marginal lands and develop appropriate protocol for propagation of these plants • To investigate the oil potential of important non-edible oil plant species grown in Pakistan • To develop an appropriate package of technology for promising bio-fuel plants and introduce it among the farmers.	• 45 grown up(2 year old) plants of Jatropha are already planted. • 2.5 kg seed of one Jatropha variety collected for nursery raising. • 150 plants of Sukhchane shifted in the fields.
66-d	Cultivation of Biofuel Plants on Marginal Lands in Pakistan **Dr. M.**	2.496	01-07.2009 to	• To cultivate the selected bio-fuel plant species/varieties on marginal lands and	• Ten acres field of Jatrofa planted at different location in Sindh.

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
	Anwar Arian, PSO, SARC, Karachi.		30.06.2012	develop appropriate protocol for propagation of these plants • To investigate the oil potential of important non-edible oil plant species grown in Pakistan • To develop an appropriate package of technology for promising bio-fuel plants and introduce it among the farmers.	• Agronomic practices such as planting time, pruning, fertilization etc evaluated. • 50 acres of castor was planted on marginal land. • Oil contents/ potential studies to be conducted on production of sufficient seed/oil.
67	Production of Export Quality Honey and Establishment of Honey Analysis Laboratory for Promotion of Honey Export. **Ms. Farida Iftikhar, SSO, HBRI, NARC**	13.414	1.10.2007 to 30.09.2010	• Training of beekeepers for integrated control of American foul brood disease, mites, pests, and use of modern methods for supplemental feeding to honeybees for production of honey free from antibiotics and pesticides residues and additional sucrose • Establishment of honey analysis laboratory to meet the honey specification requirement of importers • Determine level of insecticide and antibodies residues through chemical analysis of honey collected from different areas	Established honey analysis laboratory at NARC to meet the honey specification requirements of importers. Lab has facilities for honey analysis for pH, total acidity, moisture, electrical conductivity, HMF, diastase enzyme, sucrose, total sugars and pollen analysis. Honey samples are being analyzed and reports issued to beekeepers and stakeholders. Surveys were conducted in different areas of Pakistan to collect information about bee diseases and honey samples were also collected. Twenty beehives were purchased. New queens were produced and replaced with the old queens. The beehives were shifted for foraging to different areas to get different types of honeys. A total amount of 200 kg of Ber honey and 375 kg of Acacia honey produced during three years. Physiochemical analysis and pesticides

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					and antibiotic analysis of the collected honey samples across the country were carried out and results complied as a ready reference for end users and comparison with the Codex Standards for Honey. Organized two national beekeeping trainings courses for integrated control of American foul brood disease, mites, pests and use of modern methods for supplemental feeding to honeybees for production of honey free from antibiotics and pesticides residues and additional sucrose. Sixty participants attended the training courses.
68	Improvement in the production techniques of Royal, Jelly, Pollen, Propolis, Beeswax and their value added products for livelihood. **Mr. Rashid Mehmood, SSO, HBRI, NARC.**	3.152	01.01.2008 to 31.12.2011	• To improve and standardized techniques for he production of royal jelly, pollen, propolis and beeswax. • Transfer of technologies to the stakeholders to produce bee hive products and to prepare value added products from these bi-products.	Comparative study on pollen collection using four types (fixed pollen trap, Gujranwala made, fixed pollen trap, HBRI made, fixed pollen trap, China made, bottom board fixed pollen trap, HBRI made) of pollen traps indicate that HBRI trap better as compared to other traps. The total weight of pollen collected from the Gujranwala clipped pollen trap was 0.332 kg, HBRI clipped pollen trap was 0.486 kg, fixed bottom board trap was 0.318 kg and from the China clipped pollen trap was 0.264 kg. The total pollen collected from all the traps was 1.4 kg. Two hundred and forty five kg honey was produced and

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					sold though PATCO, PARC. Successfully produced 250 g royal jelly from queen cells.
69	Beekeeping in mountain agriculture **Mr.Muhammad Ayub, PSO, MARC, Skardu, Gilgit-Baltistan**	3.099	Jan, 2008 to Dec., 2010	• To observe the effect of honeybee pollination on the production and quality of temperate fruits. • To explore new flora and honey potential of different field and horticultural crops. • Development of honeybee Research Programme at KARINA with collaboration of Honeybee Research Programme, NARC for capacity building of local beekeepers through training courses	In Gilgit Baltistan beekeeping is not practiced on vast scale. The other pollinator populations are also not very high to exert an impact on the yield of fruits. Most of the fruit trees growing in Gilgit Baltistan are cross pollinated and limited pollinators adversely affects the production. Enough populations of honeybees and other pollinators are needed to increase the population. Initially 20 colonies of honeybees established at Skardu. There is abundant honey flora during spring and summer in area varying blooming period according altitude. Major flora are: almond, apricot, peach, cherry, apple, Robinia, Russian olive, Lucerne, maize, buckwheat. Fifteen to 35% increase in fruit setting, weight and size through honeybee pollination recorded in apple cultivars Golden Delicious, Suspolo, Five Star, Kacura Amari. Clover, wild mint, Robinia and buckwheat are important flora. Maximum 3.50 kg per colony honey production was recorded. Winter is harsh and honeybee cannot spend this season because of low temperature and

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					non-availability of nectar and pollen to develop broods from which young honeybee emerge. Honeybees could not survive even under plastic tunnels during winter. Colonies should be shifted from Gilgit Baltistan to Punjab and Khyber Pukhonkhwa.
70	Production technology of black cumin **M. Qasim, SSO, MARC, Juglote, Gilgit**	2.00	1.07.2007 30.06.2011	• Developing Technology on germina cultivation of black cumin to include in the farming system of Pakistan. • Provide new avenue of income gene the mountain farmers for socio economic upli • Capacity building of communities i and product preparation to enhance the incom • Include a new crop in the farming s	Black cumin (Bunium persicum) is wildly grown and distributed on a limited scale in Gilgit Baltistan. Approximately 7000 kg black cumin is annually collected from its natural habitat and marketed by the communities for their livelihoods. Experiments were conducted to determine the cultivation techniques of black cumin as a crop. Results indicate that black cumin grows well both by seeds and bulbs when sown in November and gives better yield if FYM is added. Sowing using bulbs produced yield same year. Seed planted trials took three years to produce seed yield. During first two years, seeds germinate in March and then wilted in the month of May before flowering stage. In third year the crops germinates and completes it maturity stage. Black cumin collected from Gorikot produced maximum seed yield of 1027 kg/ha, followed by Ghizer with a seed yield of

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					641 kg/ha. The lowest yield of 513 kg/ha was recorded in seed source collected from Rattu.
71	Soil environment: Pollutants loading, fate and management **Dr. Mehmood Ul Hassan, PSO, LRRI, NARC**	43.280	01.07.2007 to 31-12-12	• Monitor shallow groundwater, soil and crop produce quality in agricultural systems under long-term sewage and wastewater applications • Understand the dynamics and kinetics of heavy-metal release processes, re-distribution (leaching) and transformation processes • Improve the health of metal contaminated soil and quality of produce for food safety. • Simulate soil environment pollutants using transport model(s) based on information generated through studies of this project	Edibility of 324 summer and winter vegetables samples collected from Peri-urban areas of Gujranwala, Sialkhot, Hyderababad, Multan and Mirpurkhas were analyzed for heavy metal concentrations. Cadmium and chromium (Cr) concentrations were above the recommended permissible limits (RPL) in all the examined vegetables and Pb was exceeded in 90% of vegetables. More than 238 soil samples analysed to evaluate the suitability for growing vegetables and Cd, Pb and Ni concentrations in almost all soil samples were above the RPL with Cr higher than the RPL in 62 % of soils and Cu higher in 26 %. Quality of sewage sludge/ wastewater for irrigation was assessed by analysing 68 municipal effluent samples collected from peri-urban areas of Gujranwala, Sialkot, Hyderabad, Mirpurkhas, Karachi, Kausor and Multan. The Cd, Cu, Pb, Ni and Cr concentrations in the municipal/industrial effluents from all sites were above the RPL and were not suitable to dispose of to water bodies and arable lands. Apparent balance

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					sheets for Pb, Cd, Cr and Cu were prepared by growing maize fodder and spinach crops in Gujranwala peri-urban soil under municipal/ industrial effluent irrigation. Net positive balance revealed that the addition of metals through municipal/ industrial effluent was more than the removal of metals by growing crops. Natural and chemically enhanced phyto-extraction potential of seven crops (Spinach, Mustard, maize, sorghum, oat, pigweed, sesbania) explored by growing on heavy metal contaminated soils. More than 19 fungi were isolated from the metal contaminated soils, purified, morphologically characterized and screened for metal tolerance. These fungal isolates showed great potential for removal of metals from aqueous solution when loaded in bioreactor. Similarly diversified bacterial strains isolated, purified, characterized and screened for metal tolerance and used for bio-remediation of metal contaminated soil and showed great potential to solubilize metal in soil and facilitate its uptake by plant.
72	Carbon sequestration and organic mater dynamics under crop residue management in rice – wheat and	2.750	1-10-11 to 30-9-2013	• Determine SOM decomposition dynamics and carbon pools in soils under Rice-Wheat and rain-fed wheat	• A detailed survey of the rice-wheat area was undertaken and sampling of benchmark soil series with

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	rain-fed wheat system, **Dr. Ghulam Nabi, PSO, LRRI, NARC**			systems. • Determine carbon sequestration potential of lands under crops residue recycling and affect on rice and wheat crop growth performance under applied treatments.	incremental depth was done. After sample processing, various physic-chemical determination were made to determine soil carbon pools in these soils of project area. • Incubation studies have been initiated under controlled laboratory conditions to monitor rice and wheat residue decomposition dynamics as affected by soil moisture levels and residue application methods (incorporation versus mulching). Studies on release of CO2 due to applied treatments have been partly completed whereas studies on N release or under progress. • A long term field experiment on "effect of crop residue recycling and crop sowing methods on soil health and crop yields in Rice-wheat system in promoting carbon sequestration" has been initiated at farmer's field at two sites in rice-wheat area. In this regard first crop of rice was transplanted in July 2012 and will be ready for harvest in November (next month). Various soil and plant

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					physic-chemical determination be made after rice harvest and wheat sowing will be done in the same field. This study will follow rice-wheat rotations.
73	Establishment of vermiculture and vermin-composting research unit at NARC, Islamabad, **Ms. Shahida N. Khokher, PSO, LRRI, NARC**	7.100	1-2-12 to 31-1-13	• Promotion of earthworm biotechnology for soil fertility improvement and restoration of degraded lands (Long term) • Raising in door culture of three species of earthworms to be used, later on, for vermicompost production from waste organic materials (Short term) • Integration of vermiculture with organic farming (Long term)	Indigenous epigeic earthworms (EW) collected from 10 sites of Islamabad, Burewalla, Attock and Muree are being maintained on different farm waste materials for composting. Standardized the conditions (substrate, temperature, moisture) for EW rearing/multiplication. Developed infrastructure and established Vermiculture & Vermicomposting Research Unit with capacity of producing 2000 kg of Vermicompost per season. Eisenia fetida collected from Attock was found better than Pheritima in terms of rate of multiplication. It increased 8-fold in number and 4-fold in biomass over a period of three months, when grown on either Sesbania or Parthenium in the presence of animal dung. Quality of Vermicompots was evaluated by analysis of product and its plant bioassay having organic matter 26-40%. Twenty five EW culture is available, 5000 kg Vermicomposts was prepared

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					and used in different pot and field experiments. Further field experiments are required. Commercialization of three products (Vermiculture, Vermicompost and Expertise) are under progress with PATCO, PARC. Vermicompost with the name of Vermizot is in the process with registration.
74	Water Productivity improvement through deficit irrigation scheduling under centre pivot irrigation system, **Dr. M. Munir Ahmad, PSO, WRRI, NARC**	1.773	1-10-11 to 30-9-13	• To evaluate water productivity of oil seed crops through different deficit irrigation scheduling strategies under center pivot irrigation system • To determine evapotranspiration of selected oil seed crops • To develop management strategies for optimizing water productivity of selected oil seed crops	• Climatic related to daily mimimum termperature relative humidity rainfall wind speed and sun shines hours were collected from 1996 to 2004 NARC Islamabad. • Potential evapotranspiration (ET) of 109 mm in July, 90 mm in August, 87 mm in Sept. And 71 mm in October, NARC Islamabad. • Sunflowers evapotranspiration (ET) varied 3.83-5.95 mm per day in July 51.3 in August and it varied to 2.14 to 1.41 mm per day in Sept. • The crop coefficient varied as 0.35 to 0.53 at the initial stage. 0.74 to 1.15 at the development stage and at the last stage it varied from 0.53 to 0.35. The whole crop of 90-120 days, • Soil samples were collected from study site at depth 0-15 cm, 15-30 cm and 30-60 cm. Soil analysis

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					shows that soil was laom with Ph 7.8 EC 0.37 to 0.90 DS /m. The organic matter was 0.44-1.0 %. The field capacity of the soil is 25% (vol)and wilting point is 11% (vol). The total soluable salt irrigation water was 441 ppm SAR 0.05 carbonate 0.2 and bicarbonate 5.1 me/i. • Sunflowers three varieties are shows in last week of July 2012 under four irrigation scheduling strategies I_1 (1.20 *ET), I_2 (100*ET) I_3 (0.80*ET) and I_4 (0.60*ET) and recommended NPK was applied. • The rainfall after sowing the crop was 72mm in July, 3.11 mm in Aug. And 127mm in Sept, 2012. The rainfall meat crop water requirement and even there was surplus water. One irrigation was applied in the start of Oct. And 2nd in the 2nd 10 of October, 2012. • The detail data of crop yield parameter will be collected at the crop harvests time. • Water productivity analysis will be carried out and then report will be submitted.

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
75	Rangeland Improvement by re-vegetation of suitable species and development of model pasture at NARC, **Mr. Raheel Babar, SSO, RRI, NARC**	1.475	1-11-12 to 31-10-14	• Development of pasture area by monitoring the growth and production potential of grasses, shrubs, tree species and rainfed fodder crops for re-vegetation of degraded rangelands. • Develop and test various range management interventions like grazing potential and grazing response of different species by small ruminants.	Twenty five acres of degraded rangeland area at NARC was rehabilitated by evaluation and testing of various fodder tree species, grass species and seasonal fodder crops. *Acacia modesta*, showed higher survival rate followed by *Morus alba* and *Gledishia triacanthos*. Dhaman (*Cenchrus ciliaris*), Elephant Grass (*Pennisetum purpurum*), Green panic (*Panicum maximum*), Blue panic (*Planicum antidotale*), Rhodes grass (*Chloris gayana*), Steria (*Setaria incrassate*) are potential grass species for re-vegetation.
76	Demonstration of Innovative Practices to Improve Rural Livelihood Through Integrated, **Eng. Muhammad Asif, SO, CAEWRI, NARC**	18.310	1-6-13 to 31-5-15	• Demonstration of Improved Rainwater Water harvestings and Potential Utilization through innovative Technologies for Agricultural purposes. • Wastewater Management for Safe Reuse in Agriculture at Selected location. • Community Capacity Building Program for Improved Agricultural Practices and Dissemination Initiatives.	Rain water harvesting system was developed and rehabilitated on 7 acre including main reservoir and check dam on farmer's field at Kambrial Pindi Gheb. The existing capacity of the reservoir was increased from 17 acre-feet to 55 acres- feet after rehabilitation and renovation work. The average depth of existing reservoir increased from 4 ft to 8ft. Solar system was designed and installed at dam site to lift the water from main dam to accomplish the upper command area development. Tunnel farming has introduced in the command area to demonstrate off season vegetables. Fruits plants of

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					different species planted on 6 area of the command area.
77	Demonstration of Innovative Practices to Improve Rural Livelihood through Integrated Farming Resources Management under Watershed Conditions of Potohar Region (Component-1) CAEWRI, NARC and (Comp-II Bio Remediation), **Yousaf Riaz, PSO/Director NIB, NARC**	22.11	1-10-13 to 30-6-15	• Demonstration of Improved Rainwater Water harvestings and Potential Utilization through innovative Technologies for Agricultural purposes. • Wastewater Management for Safe Reuse in Agriculture at Selected location. • Community Capacity Building Program for Improved Agricultural Practices and Dissemination Initiatives.	The farmer participation activities on watershed and integrated resource management are under progress in Attock district, Teshil Pandi Gaib, Target Area Kamdrial. Total command area is 30 acres. Rehabilitated the existing dam for rain water storage capacity. The water storage capacity of the dam has been enhanced from 60 acre feet to 130 acre feet. Walking tunnel (59 feet x 60 feet) installed and tomato crop cultivated with drip irrigation. Outside tunnel, 6 kanal area cultivated with strawberry. Five areas area brought under orchards of pear, pomegranate, persimmon, Peach. Wheat crop sown on area of 5 acres. Meteorological Weather Station installed. The storage water in dam will be linked with solar pump for integrated crop activities of orchards, vegetables and crops.
78	Selection of potential sites for runoff water harvesting in D.G. Khan and Rajanpur Rod-kohi areas using GIS and Remote sensing technology, **Dr. Arshad Ashraf, PSO, CAEWRI, NARC**	2.381	1-3-14 to 30-6-15	• To investigate surface runoff potential in D.G. Khan and Rajanpur Rod-Kohi areas. • To identify potential water harvesting sites using high resolution DEM and ancillary data • Propose strategies for effective	Selection of potential sites for runoff water harvesting in D.G. Khan and Rajanpur Rod-kohi areas using GIS and Remote sensing technology was completed. The base map layers of infrastructure, physiography, soils, drainage network and climate were

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				management of surface runoff for sustainable agriculture development in rod-kohi areas.	prepared in GIS using topographic and thematic maps of D.G.Khan and Rajanpur districts. Overall 402 sites were identified in the rod-kohi area of two districts using soil and water assessment tool (SWAT) model. Out of these, 304 sites lie in D.G.Khan and 98 in Rajanpur district. About 64% of the total sites lie below 300 m elevation while 30%were identified within 300-700m elevation range. Total runoff water potential estimated in the 402 catchments at 50% rainfall probability was about 697.7 million cubic meter (MCM). The water potential ranges between 0.002-10.7 MCM in all the catchments. Most of the catchments lying in lowlands possess less than 2 MCM water potential.
79	Capacity Development for Demonstration and Comparative Evaluation of different Irrigation Systems on the Farmer' fields in Balochistan, Muhammad Yaqoob, SSO, HRI, Khuzdar	13.460	1-10-12 to 30-9-15	• To establish a reliable database of resources and farming practices of the targeted three districts (Khuzdar, Kalat, Lasbela) with reference to irrigation. • To select, design and install most suitable irrigation infrastructures for selected farms in order to improve the crop water productivity. • To demonstrate and disseminate the performance of state of the art irrigation systems to local farmers, extensionists, developers, researchers	Drip irrigation system demonstrated on farmer's field. Performance of the pistachio nursery plants evaluated under the drip, furrow irrigation system.

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				and local planner.	
80	Adaptation and indigenization of household levels solar desalination and water from air technologies, Eng. Muhammad Aslam, PSO, Pak China/Manager PATCO, CSI, NARC	3.50	1-10-13 to 30-9-15	• Adaptation of solar water desalination and water from air technologies under local agro-tech and socio-economics • Field performance and evaluation of the indigenized technologies • Up-scaling and commercialization involving PATCO	One panel of solar desalination has been imported from Australia and installed at NARC. Performance and evaluation of imported unit is under progress under local radiation condition. Performance and evaluation of Solar Desalination System installed at NARC, Umerkot, Sindh and Hub, Balochistan was monitored for suitability of water for drinking purposes. Water quality was analyzed at PCRWR and water is fit for drinking purposes.
81	Urease and nitrification inhibitors for improving nitrogen use efficiency in field crops, **Dr. Fayyaz Hussain, PSO, LRRI, NARC**	7.660	1-11-12 to 30-6-14	• To assess the effectiveness of synthetic inhibitors products being used for reducing N losses from fertilizers • To sustain and increase crop yields with low N fertilizer inputs.	Maize crop was harvested in June, 2014; chemical analysis is under progress, therefore, the final complete technical report will be submitted later on after doing the complete chemical/statistical analysis of soil and plant samples.
82	High quality honey production from Margalla hills, **Mr. Ghulam Sarwar, SSO, HBRI, NARC**		1-7-14 to 30-6-15	• To produce the branded honey of margalla and queen from Apis mellifera colonies • To shift honeybee colonies on ber plantation for ber honey production. • Capacity building of margalla community in beekeeping. • To develop network of honey producers.	More than 3 tons quality branded honey was harvested and extracted from multi flora of Margallah Hills during May 2015.Hygienic queen bees were replaced with old queen bees as per requirement and next year more trainings will be provided to local beekeeping community. Capacity building and awareness of beekeeping

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					was conducted through organizing two training workshops for Margallah community, CDA employees, Pak Navy Officers and students, in which more than 60 participants attended the two programs.Awareness regarding networking of honey producers was made by communicating with them face to face and visiting the specific areas.
	SOCIAL SCIENCES				
83	Vertical Coordination towards High-Value Agriculture in Punjab, Pakistan. **Dairy/Poultry Component) Mr. Husnain Shah, SSO, SSI, NARC**	4.617	01.10.2007 to 30.12.2010	• To assess the effects of vertical coordination on transaction costs and farm profitability of smallholders in dairy, horticulture and poultry sectors • To identify stronger or different forms of integration that could sustainably improve wellbeing of small holder farmers in dairy, horticulture and poultry value chains. • To determine the policy implications for smallholders, agribusiness, public and investment priorities	• Dairy and poultry market value chain study completed. • In dairy horizontal coordination was observed. Final report awaited.
	Vertical Coordination towards High-Value Agriculture in Punjab, Pakistan. **(Horticulture Component) Dr. M. Sharif, CSO, M (SSD), PARC**	3.896	01.10.2007 to 30.12.2010		Value chains for dairy and poultry sub-sectors were characterized; effect of vertical coordination on profitability of smallholders dairy and poultry farmers was assessed. In dairy farming, highest value added was found for chain with private dairy industry (Rs.16.40 per liter), followed by milk collection by private dairy industry (Rs.16.20 per liter), milk supplied to multinationals (Rs.15.30 per liter), to cooperatives (Rs.14.50 per liter), with a lowest to milkmen (Rs.6.40 per liter). Highest profit margins were earned by small dairy farmers selling to cooperatives,

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					followed by private dairies, wet market and multinationals. Milk processing sector is working nearly at 50 percent installed capacity. In case of poultry farming, it was found that cost of production of boiler was low in environment control houses (Rs.35 per kg) than in conventional open houses (Rs.40 per kg). The main beneficiaries of broiler chain are commission agents and large scale producers. In high supply situation, prices prevail at low levels and vice-versa. Such a situation creates uncertainty in the market and as a result farmers face difficulty in planning their businesses. It was suggested that conventional open houses be converted into environmental control houses for better production and less risk involvement. Poultry coordination boards should be established at federal as well as provincial levels. Breeding farms should be developed in public sector and good quality feed at controlled prices should be made available. Public sector should also initiate regular training programs/ workshops for poultry farmers. **i.** The study focuses on value chain analysis of mango, citrus and

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					tomato. Value chain analysis revealed that limited availability and access to quality seed/seedlings, expensive and poor quality inputs (fertilizers, herbicides and pesticides), inefficient irrigation application, low level of mechanization and high credit cost are major production constraints of these crops. Small sizes of horticultural farms impose socioeconomic and technical production restrictions the production, which result into low productivity and profitability for the growers. Inadequate backward and forward linkages of the farmers, poor market mechanisms, traditional marketing methods, exploitation of the market situation by the middlemen are major constraints hindering market access to the growers. Postharvest handling issues include unskillful fruit handling, lack of cool chains, costly packaging, absence of processing facilities at the farm level and lack of market road infrastructure. Network structure (horizontal and vertical market channel relationships); value added (key competitive aim of any business chain) and governance (covering organizational arrangements between value chain actors) are proposed as key elements for a

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					balanced analysis of horticultural value chains in future. Reorientation of subsistence horticulture to sustainable commercial farming, establishment of rural business hubs for input provision as a first segment for chain development, establishment of model on farm packing houses, encouragement of private sector investment as well as public and private partnership, and capacity building of chain stakeholders of the horticulture sub-sector etc. are proposed as possible strategies for the improvement of horticultural value chains in the study area.
84	Assessment of harvest and post-harvest losses in selected fruits in Pakistan, **Mr. Mazher Abbas, SSO, TTI (PARC) AARI, Faisalabad**	6.544	01-10-07 to 30-09-09	• To identify types of losses occurring during harvesting, processing at farm cleaning, grading, cooling, storing, packaging, transporting and marketing of selected fruits in Pakistan. • To assess the harvest and post harvest losses in quantitative and economic terms at various levels of fruit handling from farm to consumers and also to identify the technologies options available for harvest and post harvest handling and care, and also pinpointing problems and constraints in adoption of the recommended technologies for harvest ad post harvest activities. • To formulate policy guidelines and	Assessment study of harvest and post harvest losses of selected fruits were conducted in Sargodha for citrus, Multan & Raheem Yark Khan for Mango and Khairpur for dates. Harvest and post harvest losses were estimated around 28% and 27% in citrus and mango. The worth of these losses was Rs.991 per ton in citrus and Rs.9369 per ton in mango.In fresh dates (Khajoor) and dried dates (Chohara) harvest and post harvest losses were 26.2% and 35.9% respectively. Worth of these losses was Rs.20716 and Rs.8583 per ton in case of fresh and dry dates, respectively.Development of cheap,

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				strategies to minimize the post harvest losses in selected fruits.	technically, economically and socially acceptable post-harvest technologies required to minimize the post harvest losses.
85	Research Strategies for Agricultural Growth and Poverty Reduction **Dr. Umar Farooq, CSO, SSD, PARC**	4.950	01.10.2007 to 30.12.2010	• Quantifying the role of agriculture in achieving the overall economic growth and poverty reduction • To assess more effective / efficient public investment options and other policies in agriculture and rural areas in order to prioritize policies and public investment • To suggest research and development priorities by discipline, commodity and regions of the country • To suggest reform options for strengthening the national agricultural research system	• Poverty alleviation coefficient estimated for various factors contributing to poverty alleviation, which revealed a long term relationship between agriculture sector and poverty reduction. • Major crop rotations addressed on the water audit basis to save on water cost as well as water saving. • Zonal research system on the farming system research basis is found better option for research priorities as well as on product development with value addition. More profitable crops and products to be prioritised for improvement of research system. • More research system related reforms and options suggested. • Report not being submitted by P.I.
86	An analysis of Food Consumption Diversification in Pakistan, **Muhammad Ishaq, SSO, TTI,**	1.109	1-10-07 to 30-9-09	• To find out how the food consumption patterns and diversity trends have changed over time	The main objectives were to find out how the food consumption pattern and diversity trends have changed over

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	Ternab, Peshawar			• To find out demand elasticises of various food groups • To identify the determinants of food consumption diversification in Pakistan • To suggest policy recommendations based on the findings of the study.	time, to find out demand elasticities of various food groups, food consumption diversification and suggest policy recommendations. Estimations were made using Household Integrated Economic Survey 2004-05 by using LA-AIDS model. The demand for wheat, fruits, vegetables, milk and cooking oil were inelastic while elastic for rice, meat and other food. An increase in the wheat price may be helpful for wheat growers.
87	Political Economy of Sugar Industry in Pakistan, **Dr. Ali Muhammad Khushk, PSO, TTI, ARI, Tandojam**	4.086	01-07-07 to 30-6-09	• To critically review the previous sugar policies with special reference to impact on sugar industry in Pakistan • To analyze the economic efficiency of sugar industry in Pakistan • To examine the role of major stakeholders i.e. growers, middleman, sugar mills and government regarding the causes of sugar crisis in the country • To conduct detailed analysis of the current political forces that limit the potential of sugar industry in Pakistan • To calculate profit margins of major stakeholders i.e. growers, middleman, mill owners in sugarcane industry in Pakistan • To suggest policy implication for the development of sugar industry in Pakistan	Study was conducted during 2007-08 in Sindh, Punjab and Khyber Pakhtunkhwa. Five districts were selected in major sugarcane growing areas. Overall, nearly one fifth of total farm area was allocated to sugarcane crop. This proportion was highest in KPK (41%). More than 70% and 76% of total sugarcane area was planted under recommended varieties during 2006-07 and 2007-08. Among recommended varieties, Thatta-01 and CP-77-400 captured 45% and 43% of total sugarcane area. The sugarcane growers in Sindh gain the highest revenue Rs.80,833/ha, compared to Rs.70,437/ha and Rs.55,544/ha in Punjab and KPK, respectively. The profitability of sugarcane production

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					reaches a peak in the first ratoon. The growers in Sindh province gain the profit Rs.24,899/ha and growers of Punjab and KPK faced frost problem results they bear heavy loss of Rs.40,299/ha in KPK and Rs.25,103/ha in Punjab in fresh crop. The gross margin of sugarcane production in Sindh is higher Rs.48,578/ha than in other province Rs.24,315/ha and Rs.1,294/ha in Punjab and KPK respectively. Moreover, the gross margin of 2nd ratoon crop is higher Rs.37,344/ha compared to fresh crop Rs.12,881/ha and Rs.34,234/ha of Ist ratoon. There are three main competing crops of sugarcane, which are cotton, wheat and rice. In view of efficiency estimates results reveal that the sugarcane farmers were 25%, 17% and 38% technically, allocatively and economically inefficient for attaining the optimum level of production. Sugar industry of Sindh has highest extraction rate account for 93.3kg/ton of sugarcane in the production year 2007-08. Cost of sugar production indicates the competiveness when the factory can minimize cost. It was found that the average cost of sugar production was at Rs.17.99/ka in 2007-08. In 2007-08,

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					sugar industry of Punjab had the lowest cost of sugar production at Rs.17.87/kg. Industry of Punjab has gains highest profit Rs.2.36/kg on sugar production. Whereas, industry of KPK has gains the lowest profit Rs.0.50/kg on sugar during the same year due to very low recovery percentage. Ranking the sugar factories according to their competiveness shows that sugar industry of Punjab had the advantage in total quantity of sugar production. Sugar industry of Sindh had the highest advantage of extraction rate of sugar and KPK had the advantage in molasses recovery percentage. The proportion of politically and economically strong miles is relatively high in Punjab than other provinces
88	An Analysis of the Adoptation and Impact of Cultivation of new cotton varieties in Pakistan **Mr. Muhammad Ibrahim Lashari, TTI, Tandojam, Sindh**	1.610	01.07.2009 to 30.12.2010	• To generate baseline data on the area under new cotton varieties on farmer's fields in major cotton production regions of the country. • To obtain information about the varieties replaced by new cotton varieties in major cotton producing areas; • To perform a comparative economic and resource productivity analysis of cultivating conventional and new cotton varieties to see profitability impact on	The study was conducted in three providences i.e. Sindh, Punjab and Balochistan. The study area consists of 12 districts, 5 from Sindh (Khairpur, Nawabshah, Sanghar, Mirpur Khas, Ghotki), 5 from Punjab (Bahawalpur, R.Y.Khan, T.T. Singh, Vehari, Multan) and 2 (Khuzdar and Sibi) from Balochistan. In the crop year 2008-09, about half of the cotton area (47.5 percent) was planted under Bt-cotton varieties, which increased to 63.0

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
				shift to new cotton; • To estimate production function in order to determine the improvement in input use efficiencies attributed to the adoption of transgenic cotton seed varieties; • To suggest policy implications for different stakeholders.	percent in 2009-10. Among transgenic varieties Bt-121 and among traditional varieties NIAB-78 was dominant one. Largest acreage under transgenic cotton varieties was in Punjab (81.2 percent), followed by in Sindh (55.0 percent) and Balochistan (35.8 percent). Mostly conventional varieties of NIAB-78 and CIM varieties (49, 442, 473, 506 and 534) were replaced by transgenic ones. Mean yield of transgenic varieties was higher (64 mounds per ha) than conventional (47 mounds per ha) and fake Bt-cotton varieties. Similarly, net returns per hectare were also highest in case of transgenic varieties (Rs.69047 per ha), followed by from conventional (Rs. 45008 per ha) and fake cotton varieties (Rs.29905 per ha). Land, labor and fertilizer costs are significant factors of cotton production in the country. Production of Bt-cotton highly depends on agro-climatic conditions, genotype of the variety and crop management practices. There is a need to conduct research on these issues.
89	Farmers Training and Facilitation Centre for Technology Transfer **Mr. Atta Ullah Khan, Inchage/SSO, IPM Station, BZU Multan**	1.914	01.10.2009 to 30.09.2011	• Establish farmers' information and training facilitation centers in Kabirwala • Provide demand driven, farm activity and crop season based training on the	Analyzing and Reforming Farm Advisory Services in Khyber Pakhtunkhwa. Two third of the non FSCs member farmers reported that they were un-aware about membership

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				productivity enhancing technology packages.	of the FSCs program launched by the Agriculture Extension Department. Overwhelming majority (90.80%) of the FSCs members contacted farm services centers. About half of the non FSCs member farmers contacted agriculture extension department for technical advices, diseases and inputs. FSCs members received more yield per acre than the non FSCs member farmers. About two third of the FSCs members contacted livestock and dairy development department, while 57.60 of the non FSCs member did not contact livestock department & dairy department for livestock treatment. Cows and buffaloes milk yield per day of the FSCs members was more than the non FSCs members.
90	Phulkari as Empowerment of Women & Girls in Pakistan; **Ms. Nusrat Batool, SSO/Director (Cottage Industry/ Livelihood) PARC**	12.985	01-07-09 to 30-06-12	• To revive Phulkari as high value cultural as well as commercial heritage and indigenous technology. • To engage the poor women folk in creative and productive activities as potential income source for improving the status of women and adolescent girls. • To train marginalized female members of rural communities as professionals & skilled labour.	Baseline survey was conducted and social mobilization through meetings of rural community was initiated. More than one hundred poor women were engaged in various productive activities to increase their potential income. Closure of "Phulkari as Empowerment of Women and Girls in Pakistan" project resulted into partially accomplishment of its objectives.

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91	Scientists' Capacity Building through Training, **Mr. Muhammad Asif Masood Ghuman, SSO, SSI, NARC**	1.509	01-10-07 to 30-09-08	• To introduce new statistical designs for agricultural experimentation and survey methods • To introduce appropriate methods of analysis for agricultural trade policy, time series and survey analysis • To tutor statistical, economics, time series and trade policy analysis softwares for statistical, economic, time series and agricultural trade policy analysis for experimental data, survey, time series data and interpretation of Computer outputs generated by using such softwares • To prepare easy usage applied manuals for facilitating scientists in the use of novel statistics, econometric and trade policy analysis techniques	Under this project data analysis training were imparted to 68 scientists (48 social and 20 biological). They were trained about the use Biometeric techniques for agricultural research using statistical software, basic econometric techniques for social scientists, agricultural production economics, international trade theory and application, international trade analysis along with hands on statistical soft-wares viz. STATISTICA, SPSS and E-VIEWS. Training manual and CDs comprising lecture notes/ materials were also distributed to the participants of the courses.
92	National University of Agricultural Sciences (NUAS) (Phase-I) **Dr. Tariq Hassan (Registrar, NUAS/PIASA), NARC**	21.242	01.10.2008 to 30.06.2011	• Production of quality innovative M. Phil and Ph. D scholars • Integrating agriculture research and extension with the agriculture education similar to land grant agricultural universities in the USA, UK, India etc. • Strengthening linkages with national as well as international agricultural research and educational institutions in highly specialized and emerging disciplines of agriculture	The main objectives were production of quality innovative M.Phil and Ph.D scholars, enhance quality of education and strengthen linkages. Developed curriculum and ensured faculty for starting M.phil/PhD degree programs in animal genomics & Biotechnology, applied economics, plant genomics & biotechnology, natural resources management. Enrolled 304 students in higher degree programs, constituted academic council, departmental board of studies, students supervisory

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
					committees and formulated rules & regulation. Sought affilication with Khyber Pakhtunkhwa Agricultural University. Twelve students granted M.phil degrees in plant genomics & biotechnology. National linkages developed with Faisalabad Agricultural University, International Islamic University, Pir Mehar Ali Shah Arid Agricultural University, Quaid-e-Azam University, Khyber Pukhtunkhawa Agricultural University Peshawar, Agricultural University Tandojam and Engineering University Peshawar.
93	Demand and supply estimates and projections for meat in Pakistan, **Dr. Khalid Mahmood Aujla, PSO/Director, Directorate of Agriculture Sciences, SSD, PARC**	0.940	1-10-12 to 30-9-14	• To study the effect of prices, income and other variables on the demand and supply of red and white meat. • To make productions for demand and supply of red and white meat towards 2020 and 2030 under different scenarios and • To examine the prospects of attaining different growth rates in output of red and white meat to meet the growing domestic demand and suggest policy measures to attain a different set of output growths.	The livestock sector occupies a significant position in the livelihood of rural population of Pakistan. Per capita meat consumption increased over time from 10.5 kg per annum in 1980-81 to 18.1 kg per annum in 2011-12 with a compound growth rate of 1.8% per annum. Analysis of Household Integrated Economic Survey (HIES) 2010-11 and field survey data 2013 in the selected districts (Rawalpindi/Islamabad, Lahore, Faisalabad) revealed that household level per capita consumption of meat is even low; 7.5 and 10.5 kg per annum, respectively. The share of meat in

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					monthly household expenditures was 3.8% in the country. However, the share of meat in monthly household expenditure in the survey districts was 9.5%. Urban population on an average consumes more meat than rural population. The expenditure elasticities based on both field survey data 2013 and HIES data 2010-11 revealed that demand for beef is more income elastic in rural areas as compared to urban regions. However, demand for chicken, mutton and fish are relatively more income elastic in urban areas than rural areas, implying that increase in per capita income of urban population would lead to acceleration in demand of chicken, mutton and fish in the country. Increase in per capita income of rural population would stimulate demand for beef in rural regions of the country. High price elasticities of different meat types reveal high instabilities in their consumption. Results of both field survey data 2013 and HIES data 2010-11 revealed that demands of chicken and fish are highly price elastic in urban areas and beef is highly price elastic in rural areas. Results of HIES data 2010-2011 also revealed that mutton demand is highly

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					price elastic in rural areas. Thus, increase in price of these commodities would reduce their demand. The estimated consumption of beef, mutton, chicken and fish in the year 2011-12 based on total availability of meat in the country are 1590, 560, 741 and 361 thousand tones, respectively. The demand projections for meat corresponding to 3.6% GDP growth rate, usually regarded as closer to realistic situation. Under this scenario, during 2012 to 2030 demand for beef, mutton, chicken and fish is expected to grow at weighted average growth rate of 5.6, 4.0, 7.4 and 2.6 percent, respectively. These growth rates indicate that meat production industry has bright prospects in the country. The production of meat in the country is largely demand driven. The results of supply side analysis of meat production have shown achievements of considerable technological progress in production of beef, poultry meat and fish in the country. However, a technological regress in mutton production can be conceived. Feed price elasticity of mutton in the linear model is negative and significant indicating that a rise in feed price

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					would adversely affect its production. Similarly, results of linear model showed that disbursement of agricultural credit by ZTBL has significant positive impact on production of poultry meat in the country. Moreover, price elasticities of beef, chicken and fish in the polynomial model and of beef and mutton in the linear model are significant, implying that higher prices stimulate the production of these commodities. The growth rates in beef, mutton, chicken and fish production during year 2012 to 2030 have been projected at 2.3, 2.1, 9.4 and 3.2 percent, respectively. The base line data of year 2011-12 shows that there is excess of all meat types in the country i.e. demand closely followed the supply.
94	Impact Assessment of farmers field school based on IPM approach in different production zones of Pakistan, **M. Zubair Anwar, SSO, SSI, NARC**	1.241	1-10-11 to 31-3-13	• To analyze the effectiveness of FFFS approach in terms of change in knowledge, skills and production practices across different production systems. • To evaluate impacts of social, economic and environmental aspects of the participating vs non-participating communities. • To develop empirical basis for	• During the 1st quarter (July – Sept, 2012) funds were not provided therefore to some extent the activities planned for this period was delayed. Presently, data related to Sindh province is in analysis stage and hopefully it will be completed in the month of October, 2012.

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				recommending policy interventions, institutional changes and up-scaling of validated FFS-based production packages.	
95	Analyzing and reforming farm advisory services centers in Kyber Pakhtunkhwa: Empowering to combat upfront transfer technology and innovation needs of the targeted farming community, **Mr. Arshad Farooq, SO, TTI, Peshawar**	0.660	1-12-11 to 31-12-12	• To study the impact of farm services centers on agricultural in Kyber Pakhtunkhwa • To reform farm services centers working in Kyber Pakhtunkhwa based on empirical evidences perceived from all stakeholders including extension agents, researchers, farmers and other related agencies for meeting client oriented needs. • To suggest improved working design with the feed back to all stakeholders including policy makers, researchers, extensionists, educationists and farmers through ensuring sustainability of farm services cetners in Kyber Pakhtunkhwa.	• Literature collected, reviewed, questionnaires designed and pre tested and modified in the light of field observations, data collected from al sites of the study area such as Northern Dry Mountain Zone, East and West Mountain Zone and Piedmont Plains and Central Valley Plains completed. Data entry, data management were completed, data analysis is in progress.
96	Scientists' Capacity building through training – Ph-II, **Mr. M. Asif Masood Ghumman, SSO, SSI, NARC**	1.772	1-3-12 to 28-2-14	• To enhance the understanding and analysis skills of agricultural researchers about statistical methods, experimental designs, statistical and economic analysis of experimental data. • To impat training in statistical software (MINITAB, STATISTIX, SPSS, MSEXCEL) and interpretation of computer outputs generated by using such software for performing statistical	In phase 11 of this project, seven training courses were organized on "Statistical and Economic analysis of experimental data using statistical software" for provincial agricultural researchers/NARC researcher. Total 100 participants were trained across the country. The major areas of trainings were: Introduction of statistical softwares, Exploratory data analysis (EDA), Partial Budget analysis,

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				as well as economic analysis in agricultural research. • To discuss issues and problems related to statistics/economics and suggest solutions and remedial measures.	Marginal analysis sensitivity analysis, Statistical analysis of single factor experiments, Statistical analysis of factorial experiments, Economic analysis of experimental data, Stability analysis and Creation of Reports.
97	National University of Agricultural Sciences (NUAS) **Dr. Tariq Hassan (Registrar, NUAS/PIASA), NARC**	21.242	01.10.2008 to 30.06.2011	• Production of quality innovative M. Phil and Ph. D scholars • Integrating agriculture research and extension with the agriculture education similar to land grant agricultural universities in the USA, UK, India etc. • Strengthening linkages with national as well as international agricultural research and educational institutions in highly specialized and emerging disciplines of agriculture	196 Students enrolled, 648 lectures delivered. For thesis/synopsis evaluation and to manage allied academic issued with shared wisdom (8 meetings of Board of Studies were held) 35 M.Phil students successfully completed their degree program. As PIASA capacity building institute training workshop on financial management and Official management were also arranged and total 95 participants benefited.
98	Skill Development / capacity building of the farmers of Balochistan, **Dr. Muhammad Aslam, PSO/Director (API), NARC**	3.996	1-11-12 to 31-10-13	• To train farmers in different agriculture techniques. • To create awareness among farming community to improve agriculture technologies	Eighty-nine farmers and 15 Extension Officers from five districts (Qila Saif Ullah, Kachi/Bolan, Jaffar Abad, Jhal Magsi, NasirAbad) of flood affected areas of Balochistan were trained for Artificial Insemination, Large/Small Ruminants & Poultry Production, Fruit and Vegetable Production, Water Harvesting and Conservation and Farm Mechanization

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99	Skill development of graduates as service provider in Agriculture sector, Dr. Khalid Farooq, Director, API, NARC	18.330	1-10-14 to 30-6-15	• To produce skilled manpower for the existing and changing demands of agriculture sector. • To provide dexperiential training to agriculture graduates in new profitable agricultural techniques to act as service providers. • To provide opportunity to graduates to get training in employable skills and become useful citizens through self income generation.	Interacted with different stake holding Institutes of NARC and developed curricula for different training areas of the project. Advertisement was published in two leading national level newspapers, *viz.*, The Nation, Islamabad dated 29 November 2014 and Jang, Rawalpindi dated 30 November 2014 for inviting applications from agriculture and livestock graduates for admission in the project courses. The advertisement was also launched at PARC website for publicity. In response to the advertisement given in national newspapers and on PARC website, 296 applications were received from all over Pakistan. A list of candidates was prepared for selection. Obtained approval of Selection Committee from the competent authority in the Council and interviewed candidates telephonically. Offer letters to 80 selected candidates were posted through UMS and were also informed on telephone about their selection and deadline for arrival at API (NARC) for registration. Organized Welcome & Orientation Ceremony for the trainees of

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					Agricultural and Livestock Courses on 05-01-2015. The trainees were briefed about PARC & NARC role in agriculture development with emphasis on the importance of the training as service providers in the fields of agriculture and livestock. After briefing, they were escorted to different institutes and NARC field for orientation and briefing about different research activities of the Centre. Prepared schedule for agriculture and livestock classes and distributed among the trainees. Eighty trainees (40 agricultural and 40 livestock graduates) from Punjab, Sindh, Balochistan, FATA, Gilgit Baltistan, AJK and KPK were trained in different agricultural disciplines.
100	Strengthening/Up-Scaling of Audio Visual Communication Facilities at NARC, **Ms. Qurat ul Ain, Director, AVC, NARC**	5.790	1-7-12 to 30-6-15	• To strengthen the existing audio-video library and develop an archive and research & reference knowledge repository for students and researchers & upgrade the existing recording and production facilities at AVC. • To support creation, capture, storage and dissemination of information. • To create awareness and educate farmers to market their products. • To document and support PARC research endeavors to improve	To strengthen and upgrade the existing production facilities at Directorate of Audio Visual Communications, it is worth mentioning that the state of the art AV equipment has been procured. The production work of documentaries/ TV programs containing significant and research based information is in progress. MoUs with Such TV and Rohi TV has been signed for collaboration and co-production of programs for the dissemination of information and

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				productivity of agriculture commodities to induce confidence and promote the creative thinking among the stake holders.	Agricultural practices in Pakistan. About 100 informational Agricultural TV programs have been on aired through different TV channels and weekly four programs are going On-Air regularly which are creating awareness to farmers as well as scientists who are enhancing their communication and presentation skills by increased exposure on mass media. More than one hundred scientists have availed the opportunity to present their work on media. AVC studio and NLE systems has been made functional and 3 weekly TV programs are being recorded at AVC studio and going on air from Such TV and Rohi TV.
	ANIMAL SCIENCES				
101	Comparison of oestrous synchronization protocols to improve fertility in buffalo. **Dr. M. Anwar, PSO, ASI, NARC**	21.150	1.07.2007 to 30-6-2011	• To assess efficacy of the oestrous induction protocols in buffalo for enhancing fertility through AI during peak breeding season • To evaluate oestrous induction protocols for overcoming summer (low) anoestrous in buffalo	70% conception rate was achieved in buffaloes after estrus synchronization with hormonal treatments/devices during peak breeding season (winter).More valuable finding was that 80% buffaloes showed estrus in low breeding season (summer) after the application of hormonal treatment/device and 40% treated animals became pregnant. In this way seasonality of breeding was partially overcome in buffaloes. So these

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					treatments could be used to popularize artificial insemination in buffaloes.
102	Cryopreservation and evaluation of buffalo and goat semen. **Dr. Abid Mehmood, PSO, ASI, NARC**	24.185	01.10.2007 to 30-06-11	• Improvement of quality of frozen thawed buffalo semen through better extenders and processing techniques • Development of artificial insemination techniques with chilled-liquid and frozen thawed semen in local goat • Standardization of in vitro tests for semen to predict fertility of semen donor buffalo bulls and bucks	Developed milk based extender for the cryo-preservation of buffalo semen. Results indicated better post thaw semen-motility (72 vs 54%), membrane integrity (74 vs 63%) and conception rate (72 vs 54%) by using this extender.A cost effective and short duration heat synchronization protocol was devised and effectively used for fixed timed artificial insemination in goats under field conditions. The findings clearly indicated that the breeding during low (May to August) breeding season can be accomplished in does.
103	Study on Biology, Captive breeding aspects of indigenous endangered wild animals and birds **Mr. Saleem Zahid, PSO, Poultry, ASI, NARC**	7.340	01.07.2009 to 30.06.2011	• To establish an ex-situ conservation/ breeding research facilities at NARC. • Procumbent of wild animals and bird species i.e. Black buck, Chinkara, Nile guye, Grey goral, Para, Urial, Indian peafowl, Pheasants, Partridges and Waterfowls. • To conduct studies on captive breeding of wildlife species and transfer knowledge to both public and private wildlife management and conservation organizations and wildlife farmers.	• In-situ breeding research facilities established at NARC. • Wild animal procured for behaviour/breeding studies.

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104	Characterization of avian influenza & FMD viruses and development of immunogenic vaccines. **Dr. Khalid Naeem, CSI, NARC**	31.682	01.07.2007 to 30.06.2010	• Establish basic facilities for undertaking recombinant DNA vaccine development • Identification & characterization of viral strain for the development of vaccines against Foot and Mouth Disease Virus (FMDV), and Influenza Virus (AIV) • Employ conventional & recombinant DNA approaches for development of above referred vaccines	Basic infrastructure with bio-safe labs, first of its kind in animal health sector in the country has been set up at AHP, ASI, NARC for handling class I-II microbes. This system would continue collection of new FMD and AIV isolates for molecular characterization and genome sequencing to develop DNA recombinant vaccines. Real time PCR and cell culture propagation of FMDV was established
105	Diagnosis and Control of Parasitic and Microbial Infestation in Exotic/ Indigenous Carp Cultured in Fish Farm of Punjab. **Dr. Muhammad Afzal, SSO, Aquaculture & Fishries Program, NARC**	6.795	01.04.2009 to 31.03.2012	• To study the incidence, occurrence and prevalence of parasitic and microbial pathogens and their host susceptibility levels in fish ponds and hatcheries of selected division of central and northern Punjab. • To study control of most prevalent parasitic and microbial diseases of the areas under study.	Prevalence of external parasitic (*Lernaeasis* and *Argulosis)*, bacterial and fungal diseases in fish farms of Punjab (Lahore, Gujranwala, Faisalabad and Rawalpindi divisions) was studied and appropriate diagnosis and control measures have been developed.
106	Feed formulation and disease diagnostics studies of trout fish in northern areas, **Mr. Muhammad Aziz, SSO, MARC, Gilgit**	4.930	01-01-08 to 31-12-10	• Development of cost effective and nutritious artificial feeds for early trout Fry, Fingerlings and Grow out fish for use on commercial scales. • Diagnostic studies of bacterial and nutritional diseases of trout fish and their proper control. • Reduce mortality both in early fry, Fingerling stages and Grow out fish through provision of balanced feeds, diseases diagnosis and treatment	Least-cost and balanced trout-fish feed has been formulated. Introduction of balanced feed reduced the occurrence of bacterial diseases**.** Seven bacterial diseases were identified and successfully treated with 90% recovery rate. The research findings have been communicated through personal contacts to the local trout farmers and extension workers of G-B Fisheries Department.

S. No.	Project Title with Name of PI & Location	Cost (Rs. Mil)	Period	Objectives	Achievements/Outputs
				thereby increasing production at sustainable level.	
107	Stair-step heifer development program for induction of early puberty. **Dr. Imdad Hussain Mirza, Director, ASI, NARC**	59.506	01.07.2007 to 30.06.2012	• To determine stair–step feeding scheme on weight gain, nutritional input and feed efficiency in buffalo and cattle heifers • To evaluate the effect of stair-step feeding scheme on pubertal development, conception and pregnancy rate in buffalo and cattle heifers	Based on the results, it can be concluded that better growth rate, efficient nutrient utilization, attainment of early puberty (18-23 month of age), and conception in Nili-Ravi buffalo and Sahiwal cattle heifers can be achieved at comparatively lower cost without any performance loss with the help of SSFS-Stair Step Feeding Scheme (6 phases of 4-2-4-2-4-2 months i.e., low energy diet (80 % ME of NRC) for 4 months (1st phase) followed by high energy diet (120 % ME of NRC) for 2 months (2nd phase), low energy diet for 4 months (3rd phase), high energy diet for 2 months (4th phase) and so on) as compared to NRC feeding requirements. SSFS offered a simple, practical and cost effective method for raising dairy cattle and buffalo heifers. By stair-step feeding farmers can achieve puberty of heifers at an age of 18-23 months and can get an additional lactation in productive life span of buffalo/cattle with a benefit of Rs.45000 to 50000. Stair-step feeding scheme is more effective in cattle than buffalo heifers in terms saving of feeding cost.

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108	Study of Dairy Traits in Saanen Cross breeding with Goat Breeds of Pakistan **Dr. Muhammad Rafique, PSO, ASI, NARC**	15.910	01.11.2009 to 31.10.2012	• To evaluate Saanen as dairy breed under Pakistan's field conditions. • To improve milk production in indigenous breeds of goats by crossing with Saanen. • Competitiveness of cost of milk and mutton production in Saanen crossbreds.	• L/C for Saanen goats was opened but could not be procured due to road blocked at Attaabad. • Sheds made. • Sub-project closed due to ban on import of Saanen goats.
109	Establishing the Sero-diagnostic and sero-surveillence system for the control of Warble fly in Pakistan, **Dr. Munib Hussain, SO, Animal Health Program, NARC**	2.10	01-12-11 to 30-11-13	• Identification of protective antigen of H. lineatum and P. silenus for cattle and goats, respectively. • Development of a Sero-diagnostic assay (ELISA) • Determination of timing for instituting effective treatment.	Warble fly is an economically important pest of cattle and goats in Pakistan in hilly, semi-hilly and sandy areas of Pakistan. An estimated economic loss of Rs.20.6 and 2.2 m due to Warble fly infestation in D.G. Khan and Rajanpur has been reported. Manual palpation reveals that cattle 105 (49.06%) out of 214 were found positive for WFI. Indirect ELISA was standardized. The sensitivity & specificity of the ELISA technique was 96.18% & 96.38& respectively. Animals of local breeds had higher incidence as compared to crossbreeds. The pattern ration of seropositivity in different breed was 40% in Cholistani, 32.73% in Cross breed, 73.47% in Lohani, 58.00% in Dhanni and 55.0% in Red Sindhi. The best time of blood sampling was June to August. No effects of age on seropositivity were observed. The sero-prevalence varied

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					from month to month. The annual antibody kinetics showed two peaks. Maximum number of animal found seropositive in December. July to August is the best time of medication to control this threat. ELISA developed in this study is more useful assay for the early detection of Hypodermosis in cattle as compared to direct clinical methods of manual palpation.
110	Carrier potential of small ruminants in the persistence and transmission of PPR virus, **Dr. Aamer Bin Zahur, SSO, Animal Health Program, NARC**	7.50	01-12-11 to 30-11-13	• To quantify the risk factors of PPR in small ruminant population of the country. • To study the persistence and transmission of PPR virus under field conditions • To monitor the changes in virulence of virus circulating in small ruminants population of country through genetic characterization.	Factors responsible for the persistence/transmission ascertained in the country. Sero-converison against PPR virus was demonstrated in cattle and buffaloes. A standardized panel of diagnostic assays including RT-PCR and real time RT-PCR for the specific diagnosis and detection of persistent PPR virus infection in the country was optimized.
111	Study on the production potential of different sheep and goats for mutton production under high input system, **Dr. M. Fatah Ullah Khan, PSO (SRP), ASI, NARC**	5.949	01-07-09 to 30-6-13	• To compare high input system with low input system for small ruminant production. • To examine the carcass quality of lambs and kids as affected by various planes of nutrition. • To determine the economic feasibility of raising sheep and goat under high input system in the prevailing production circumstances (system).	Fattening potential of Beetal goats and Thalli & Sipli lambs was assessed under three feeding regimes. Supplemental feeding along with grazing/traditional feeding was found more economical for lamb/kid fattening. Cost of production per kg body weight ranged from Rs. 117 to Rs. 181 for Beetle kids and Rs. 161 to 221

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					for Thalli lambs under the three feeding regimes. Artificial insemination of African Boar goats with Beetle goat was also carried out at Livestock Research Station Jaba, Mansehra where ten goats were upgraded with exotic germplasm of African boar goat. Five kids of boar goats cross bred have been born.
112	Culture and Breeding of Ornamental Fishes (Goldfishes, Koi Carp and Guppies) and feed development for their different developmental stages, **Dr. Abdul Rab, PSO, Aquaculture and Fisheries, NARC**	2.58	01-10-11 to 31-9-13	• To study the culture prospects of fresh water ornamental fishes (Guppies, Goldfishes and Koi Carp) in our local environmental conditions. • To develop sustainable technology for ornamental fish culture, breeding, larval rearing and development of balanced nutritional diets for ornamental fishes in the country.	Broodstock of ornamental fish i.e. Goldfish Shubunkin (*Crassius auratus auratus*), Double tail (Oranda Goldfish), Koi Carp (Local), Imported Koi Carp White and high fin, Rainbow shark (*Epalzeorhynchos frenatus*), Albino Shark (*Epalzeorhynchos munense*) and Guppies (*Poecilia reticulata*) procured from the Local Market. Ornamental fish infected with ectoparasites i.e. Learnea and Argulus were successfully treated with Trichlorfon (Dimethyl (2,2,2 trichloro – 1-hydroxyethyl) phophate) @ 0.5mg/100 liters. Ornamental fish infected with fungal diseases were treated with the solution of formalin (0.025 ml/l and malachite green(0.1

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					mg. /l) Successful breeding of ornamental has been achieved. All the species showed better growth fed on diet containing 30% CP level and can be used as a replacement of imported pelleted diet. Germplasm of Shubunkin, Double Tail, Koi carp (orange and white) and High fin Koi carp has been transplanted to different farmers, Directorate of Fisheries Khyber PakhtunKhwa, Peshawar, Directorate of Fisheries, Gilgit Baltistan, Punjab Fisheries Department, Lahore and Aquaculture and Fisheries Department, University of Veterinary and Animal Sciences, Lahore .
113	Studies on biology, captive breeding and other behavioural aspects of indigenous endangered wild animals and birds (Phase-II), **Mr. Saleem Zahid/Babar Hilal, SSO, Poultry Program, ASI, NARC**		1-7-12 to 30-6-13	• To establish an ex-situ conservation/breeding research facilities at NARC. • Procumbent of wild animals and bird species i.e. black buck, Chinkara, Nile guye, Grey goral, para, urial, Indian peafowl, pheasants, patridges and waterfowls. • To conduct studies on captive breeding of wildlife species and transfer knowledge to both public and private	Facilities for breeding of endangered wild animals and birds were established at ASI, NARC. Currently 10 wild animals and 18 wild birds are maintained at this facility. Breeding of Hog deer, Black Buck, Jungle fowl, Pheasants and Peafowl under captivity was achieved successfully for their conservation and further propagation. Breeding results and data on captive

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				wildlife management and conservation organizations and wildlife farmers.	breeding are being compiled to share with students, researchers, farmers and wildlife lovers to start wildlife farming on scientific lines for exploring alternate meat sources.
114	Semi commercial trials of yogurt production with locally developed indigenous starter culture, **Dr. Haider Khan, SSO, Dairy Technology, ASI, NARC**	2.072	1-7-14 to 31-10-15	• To propagate and preserve selected strains of yogurt stater culture. • To conduct semi commercial trials of yogurt and its consumer level sensorial evaluation. • To initiate dairy entrepreneurship by marketing a new brand of yogurt through PATCO.	This project aimed at the development of a local starter culture for yogurt preparation and conduction of semi commercial trials for testing the quality of developed starter culture. To hunt for desirable bacterial strains for yogurt culture 21 samples of commercial branded and non-branded traditional yogurt (dahi) were collected and processed by streaking on microbiological media plates. Out of these 21 samples 25 strains of *Lactobacillus delbrueckii* ssp. *bulgaricus* and 26 strains of *Streptococcus thermophilus* were identified. The identification process included Gram's staining and a series of biochemical tests such as catalase test, fermentation profile of various sugars, growth at various salt concentrations, pH and growth at selected temperatures. After identification the next important step was to propagate the identified strains to form yogurt starter culture. For this purpose, a whey based medium

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					(to which yeast extract and casein hydrolysate was added) was tested. It was found to successfully support the growth of desirable bacterial strains and, therefore, was used to propagate the yogurt culture. Selected strains of *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus thermophilus* were independently propagated in the whey based medium and the cells were harvested by centrifugation. *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus thermophilus* cells were then mixed in a 1:1 ratio in skim milk with monosodium glutamate added as cryoprotectant. This mixture of the cells of two bacterial species was the yogurt starter culture. After preparation of starter culture the final step was to conduct semi-commercial trials for evaluation of the yogurt which was liked very much in terms of color, texture, flavor and taste. The sensory evaluation has been done by senior officials included Secretary MNFS&R and Chairman, PARC. The final objective of the project was to initiate dairy entrepreneurship by marketing a new brand of yogurt through PATCO. To achieve this objective sale of yogurt

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					has been started through PATCO.
Agricultural Engineering Division					
115	Up-gradation and Rehabilitation of Existing Solar Dates-Dryers in District Khairpur **Mr. Asif Ali Mirani, SSO (ABEI) NARC**	1.640	1-7-14 To 31-12-15	• To repair and operationalize the existing Solar dates dryers in District Khairpur, Sindh	• Solar dates-dryers were installed in the year 2012 in Khairpur districts in collaboration with Governments of Sindh, USAID and PARC aiming to reduce the post harvest losses of Date palm. Some solar dryers are in operation, whereas the most dryers are not in operation due to some technical reasons. Due to lack of local technical experts in this field, these dryers have not been effectively used. Therefore, a great scope exists for up-gradation and rehabilitation of these existing solar dryers for dates drying. Furthermore, on the date palm growers demand of District Khairpur, ABEI launched an RADP funded project to up-grade and rehabilitate these dryers to reduce 50% post harvest losses through promoting solar dehydration technique of date palm. • Estimated the cost of repair work of solar date dryers for preparation of tender document at Khairpur, Sindh. An MoU was signed between

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					PATCO and ABEI in order to sell the dried dates at PATCO sale point and payback its base price to NARC account. Two tonnes of dates were dried using Solar tunnel dryer and Solar-cum-gas date dryer at WADO office near village Arab Solangi , District. Khairpur, Sindh in July-August, 2014. Six solar dates dryers were repaired. Three solar-com-gas dates dryer were repaired at Village Chhudaho, Village Arab Solangi, District Khairpur and ABEI, NARC Islamabad respectively. Two solar tunnel dates dryers were repaired at Thehri, District Khairpur .One solar tunnel dates dryer was repaired at Village Arab Solangi, District Khairpur.