वार्षिक प्रतिवेदन

Annual Report

2013-14

भाकृअनुप
ICAR

कृषि प्रणाली अनुसंधान परियोजना निदेशालय
मोदीपुरम, मेरठ–250 110 (उ.प्र.), भारत

Project Directorate for Farming Systems Research
Modipuram, Meerut - 250 110 (U.P.), India

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ANNUAL REPORT

2013-14

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Project Directorate for Farming Systems Research

(Indian Council of Agricultural Research)

Modipuram, Meerut - 250 110, India

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Citation: **ANNUAL REPORT 2013-14**
Project Directorate for Farming Systems Research
(Indian Council of Agricultural Research)
Modipuram, Meerut - 250 110, India

Printed at: Yugantar Prakashan Pvt. Ltd.
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PREFACE

Farm innovation through partnership is essential for achieving the targeted results on the ground. The farming system approach of technology development by testing and refinement is essential for reaching to the marginal and small farm holders whose average size of operational holding stands at 0.38 and 1.42 ha, respectively as per the 2010-11 agricultural census. The processes of farm innovation for these groups of households are entirely different in the context of holding, family size and their capital and risk bearing ability. Considering these points, Director General, ICAR and Deputy Director General (NRM) were always emphasizing the linking of various ICAR institutes with PDFSR for developing effective partnership in technology development and refinement. In continuation of the interaction meeting held with all the institutes during July 2013, the Statement of Understanding (SoU) have been developed with 10 ICAR institutes, 6 AICRP's and 1 Zonal Project Directorate. The best available knowledge, materials and human resources available in these institutes and AICRP's will be put in the on-station and on-farm farming system models being developed at various locations in the country. Further, regional committee has assigned the responsibility of preparing zone/district wise farming system models for different states. The Scientific strength of the Directorate rose to 37 for the first time in the history of Directorate. Consequent on the joining of new scientists, a total of 11 new projects and 4 exploratory studies were initiated in the farming systems perspective. A total of 18 packages for organic farming of various crops and cropping systems has been made and placed in public domain. During the year, an international project on Global yield gap analysis was also initiated. The year 2014 is declared as "International Year of Family Farming" by United Nations General Assembly aims to become a tool to stimulate active policies for sustainable development of agricultural systems based farmer families, communal units, indigenous groups, cooperatives and fishing families. The family farming aims to utilize all the resources available within the household including the family manpower to meet the household and national food security. Farming system modules and models should always aim to produce more with less.

I take this opportunity to express my sincere thanks to Dr. S. Ayyappan, Director General, ICAR and Secretary (DARE), Govt. of India; Dr. A.K. Sikka, Deputy Director General (Natural Resource Management) and Dr. B. Mohan Kumar, Assistant Director General (Agronomy), Indian Council of Agricultural Research for their keen interest in growth and development of this Directorate.

Scientific inputs received from Research Advisory Committee and Institute Management Committee provided an immense help in taking new initiatives and improvement of the ongoing research programmes. Scientific, technical and administrative staff of Project Directorate for Farming Systems Research, Modipuram, who have contributed at different levels in preparing this annual report, deserve appreciation for their hard and sincere work.

Modipuram
01 July, 2014

(B. Gangwar)
Project Director

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EXECUTIVE SUMMARY

1. Name and address of the Institute Project Directorate for Farming Systems Research, Modipuram, Meerut-250110, Uttar Pradesh, India

2. Budget (2013-14)

a) Institute (₹ In Lakhs)

Plan					Non Plan		
Provision	Expenditure	Govt. Grant	Allocation internal+ additional amount provided by Hqrs out of Council shares	Total Allocation (col.3+4)	Exp. Out of Govt. grant	Exp. Out of revenue generation	Total expenditure (col.6+7)
1	2	3	4	5	6	7	8
95.0	79.39	883.3	10.0	893.3	844.23	28.58	873.12

b) External sources (₹ In Lakhs)

Source	Amount
Pension and other retirement benefits	28.49
ICAR	-
Personal loan and advances	3.19
Externally funded projects	11.21
Total	44.89

c) Revenue generated (₹ In Lakhs) during 2012-13

Source	Amount
Farm Produce	29.97
Sale of fish, milk and livestock	2.30
Sale of Publication	0.22
License fee/ water b charges	7.86
Cost of tender form	0.25
Service render	0.2
Training	-
Miscellaneous	0.45
Interest on loan and advances	4.59
Interest on TDR	12.46
Others (Royalty and Inst. Charges)	1.57
Total	

3. Staff position (as on 31.03.2014)

Category	Sanction	Position	Vacant
Scientific			
Project Director	01	01	-
Principal Scientist	07	15	-
Senior Scientist	12	09	03
Scientist	19	13	06
Total	39	38	-
Technical Staff			
Category III(T-6, 7/8, T-9)	02	02	-
Category II(T-3, T-4 and T-5)	18	18+1*	-
Category I (T-1 and T-2)	3	3+1**	-
Total	21	23	
Administrative staff			
Sr. Administrative Officer	01	01	-
F & A.O	01	01	-

Category	Sanction	Position	Vacant
A.A.O	01	-	01
Assistant	04	04	-
U.D.C	02	02	-
P.S	01	01	-
P.A	02	03#	-
Jr. Steno (Gr.III)	01	02##	-
LDC	03	03	-
Total	16	17	
Supporting Staff	10	10	-
Temporary status staff	16	16	-
Total	58	60	01

*One post of overseer from CSSRI, Karnal had been transferred which are to be returned in future

**One post of driver from CSWCRTI, Dehradun had been transferred, which are to be returned in future

#&## As per the revised cadre strength after restructuring of the administrative cadre these are surplus the cadre and as per the direction of the ICAR, they are to continue till further direction of the Council

3.1 New appointments/joining

Sl. No.	Name	Designation	Date of joining	From	Remarks
1	Dr. Amit Nath	Pr. Scientist	13-06-2013 (Food Technology)	ICAR Research Complex for NEH Region, Umiam (Meghalaya)	On selection
2	Dr. Debasish Dutta	Sr. Scientist (Agricultural Chemicals)	10-07-2013	Deptt. of Agriculture, Govt. of West Bengal, Jalpaiguri (WB)	On selection
3	Sh. T.C. Sharma	F & A.O.	01-07-2013	Directorate of Wheat Research, Karnal	On transfer
4	Dr. Tulsa Ram	Sr. Scientist (Agronomy)	14-08-2013	SKAUST & K Shalimar, Shrinagar (J&K)	On selection
5	Dr. Dushyant Mishra	Sr. Scientist	31-08-2013 (Fruit Science)	CISH, Luknow	On selection
6	Dr. Vinod Kumar	Pr. Scientist (Animal Nutrition)	30-10-2013	Education Division, ICAR H.Q., New Delhi	On transfer
7	Dr. S. Malik	Sr. Scientist (Poultry Science)	20-11-2013	ICAR Research complex for NEH Region, Tripura centre, Lembucherra(T.W.)	On transfer
8	Dr. Devendra Kumar	Sr. Scientist (Plant Breeding)	23-11-2013	IISR Regional Research Centre Motipur, Muzaffarpur, Bihar	On transfer

Sl. No.	Name	Designation	Date of joining	From	Remarks
9	Dr. M.P.S. Arya	Principal Scientist (Agronomy)	02-12-2013	Directorate of Research on Women in Agriculture (ICAR), Bhubaneswer (Odisha)	On transfer
10	Dr. L.R. Meena	Principal Scientist (Agronomy)	01-02-2014	CSWRI, Avikanagar	On selection
11	Shri Raghuvir Singh	Scientist (Agronomy)	12 April, 2013		First appointment
12	Dr. (Miss) Nisha Verma	Scientist (FRM)	12 April, 2013		First appointment

3.2 Promotion/transfer

Sl. No.	Name	Designation	Date of transfer	To	Remarks
1	Dr. K.P. Tripathi	Principal Scientist	27-06-2013	Education Division, ICAR H.Q., New Delhi	Transfer
2	Dr. K.K. Singh	Principal Scientist (FMP)	16-09-2013	ICAR KAB-II, Pusa New Delhi	Selected as ADG (Agril. Engineering)
3	Er Monolisha Pramanik	Scientist	05-11-2013	CSWCR & TI, Dehradun	Transfer
4	Sh. H.S. Chuahan	Asstt. Admin. Officer	07-09-2013	NBPGR, New Delhi	Promoted as Admin-istrative officer
5	Shri Anil Aggrwal	Finance & Accounts Officer	20-06-2013	Directorate of Wheat Research, Karnal	Transfer

4.	**Research projects**	**Numbers**
	a) Institute based	24
	b) Externally funded	10
5.	**Exploratory study**	**Numbers**
	a) Institute based	04

6. Training programme conducted

Level	No. of Programmes	No. of participants
National		
International	-	

7. Manpower development

No. of person trained at national level

No. of person trained at international level

8.	**Workshop organized**	
	National	
	International	
9.	**Participation in seminars/symposia etc**	
	Level	**No. of participants**
	National	
	International	
10.	**MoU signed**	
	University	2
	Government Organizations	1
	Private organization/NGOInternational	22
11.	**Statement of Understanding (SoU) signed**	
	ICAR institutes	12
	AICRPs	8
12.	**Infrastructure Development- Nil**	

13. Salient Research Achievements

- ✓ House hold requirement of cereals, pulses, oil seed, and fodder can be met with in the farm for small farmers in farming systems perspective. Beekeeping is not economical with 5-6 boxes. ₹ 31580 from 0.2 ha of horticulture component can be obtained. Net return of ₹ 19300 from 0.1 ha fish pond was obtained. The total biogas slurry produced in bio gas unit is about 100 quintal per year. The composition of slurry on fresh weight basis on an average consists of 40 % moisture, 11.8% OC, 0.71% N, 0.43% P and 0.33% of K. In this way the total NPK produced and added in to soil was 42.6 kg N, 25.8 kg P and 19.8 kg of K.

- ✓ During the preliminary survey, crops + livestock turned out to be the predominant farming systems in Dumka district (Jharkhand). Inadequate water availability is the major constraint in the existing farming system.

- ✓ Human labour still accounts for a significant proportion of operational cost for major cereals, pulses and oilseeds.

- ✓ Highest gross and net return with maximum employment generation (100 days) was obtained in the module having fish and horticulture component.

- ✓ Vegetable based system proved most effective in terms of net returns. The net returns per ha from the vegetable based system was found to be ₹ 151640 followed by crop based system (₹ 68765) followed by fruit crop based system (₹ 44660) in the second year of its establishment.

- ✓ Bio-intensive system of raising maize for cobs + vegetable cowpea in 1:1 ratio on broad beds (BB) and *sesbania* in furrows during *kharif* and mustard

in furrows and 3 rows of lentil on broad beds in *rabi* while 3 rows of green gram on beds in summer produced highest rice equivalent yield (REY) of 27.6 t ha^{-1} with productivity of 55.6 kg grain $ha^{-1}day^{-1}$ and profitability of ₹ 529 $ha^{-1}day^{-1}$ and was remarkably better than other systems.

- ✓ The complimentary effects were reflected in the system as in broad bed and furrow (BBF) system, the furrows served as drainage channels during heavy rains in *kharif* which were utilized for in-*situ* green manuring with 32 t ha^{-1} green foliage incorporated after 45 days of sowing and timely sown mustard crop in these furrows resulted a good harvest 1.08 t ha^{-1} and a bonus yield of lentil (1.17 t ha^{-1}) could be harvested on one hand and 47% of irrigation water was saved.

- ✓ A substantial temporal yield reduction of 1.47 t ha^{-1} in case of rice and 0.87 t ha^{-1} in case of wheat was recorded under recommended NPK plots, Inclusion of S in fertilizer schedule helped not only sustaining the yield at initial level but recorded a yield gain of 0.31 to 0.44 t ha^{-1} over the years.

- ✓ Zero, strip and rotary till drills and bed planter provided higher wheat yields (8-12%), net returns (8-19%), cost effectiveness (8-13%) and energy efficiency (19-26%); besides reduction of *Phalaris minor* (57-82%), in comparison to conventional sowing.

- ✓ Recycling of wheat residue provided rice yield of 5.74 t ha^{-1} that was 14 and 10% higher than retrieval and burning. Also, B: C ratios were 7 & 4% higher.

- ✓ Recycling of rice residue provided wheat yield of 6.52t ha-1 that was 9 and 5% higher than retrieval and burning. Also, B: C ratios were 4 & 3% higher.

- ✓ Tillage system, cropping system and rice residue mulching in combination of fertilizer doses did not have any significant ($P<0.05$) influence on pH and EC at both surface (0-15 cm) as well as sub surface (15-30 cm) soil depth. Ph varied from 8.27 to 8.57 at both depths.

- ✓ Enzymatic activities (DHA, AcP and AkP) were significantly ($P<0.01$) affected by tillage practices, cropping systems and rice crop mulching in combination with RDF application at both soil depths. The activities of DHA, AcP and AkP in the plots under ZT were significantly ($P<0.01$) higher compared with the activities under CT. In addition, lower value of the enzymatic activities were recorded for lower depth (15-30 cm) than that of surface depth (0-15 cm) for both the tillage practices and difference among the treatment were significant ($P<0.01$).

- ✓ The SOC was significant ($P<0.01$) and positively correlated with MBC (0.924), available P (0.712), and enzymatic activities such as DHA(0.704), AcP (0.472) and AkP (0.646). The MBC had significant positive correlation with available P (0.841), and all enzymatic activities (DHA (0.790), AcP (0.583) and AkP (0.614).

- ✓ Significantly higher heat unit (2060^{o}day) was recorded in Pusa Sugandha 4 fertilized with 150 kg N /ha and transplanted on 3rd week of June and the lowest in Saket 4 (1625^{o}day) fertilized with 60 kg N /ha and transplanted on 3rd week of July.

- ✓ Higher GDD (1975^{o}day) was recorded in PBW 343 fertilized with 150kg N/ha and sown during 4th week of October. Higher RUE (1.73 g/Mjm^{-2}) and HUE (3.4 Kg/ ^{o} day) was recorded in PBW 343 over PBW 226 genotype irrespective of date of transplanting and dose of nitrogen.

- ✓ CERES Wheat and CERES Rice models were validated with field data and it was found good to predict the phenology and grain of the crops.

- ✓ Higher RH (44.1%) in PBW 343 fertilized with 60Kg N/ha, CO_2 (453.9 ppm) in PBW 226 fertilized with 150 Kg N/ha and temperature (24.6^{0}C) in PBW 226 fertilized with 60 Kg N/ha were recorded at panicle initiation pheno phase.

- ✓ Maximum water productivity in wheat was noticed with Sulphur coated urea applied at 0.7atm moisture tension which was equal to the irrigation applied at 0.5 atm. Water productivity ranged between 99.5 kg/ha-cm to 299.7 kg/ha-cm and maximum being with cv. PBW-550 at 0.7 atm soil moisture tension.

- ✓ The GHG emission in the Meerut district having average holding size of 2.07 ha was found to be 9.76 t/farm household/year with net emission of 6.16 t/ farm household/year.

- ✓ Among C emission sources, livestock contributed 58.2 % followed by N applications (22.5 %) and farm families (11.4 %).

- ✓ *Pleurotus sajor* caju mushroom was found suitable to grow during October-November whereas *P. florida* is suitable for cold months.

- ✓ In rice, conventional (puddled transplanted) rice recorded significantly higher grain yield (11.0%) and weed control efficiency (WCE) (66.1%) over direct seeded zero tilled rice (DSR-ZT).

- ✓ In wheat, the significantly highest grain yield (6.43 t/ha) and weed control efficiency (WCE) (64.9%) was recorded in conventional practice over zero tilled wheat. However, zero tilled wheat with residue management recorded the higher grain yield (6.14 t/ha) and lesser weed density (43.5%) over zero tilled without residue management.

- ✓ Per day income from vegetable based cropping systems (Rice- cauliflower - B.gourd) was highest (₹ 412) among all the cropping systems under demonstration as compared to farmers practice.

- ✓ Among cereals based cropping systems Rice-Garlic-Sesbania recorded highest net return per day per ha (₹ 341) whereas among pulse based systems, Pigeon pea + Maize (Rb) 1:1 - Wheat (Rb) + Radish 2:1 returned highest net return per day per ha (₹ 305) as compared to farmers practice.

- ✓ Seventy per cent farmers are adopting sugarcane-sugarcane-wheat system under UGP and TGP zones. High cost of agricultural inputs was the top most constraint reported by the farmers.

- ✓ Twenty-six on-farm trials on plant protection and twenty-three recommended doses of fertilizers and micronutrient were laid.

- ✓ In sugarcane, the result revealed that increase in yields over the farmers' practice of the varieties CoS-767, Co-0238 and Co-312 through recommended chemical pesticides were 10.19, 9.54 and 8.33 and through bio-control agents were 11.32, 10.30 and 9.88, respectively. In case of balanced use of fertilizer the result revealed that increase in yields over the farmers' practice of the varieties CoS-767, Co-0238 and Co-312 through recommended NPK were 11.78, 12.33 and 11.06 and the application of recommended NPK combination with Zinc contributed 14.83%, 15.49% and 13.79% respectively.

- ✓ Deworming resulted in lower incidence of parasitic problems in calves.

- ✓ The improved practice (use of recommended varieties and optimization of plant population) of wheat resulted in increase in yield of varieties PBW-550, PBW-226 and PBW-343 by 4.23%, 4.84%, and 4.87%, respectively over the farmers' practice.

- ✓ Database on Organic Farming Experiments under Network project has been developed in GUI mode (Graphical user interface).

- ✓ All the 20 GCMs predicted higher mean monthly maximum and minimum temperature in all the months during mid-century period 2040-2069 under RCP8.5 compared to baseline period 1980-2010. Overall, under climate change situation, APSIM crop model predicts losses (1-12%) whereas DSSAT model shows gains (15-21%) in mean net farm returns.

INTRODUCTION

Considering the importance of farming systems research in India, as per recommendation of 3 consecutive QRT's, RAC's and expert groups of the ICAR considered the main focus from cropping systems research towards farming systems research and accordingly the 'Project Directorate for Cropping Systems Research' became 'Project Directorate for Farming Systems Research' during 11th plan and started working from April 2010 with the following revised mandate.

- To undertake basic and strategic research in integrated farming system on production technologies for improving productivity and resource use efficiencies.
- To develop efficient, economically viable and environmentally sustainable integrated farming system models for different farming situations.
- To undertake on-farm testing, verification and refinement of system-based farm production technologies.
- To undertake human resource development and capacity building in integrated farming system.
- To act as a repository of information on all aspects of farming systems research and development.
- To coordinate and monitor integrated farming systems research in the country

Brief History

The genesis of the Cropping Systems Research Project may be traced back to the visit of Dr. A.B. Stewart of Macaulay Institute of Soil Research, Aberdeen, U.K., somewhere in mid-nineteen forties. He was invited by the

then 'Imperial Council of Agricultural Research' to review the status in respect of soil fertility investigations, in general, and manuring in particular, and to suggest necessary steps which might be taken to obtain adequate information under different conditions of soil and climate within a very short time so that the agricultural departments could provide relevant instructions to the farmers for increasing the crop yields. His review report, published in 1947, significantly influenced the philosophy and practice of fertilizer experimentation in the county. The importance of conducting simple fertilizer trials on cultivators fields and complex experiments at selected centers was emphasized in the report which promoted the initiation of "Simple Fertilizer Trials on Cultivators Fields" in 1953 under Indo-American Technology Cooperation Agreement through Soil Fertility and Fertilizer Use Project:" with the following objectives:

OBJECTIVES

- To study crop responses to NPK, when applied separately and in different combinations under the cultivator's field conditions.
- To investigate the relative response of different fertilizers in various broad soil groups and to work out the optimum fertilizer combinations for different agro-climatic regions.
- To study the relative performance of different nitrogen and phosphatic fertilizers for indigenous production.
- To demonstrate the role of fertilizer use on crop production before the farmers.

Later, in 1956, Model Agronomic Experiments, i.e, complex experiments on carefully selected centers, were also brought under the purview of the project and it was renamed as 'All India Coordinated Agronomic Experiments Scheme (AICAES)'. With the passage of time the scheme went through various stages of evolution to keep pace with the development in science and technology and to meet the increasing demands. The research arena was expanded to include agronomic research encompassing cultural practices, irrigation, nutrition, chemical weed control and multiple cropping. But the emphasis continued to remain on soil fertility and fertilizer use efficiency. In 1968-69 the scheme was sanctioned as 'All India Coordinated Agronomic Research Project (AICARP) with two components viz; 'Model Agronomic Experiments' and 'Simple Fertilizer Trials'.

Nevertheless, even after green revolution, agricultural research centered on only individual crops in isolation. But for a sustainable development the system approach is a must. This realization might have given an impetus to start cropping systems oriented research and the project was upgraded into a Directorate during 7th five year plan and was established as the '**Project Directorate for Cropping Systems Research (PDCSR)**', which became functional in March, 1989 with its headquarters at Modipuram, Meerut, U.P. Further, during 11th five year plan PDCSR has been re-designated as '**Project Directorate for Farming Systems Research (PDFSR)**'.

Since its inception, the Directorate has made significant contributions to the development and refinement of crop production technologies for diverse eco-edaphic and resource-base situations. These technologies have been aimed at efficient resource utilization and yield maximization through new technologies.

Some of the major areas of research are:

- Development of need-based efficient and profitable cropping/farming systems.
- Optimum varietal combinations for various crop sequences.
- Optimum crop combinations and planting geometry for intercropping systems.
- Tillage requirements and crop establishment practices under different cropping systems.
- Agricultural resource characterization and constraint analysis under different agro-ecological regions/ farming situations.
- Farming/ cropping systems analysis.
- Efficient sources of fertilizers for different crops and soil types.
- INM in different farming/cropping systems.
- Effect of long term INM and chemical fertilizer use on crop yields and soil fertility.
- Options for introducing legumes in cereal-cereal cropping systems.
- Resource conservation technologies.
- Farm mechanization and crop residue management.
- Climate resilient agriculture.
- Organic farming.
- Precision farming.
- Integrated farming systems.
- On-farm evaluation and refinement of cropping systems technologies.
- Cropping/ farming systems related database management
- Human Resource Development related to Cropping/Farming Systems Research

During 2010-11, PDFSR was operating through following three plan schemes:

1. **PDFSR** -– Strengthening and continuation of PDFSR headquarters at Modipuram.

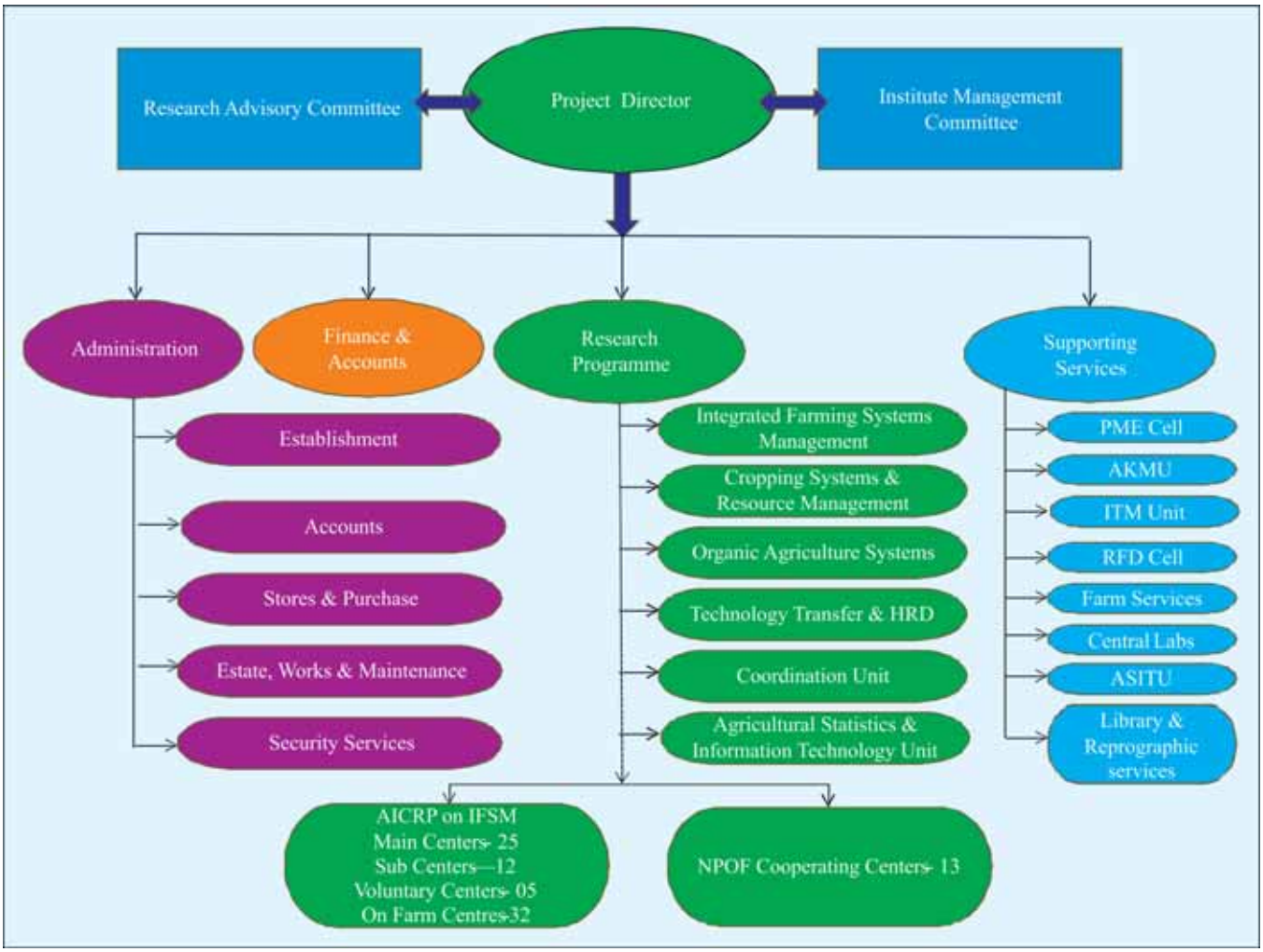
2. **AICRP** on **Integrated Farming Systems (IFS)**:

*(a) IFS Research Centres***:** On-station research is initiated at 31 main centres and 11 sub centres. These centres are engaged in basic and applied research at research stations and are necessarily located at SAUs or their Regional Research Stations or agriculture colleges of those general universities, where strong agricultural research base is available**.**

(b) On-Farm Research: On-farm research is going on at 32 centres. These centres are engaged in farmers' participatory research. On-farm research (earlier known as Experiments on Cultivators' Fields) centres are located in different agro climatic zones and cover the entire zone**.**

3. Network Project on Organic Farming (NPOF) - **The project is presently under progress at 13 cooperating centres, located at SAUs/ ICAR Institutes in 12 states.**

PDFSR ORGANOGRAM



RESEARCH ACCOMPLISHMENTS

Integrated Farming Systems Management

Project title **:** Development of cost effective and sustainable Integrated Farming System Models for livelihood improvement of small farm holders

Project code **:** NRMAPDFSRSIL201100200120

Funding Agency **:** Institute based

Duration **:** 2011-2015

Project Personnel **:** *Jag Pal Singh, B. Gangwar, Poonam Kashyap and A.K. Prusty*

Prevailing farming systems and farm practices generally based on component technologies and lack of diversification were found less profitable and inefficient to meet household food and fodder needs and led more dependency on market. Diversification of crops and cropping systems and farming system as a whole through integration of latest technologies and cost effective low cost enterprises suited to farmers need and their resources under small far conditions has been found effective for overall improvement in livelihood of small farmers and bring sustainability in agriculture. Decreasing cost of production through recycling of farm products and by products, crop residues and more use of organic resources is the key of success of the programme.

Analysis of production and economic parameters of different components of IFS Model at PDFSR, Modipuram during reporting period 2012-13 (Tables 1&2) established the fact that IFS approach is not only an viable and sustainable way of ensuring household food, feed & fuel needs but provide additional farm commodities for improving nutritional status of daily meal (milk, fruits, vegetables, mushroom, fish, honey etc.) and continuous supply of nutritious fodder (round the year green fodder with leguminous species cowpea, berseem, Subabbol etc.). When talking of long term impact of the study, total farm production increased from an average of 87.94 ton (SEY) / ha / annum of first phase (2004-10) of the study to 159.71 ton/ha/annum in 2012-13 which was 81.61 % more. Similarly, the net profits increased by 45.73% (From ₹ 1, 09,924 to ₹ 1, 60,195). Intermittent use of farm products and by products of one enterprise as input for others (Green and dry fodders and grains from crops to dairy and cow dung and draught animals from dairy to crops and many more) and recycling of farm wastes (cattle urine, spent wash of mushroom, biogas slurry, pond silt and water) and crop residues (leaves of sugarcane, pigeon pea, potato) etc. could save in costly inputs to the tune of 40%. This all promoted organic farming one side and reduced cost of production.

Integrated Farming system practices during 8 years enhance the farm productivity upto 81%

A mix of fish species including rohu, katla, mrigal, common carp, silver carps and grass carp were stocked @ 10000 fingerlings per hectare in ratio of 20:20:20:10:20:10 during year 2013-14.

Table 1: Farm production and profits during reporting period 2012-13

Components of IFS Model	Size of unit(ha)/ Nos.	Farm produces- Production/annum (Kg/liter/ton)	Production ton/ annum (SEY)	Cost of production (₹/Annum)	Net Returns (₹/Annum)
Crops including green fodders	0.84 ha	Cereals – 2562 kg Pulses- 496 kg Oilseeds- 288 kg Green Fodders–74.3 ton Dry Fodders-5.0 ton Potato– 7040 kg Vegetables– 120 kg	65.28(₹ 1,79,520)**	Total:82,8449240 (M.I.) 33,600 (R.I.)	96,680
Dairy + Vermicomost	2B+1C0.01 ha	Milk – 5256 liter V.compost-22 ton Sold Animal – 4 Nos.	96.62(₹ 2,65,732)**	Total:2,30,5621,69,762 (M.I.)60,800 (R.I.)	35,170
Horticulture Including boundary plantations	0.22 ha	Fruits -1863 kg Fodder-1800 kg	17.59(₹ 48,380)**	Total:16,8008,000 (M.I.)8,800 (R.I.)	31,580
Fishery	0.10 ha	Fish – 480 kg	10.18(₹ 28,000)**	2,300	25,700
Apiary	5 bee boxes	Honey- 16 kg***	0.54(₹ 1,480)	800	680
Mushroom	12 , four tier Iron racks	Mushroom – 66 kg	1.44(₹ 3,960)	1,500	1,460
Boundary Plantations*	All around the field borders	Citrus - 1170 kg Beal – 88 pieces Aonla – 10 kg Karonda – 47 kg Green Fodder – 1512 kg Fuel wood – 800 kg	12.58*(₹ 36,390)	NA	-
Total	1.20 ha (IFS Model)	-	191.655,27,037	3,34,802	1,92,230

Production and profits on the basis of per hectare area per annum:

Annual production : Crops Alone = 77.71 t/ha/annum (SEY)
: IFS Approach = 159.71 t/ha/annum
Gross returns : Crops Alone = ₹ 2,13,714/ha/annum
: IFS Approach = 4,39,226/ha/annum
Net returns : Crops Alone = ₹ 1,15,095/ha/annum
: IFS Approach = 1,60,195/ha/annum

Percent increase over crops alone: Total production (105%); Net returns (39.18%)

Inputs Recycled Within the System : ₹ 1,03,200 (G.F.+D.F.+Vermicompost) + Green manuring of Sesbania aculeate and cowpea + Incorporation of crop residues (Sugarcane, redgram and potato leaves)+ Pond silt and water used for irrigation in fruit orchard and field crops.

• Boundary plantations included in component of Horticulture

** Gross Returns/annum

*** During the year, the honey bees were badly affected by insect Baravo. M.I.; Inputs purchased from Market and other cultivation costs. R.I.; Inputs recycled within the system. Prevailing Market rates of the produces Sugarcane@2750/ton, Milk @ ₹ 29/liter; Vermicompost @ ₹ 4/kg

Table 2: Demand (An average family of 7 members) and supply (Farm Produces) under IFS

Farm produces	Family Annual Need (kg)	Annual production (kg)
Cereals	1550	2562
Pulses	130	496
Oilseeds	200	288
Vegetables including potato	900	7040
Fruits	200	1288
Green Fodder	36500	74300
Milk	1120	5256
Fish	150	480
Fuel Wood (Arhar, Subabool)	3650	4100
Honey	6	16
Mushroom	NA	66
Vermicompost	10000	22000

A production of 480 kg fish was achieved in the year of 2013 Keeping in view the requirements of small and marginal land holders of the region, low input based management system, relying on enhancing the fertility of pond through maintaining sufficient feed in terms of phytoplankton and zooplankton in the pond for entire growth phases, locally available inputs such as raw cowdung/ cowdung slurry and supplementation of rice polish mainly during the early growth phase were used. For enriching natural fish feed and keeping pond water clean and safe, inorganic fertilizers NPK and lime were also used periodically. Periodic water exchange was carried out for maintaining optimum dissolved oxygen level in the pond. Pond dykes were utilized for different type of plantations like lemon, guava, leucenea etc. which not only protected the slopes of the dykes against soil erosion but also provided additional income in term of fruits, fodder, fuel and green manure. Besides cash income, the vegetation on dykes also served as feed for herbivorous fish species like grass carp. In addition analysis of pond soil was carried out for analysis of nutrients (N,P, K and OC %) in the soil. Similarly, analysis of pond water was carried out for physiological parameters as well as availability of macro and micro nutrients (Table 3).

Besides cash income the vegetation on dykes also served as feeds for herbivorous fish

Table 3. Analysis of pond soil and water for nutrient composition and physiological parameters

Soil Parameters	Values
pH	8.15
EC	0.624
OC (%)	0.6-0.9
N (kg/ha)	890.62
P (kg/ha)	4.99
K (kg/ha)	239.68
Water Parameters	**Values**
Temp. (^{0} C)	22.5-30.3
pH	7.5-7.8
EC (µs/cm)	570-900
D.O. (mg/l)	7.6-8.0
TDS (mg/l)	300-455
Total N (mg/l)	1.2-1.5
Total P (mg/l)	0.05-0.1
Total K (mg/l)	0.6-0.8
Zn	0.0063
Fe	0.2436
Mn	0.0651
Composition of fish	**Values**
Protein Content (%) on wet weight basis	12.5-15.4

Project title **:** Characterization and Evaluation of Existing Farming Systems in India

Project code **:** NRMAPDFSRSIL200900100104

Funding Agency **:** Institute based

Duration **:** 2009-2014

Project Personnel **:** *Harbir Singh, Anil Kumar, B. Gangwar and Sunil Kumar*

Initially, thirty percent districts from each zone having 50 percent representation of high productivity districts and 50 percent representation of low productivity districts were selected. From every district four representative blocks and three village *panchyats* from each block were selected by adopting stratified four stage random sampling. Six farmers, from each village *panchayat* consisting two each marginal, small and two farmers from among medium and large size category were interviewed on random basis to fill up the pre-tested schedule and questionnaire.

Project title **:** Implications of Changing Input Use Pattern in Major Farming/ Cropping Systems in India

Project code **:** NRMAPDFSRSIL 201100800126

Funding Agency **:** Institute based

Duration **:** 2011-2014

Project Personnel **:** *Harbir Singh and G.C. Sharma*

In the first stage, the proposed study would use available data on the cost of cultivation of major crops as covered under the cost of cultivation scheme of the Government of India. The changes in cost structure would be worked out for major crops during the last 5-10 years. Further, an attempt would be made to identify the share of various cost components in the cost of farming and implications of these changes particularly for small and marginal farmers. In the second phase of the study, data generated under AICRP-IFS would be utilized for validating the results achieved during first phase. The project progress reported here shows only preliminary results about the temporal changes in share of different items of operational cost for major cereals, pulses and oilseeds cops in major producing states during last one decade (2000–2010).

Human labour cost is the highest operational cost of cultivation in case of sugarcane and pulses. Hence mechanization of farm operation has ample scope in these crops

It is evident from these tables that expenditure on human labour forms major portion of operational cost followed by fertilizers and manures in cereals (paddy and wheat). Except Punjab, the share of human labour cost in paddy cultivation ranges from about 30 percent to more than 60 percent depending upon the states where it is grown. It can be inferred that share of human labour cost is high in those states which have probably low level of farm mechanization. The same holds true for wheat cultivation also. Thus, it may be concluded that the variation in the share of human labour cost and application of fertilizers and manures depends to a large extent on the level and extent of mechanization in these crops. It may be noted that share of human labour cost has an inverse relationship with the farm mechanization in the state/region where these crops are grown. On an average, human labour, machine labour, seeds, insecticides and irrigation charges account for more than three-fourth share of operational cost of cultivation for paddy and wheat (Fig. 1 & 2). In case of sugarcane, share of human labour cost is the highest in major producing states, as harvesting of the crop is mainly done manually.

In case of pulses (chickpea and lentil), human labour and seed cost alone account for more that 50 percent share in the operational cost of cultivation for these crops. Since these crops are labour-intensive, human labour cost is the single largest item of operational cost. However, it may be noted that fertilizers and manures also account for 2–9 percent share in operational cost of these pulse crops. In case of oilseeds (rapessed & mustard and soybean) also, share of human labour followed by seeds

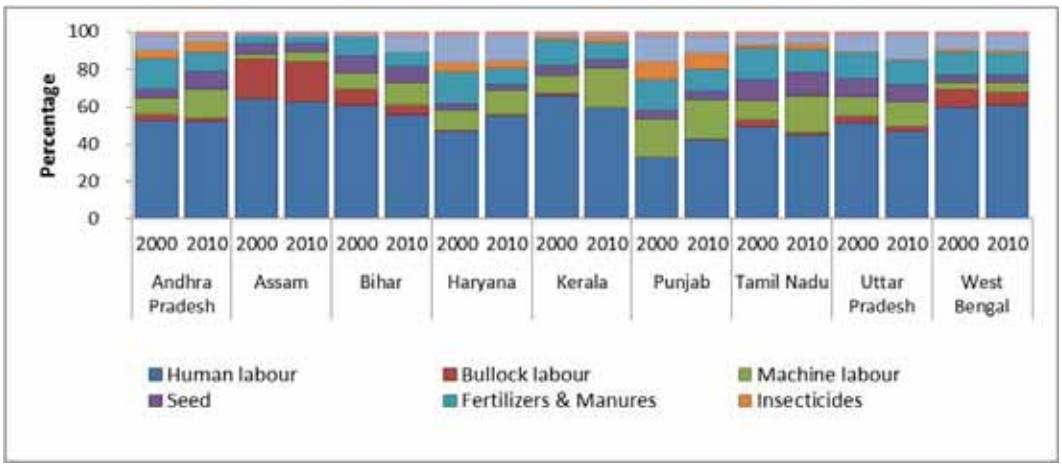


Fig. 1. Percentage share of different cost items in operational cost of paddy in major producing states

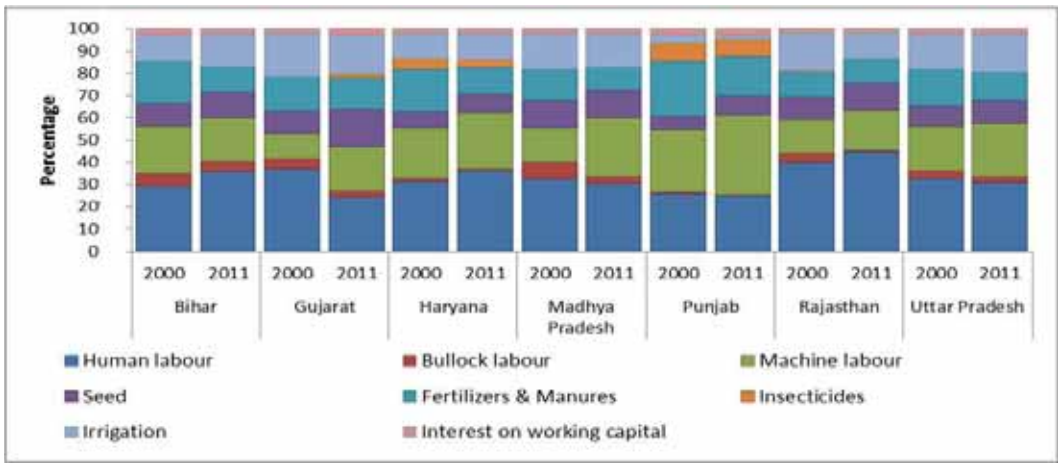


Fig. 2. Percentage share of different cost items in operational cost of wheat in major producing states

and fertilizers & manures account for major share of the operational cost of cultivation of these crops. Higher share of human labour cost in operational expenses indicate that there is ample scope for mechanization of farm operations in the crops sector as a whole. Comparatively higher efficiency of small and marginal farms as reported in the literature may be attributed to higher labour availability on these farms. However, plateauing of yields and stagnation in farm returns are some of the major factors leading to out-migration of farm labour which might have adverse impact on the economic viability of smallholders. Further, the challenges to sustaining the economic viability of farming can be gauged by the ratio of gross returns to total cost of cultivation for the selected crops. In case of paddy, the ratio of gross returns to total cost has either declined or remained almost constant for major growing states during last ten years though marginal improvement is seen in case of returns from wheat. The relevant ratios for other crops (sugarcane, lentil, chickpea, rapeseed & mustard and soybean) point to a mix picture with some states showing marginal improvements while decline in farm profitability in other cases. Still, it can be inferred that returns in farming have not increased significantly in the last decade.

Plateauing of yields and stagnation of farm returns leads to out migration of farm labours which will adversely affect the viability of small holders

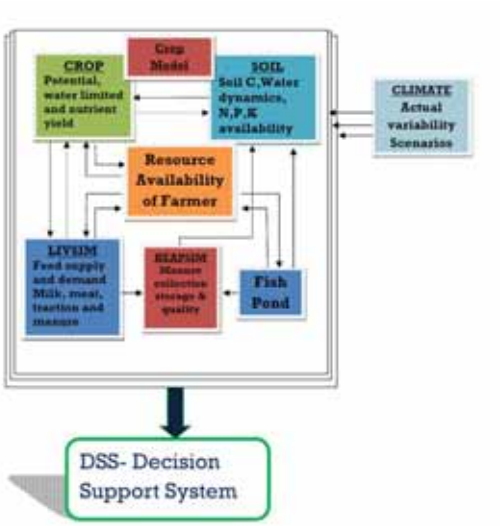
Project title **:** Assessment of Climate Change Impact on Integrated Farming Systems through Modelling

Project code **:** NRMAPDFSRSIL201300300132

Funding Agency **:** Institute based

Duration **:** 2013-2016

Project Personnel **:** *N. Subash, M. Shamim, J. P. Singh, A. Prusty and M. Pramanik*



This project was started in 2013 for duration of 3 years with the objectives to identify the climate resilient components of IFS under projected climate change scenarios through modelling approach and to develop DSS for identifying the best IFS options for small and marginal farmers of western UP. During the first year of the project, we have reviewed

Table 2. The layer wise initial physical and chemical soil characteristics at different crop/ horticulture enterprises of IFS model

Depth (cm)	N (kg/ha)	P (kg/ha)	K (kg/ha)	OC %	pH	EC (dS/m)	BD (g/cm^3)
Horticulture							
0-15	121.26	12.14	254.61	0.46	7.74	0.12	1.74
15-30	104.53	8.44	240.05	0.30	7.91	0.10	1.95
30-60	87.81	5.08	220.64	0.16	7.91	0.08	2.04
60-90	62.72	7.40	212.80	0.12	7.93	0.07	-
Sugarcane							
0-15	125.44	8.24	279.25	0.62	7.78	0.36	1.66
15-30	108.71	6.71	245.28	0.33	7.86	0.36	1.91
30-60	91.99	7.89	252.37	0.24	8.18	0.36	1.83
60-90	62.72	6.81	225.12	0.19	8.33	0.07	-
Lentil+Mustard							
0-15	125.44	15.00	244.16	0.70	7.66	0.12	1.72
15-30	112.90	12.43	225.12	0.63	7.72	0.11	1.91
30-60	108.71	13.66	226.61	0.59	7.80	0.13	1.94
60-90	41.81	8.09	218.03	0.52	7.85	0.13	-
Mustard (In standing crop)							
0-15	129.62	9.57	214.67	0.52	7.68	0.11	1.70
15-30	112.90	8.04	196.75	0.43	7.64	0.10	1.90
30-60	100.35	7.00	191.52	0.37	7.65	0.09	1.92
60-90	60.63	6.66	185.55	0.32	7.66	0.12	-
Wheat							
0-15	100.35	9.57	255.73	0.76	7.75	0.24	1.83
15-30	129.62	7.99	215.79	0.45	7.77	0.17	1.88
30-60	158.89	6.66	224.37	0.39	7.81	0.15	1.96
60-90	91.99	10.26	241.55	0.36	7.82	0.15	-

the different IFS models available. We found that AusFarm, IAT and IFSM are some of the IFS models already developed to study the integrated assessment of different farm activities which will integrate animal, pasture and crop production with labor and land requirements, accounts for revenue and costs and evaluates these against existing land, labor and financial resources. These models developed for particularly with different farming situations followed in their developers. IFSM provide IT of crop-livestock interaction in a big farm with the only mechanized situation, which exists in USA and other developed nations. We have collected soil physical and chemical properties at different layers (0-15, 15-30, 30-60 & 60-90) at each crop enterprises during the start of the kharif season and also monitored the phenology, yield and yield attributes from the ongoing IFS experiment at the Directorate. The methodological framework of the IFS modelling was also prepared.

Project title **:** Comparative studies of fish and crop based farming systems

Project code **:**
NRMAPDFSRSIL 201200200128

Funding Agency **:** Institute based

Duration **:** 2013-2016

Project Personnel **:** *A. K. Prusty, J. P. Singh and Poonam Kashyap*

Results for different modules (0.4 ha each) were synthesized by taking data from ongoing experiments for crop component and for fisheries component data were upscaled from results of 0.1 ha fish pond of PDFSR. Highest gross and net return was obtained in the module M3 having fish and horticulture component. Highest employment generation of 100 days was also observed in M3 module having fish pond and horticulture component on pond dike. Benefit cost ratio was better in M1 module (RICE- WHEAT System) followed by M2 (SUGARCANE-S.RATOON System).

Project title **:** Status of organic agriculture in Eastern Himalayan region

Project code **:**
NRMAPDFSRSIL 201000900115

Funding Agency **:** Institute based

Duration **:** 2010-2015

Project Personnel **:** *Sunil Kumar, B. K. Sharma, N. K. Jat, B. Gangwar and Anil Kumar*

Survey of Sikkim was conducted during 2012-13 and 4 districts namely East Sikkim, West Sikkim, North Sikkim and South Sikkim were selected using multistage stratified random sampling method. Again 2 blocks namely Sarmsa and Ranipul from East Sikkim, Tashinding and Gayzing from West Sikkim, Tanik from North and Namchi and Tarku form South Sikkim districts were selected using the same sampling procedure. Thus, a total of 7 blocks were chosen for the proposed study. Thereafter, 2 villages from each block and 10-13 farm families from each village were selected. Finally a total of 160 households were selected for collecting the data. Besides general information, the area under organic agriculture of each farm group was collected on the prescribed and well tested questionnaire through interview of the head of the farm families. The productivity of rice, maize, zinger and other such crops were also recorded. The information about other enterprises kept by the farmers, expenditure incurred and income derived from each enterprise was also noted. From the survey of East, west, north and

south districts, it was observed that the farmers were cultivating organic agriculture wherein they were using only cow dung no used chemical fertilizers. All the districts, farmers are cultivating maize, rice, ginger, vegetables and fruit crops whereas, maize and rice are major cereal crops in the entire districts. After rice ginger and vegetables was observed most remunerative cash crop in the area. Cow, bullock, poultry and goat found common enterprise keeping by all farmers groups to enhance household income. This showed a good scope of organic farming system in the state.

Cent percent farmers of Sikkim are practicing organic cultivation for raising the crops

Status of organic producers and their crop production scenario

In Sikkim, the farmers were found cultivating organic farming as per norms of the organic agriculture during course of survey. The practice followed by the majority of farming community for crop cultivation was traditional and natural and as such, the crop cultivation in practice in Sikkim may be termed as 100% organic agriculture. The plants residues which decompose in the field and minerals came through irrigation water from hills, cater the nutrients needs of rice crop. The data presented in Table 4 showed that out of age total sample farmers 25, 27.5, 10 and 27.5 percentage were following organic agriculture in East Sikkim, West Sikkim, North Sikkim and South Sikkim districts. The average of all the districts indicated (100%) organic cultivators. Marginal farmers constitute a major portion (30 %) of the farmers followed by small farmers (50%).

The average productivity of rice and maize shown in Table 5 indicated marginal variation in productivity of these crops between both farm groups. The average productivity of rice and maize was recorded 14.75 q/ha and 10.7 q/ha of organic cultivators. However, the

Table 4. Socio-personal characteristics of respondents in Mizoram 2012-13

Particulars	East Sikkim		Wast Sikkim		North Sikkim		South Sikkim		Average	
	No.	%	No.	%	No.	%	No.	%	No.	%
Age										
Young (<25 years)	13	32.50	10	25.00	5	12.50	12	30.00	40	25.00
Middle (25 - 50 years)	37	92.50	19	47.50	11	27.50	17	42.50	84	52.50
Old (> 50 years)	10	25.00	11	27.50	4	10.00	11	27.50	36	22.50
Education										
Literate	5	12.50	6	15	3	7.5	4	10	18	11.25
Primary	11	27.50	9	22.5	4	10	5	12.5	29	18.13
High School	28	70.00	14	35	9	22.5	21	52.5	72	45.00
Graduate	10	25.00	7	17.5	2	5	6	15	25	15.63
Post Graduate	6	15.00	4	10	2	5	4	10	16	10.00
Land Farm Size (ha.)										
Small (< 2)	32	80.00	18	45.00	11	27.50	19	47.50	80	50.00
Medium (2 - 5)	18	45.00	13	32.50	7	17.50	11	27.50	49	30.63
Large (>5)	10	25.00	9	22.50	2	5.00	10	25.00	31	19.38
Type of Occupation										
Agriculture only	11	27.50	9	22.50	6	15.00	9	22.50	35	21.80
Agriculture+ Livestock	31	77.50	21	52.50	10	25.00	23	57.50	85	53.12
Agri + Poultry+ Fish	8	20.00	4	10.00	2	5.00	3	7.50	17	10.62
Agri.+Service+Hort.	6	15.00	3	7.50	1	2.50	3	7.50	13	8.12
Agri.+Service+Business	4	10.00	3	7.50	1	2.50	2	5.00	10	6.25

average productivity of these crops together organic was below to the national average productivity of 21.8 q/ha for rice and 14.49 q/ha of maize reported during 2012. Since organic farmers do not provide any manure to cereal crops in general, the fertility of the soils deteriorates continuously resulting poor crop yield. If the organic materials like plant leafs, weeds and animal waste easily available with the farmers would have been decomposed and put in the soils, the crop productivity and soil fertility could have been sustained. Further, Sikkim being a high rainfall area, vermi compost could be easily prepared by the farming community and used for cropping. Besides, to cater the need of milk, meat and FYM, keeping more cows on the farm needs to be encouraged for promoting the organic agriculture in Sikkim.

Table 5. Rice and maize productivity of organic cultivators in Sikkim (2012-13)

Districts	Organic Paddy (q/ha)	Organic Maize (q/ha)
East Sikkim	15.5	11.5
West Sikkim	14.7	9.5
North Sikkim	13.9	8.8
South Sikkim	14.9	10.5
Average	**14.75**	**10.7**

Animal population and annual income therefrom

Vermicomposting and its application to the field would be the best practice to sustain the soil fertility

Animals are major component for adoption of organic agriculture in any region or state. Further, cow, buffaloes, poultry, goats and pigs are not only the source of organic manures but it also provides additional income to the farming community in general and resource in particular. Food nutritional values also improve through inclusion of milk, egges and meat in food items. The data presented in Table 6 indicated average number of different kinds of animals kept on the farm by individual household in each district included in the study.

In a predominantly rural economy such as Sikkim, animal husbandry activities form an extremely important element in the effort to bring about substantial improvements in living standards. As apparent from the data, every household from each selected district were keeping animals. The average number of goat was recorded 1.05 with an average income of ₹ 1415/ annum and per household poultry were 5.82. However, the average number of cow was only 1.05 household which appeared very less compared to organic agriculture. The overall figure showed 8.65 animals with each farm families

Rural economy of Sikkim, animal husbandary form an extremely important activities in substantial improvement of households

Table 6. Average number of animals per household and annual income there from Income (')

District	Cow		Goat		Poultry		Total	
	No	Income	No	Income	No	Income	No	Income
East Sikkim	1.5	1900	1.8	2100	6	1950	9.3	5950
West Sikkim	0.9	1250	2	2390	5.4	1780	8.3	5420
North Sikkim	1	1360	1.9	2250	7.3	2130	10.2	5740
South Sikkim	0.8	1150	1.4	1980	4.6	1540	6.8	4670
Overall	1.05	1415	1.775	2180	5.82	1850	8.65	5445

which generate an average annual income of ₹ 5445. These farm animals' figures underline the bright scope of organic farming in Sikkim. Further, if excreta, urine, other waste of these animals are decomposed with plant leafs and weeds, sufficient organic manure could be produced and used for crop improvement. Further farmers needs to be encouraged to keep more cows on the farm to enhance the dung production besides to solve the milk and meat problem of the state. Further, the population of goats, poultry, pigs and other such animals also needs to be increased by giving incentive to the farmers for success of organic farming in the state.

Yield trend under organic farming

As Rice, maize, ginger and vegetables was marked an income generating crops for the state, the major portion of available organic manures was used for this crop. However, human population of all corners of the country including Sikkim is growing fast and per capita land is sharply declining, the per unit productivity of rice which is important stable food for the state, is required to be increased and for that other source of organic material are to be searched for improving the soil fertility and crop productivity. The rice productivity of conventional inorganic farmers was also not comparable to national average. This showed that soils of these farm groups were also hungry for plant nutrients. These results call for implementation of full package of organic agriculture by educating the north eastern farmers including Sikkim for sustaining the crop yield. However, growing rice without organic manure/ fertilizers causing low crop yield below the national average will defeat the objectives of the organic farming. The major constraints as perceived by the organic growers were unsustainable farm incomes during the conversion period in which yields are usually lower followed by the inadequate pest and disease control measures and non-availability of financial means to compensate initial yield loss (Fig. 3).

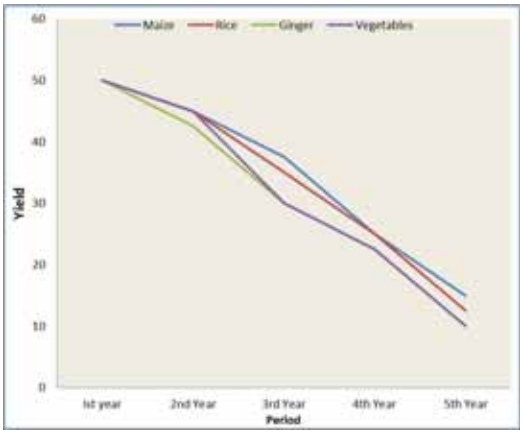


Fig. 3. Yield trend under organic farming

Through adoption of improved package of practices, productivity of horticultural crops can be increased substantially in the North Eastern state like Sikkim

Horticulture

Horticulture is one of the major components of farming systems of Sikkim. Large Cardamom, ginger and turmeric are the principal crops while Mandarin orange, guava, mango, banana and so on are the principal fruits grown in the state. The reasons of low production and productivity are use of local varieties, improper nutrient management, incidence of insect pests and diseases and inadequate facility for irrigation. The problem could be solved by adopting improved production technology. These include tomato, cabbage, cauliflower, beans, radish, brinjal, broccoli, Chinese mustard, okra, garden pea, palak, carrot, etc.

Farmer's perceptions about organic farming

While conducting the survey, views of the farmers were gathered about the effect of conventional farming on soil fertility, weed infestation, disease and insects pests, consumer demand, market price, produced quality and

environmental pollution. The opinion expressed by the farmers of each selected district is presented in (Table 7).

Table 7. Opinions of the farmer's perception about organic farming

Particular	Farmer perception (%)
Crop yields	93 (Lower)
Soil quality	100 (Higher)
Weed Infestation	100 (Higher)
Disease and insect-pest incidence	100 (Low)
Market price	100 (Higher)
Consumer acceptability	100 (Higher)
Effect on human health	100 (Good)
Effect on natural environment	100 (Good)
Produce keeping quality	100 (Good)

Project title **:** Productivity and economic evaluation of horticulture based farming systems

Project code **:** NRMAPDFSRSIL201100300121

Funding Agency **:** Institute based

Duration **:** 2011-2015

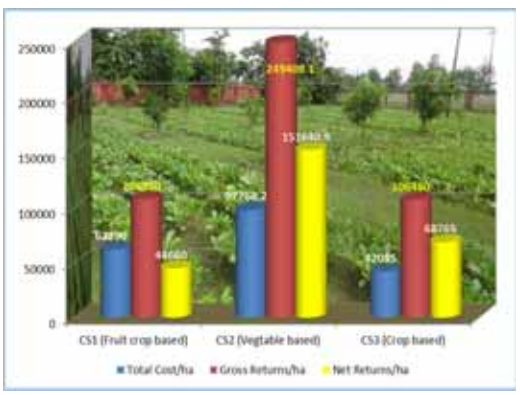
Project Personnel **:** *Poonam Kashyap, Kamta Prasad and Harbir Singh*

Experiments were conducted to develop horticultural crop based model for improving profitability, enhancing productivity and nutritional security of small and marginal farmers particularly of western plain zone of Uttar Pradesh. Three modules, viz., Fruit based (CS 1, 0.3 ha), vegetable crops based (CS 2, 0.22 ha) and field crop based (CS 3, 0.4 ha) were evaluated under this project.

Under fruit crop based system (CS-1), mango, guava and banana were grown as the main crops whereas cucumber, raddish, carrot and onion as the intercrop in mango, brinjal, veg pea and okra as intercrops in guava and turmeric as intercrop in banana respectively. In vegetable based system (CS-2) turmeric, bottlegourd-cauliflower-tomato and brinjal-potato were grown while under crop based system (CS-3), Rice-wheat and suagarcane-ratoon were evaluated.

Among the modules, vegetable based system has been found most effective in terms of net returns. The net returns per ha from the vegetable based system (CS- 2) was found to be ₹ 151640 followed by crop based system (CS- 3) being ₹ 68765 followed by fruit crop based system (CS- 1) being ₹ 44660 in the second year of its establishment. The higher return from vegetable based system was mainly due to contribution by cash crops. Fruit based system gave lowest net returns per ha as there was no return from fruit plants in its initial years. Returns obtained from the system were achieved from the intercrops only.

Vegetable based system has been found best over other cropping systems



Cropping System and Resource Management

Project title **:** Identification of bio-intensive, complementary cropping systems for high productivity and efficient resource use

Project code **:** NRMAPDFSRSIL200800200093

Funding Agency **:** Institute based

Duration **:** 2008-2014

Project Personnel **:** *B. Gangwar, K.K. Singh, M. Shamim*

Combination of maize for cobs + vegetable cowpea in 1:1 on broad beds and *Sesbania* in furrow during *kharif* and mustard in furrows and 3 rows of lentil on braod beds during *rabi* along with 3 rows of green gram on beds in summer give highest profitability

Ten combinations of bio-intensive complimentary cropping systems were evaluated for higher productivity and profitability. The treatments were T_0: Rice – Wheat, $\mathbf{T_1}$:Hybrid rice - Lentil (B) + Wheat (B) - Cowpea (V+R), $\mathbf{T_2}$: Maize(C) + Veg. Cowpea (BB) + Sesbania (F) – Lentil (BB) + Mustard (F)-Green gram (MT) (G+R), $\mathbf{T_3}$:Maize (G) + Black gram (1:1) – Mustard + Veg. Pea (B) - Green gram (G+R), $\mathbf{T_4}$:Maize (C) + Sesbania – Toria + G. Sarson (TPT) – Green gram (ZT) (G+R), $\mathbf{T_5}$:Sorghum + Cluster bean (f) - Maize (C) + Black gram (1:1) – Methi - Cowpea (V+R), $\mathbf{T_6}$:Pigeon pea + Black gram (1:1) – Wheat + Mustard (6:1) (ZT) - Cowpea (f)(ZT), $\mathbf{T_7}$:Pigeon pea – Wheat + Methi (6:1) (ZT) - Cowpea (f) (ZT), $\mathbf{T_8}$:Maize + Cowpea (f) - Maize (G) + Black gram – Wheat + Methi (6:1) – Green gram (G+R), $\mathbf{T_9}$:Sorghum (G) + Cowpea (V) - Oat (F) –Pearl millet (f) + Cluster bean (V).

The effects of these systems on Rice Equivalent Yield (REY), net returns, per day productivity and per day profitability are presented in Figures 4 to 6. Bio-intensive system of raising maize for cobs + vegetable cowpea in 1:1 ratio on broad beds (BB) and *sesbania* in furrows during *kharif* and mustard in furrows and 3 rows of lentil on broad beds in *rabi* along with 3 rows of green gram on beds in summer produced highest REY of 27.6 t ha^{-1} with productivity of 55.6 kg grain $ha^{-1}day^{-1}$ and profitability of ₹ 529 ha^{-1} day^{-1} and was remarkably better than other systems. The complimentary

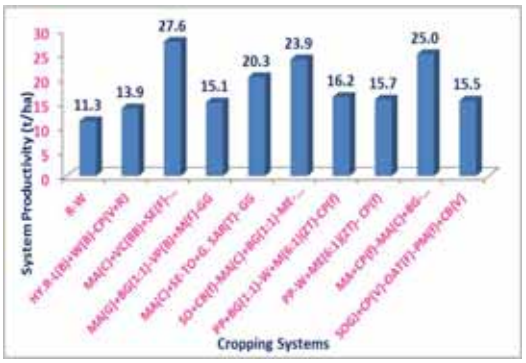


Fig. 4. Effect of bio-intensive Complementary Cropping Systems on Rice Equivalent Productivity

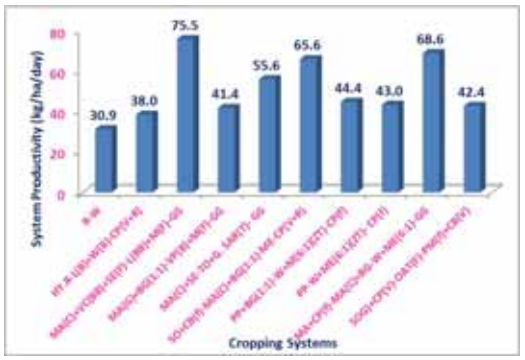


Fig. 5. Effect of Bio-intensive Complementary Cropping Systems on per day Rice Equivalent Productivity

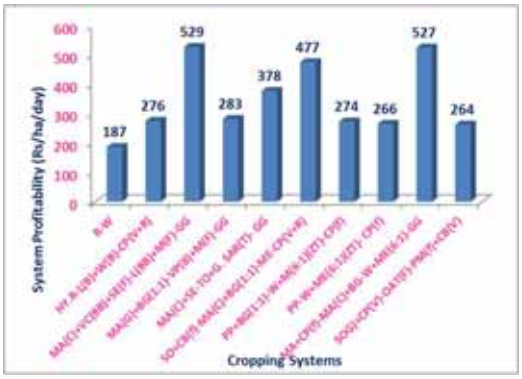


Fig. 6. Effect of Bio-intensive Complementary Cropping Systems on System Profitability

effects were reflected in the system as in broad bed and furrow (BBF) system, the furrows served as drainage channels during heavy rains in *kharif* which were utilized for in-*situ* green manuring with 32 t ha^{-1} green foliage incorporated after 45 days of sowing. The timely sown mustard crop in these furrows resulted a good harvest 1.08 t ha^{-1} and a bonus yield of lentil (1.17 t ha^{-1}) could be harvested on one hand and 47% of irrigation water was saved. In the summer season green gram could yield 1.0 t ha^{-1} as grain while incorporation of green foliage of about 4 t ha^{-1} in the soil further helped the system favourably. Bio-intensive System of raising [Maize + Cowpea] (f) - Maize(C) + Blackgram-Wheat + Methi (6:1)–Green gram(G+R) was second best which resulted in REY of 25.0 t ha^{-1} with productivity of 68.6 kg grain ha^{-1}day^{-1} and profitability of ₹ 527 ha^{-1} day^{-1}. This system proved to be the second best in the order of merit. The lowest yield (11.3 t ha^{-1}) and profitability (₹ 68.3 ha^{-1} day^{-1}) was obtained under the conventional rice-wheat systems.

Bio- intensification of different cropping system was evaluated based on physiological parameters for the *Rabi* crop season 2012-2013. Observations showed that bio intensification of different crops affects the growth of crops. Wheat

Table 8. Morphophysiological traits of crops during *rabi* season

Treat-ments	Crops	Plant height (cm)	LAI at 60 DAS	Photosynthesis rate (µ mole/ m^2/s)	Transpiration (m mole/s)	PWUE	PRUE	Root length at 60 DAS
T_0	Wheat	88.4	3.46	20.3	5.85	3.96	1.23	9.0
T_1	Lentil	30.44	4.09	22.4	6.81	3.45	1.34	7.8
	Wheat	90.55	2.5	21.8	5.07	5.21	1.38	8.2
T_2	Lentil	34.7	5.14	24.32	6.73	3.95	1.56	9.7
	Mustard	141.6	3.66	23.6	6.51	4.22	1.47	21.9
T_3	Veg. Pea	29.8	3.36	17.2	7.1	2.53	1.01	11.2
	Mustard	124.8	3.91	25.9	6.92	4.12	1.69	12.6
T_4	Toria	79.8	3.37	20.22	5.09	4.38	1.13	10.7
	G. Sarson	61.3	3.69	25	7.49	3.55	1.54	11.7
T_5	Methi	33.8	3.18	14.6	4.1	4.10	0.82	8.6
T_6	Wheat	79.8	4.41	23.6	7.86	3.19	1.50	11.4
	Mustard	127.5	3.9	27.96	7.47	4.39	1.81	23.8
T_7	Wheat	84.8	4.08	21.3	5.04	5.04	1.31	12.0
	Methi	33.6	3.67	14.5	4.61	3.23	0.83	8.8
T_8	Wheat	78.5	3.93	22.19	6.05	4.46	1.44	11.4
	Methi	35.4	3.37	14	4.64	2.96	0.72	7.9
T_9	Oat	71.5	3.77	26	8.53	3.24	1.61	14.0

Table 9. Morphophysiological traits of crops during *kharif* season

Treat-ments	Crops	Plant height (cm)	LAI at 60 DAS	Photosynthesis rate (µ mole/ m^2/s)	Transpiration (m mole/s)	PWUE	PRUE
T_0	Rice	86.15	5.48	29.70	2.93	10.14	1.98
T_1	Hybrid Rice	89.39	5.99	34.00	3.33	10.21	2.27
T_2	Maize	152.79	4.33	27.50	6.64	4.14	1.83
	Cowpea	80.50	4.65	22.12	5.11	4.33	1.47
	Sesbania	71.50	2.02	17.10	3.77	4.54	1.14
T_3	Maize	139.40	5.00	25.60	6.34	4.04	1.71
	Black gram	41.10	3.79	25.24	5.68	4.44	1.68
T_4	Maize	149.70	4.30	25.30	6.62	3.82	1.69
	Sesbania	58.40	2.63	16.10	4.10	3.93	1.07
T_5	Sorghum	107.30	3.14	25.50	6.04	4.22	1.70
T_6	Cluster bean	100.30	2.77	21.60	5.02	4.30	1.44
T_7	Pigeon pea	101.50	1.77	22.92	3.88	5.91	1.53
	Black gram	42.30	3.12	24.40	5.58	4.37	1.63
	Pigeon pea	96.90	2.83	21.50	4.92	4.37	1.43
T_8	Maize	145.20	4.54	27.24	6.53	4.17	1.82
	Cowpea	85.40	3.36	20.10	5.06	3.97	1.34
T_9	Sorghum	162.90	2.80	25.80	6.48	3.98	1.72
	Cowpea	82.80	2.62	19.60	5.28	3.71	1.31

among the five treatments showed variations in recorded parameters. It showed higher plant height in T_1 while LAI values are higher in treatment T_6 with mustard. Mustard, among three treatments showed higher plant height in treatment T_2 while LAI is higher in treatment T_3.

Wheat and mustard both showed higher photosynthetic rate in treatment T_6 along with higher transpiration rate. Among the entire crops highest transpiration rate is recorded in oat. Root studies also showed the effect of intercropping but do not have any definite trend. Among all the crops at 60 days after sowing of mustard showed higher values in treatment T_6.Small canopy crops like Methi, lentil and veg. pea showed higher LAI comparing to mustard and wheat. Observations indicate that crops behave differently in different intercropping combinations and their parameters varied accordingly.

Bio- intensification of different cropping system was evaluated based on physiological parameters for the *kharif* crop season 2013. Hybrid rice showed higher values for LAI, photosynthetic rate 34 µ mole/m^2/s, higher photosynthetic water use efficiency (PWUE) 10.21 and higher radiation use efficiency (PRUE) i.e. 2.27. Maize performs well when grown with lower canopy crops like black gram, sesbania and cowpea. Sorghum also follows the same trend. Being the *kharif* season hot and humid most of the crops showed higher transpiration rate.

Project title **:** Resource conservation and sustaining high productivity through cropping system management and land configuration

Project code **:**

NRMAPDFSRSIL201000100107

Funding Agency **:** Institute based

Duration **:** 2010-2014

Project Personnel **:** *B. Gangwar and K.K. Singh*

To study the effect of different land configurations and cropping systems on resource conservation, system productivity and profitability as well as soil fertility, an experiment with twelve treatment combinations of land configuration [flatbed (FB), furrow irrigated raised bed (RB) and broad bed-furrow (BBF)] with different cropping systems were evaluated in the strip plot design. The cropping systems were as follows.

Kharif	*Rabi*	*Summer*
Flatbed Systems		
Maize (Ma)	Vegetable pea (VP)	Green gram (GG)
Rice (R)	Lentil (L)	Green gram (GG)
Sorghum f (Sf)	Mustard (M)	Green gram (GG)
Pigeon pea (PP)	Wheat (W)	Green gram (GG)
FIRB Systems		
Ma (B) + Se (F)	VP (B) + W (F)	GG (G+R)
GG (B) + R (F)	W (F) + L (B)	GG (G+R)
Sf (B) + Se (F)	L (B) + M (F)	GG (G+R)
Broad bed furrow (BBF) Systems		
[Ma + VC] (BB) (2:1) + Se (F)	VP (BB) + W (F)	GG (G+R)
GG (BB) + R (F)	L (BB) + W (F)	GG (G+R)
[Sf + VC] (BB) (2:1) + Se (F)	L (BB) + M (F)	GG (G+R)
[PP+ BG] (BB) (2:1) + Se (F)	W (BB) + M (F)	Fallow

Note: B – bed, F – furrow, Se – sesbania, VC – vegetable cowpea

The effect of land configuration and cropping systems on rice equivalent yield and water use are presented in Figures 7 to 11. The bio-intensive complementary cropping system [Maize + vegetable Cowpea] (BB) + Sesbania (F) - Veg. pea (BB) + Wheat (F) - Green gram produced maximum REY of 15.8 t $ha^{-1}$with productivity of 43.3 kg $ha^{-1}day^{-1}$

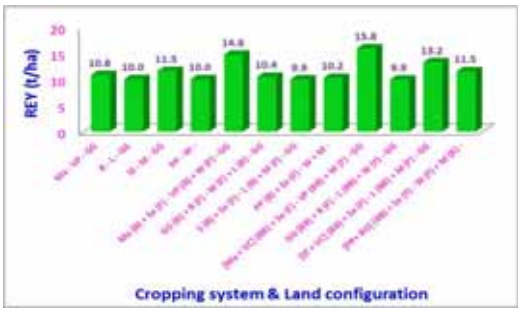


Fig. 7. Effect of bio-intensive complementary cropping systems and land configurations on Rice Equivalent System Productivity

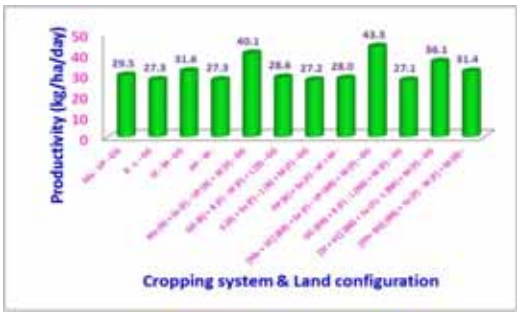


Fig. 8. Effect of bio-intensive complementary cropping systems and land configurations on per day Rice Equivalent System Productivity

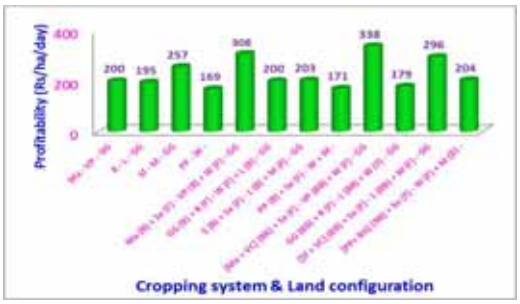


Fig. 9. Effect of bio-intensive complementary cropping systems and land configurations on Profitability

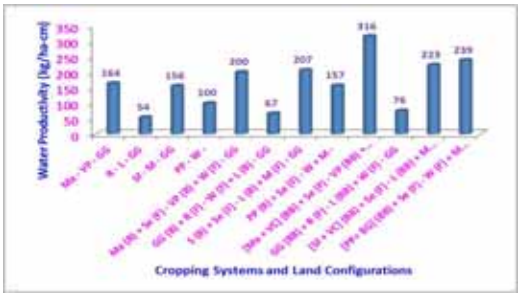


Fig. 10. Effect of bio-intensive complementary cropping systems and land configurations on Water Productivity

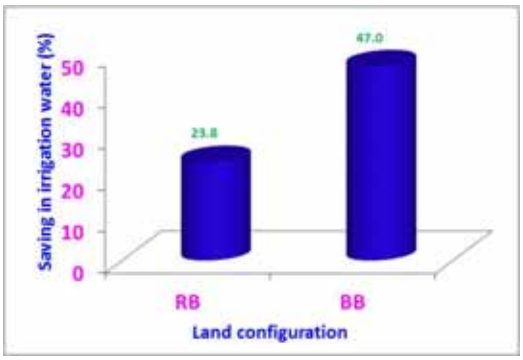


Fig. 11. Effect of land configurations on Water saving compared to Flat Bed system (RB – Raised Bed, BB – Broad Bed)

and profitability of ₹ 338 ha^{-1}day^{-1}, which was followed by Maize (RB) + Sesbania (F) – vegetable Pea (RB) + Wheat (F) – Green gram system (14.6 t ha^{-1}) and [Sorghum (f) + veg. Cowpea] (BB) + sesbania (F) – [Lentil (BB) + Mustard (F)] – Green gram system with REY of 13.2 t ha^{-1}, productivity of 40.1 kg ha^{-1}day^{-1} and profitability of ₹ 308 ha^{-1}day^{-1}.

The system [Maize + vegetable Cowpea] (BB) + Sesbania (F) - Veg. pea (BB) + Wheat (F) - Green gram provided maximum water productivity of 316 kg ha-cm^{-1}, which was followed by [Pigeon pea + Black gram] (BB) + sesbania (F) – [Wheat + Mustard] (5:1) (239 kg ha-cm^{-1}) and [Sorghum (f) + veg. Cowpea] (BB) + Sesbania (F) – Lentil (BB) + Mustard (F) – Green gram system (223 kg ha-cm^{-1}). About 24 and 47 % irrigation water was saved using Raised Bed and Broad Bed than Flat Bed system.

Physiological observations for the various crops i.e. wheat, lentil, mustard and vegetable pea during *Rabi* season (2012-2013) showed the effect of land configuration. Vegetable pea showed better performance in terms of growth and other parameters in furrow irrigated raised bed (FIRB) land configuration with wheat(in furrow), in comparison of broad bed furrow (BBF) and flat bed. It showed

Table 10.Morpho physiological traits of the different crops under Rabi season effected by various land configurations at 60 days after sowing

Land Configu-ration	Crops	Plant height (cm) at harvest	LAI	Photosynthesis rate (µ mole/ m^2/s)	Stomata conductance (m mole/s) (mol m^{-2} s^{-1})	Transpiration	PWUE	PRUE
FLAT BED	Vegetable Pea	32.7	3.1	19.2	0.3	4.3	4.5	1.3
	Lentil	39.6	3.9	5.6	0.4	4.3	1.3	0.4
	Mustard	141.8	5.2	26.6	0.1	4.2	6.3	1.8
	Wheat	89.6	3.1	12.4	0.2	4.1	3.0	0.8
BBF	Vegetable Pea	28.4	3.4	23.9	0.2	4.1	5.8	1.6
	Wheat	81.5	2.7	9.4	0.1	5.4	1.8	0.6
	Wheat	86.9	2.8	11.3	0.2	5.3	2.1	0.8
	Lentil	36.2	2.7	9.2	0.3	5.3	1.7	0.6
	Mustard	138.5	3.1	23.1	0.2	5.3	4.4	1.5
	Lentil	32.6	5.2	11.2	0.1	5.3	2.1	0.8
	Mustard	74.8	2.7	19.5	0.2	4.0	4.8	1.3
	Wheat	81.4	4.4	12.6	0.2	4.0	3.2	0.8
FIRB	Wheat	85.9	3.3	13.6	0.3	4.0	3.4	0.9
	Vegetable Pea	35.6	3.6	23.6	0.2	3.9	6.0	1.6
	Wheat	84.5	3.0	13.4	0.2	3.9	3.5	0.9
	Lentil	39.8	3.1	9.9	0.2	2.5	3.9	0.7
	Mustard	132.8	3.0	24.6	0.2	2.5	9.7	1.6
	Lentil	36.4	5.1	9.3	0.1	2.6	3.6	0.6
	Wheat	86.6	2.9	10.4	0.2	4.4	2.4	0.7
	Mustard	103.4	5.1	19.3	0.2	4.4	4.4	1.3

highest dry weight i.e. 206.5 g/ 5 plants and highest LAI i.e. 3.64 among all the three land configurations. Wheat performed differently in all three configurations.

Under flatbed it attained highest plant height while in BBF with mustard intercropping LAI was 4.35. Mustard showed better performance under flatbed condition among all. Photosynthetic water use efficiency clearly indicates that most of the crops showed higher values under FIRB, which prove the importance of the land configuration for its water saving ability. It's evident from the observations that land configuration effects the growth and development of *Rabi* crops.

During Kharif season, observations indicate that maize showed higher plant height i.e. 152 cm and higher LAI i.e. 3.91 under flatbed followed by BBF and FIRB respectively. From the observations its evident that sole maize crop perform well in flat bed in comparisons to BBF and FIRB where its intercropped with other short canopy crops. Sorghum also follows the almost same trend like maize in most of the observations. Under flatbed sorghum performs well. Rice does not show a definite trend under all three configurations. In flat bed it showed higher LAI but under FIRB it showed higher dry weight. Among all the crops rice showed highest LAI and highest photosynthetic rate under flat bed. Pigeon pea also showed slightly edged under flatbed among three configurations. Though here the crops did not showed a definite trend among three land configurations but still observations indicate that in kharif

Table 11. Morpho physiological traits of the different crops under Kharif season effected by various land configurations at 60 days after sowing

Land Configu-ration	Crops	Plant height (cm) at harvest	LAI	Photosynthesis rate (µ mole/ m^2/s)	Transpiration (m mole/s)	PWUE	PRUE
FLAT BED	**Maize**	152.0	3.9	27.9	6.5	4.3	1.9
	Rice	88.0	4.6	29.1	3.0	9.6	1.9
	Sorghum	128.0	3.3	26.6	6.4	4.2	1.8
	Pigeon pea	132.0	3.4	22.0	5.1	4.4	1.5
BBF	**Maize**	143.8	2.7	26.9	6.5	4.1	1.8
	Lobia	91.6	3.3	21.4	5.6	3.8	1.4
	Sesbania	78.4	0.9	22.2	4.5	4.9	1.5
	Rice	88.3	2.1	30.7	3.3	9.2	2.1
	Mungbean	80.8	3.3	23.9	7.7	3.1	1.6
	Sorghum	124.6	1.9	25.8	6.7	3.9	1.7
	Cowpea	74.8	3.1	23.1	6.1	3.8	1.5
	Sesbania	73.6	0.2	21.5	3.9	5.5	1.4
FIRB	**Maize**	96.8	2.4	21.5	4.6	4.6	1.4
	Sesbania	64.6	2.7	23.0	7.6	3.0	1.5
	Rice	92.8	3.2	27.7	6.6	4.2	1.9
	Mungbean	56.9	1.0	20.6	4.2	4.9	1.4
	Sorghum	88.4	2.1	22.4	3.5	6.5	1.5
	Sesbania	54.4	3.0	21.6	7.1	3.1	1.4
	Pigeon pea	112.8	2.0	25.4	5.9	4.3	1.7
	Sesbania	68.4	1.1	23.2	4.0	5.8	1.6

seasons crop performed well in flatbed condition.

Project title **:** Integrated nutrient management in rice based cropping systems

Sub Project **:** Sustainable rice-wheat system through integrated nutrient management

Project code **:** NRMAPDFSRSIL201000100107

Funding Agency **:** Institute based

Duration **:** Long term (1993-94)

Project Personnel **:** *V.K. Singh, R. P. Mishra, N. Subash and K. P. Tripathi*

In order to study the production sustainability and changes in soil physico-chemical as well as microbial population under integrated use of fertilizers and organic manures, a long-term study initiated in kharif 1993 on sandy loam (Typic Ustochrept) soil at Project Directorate's research farms, Modipuram, was continued consecutively for the 20th year during 2012-13. The initial values for important soil characteristics at onset of the experiment were pH 7.98, EC 0.42 dS/m, organic carbon 0.41 percent, other P 16.4 kg ha^{-1}, available K 96 kg $ha^{-1}$and available S 14.5 kg ha^{-1}. Thus, the soil was low in OC, available K and S, and medium in available P content. The experiment was conduct in randomized block design with 11 treatments, including different levels of fertilizer nutrients and partial substitution of fertilizer with farmyard manure (FYM), sulphitation press-mud (SPM), green gram residue (GR) or rice/wheat residue (CR). I worked as PI. The long term sustainability studies made during the report period is being described here as under.

Grain yields of crops and system sustainability

At onset of LTE rice yield ranged between 2.38 and 5.36 t ha^{-1} and wheat yields between 1.39 and 4.82 t ha^{-1} with the lowest yield in unfertilized control (T_1) and the highest in plots receiving recommended NPK along with S and Zn (T_3) treatments (Fig. 12). The yield (4.89 t ha^{-1}) under T_2 i.e., local recommendation was comparable with treatments having 25% NPK substitution during Kharif ($T_{4)}$ though substantially higher than plots receiving 25% of recommended N, P and K through incorporation of green gram residues after pod picking during (T_6) or treatment

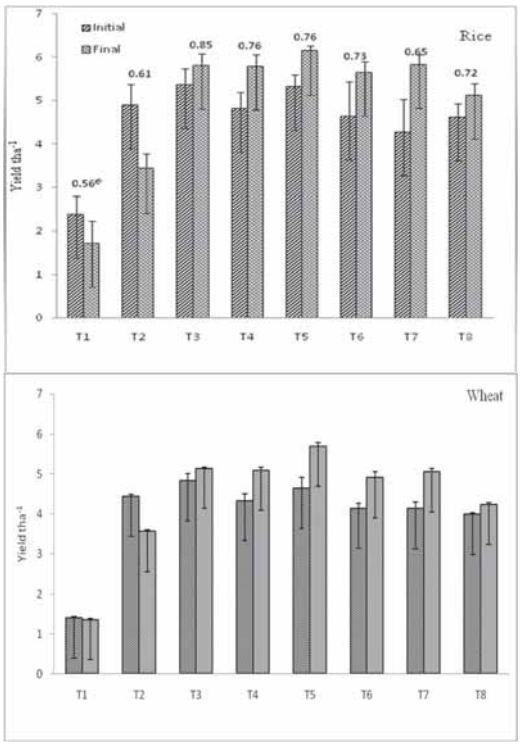


Fig. 12. Initial (1993-94 to 1995-96) and final (2008-9 to 2010-11) rice and wheat grain yield and sustainability index (1993-94 to 2010-11) as influenced by different nutrient management options. Bar Indicates the Standard error of mean (n=12) @Sustainability Index of nutrient option over the years

receiving organic inputs in both the seasons. The treatment performance, however, changed during the course of experimentation resulting into the highest yield of rice (6.13 t ha^{-1}) and wheat (5.69 t ha^{-1}) under treatments 25% substitution of recommended NPK was made through Sulphitation Press mud (T_5). A substantial temporal yield reduction of 1,47 t ha^{-1} in case of rice and 0.87 t ha^{-1} in case of wheat was recorded under T_2, indicating the inadequacy of this treatment to sustain the initially recorded yields. The yield reduction in Control (no-fertilizer, T_1) was much lower compare to T_2. Inclusion of S in fertilizer schedule helped not only sustaining the yield at initial level but recorded a yield gain of 0.31 to 0.44 t ha^{-1} over the years. The performance of treatments receiving conjoint use of fertilizer and organic constantly improve over the years, as evident from the marked yield improvements in both the crops. Among the treatment receiving fertilizer or fertilizer + organics, sustainability index compared for the entire experimentation period was lowest under T_2, which is further supported the non- sustainability of this treatment.

Project title **:** Long Term influence of Resource Conservation Technologies and crop Residue Management Practices on Crop Productivity, water requirement and soil health in Rice-Wheat cropping system

Sub Project **:** Long Term influence of Resource Conservation Technologies on Crop Productivity, weed management, water use and soil health in Rice-Wheat cropping system

Project code **:**

NRMAPDFSRSIL200400100058

Funding Agency **:** Institute based

Duration **:** 2004-2015

Project Personnel **:** *K. K. Singh, V. P. Choudhary and R. P. Mishra*

Evaluation of different resource conservation technologies for planting of rice

The comparative performance of different methods of rice planting, namely; hand transplanting (HT), transplanting by self-propelled transplanter (MT), transplanting by manual transplanter (MaT), bed planting (BP), zero till drilling (ZT), strip till drilling (ST), rotary till drilling (RT), drum seeding (DS) and sprouted broadcasting (BS), with respect to rice yield (Y), benefit: cost ratio (B: C), energy output: input ratio (EE), water use (WU), infiltration rate (IR) and weed infestation (We) was evaluated. The effect of planting methods on rice yield, benefit: cost ratio and energy efficiency is depicted in Fig. 13. The effect of planting methods on rice yield over the years is depicted in Fig. 14. We noted that the rice (Saket – 4) yield was higher in MT (7.2%), MaT (9%), ZT (6%), ST (2.1%), RT (0.8%) and BP (0.4%); but lower in DS (3%), CS (7%) and BS (10%), respectively, compared to traditional HT (5.13 t ha^{-1}). The net return was 39 higher in ZT, 32 to 35% higher in MT and MaT; 19 to 25% higher in BP, RT and ST; 17% higher in DS; but 1 and 8% lower in CS

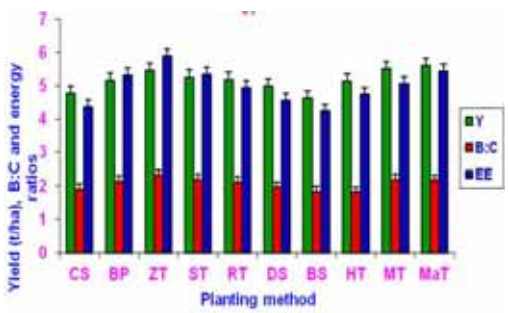


Fig. 13. Effect of planting methods on rice yield (Y), benefit: cost (B:C) and energy ratios (EE) *(CS – Conventional sowing, BP – Bed planting, ZT – Zero till drilling, ST – Strip till drilling, RT – Rotary till drilling, DS – Drum seeding, BS – Sprouted broadcasting, HT – Hand transplanting, MT – Mechanical transplanting, MaT _ Transplanting by manual transplanter)*

and BS, respectively, compared to HT (₹ 22280 ha^{-1}). The B: C ratio was 27% higher in ZT; 16 to 20 per cent higher in ST, MaT, MT, BP and RT; 0.5 to 8% higher in BS, CS and DS, respectively, compared to HT (1.82). Energy output: input ratio was 24% higher in ZT, 15 to 4% higher in all the methods except DS, CS and BS, where it was 3 to 10% lower, compared to HT (4.73). The water use was 35% lower in BP; 3 to 9 per cent lower in all other methods except CS, DS and BS, where it was 3 to 5% higher, compared to HT (214 ha-cm). The infiltration rate was maximum in BP (87 mm day^{-1}) and lowest (39 to 43 mm day^{-1}) in the three transplanting methods because of puddling. The weed dry matter was 64 to 206% higher in all the methods but 34 and 39 per cent lower in MaT and MT, compared to HT (67 kg ha^{-1}).

Rice seeding machines saved cost upto 81% along with higher grain production upto 14% over conventional sowing

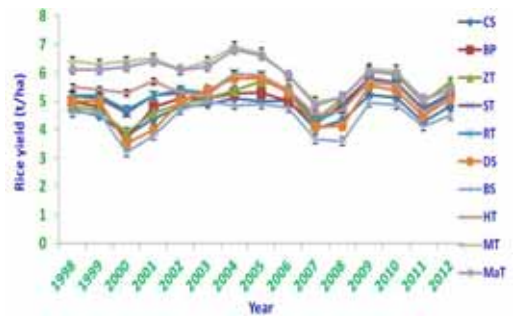


Fig. 14. Effect of planting methods on rice yield over the years

(CS – Conventional sowing, BP – Bed planting, ZT – Zero till drilling, ST – Strip till drilling, RT – Rotary till drilling, DS – Drum seeding, BS – Sprouted broadcasting, HT – Hand transplanting, MT – Mechanical transplanting, MaT _ Transplanting by manual transplanter)

Evaluation of different machines for direct dry seeding of rice

Mechanical seeding of wheat saved a cost upto 76%

Five machines for direct dry seeding of rice, namely; conventional drill (CS), zero-till drill (ZT), strip-till drill (ST), rotary-till drill (RT) and bed planter (BP) were evaluated using uniform seed (Saket - 4) rate of 30 kg ha^{-1}. Under ZT, ST, RT and BP sowing was done directly without any field preparation but sowing under CS was done after preparing the field with two harrowing, 2 cultivator passes and one planking operations. The row spacing was kept at 180 mm in CS, ZT, ST and RT, and 120 mm in BP.

The performance parameters of different rice seeding machines saved time (87 to 84%), labour (85 to 81%), diesel (86 to 60%), cost (81 to 63%), energy (86 to 61%) and also irrigation water (8 to 36%) as compared to conventional sowing. The rice yield, economics and energy use affected by different methods is presented in Fig. 13. The zero till drilling produced higher rice (14 %), net returns (40 %), B: C ratio (21 %) and energy output: input ratio (35 %), compared to conventional sowing. The rotary till drilling produced higher rice (8%), net returns (22%), B: C ratio (11%) and energy output: input ratio (13 %), compared to conventional sowing. The strip till drilling produced higher rice (10 %), net returns (26 %), B: C ratio (14 %) and energy output: input ratio (22 %), compared to conventional sowing. The bed planting produced higher rice (8 %), net returns (20 %), B: C ratio (12 %) and energy output: input ratio (22 %), compared to conventional sowing.

Evaluation of different drill machines for planting wheat succeeding rice

The comparative performance of different machines namely; bed planter (BP), zero-till drill (ZT), strip-till drill (ST), rotary-till drill (RT), and conventional drill (CS), in terms of wheat yield (Y), benefit: cost ratio (B: C), energy output: input ratio (EE), water use (WU), infiltration rate (IR), *Phalaris minor* (PM) and other weeds (OWE) was assessed. The effective field capacities of RT, ST, ZT, BP and CS were 0.42, 0.39, 0.52, 0.35 and 0.45 ha h^{-1}, respectively. The rotary,

strip and zero till drilling and bed planting were time saving (74 to 81%), labour saving (68 to 77%), diesel saving (63 to 82%), cost saving (67 to 76%), energy saving (63 to 85%) and also irrigation water saving (9 to 34%) compared to conventional sowing of wheat. Also, there was saving of about 20-25% in seed and fertilizer inputs in bed planting compared to conventional sowing. Zero, strip and rotary till drills and bed planter provided higher wheat yields (8-12%), net returns (8-19%), cost effectiveness (8-13%) and energy efficiency (19-26%); and reduced *Phalaris minor* (57-82%), other weeds (65-82%), compared to conventional sowing of wheat (Fig. 15). The effect of planting methods on wheat yield over the years is depicted in Fig. 16.

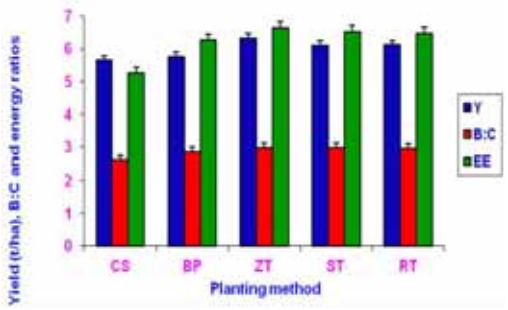


Fig. 15. Effect of planting methods on wheat yield (Y), benefit: cost (B:C) and energy ratios (EE) *(CS – Conventional sowing, BP – Bed planting, ZT – Zero till drilling, ST – Strip till drilling, RT – Rotary till drilling)*

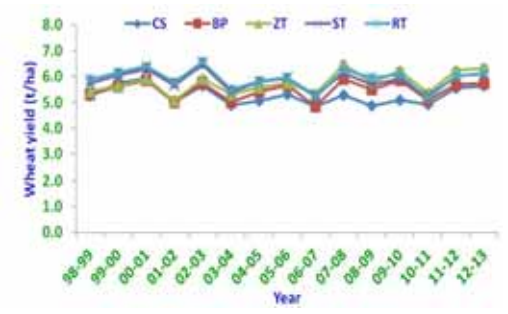


Fig. 16. Effect of planting methods on wheat yield over the years
(CS – Conventional sowing, BP – Bed planting, ZT – Zero till drilling, ST – Strip till drilling, RT – Rotary till drilling)

The effect of different resource conservation technologies on soil organic carbon (OC), mean weight diameter of aggregates (MWD) and percent change in OC and MWD revealed that there was an improvement in soil properties by the use of these drills. Zero till drilling resulted in maximum moisture content at all the growth stages of crop, minimum cone index and bulk density, and maximum OC and MWD than any other method. Bed planting, and zero and strip till drilling improved soil organic carbon (15-39%) whereas rotary till drilling and conventional sowing reduced OC (2-13%) after fifteen crop cycles. Bed planting, and zero and strip till drilling also improved mean weight diameter of aggregates, MWD (18-72%), whereas rotary till drilling and conventional sowing reduced MWD (13-20%) after fifteen crop cycles.

Mechanical seeding of wheat is very much effective in reduction of *Phalaris minor* infestation upto 82%

Sub Project **:** Long Term influence of Resource Conservation Technologies on Crop Residue Management practices on crop productivity and soil health in Rice-Wheat cropping system

Project code **:**
NRMAPDFSRSIL 200400100058

Funding Agency **:** Institute based

Duration **:** 2004-2015

Project Personnel **:** *K. K. Singh, V. P. Choudhary and R. P. Mishra*

A field experiment is in progress since 1998 to study the energy requirement and cost of recycling of rice-wheat straw after combine harvesting and to evaluate the performance of subsequent crops in straw recycled fields. The recycling was done by rotavator and achieved in shallow layer only (20-50 mm). The action of rotavator was to impart rotation to successive bites of soil so that chopped/ broken straw falls between these bites for uniform mixing with the

soil. After harvesting of rice and wheat, three straw management practices (recycling, retrieval and burning) were practiced before the planting of next crop. Self-propelled transplanter was used for transplanting of rice after wheat straw recycling. Zero, strip and conventional drills were used for wheat sowing after rice straw recycling. It was observed that recycling of rice (5 to 6 t ha^{-1}), as well as wheat straw (8 to 9 t ha^{-1}), the degree of recycling was 75-80% and cost and energy of recycling of ₹ 4250 ha^{-1} and 2425 MJ ha^{-1}, respectively. There was appearance of yellowing in seedlings at the initial stage but subsequent establishment and growth of crops was found similar to non-straw recycled fields. The recycled wheat straw got decomposed after about 50 to 55 days in rice fields.

The effect of different crop residue management practices on yield, benefit: cost ratio (B: C) and energy efficiency (EE) of rice and wheat are given in Fig. 17. The effect of crop residue management practices on the yield of rice and wheat over the years is depicted in Figs. 18 and 19.

Insitu recycling of wheat straw produced upto 14% higher grain yield of rice over straw retrieval and burning treatments

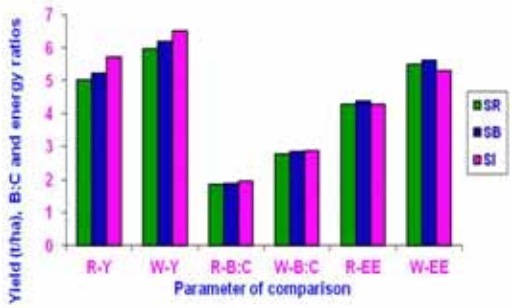


Fig. 17. Effect of crop residue management practices on yield (Y), economics (B:C) and energy efficiency (EE) of rice (R) and wheat (W)
(SR – Straw removed, SB – Straw burnt, SI – Straw incorporated)

Crop residue recycling improved soil organic carbon upto 43% over 15% crop cycles

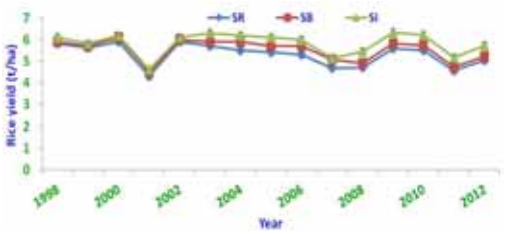


Fig. 18. Effect of crop residue management practices on rice yield over the years
(SR – Straw removed, SB – Straw burnt, SI – Straw incorporated)

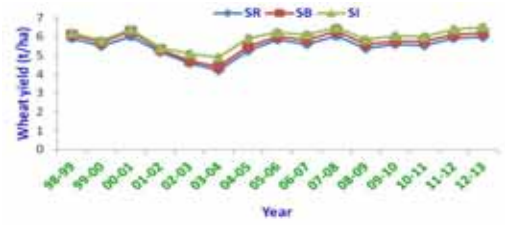


Fig. 19. Effect of crop residue management practices on wheat yield over the years
(SR – Straw removed, SB – Straw burnt, SI – Straw incorporated)

The *insitu* recycling of wheat straw produced 14 and 10 per cent higher rice yield than straw retrieval and burning treatments, respectively. The net returns under straw recycling were 22 and 14 per cent higher; B: C ratio and energy output: input ratio were 7 and 4% higher, and 0.5 and 0.2 per cent higher, respectively. The recycling of rice straw increased the wheat yield (9%), net returns (11%) and B: C ratio (4%). Crop residue recycling improved mean weight diameter of aggregates, MWD (15%), whereas retrieval decreased MWD (5%) compared to initial values after fifteen crop cycles. energy output: input ratio (3%) compared to straw retrieval treatment. Crop residue recycling and burning improved soil organic carbon, SOC (43 and 11%) whereas retrieval decreased SOC (11%) compared to initial values after fifteen crop cycles. The

recycling also improved SOC (22 and 15%) compared to retrieval and burning treatments.

Project title **:** Resource conservation modules for high yield realization for different cropping systems

Project code **:** NRMAPDFSRSIL200700900090

Funding Agency **:** Institute based

Duration **:** 2007-13

Project Personnel **:** *V. P. Choudhary and M. Shamim*

The field trial was undertaken at Modipuram to study the effect of tillage, mulch and fertilizer management practices on growth, productivity, soil fertility and economics of rice based cropping systems. Two tillage systems, four cropping systems and four crop residue mulching and fertilizer combination were factorially combined in a split-split plot design with three replications. The tillage systems (main plots) were: no tillage (NT) and conventional tillage (CT), i.e. 4 harrowing and one patella. The cropping systems (sub-plots:C_1- rice-wheat; C_2- rice-winter maize; C_3-rice-barley and C_4- rice-mustard). The crop residue used as mulching and fertilizer combination treatments (sub-sub-plots) consisted of four M_1 - No mulch + recommended dose of fertilizer (RDF), M_2 - Mulch (6 t/ha) + recommended dose of fertilizer (120:60:40 kg NPK) (RDF), M_3 - Mulch (0) +125% recommended dose of fertilizer (RDF), M_4 - Mulch (6 t/ha) +125 % recommended dose of fertilizer (RDF). A recommended fertilizer dose of 120-60-40 kg ha^{-1} was applied in all *rabi* crops. All the crops were sown as per recommended package and practices with seed rate 100, 25, 100, 6 kg ha^{-1} and line spacing 20, 60, 20 and 45 cm apart of wheat (PBW-343), maize (Naveen), barley (K-508) and mustard (Pusa bold), respectively.

Effect of growth parameters of wheat

The crop growth parameters of crops (i.e. Leaf area index (LAI), shoot & root dry weight and total biomass mass accumulation) were analysed. The leaf area index (LAI), shoot dry weight, root dry weight and total biomass accumulation (Fig. 20) were influenced significantly (P=0.01) by residue mulching with combination of recommended dose of fertilizer (RDF) – M at beginning grain filling (BGF) and dough stages, however, at ear emergence stage, it was only significant (P=0.01) on shoot dry weight and total biomass accumulation. Tillage system influenced significantly (P=0.05) on shoot dry weight and total biomass accumulation at all three growth stages *i.e.* ear emergence (EE), BGF and dough stages, however, on LAI at dough stage, it significant at P=0.01. Zero tillage treatment has shown higher value as compared to conventional tillage but not significant in respect of all parameters. Significantly (P=0.01) higher growth parameters (*i.e.* LAI, shoot dry weight, root dry weight and total biomass accumulation) at almost three stages were observed in treatments M_4 than M_2, M_1 and M_3. Except at ear emergence stage of LAI and root biomass, the treatments M_4 was noticed at pat with other treatments. The lowest all growth parameters were observed in M_1 and most of cases it was at par with M_3. The

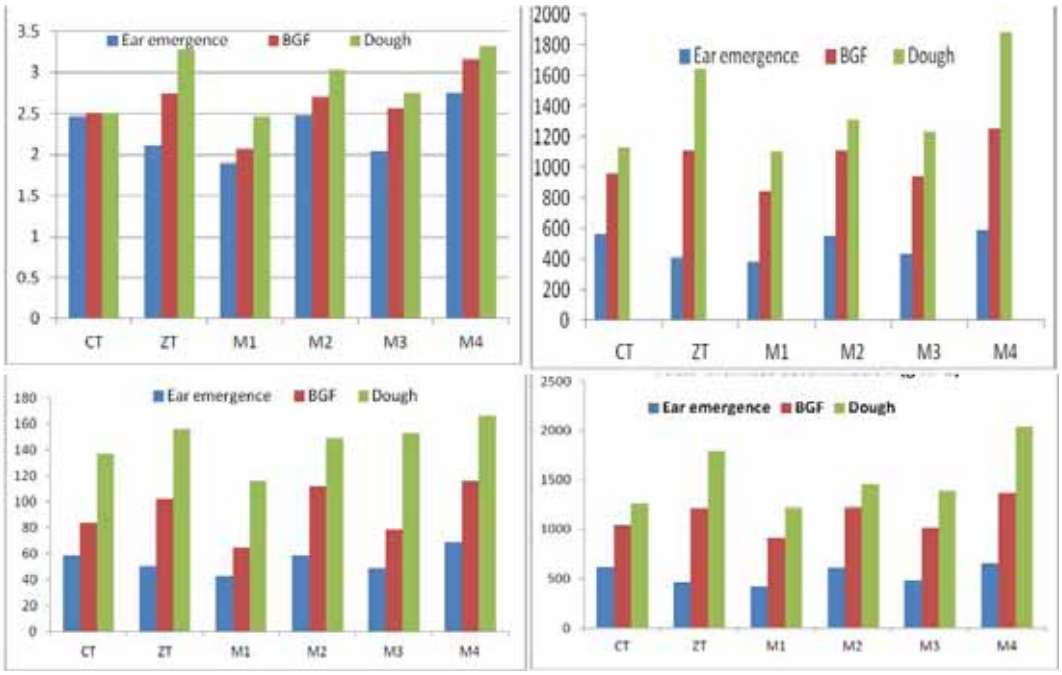


Fig. 20. The growth parameters (LAI, shoot dry weight, root dry weight and total biomass accumulation) of wheat crop

interaction of tillage system with crop residue mulching and combination of RDF was significant at P=0.01 on LAI at BGF and root biomass at dough stage but other all interactions were not significant.

Effects of tillage, crop residue mulching and fertilizer application on systems productivity

The tillage influence significantly ($P < 0.05$) on REY, whereas, the cropping systems and crop residue mulching and RDF combination significantly ($P < 0.01$) affect on rice equivalent yield (REY). However, the interactions of tillage with cropping systems, rice residues mulching x RDF and cropping system with rice residues mulching x RDF were responded non-significant. The tillage increased significantly ($P < 0.05$) the REY of all years as well as pooled REY in CT plot as compared to ZT plot. It was due to different winter crops like wheat, winter maize, barely and mustard which had converted in REY. It was revealed that some crops like mustard were not performed well in zero till plot as compared conventional plots. After four years continuous no till and tillage plot, the yield difference among the treatments was less than initial year yield but it was significant difference ($P < 0.05$). Significantly ($P < 0.01$) higher pooled REY observed in C_1 (12.35 Mg ha^{-1}) than other treatment. Significantly ($P < 0.01$) lowest REY observed in C_4 (rice- mustard system) than C_2 and C_3 which was at par. Similar results were also observed in all years of REY. Significantly higher ($P < 0.01$) REY recorded in treatment M_4 and M_2 as compared to M_1 and M_3 which also had significant difference ($P<0.01$) in all year REY as well as pooled data except 2011-12 REY where pattern was same but significant difference at $P < 0.05$ in all treatments. The REY in treatment M_4 and M_2 had shown at par value in all years. The REY was ranked in order $M_1 < M_3 < M_4 < M_2$ in all years. From time series analysis of change of REY over the years due to different treatments, it was conspicuous that initial

Conventional tillage increased the rice equivalent yield over zero tillage

years yield improvement was not higher in CT (R^2 = 0.40, P < 0.05) compared to NT (R^2 = 0.15) (Fig. 21). Improvement of REY was higher in rice-mustard sequence compared to other cereal-cereal systems.

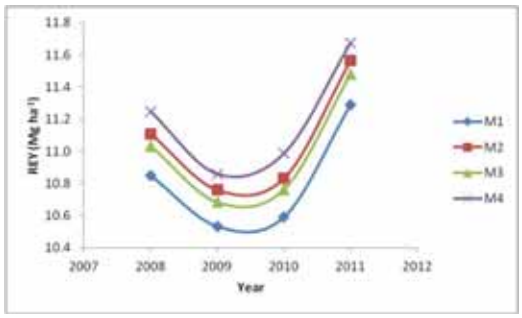


Fig. 21. Rice equivalent yield as influenced by tillage, cropping systems and nutrient management over the years (time series)

Project title **:** Climate Change: Effects on productivity of Rice-wheat cropping system in western plain zones of U.P. and its mitigation by using DSSAT model

Project code **:**

NRMAPDFSRSIL201000800114

Funding Agency **:** Institute based

Duration **:** 2010-2015

Project Personnel **:** *M. Shamim, K. P. Tripathi and Sudhir Kumar*

A field experiment was started during *kharif* 2010 to calibrate and validate the DSSAT model to find out the effects of climate change on productivity of rice-wheat cropping system and its mitigation strategies by using DSSAT model in western plain zone of Uttar Pradesh. Two wheat genotypes *viz,* PBW 343 and PBW 226 with two levels of Nitrogen (60 Kg ha^{-1} and 150 Kg ha^{-1}) were sown on three different dates viz, D_1 (4^{th} week of October), D_2 (4^{th} week of November) and D_3 (4^{th} week of December) with four replications during *Rabi* 2012-13. Two rice genotypes *viz,* Pusa Sugandha 4 (PS 4) and Saket 4 with two levels of Nitrogen (60 Kg ha^{-1} and 150 Kg ha^{-1}) were transplanted on three different dates viz, D_1 (3^{rd} week of June), D_2 (1^{st} week of July) and D_3 (3^{rd} week of July) in four replications during *Kharif* 2013.

Validation of the CERES-Rice and CERES- Wheat model with observed data

The DSSAT family of CERES-Rice model was employed to simulate grain yield and biomass of rice crop for comparison with those respective ones which were observed under field experiment with a view to assess the performance of the model in simulating the results of these characters. The results of simulated yields are described below.

The simulated grain yield by the model was in higher side in general but correlation coefficient (r=0.61) between the simulated and observed grain yield was significantly associated (P=0.05). Other test criteria for evaluation of model were also computed and presented in Table 12. Lower RMSE also shows the strength of the model. Per cent error was also low in 3^{rd} week of June and 1^{st} week of July transplanting. However average per cent error was high (Fig. 22 and Table

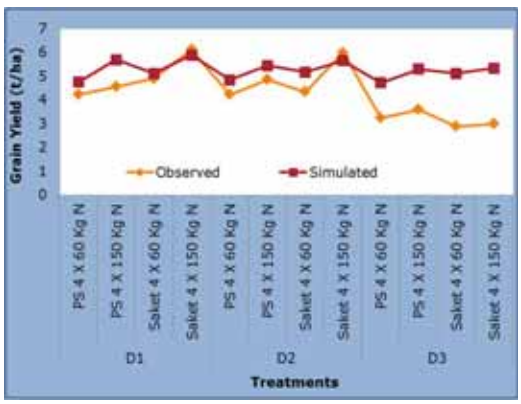


Fig. 22. Treatmentwise validation of the CERSE-Rice Model in terms of grain yield of rice with observed data

12) and it was only due to overestimation of the grain yield in case of 3rd week of July. Simulation results also revealed model performs well in simulation of grain yield in case of cultivar Saket over the Pusa Sugandha 4.

Table 12. Statistical tools used for validation of the CERES-Rice and CERES-wheat model

Statistical tools used	Rice	Wheat
Observed mean yield (t ha^{-1})	4.33	4.785
Standard deviation of observed yield (t ha^{-1})	1.05	1.205
Simulated mean yield (t ha^{-1})	5.26	4.733
Standard deviation of simulated yield (t ha^{-1})	0.38	1.063
Correlation coefficients between simulated and observed values	0.61	0.981
Mean average error	1.02	0.008
Mean biased error	0.92	-0.053
Root mean square error	1.25	0.256
Percent error	28.84	5.356

The simulated grain yield by the model was found quite closer to the observed values of both the wheat cultivars (Fig. 23). Almost all the test criteria used for validation of the model was found in the support of the strength of the CERES-wheat model to simulate the grain yield in Western Plain zone of Uttar Pradesh across the sowing window of the crops (Table 12).

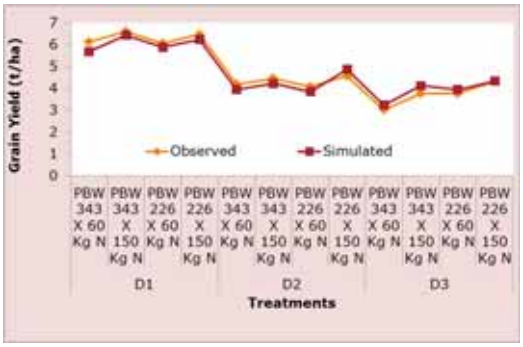


Fig. 23. Treatmentwise validation of the CERSE-Wheat Model in terms of grain yield of whaet with observed data

Probability of performance of various treatments of rice under rice wheat cropping system on the long term simulation basis using APSIM

Long-term (1993-2010) simulation of APSIM crop model revealed the consistency in the productivity of the wheat crop was higher in the treatments fertilized with higher dose (150 Kg N ha^{-1}) in comparison to other treatments under rice wheat cropping system (Fig. 24). The grain yield (t ha^{-1}) with probability of 80 percentile was remained in the range of 2639 and 5855.

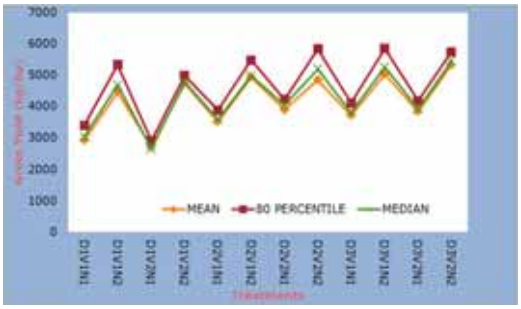


Fig. 24. Probability of performance of various treatments of rice under rice wheat cropping system on the long term simulation basis using APSIM

Project title **:** Studies on water and nitrogen use efficiency of different varieties of rice under aerobic conditions

Project code **:** NRMAPDFSRSIL201001000116

Funding Agency **:** Institute based

Duration **:** 2010-2015

Project Personnel **:** *R. P. Mishra*

Field experiment was conducted to assess the water and nitrogen use efficiency of different rice and wheat cultivars in rice-wheat system (RWS) under aerobic conditions. Four rice cultivars (Subhangi, PRH 10, Saket-4 and Pro-agro 6444) and wheat cultivars

(PBW 373, PBW 343, Lok-2 abd PBW 226) with three sources of N (Normal urea, neem coated urea and sulphur coated urea) and three level of soil moisture tension (0, 20 and 40 K Pa) during rice and (0.3, 0.5 and 0.7 atm) during wheat were tested in split-plot design and replicated 03 times. The major outcomes of the study during the report period are given here as under.

Results reveals that 0 K Pa moisture tension along with sulphur coated urea has maximum productivity in term of rice yield equivalent (13.4 t/ha) under rice (CV PRH-10) wheat (CV PBW-343) system. Application of sulphur coated urea proved its superiority over neem coated urea in terms of N use efficiency and over all rice, wheat and rice-wheat system productivity. Interactive effect of soil moisture regime and coating of urea fertilizer was fond significant in improving water productivity in rice. Use of sulphur coated urea at 40 K Pa has highest irrigation water productivity (61.5 kg/ ha-cm) which was 44% higher than that of simple prilled urea applied at 0 K Pa moisture regime. In wheat also, Maximum water productivity was noticed with sulphur-coated urea applied at 0.7 atm moisture tension which was almost equal to the irrigation applied at 0.5 atm. In rice water productivity was maximum under (CV Arize-6444) grown at 40 K Pa soil moisture tension closely followed by 20 K Pa irrigation regime. In succeeding wheat, water productivity ranged between 99.5 kg/ha-cm to 299.7 kg/ha-cm and maximum being with (CV PBW-550) grown at 0.7 atm soil moisture tension. An interactive effect of soil moisture regime, fertilizer sources and cultivars grown indicate that application of water at 0.7 atm in wheat (CV PBW-550) along with sulphur coated urea was optimum for irrigation water use and higher water productivity (Fig. 25). After 03 rice-wheat cycle, soil organic carbon and available N content were more under sulphur coated urea applied plots which was significantly at par to the neem coated urea but much superior (P=0.05) over normal prilled urea. Varietal variation in rice and wheat could not produce any significant effect on soil organic carbon and available N content. Fertilizer sources and soil moisture regime had interactive effect on available N content and values were more under sulphur coated urea and irrigation at 40 K Pa in rice and 0.5 atm in wheat crop.

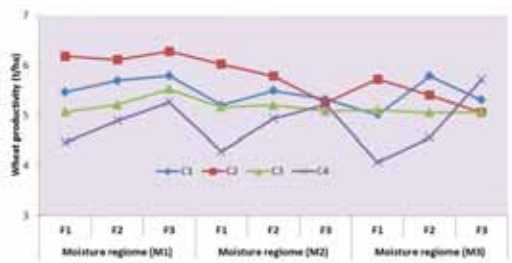


Fig. 25. Interactive effect of moisture regime, fertilizer sources and wheat cultivars

Organic Agriculture Systems

Project title **:** Development of organic farming package for maize-potato-onion system

Project code **:** NRMAPDFSRSIL200300200048

Funding Agency **:** Institute based

Duration **:** 2003 – 2014

Project Personnel **:** *S.S. Pal*

Highest maize equivalent yield (31.1 t ha^{-1}) was recorded under treatments which received organic source of nutrients + rock phosphate and bio fertilizer N & P

The experiment is being conducted since 2003 and has completed 9th crop cycles. Seven treatments *viz.* 50% recommended NPK + Zn + S as per soil test + 50% N as FYM (T_1); 100% organic nutrient sources as FYM, vermi compost and neem oil cake each equivalent to 1/3 of recommended N (T_2); T_2 + intercropping (T_3); T_2 + agronomic practices for weed and pest control without addition of chemical sources of plant protection (T_4); T_2 + bio fertilizers containing N and P carries+ rock phosphate (T_5) ; T_2 + bio fertilizers containing N and P carries (T_6) and 100% NPK + Zn + S based on soil test (T_7) were compared at PDFSR research farm.

Highest grain yield (6.6 t ha^{-1}) of maize during kharif 2012 was recorded under T_6 which received organic nutrient sources each equivalent to 1/3 recommended N and bio fertilizers containing N and P carriers. Percent yield increase under this treatment was 11.9 % compared to T_7. The yield increase under other organic nutrient management packages varied from 5.1 to 10.2 % (Table 13). Highest grain yield (25.6 t ha^{-1}) of potato was achieved under T_5 which received T_2 + rock phosphate and bio fertilizers containing N and P carries. Potato yield was increased in T_5 (32%) as compared to treatment T_7 (Table 13).

Highest tuber yield (16.8 t ha^{-1}) of onion was recorded under T_4 which received organic sources each equivalent to 1/3 N requirement of crops as FYM, Vermicompost and neem oil cake and agronomic practices for weed and pest control. The percent yield increase in this treatment over T_7 was highest 18.3%. However, maize equivalent yield was highest (31.11 t ha^{-1}) under T_5 which received organic

sources of nutrients + rock phosphate and bio fertilizer N & P it increased 37.1% over T_7 (Table 13).

After completion of 9th crop cycles, soil fertility status under different organic nutrient management has been presented in (Table 14). Organic carbon and available N were highest under T_3 at 0.66% and 289 kg ha^{-1}. Av. P and K were highest under T_3 and T_5 and microbial biomass carbon (383.5 µg g^{-}

Table 13. Yield of crops in maize-potato-onion system under organic nutrient management packages

Treatments	Crop Yield (t ha^{-1})			MEY (t ha^{-1})	% I / D over T_7			System Yield
	Maize	Potato	Onion		Maize	Potato	Onion	
T_1	6.2	20.5	14.8	23.9	5.1	5.7	4.2	5.1
T_2	6.5	24.8	15.8	30.9	10.2	27.8	11.2	35.9
T_3	6.1+1.5*	23+2.5**	16.2	30.6	-	-	13.7	34.7
T_4	6.3	22.3	16.8	29.8	6.8	15.1	18.3	31.2
T_5	6.4	25.6	15.6	31.1	8.5	32.0	9.9	37.1
T_6	6.6	23.8	14.7	29.7	11.9	22.7	3.6	30.9
T_7	5.9	19.4	14.2	22.7	0.0	0.0	0.0	0.0

* Intercrop yield of cowpea; ** Intercrop yield of radish

Table 14. Soil fertility after completion of 9th crop cycle in maize-potato-onion system

Treatments	Soil parameters					Increase / Decrease over initial				
	O.C. (%)	Av. N (kg ha^{-1})	Av. P (kg ha^{-1})	Av. K (kg ha^{-1})	MBC (µg g^{-1} soil)	O.C. (%)	Av. N (kg ha^{-1})	Av. P (kg ha^{-1})	Av. K (kg ha^{-1})	MBC (µg g^{-1} soil)
T_1	0.63	271	31.80	265.0	348.9	31.3	81.9	191.7	29.9	203.4
T_2	0.64	254	28.10	225.0	352.3	33.3	70.5	157.8	10.3	206.3
T_3	0.66	289	33.40	218.0	371.2	37.5	94.0	206.4	6.9	222.8
T_4	0.63	268	32.90	220.0	352.3	31.3	79.9	201.8	7.8	206.3
T_5	0.64	235	33.80	250.0	318.6	33.3	57.7	210.1	22.5	177.0
T_6	0.66	264	29.50	241.0	383.5	37.5	77.2	170.6	18.1	233.5
T_7	0.52	221	22.40	182.0	225.1	8.3	48.3	105.5	-10.8	95.7
Initial	0.48	149	10.9	204	115	0.0	0.0	0.0	0.0	0.0

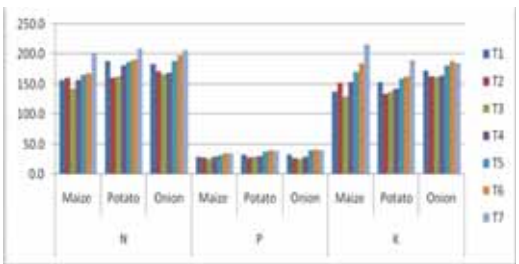


Fig. 26. Nutrient uptake in M-P-O crop under organic nutrient management packages

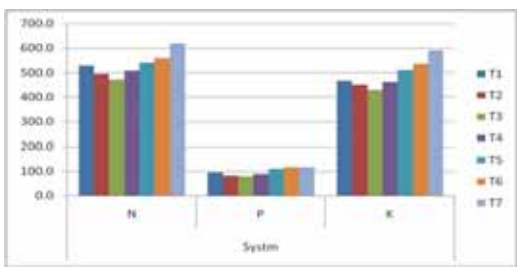


Fig. 27. Nutrient uptake in M-P-O system under organic nutrient management packages

^{1}) soil under T_6. The uptake of N, P and K in individual crop and also in the system has been presented in (Fig. 26). The total N, P and K uptake in the system was 557.5, 114.8 and 535.7 kg ha^{-1} under T_6 respectively among organic treatments (Fig. 27). Irrespective of treatments, microbial population was highest under maize crop compared to onion. Further, important fact is that compared to inorganic and integrated nutrient management packages, organic nutrient management packages harbored higher microbial population in terms of bacteria, fungi, actinomycetes and phosphate solubilizing bacteria and treatment T_6 was superior to all (Fig. 28).

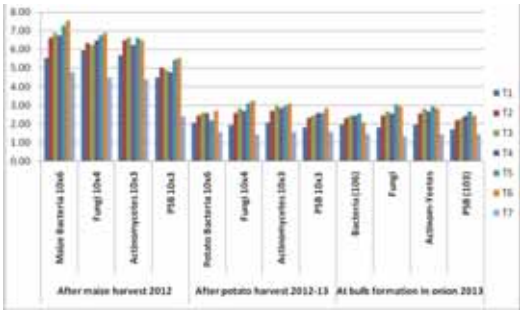


Fig. 28. Effect of organic nutrient management packages on microbial population (2012-13) in M-P-O system

Project title **:** Carbon accounting of farming systems in Meerut district (Exploratory study approved for one year)

Project code **:** ES/01/2013

Funding Agency **:** Institute based

Duration **:** 2013 – 2014

Project Personnel **:** *R. S. Yadav, Anil Kumar and N. K. Jat*

The project was started from April, 2013 with the objectives of i) quantification of C in terms of CO_2 equivalent emissions for effective and targeted C management strategies in farming system, ii) identification of C hot spots for targeting mitigation of CO_2, and iii) conceptualizing C minimum farming system models. To achieve these objectives, activity data schedule for collecting activity data was prepared. Four blocks viz. Sardhana, Hastinapur, Rohta and Rajpura blocks of Meerut district were selected. From each block, two villages and from each village, 10 farm households were selected for the study. The C accounting methodology follows the standard Intergovernmental Panel on Climate Change (IPCC) accounting and reporting guidelines with available default and country specific emission coefficients. The C accounting took into account the three Green House Gases (GHG) viz. CO_2, CH_4 and N_2O. CH_4 and N_2O emission was converted into CO_2 equivalent by Global Warming Potential (GWP) of 1 for CO_2, 21 for CH_4 and 310 for N_2O. The study also took C sequestered by trees on the farms into account for net emission of GHGs. The operational boundary of the study consisted of agricultural soils, livestock production, paddy cultivation, farm operations, crop residue burning and farm families.

Total mean emission of GHG from farming systems in the Meerut district was found to be 9.76 ton farm house $hold^{-1}$ yr^{-1} with net emission of 6.16 ton farm $household^{-1}$ yr^{-1} (Table 15). In the district, Hastinapur block contributed 37.5 per cent of the total emission of GHG followed by the Rohta block (25.1 per cent), Rajpura block (20.9 per cent) and Sardhana block (16.5 per cent), while the net emission was maximum in Rajpura block (30.5 per cent) followed by Hastinapur block (29.1 per cent), Rohta (20.7 per cent) and Sardhana (19.7 per cent).

Among different categories of emission sources in the district (Table 1), livestock contributed 58.2 per cent of

Table 15. Source and block wise emission of CO_2 and CO_2-e (kg) farm household^{-1} yr^{-1} in the Meerut district

Category	Hastinapur	Rajpura	Sardhana	Rohta	Mean
Livestock	8760	3901	3977	6070	**5677**
Agricultural soils	3835	2027	1076	1846	**2196**
Paddy cultivation	31.1	232	49.0	0.00	**78.0**
Farm operations	549	741	375	589	**564**
Residue burning	222	95.1	78.0	131	**132**
Farm Families	1240	1178	880	1143	**1110**
Total emission	**14637**	**8174**	**6435**	**9779**	**9756**
Net emission	**7162**	**7507**	**4860**	**5101**	**6157**

total CO_2 equivalent emissions followed by agricultural soils (22.5 per cent) by N application in crops, farm families (11.4 per cent), farm operations (5.78 per cent), residue burning (1.35 per cent) and paddy cultivation (0.800 per cent). Among the blocks under study, contribution to emission of GHGs from livestock varied between 47.7 – 62.1 per cent with lowest in Rajpura block and highest in Rohta block. Likewise, contribution to emission of GHG from agricultural soils by application of N through fertilizer, manure and residue incorporation varied between 16.7 – 26.2 per cent, from farm families between 8.48 – 14.4 per cent, from farm operation between 3.75 – 9.07 per cent and residue burning between 1.16 – 1.52 per cent with corresponding lowest in Sardhana, Hastinapur, Hastinapur, Rajpura and highest in Hastinapur, Rajpura, Rajpura and Hastinapur blocks, respectively.

By adopting agroforestry with additional trees of 273 per farm household with an average size of holding of 2.07 ha makes the farming systems in the Meerut district C neutral. In other words, it is advocated that by planting 132 trees more ha^{-1} or having 209 trees ha^{-1} by each farm households in the Meerut district, farm households can be C neutral. At block level, planting 318, 334, 216 and 227 additional trees per farm household makes the farms C neutral in Hastinapur, Rajpura, Sardhana and Rohta block, respectively. Further, by adopting minimum balanced fertilization, better livestock management, reducing farm operations and adopting energy efficiency measures by farm families can make the farming systems C –ve by 1.18 t CO_2 –e farm household^{-1} year^{-1} in the district.

Through additional plantation of 273 trees per farm household with an average size of 2.07 ha makes the farming system carbon neutral in Meerut district

Project title **:** Conservation agriculture based weed management practices in rice-wheat cropping system

Project code **:** NRMAPDFSRSIL201200300129

Funding Agency **:** Institute based

Duration **:** 2012-2016

Project Personnel **:** *N. K. Jat, R. S. Yadav and Sudhir Kumar*

The experiment was carried out in split plot design with three replications with four crop establishment techniques *viz.*, rice-wheat (conventional), rice (DSR-ZT) - wheat (ZT), rice (DSR-ZT) - wheat (ZT) + rice residue and rice (DSR-ZT) - wheat (ZT) + rice residue+ summer mungbean in main plots and five weed management practices as W_1 (weedy

Conventional method of rice transplantation yielded higher grain over other methods of seeding of rice

check), W_2 (Bispyribac15-25 DAS @ 25 g a.i./ha),W_3 (Pendimethalin @ 1.2 kg a.i./ha+ Bispyribac 15-25 DAS @ 25 g a.i./ha), W_4 (Glyphosate @ 1.0-1.5 kg a.i./ha + Pendimethalin @ 1.2 kg a.i./h) + Bispyribac15-25 DAS @ 25 g a.i./ha) and W_5 (weed free) applied to rice in sub-plots. In wheat, weed management was done by applying W_1 (weedy check), W_2 (Sulfosulfuron+Metsulfuron 30-35 DAS @ 25+2 g a.i./ha), W_3 (Pendimethalin @ 1.2 kg a.i./ha) + PoE (Cladinofop 30-35 DAS @ 60 g a.i./ha), W_4 (Glyphosate @ 1.0-1.5 kg a.i./ha) + (Pendimethalin @ 1.2 kg a.i./ha) + (Carfentrazone30-35 DAS @ 20 g a.i./ha) and W_5 (weed free) in sub-plots and replicated thrice. In rice, conventional (puddled transplanted) rice recorded significantly higher grain yield (11.0%), weed control efficiency (WCE) (66.1%) and significantly lower weed density and weed dry weight over direct seeded zero tilled rice (DSR-ZT). Among weed management practices, W_5 (glyphosate+pendimethalin+bispyribac) recorded the significantly highest grain

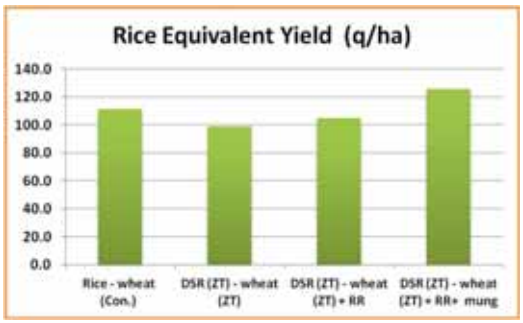


Fig. 29. System productivity in terms of Rice Equivalent Yield under different crop establishment techniques of rice and wheat

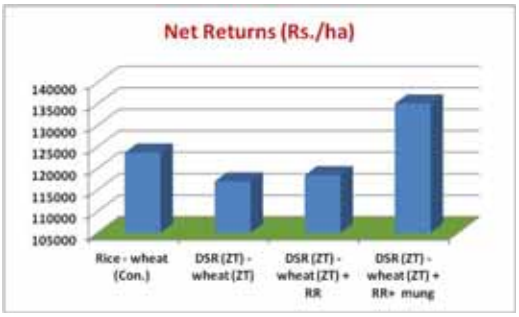


Fig. 30. Net returns of rice-wheat system under different crop establishment techniques

yield (38.1%) and WCE (73.9%); and significantly lowest weed density and weed dry weight over weedy check. In wheat, the significantly highest grain yield (6.43 t/ha), weed control efficiency (WCE) (64.9%) and significantly lower weed density and weed dry weight was recorded in conventional practice over zero tilled wheat. However, zero tilled wheat with residue management recorded the higher grain yield (6.14 t/ha) and lesser weed density (43.5%) over zero tilled without residue management. Among weed management practices, W_3 (sulfosulfuron+metsulfuron) recorded the significantly highest grain yield (63.6%) and WCE (73.2%); and significantly lowest weed density (74.3%) and weed dry weight over weedy check. The system of rice (DSR-ZT) - wheat (ZT) + rice residue - summer mung recoded the 8.68% higher system productivity (REY, 125.5 q/ha) and 8.40% higher net returns (Rs. 135060) over rice - wheat (conventional) (Figs. 29 & 30).


Technology Transfer & Human Resource Development

Project title **:** Proven systems based technologies under demonstration

Project code **:** NRMAPDFSRSIL 200701000091

Funding Agency **:** Institute based

Duration **:** 2007-2014

Project Personnel **:** *M.P. Singh and B. Gangwar*

Different proven technologies based cropping systems (25 nos.) viz., vegetable based (8 nos.), cereal based (12 nos.), and pulse based cropping systems (5 nos.) were demonstrated in the technology park of PDFSR. All of the systems comprised of different proven improved technologies (improved verities, system for rice intensification(SRI), mechanical transplanting of rice, nutrient management, relay cropping ,inter cropping in sugarcane ,green manuring (GM), raise bed planting(RB) ,broad bed furrow system(BBF), zero tillage technology in wheat, mustard and lentil, crop residue management in wheat) superimposed with each other. Farmers practice was also demonstrated to compare the technologies. To evaluate the above cropping systems rice equivalent yield (REY t ha^{-1}) and net returns per day ha^{-1} were calculated by considering the cost of cultivation and income. Results obtained from the study revealed that vegetable based cropping systems gave maximum rice equivalent yields highest being in Rice-Cauliflower-Bottle gourd (27 t ha^{-1}) followed by Rice-Potato- Blackgram (BB) (20 t ha^{-1}), and Rice-Potato-Greengram (BB) (19.2 t ha^{-1}), However, lowest rice equivalent yield (12.4 t ha^{-1}) was obtained in Rice-Veg. pea (FB)-Sesbania. The maximum increase in production of yield ha^{-1}(154%) was found in Rice-Cauliflower-Bottle gourd) systems whereas lowest increase in production (17.7%) was observed in relay cropping system Rice-Veg. pea (FB)-Sesbania over the farmers practice (Rice (FP) -Wheat (FP) – Sesbania).

Cereal based cropping systems provided rice equivalent yield (t ha^{-1}) for Rice (RDF)- Garlic-Sesbania, Rice (MT. RDF+20%)-Wheat (RM, RDF+20%)-Sesbania, Rice (SRI. RDF+ 20%)-Wheat (ZT, RDF+20 %)- Sesbania, Rice

Table 16. Production (REY) from different vegetable based cropping systems under demonstration

Treatments	REY (t ha^{-1})	Increased (%)
RICE -POTATO- G.GRAM(F)	188.95	78.25
RICE -POTATO- G.GRAM(BB)	191.89	81.02
RICE -POTATO- B.GRAM(F)	191.05	80.23
RICE -POTATO- B.GRAM(BB)	199.88	88.56
RICE -WHEAT(F)+V. PEA(RB)-OKRA	183.4	73.01
RICE -V.PEA(BB)+WHEAT(F)-SESBANIA	139.06	31.18
RICE -V. PEA(FB)-SESBANIA	124.84	17.77
RICE- C. FLOWER-BOTTLE GUARD	270.05	154.7
RICE (FP) -WHEAT (FP) - SESBANIA	106	0

Table 17. Production (REY) from different cereal based cropping systems under demonstration

Treatments	REY (t ha^{-1})	Increased (%)
RICE (SRI + RDF)- WHEAT (ZT +RDF)- SESBANIA	130.31	22.93
RICE (SRI. RDF+ 20%)- WHEAT (ZT ,RDF+20 %)- SESBANIA	141.61	33.59
RICE (MT+ RDF)- WHEAT (RM+RDF)- SESBANIA	132.13	24.65
RICE (MT. RDF+20%)- WHEAT (RM, RDF+20%)- SESBANIA	141.71	33.69
RICE (RDF)- WHEAT (BB) + MUSTARD (F) - SESBANIA	110.24	4
RICE (RDF+ 20%)- LENTIL (ZT) - SESBANIA	87.46	-17.49
RICE (RDF)- LENTIL (BB)+ WHEAT (F) - SESBANIA	117.19	10.55
RICE (RDF)-CHICKPEA (BB) + WHEAT (F) - SESBANIA	123.05	16.08
RICE (RDF)- LENTIL (BB)+ WHEAT (F) - SESBANIA	104.9	-1.03
RICE (RDF)- MUSTARD (ZT) - SESBANIA	96.39	-9.06
RICE (RDF)- GARLIC - SESBANIA	215.95	103.7
RICE (FP)- WHEAT(FP) - SESBANIA	106	0

Table 18. Production (REY) from different pulse based cropping systems under demonstration

Treatments	REY (t ha^{-1})	Increased (%)
PIGEONPEA single row (RB)–WHEAT (RB)+WHEAT (F) 2:1	147.65	39.29
PIGEONPEA+MAIZE (RB) 1:1-WHEAT (RB)+RADISH 2:1	166.28	56.86
PIGEONPEA+MAIZE (RB) 2:1-WHEAT (FB)	142.2	34.15
COWPEA(BB)+SESBANIA (F)- GRAM(BB)+MUSTARD (F) 3:1	128.66	21.37
COWPEA(BB)+SESBANIA (F)-LENTIL(BB)+MUSTARD (F)3:1	135.61	27.93
RICE(FP)-WHEAT(FP)-SESBANIA	106	0

(MT+ RDF)-Wheat (ZT + RDF)-Sesbania, Rice (SRI + RDF)-Wheat (ZT +RDF)- Sesbania, and Rice (RDF)-Chickpea (BB) + Wheat (F)-Sesbania systems as 21.5,14.1,14.1,13.2,13.0 and 12.3 t ha^{-1} respectively, as compared to farmer practice of 10.6 t ha^{-1} for Rice (FP)-Wheat (FP)-Sesbania. The maximum higher returns per day per ha (₹ 342) was recorded from rice (Rice (RDF)-Garlic-Sesbania)– sesbania whereas lowest returns was recorded from rice (Rice (RDF+20%)-Lentil (ZT)- Sesbania) – Sesbania (₹ 103) system.

Among different pulses based cropping systems, maximum higher rice equivalent yield (16.6 t ha^{-1}) was obtained from Pigeonpea + Maize (RB) 1:1 - Wheat (RB) + Radish 2:1 system followed by Pigeonpea single row (RB) – Wheat (RB) +Wheat (F) 2:1 (14.7 t ha^{-1}) and Pigeonpea + Maize (RB) 2:1 - Wheat (FB) (14.2 t ha^{-1}) in comparison to farmer practice system of Rice (FP)-Wheat (FP) - Sesbania (10.6 t ha^{-1}). The maximum higher return (₹ 305 day^{-1} ha^{-1}) wasobtained from Pigeonpea + Maize

(RB) 1:1 - Wheat (RB) + Radish 2:1 system.

Visitors Opinion

Visitors and farmers visiting the technology park also shown curiosity for broad bed and resource conservation based (Residue management) system and 70-75% visitor opined the usefulness of technologies such as SRI in rice, mechanical transplanting of rice, broad bad, (rice) residue management through ZT in wheat and SSNM at farmer's field.

Project title **:** Adoption behaviour of different farming system components by farmers of UGP and TGP Zones

Project code **:** NRMAPDFSRSIL201000400110

Funding Agency **:** Institute based

Duration **:** 2010-2014

Project Personnel **:** *Anil Kumar, B. K. Sharma and R. P. Mishra*

Under the project, survey conducted in Meerut district of Uttar Pradesh covering a total of 80 farmers from 8 villages and four blocks of the district revealed that average family size of the respondents was 6 persons, whereas the average land holding was 1.5 hectares. The crop component contributed 53 per cent of the total income of the respondents, while dairy contributed 16 per cent followed by horticulture (10 per cent). The subsidiary enterprises like labour, service etc. contributed around 15 percent of their total income which reflected shift in income pattern (Table 19).

Crop+Dairy was the predominant farming system in the district and

Table 19. Share of income from different sources

Source of income	% Average Income
Crop	53
Dairy	16
Horticulture	10
Agro-forestry	6
Business/ Service/ Labour	15

adopted by 56 per cent of the respondents (Table 20). The study area was found to be having several acreage of mango orchards which contributed assured income to the farmers. It was found that Crop+Dairy+Horticulture was the second most prevalent farming system adopted by 22 per cent of the respondents. Another trend was found to be the increased plantation of poplar and eucalyptus trees mainly on the field bunds. The agro-forestry contributed significantly to the total family income and the farmers preferred this enterprise due to lack of time to devote on field crops on account of their engagement in other allied activities.

Table 20. Farming systems prevalent in the study area

Farming system components	% Respondent farmers
Crop + Dairy	56
Crop + Dairy + Horticulture	22
Crop + Dairy + Agro-forestry	13
Crop + Dairy + Horticulture + Agro-forestry	9

Sugarcane (plant)-Sugarcane (ratoon)-Wheat was found as the major cropping system adopted by 78 per cent of the respondents followed by Paddy-Wheat adopted by 24 per cent respondents (Table 21). Marigold was found to be a highly suitable crop with potential of providing substantial additional income to the farmers for over 3-4 months. It was mainly cultivated as

Table 21. Major Cropping systems prevalent in the study area

Cropping system components	% Respondent farmers
Sugarcane (plant)- Sugarcane (ratoon)- Wheat	78
Paddy - Wheat	24
Paddy-Potato- Marigold/Sorghum	18
Sugarcane(plant)- Sugarcane (ratoon) - Potato	12
Paddy-Mustard-Sugarcane-Sugarcane (ratoon)	9
Pigeon pea -Wheat -Sorghum	8
Sorghum-Cowpea (GM)- Wheat-Maize	5

rabi crop, but many farmers also cultivate it as intercrop with sugarcane. Potato was another crop which fits well in both rice based and sugarcane based cropping systems. Besides, a substantial area was also found to be under cultivation of mustard, Pigeon pea and maize under different cropping systems.

The yield gap analysis revealed that the highest yield gap was in case of sugarcane to the extent of 50 per cent due to heavy infestation of insect-pests in the crop (Table 22). Among the crops, potato was found to be having second highest yield gap (36 per cent) due to lack of awareness of the farmers about proper fungicide use to control the late blight disease. Although wheat was cultivated by almost all the farmers, many of them cultivated it for consumption purpose which indicated lack of farmers' preference to adopt promising technologies for this crop. Wheat recorded an yield gap of 30 per cent mainly due to non-use of quality seed and improper seed rate. The number of milch animals per family had gone down from 5 to 2 due to non-availability of family members to take care of them. Hence, dairy enterprise was also adopted mainly for consumption purpose, thereby leading to poor technology adoption and higher yield gap.

The majority of the respondents perceived crop enterprise as most sustainable followed by horticulture and dairy enterprises, respectively (Table 23). The crop enterprise was rated highest on adaptability, viability and risk involved parameters. The horticulture enterprise including agro-forestry was rated highest on adaptability, cost of production, productivity and environmental soundness parameters. On the other hand, the dairy enterprise was perceived as having medium profitability and medium risk involved.

Table 22. Adoption and Yield gap of different crops/ enterprises

Name of crop/ enterprise	Adoption percent	Actual Yield (A)(t ha^{-1})	Achievable Yield (B) (t ha^{-1})	%Yield Gap*
Sugarcane	79	57.0	120.0	53
Wheat	92	4.2	6.0	30
Paddy	48	3.6	5.0	28
Potato	30	16.0	25.0	36
Mustard	09	2.2	3.0	26
Cow	70	9.5 lit./day	20 lit./day	52
Buffalo	82	7.2 lit./day	12 lit./day	46

***%Yield Gap= [(B-A)/B] x100**

Table 23. Farmers' perception scores on sustainability of farming system enterprises

Attributes	Farmers' perception score (%)		
	Crop	Horticulture	Dairy
Adaptability	80.0	80.0	74.7
Cost of production	54.7	60.0	49.3
Resource use efficiency	73.3	80.0	78.0
Productivity	67.3	73.3	67.3
Viability/ Profitability	60.0	53.3	55.3
Risk involved	62.0	46.7	55.3
Environmental soundness	66.7	70.0	68.7
Overall	**66.3**	**66.1**	**64.1**

Project title **:** On-Farm Integrated Farming Systems Management

Project code **:** NRMAPDFSRSIL201100700125

Funding Agency **:** Institute based

Duration **:** 2011-2016

Project Personnel **:** *B. K. Sharma, Anil Kumar and A. K. Prusty*

Fifty farmers from Alipur and Madarpur villages of Sardhana block, Meerut district were adopted villages under the project "On-farm Integrated Farming Systems Management" since November, 2011. To narrow down the yield gaps between farmers' practice and the achievable yields of different field crops, horticultural crops grown and rearing the milch animals in the villages identified technological interventions based on their constraints were introduced through on-farm trials, demonstrations and other extension methods. It can be concluded that through improved technological interventions and extension methods, different crops yield can be increased by 4 to 15 percent and farming system profitability (crop- dairy) can be increased by 15 to 23 percent in the adopted villages.

Twenty-six farmers were selected randomly from Alipur and Madarpur villages of Sardhana block, Meerut district for conducting on-farm trials (OFTs) on sugarcane plant crop during 2012-13. Three treatments were taken under each OFT and each of these treatments was laid on an area of 800 sq. m.

The three treatments were- T_1: Farmers' Practice (FP), T_2: Recommended doses of chemical pesticides, T_3: Recommended doses of bio-control agents (*Beauvaria bassiana*, *Metarhizium* and *Trichogramma*)**.** The result revealed that increase in yields over the farmers' practice of the varieties CoS-767, Co-0238 and Co-312 through recommended chemical pesticides were 10.25%, 9.69% and 8.86%, respectively. Increase in yields over the farmers' practice of the varieties CoS-767, Co-0238 and Co-312 through bio-control agents were 11.34%, 10.69% and 9.93%, respectively. The application of bio-control agents (Beauveria bassiana, Metarhizium and Tricho-card) in the varieties CoS -767, Co-0238 and Co-312 contributed 1.09%, 1.00% and 1.07% increase in yield, respectively over the chemical pesticide treatments. Cost of cultivation of both improved practice (IP) and farmers' practice (FP) of sugarcane was worked out. The results revealed that with an additional expenditure of Rs. 6000/- in form of chemical pesticides, there was an increase in net return of Rs 11080/- per hectare in improved practice over the farmers' practice. As regards benefit cost ratio, it was 1.90 in IP as compared to 1.84 in FP. In case of pest control through bio-agents, the results revealed that with an additional expenditure of Rs. 1500/- in form of bio-agents, there was an increase in net return of Rs17540/- per hectare in IP over FP. As regards benefit cost ratio, it was 2 in IP as compared to 1.84 in FP.

On-farm trials (OFTs) on balanced use of fertilizers (MOP) and zinc in sugarcane

.Twenty-three farmers were selected randomly from the abovementioned two villages for conducting on-farm trials (OFTs) on sugarcane plant crop during 2012-13. Three treatments were taken under each OFT and each of these treatments was laid on an area of 800 sq. m. The three treatments were- T_1: Farmers' Practice (FP), T_2: FP + recommended doses of Potash (MOP), T_3: FP + recommended doses of Potash + Zinc sulphate. The result revealed that

increase in yields over the farmers' practice of the varieties CoS-767, Co-0238 and Co-312 through recommended NPK were 11.8%, 12.29% and 11.08%, respectively. The application of recommended NPK in combination with Zinc in the varieties CoS -767, Co-0238 and Co-312 contributed 14.79%, 15.49% and 13.89% increase in yield over the farmers' practice, respectively. Cost of cultivation of both improved practice (IP) and farmers' practice (FP) of sugarcane was worked out. The results revealed that with an additional expenditure of ₹ 2250/- in form of potash there was an increase in net return of ₹ 19030/- per hectare in improved practice over the farmers' practice. As regards benefit cost ratio, it was 1.9 in IP as compared to 1.85 in FP. In case of application of potash combination with zinc, the results that with an additional expenditure of ₹ 3250/- in form of potash and zinc, there was an increase in net return of ₹ 23630/- per hectare in improved practice over the farmers' practice. As regards benefit cost ratio, it was 2 in IP as compared to 1.85 in FP.

Demonstrations on recommended seed rate and use of quality seed in wheat

A total of eighteen demonstrations on recommended seed rate and use of quality seed in wheat varieties PBW-550, PBW-343 and PBW-226 were laid in Alipur and Madarpur villages of Sardhana block, Meerut district during *Rabi*, 2012-13. The comparison of improved practice (use of recommended varieties and optimization of plant population) and farmers' practice was made. The improved practice resulted in increase in yield of varieties PBW-550, PBW-226 and PBW-343 by 4.23%, 4.84%, and 4.87%, respectively over the farmers' practice. Cost of cultivation of both improved practice (IP) and farmers' practice (FP) of wheat was worked out. The results revealed that with an additional expenditure of ₹ 10/- in form of good quality of seed, there was an increase in net return of ₹ 3250/- per hectare in improved practice over the farmers' practice. As regards benefit cost ratio, it was 1.5 in IP as compared to 1.44 in FP.

Demonstrations on balanced use of fertilizers in wheat

Eighteen demonstrations on balanced use of fertilizers in wheat were laid in above mentioned villages during *rabi,* 2012-13. The comparison of improved practice (farmers' fertilizer + recommended K.) and farmers' practice was made. The results revealed that the improved practice resulted in increase in yield of varieties PBW-550, PBW-226 and PBW-343 by 7.2%, 7.6% and 6.6% over the farmers' practice. Cost of cultivation of both improved practice (IP) and farmers' practice (FP) of wheat was worked out. The results revealed that with an additional expenditure of ₹ 1110/- in form of potash, there was an increase in net return of ₹ 3645/- per hectare in improved practice over the farmers' practice. As regards benefit cost ratio, it was 1.5 in IP as compared to 1.44 in FP.

On-farm trials (OFTs) on recommended doses of pesticides in Rice

Five farmers were selected randomly from the two villages for conducting on-farm trials (OFTs) on two varieties of rice (Sugandha-4) during *kharif* 2013. Three treatments were taken under each OFT and each of these treatments was laid on an area of 500 sq. m. The three treatments were- T_1: Farmers' Practice (FP), T_2: Recommended doses of chemical

pesticides, $T_{3:}$ Recommended doses of bio-control agents (*Beauvaria bassiana, Metarhizium* and *Trichogramma*)**.** The results revealed that treatment T_3 provided highest yield (3.54 t ha^{-1}) followed by T_2 (3.5 t ha^{-1}) and T_1 (3.1 t ha^{-1}). The pest control in rice through chemical pesticides and bio-control agents resulted in increase in yield by 11.2% and 11.9 %, respectively over the farmers' practice. Cost of cultivation of both improved pratice (IP) and farmers' practice (FP) of rice was worked out. The results revealed that with an additional expenditure of ₹ 4800/- in form of chemical pesticides, there was an increase in net return of ₹ 6400/- per hectare in improved practice over the farmers' practice. As regards benefit cost ratio, it was 2.00 in IP as compared to 1.97 in FP. In case of pest control through bio-agents, results revealed that making an additional expenditure of ₹ 1500/- in form of bio-agents, there was an increase in net return of ₹ 10340/- per hectare in improved practice over the farmers' practice. As regards benefit cost ratio, it was 2.13 in IP as compared to 1.97 in FP.

On-farm trials (OFTs) on balanced use of fertilizers (MOP) and zinc in Rice

Five farmers were selected randomly from the two villages for conducting on-farm trials (OFTs) on two varieties of rice (Sugandha-4) during *kharif* 2013. Three treatments were taken under each OFT and each of these treatments was laid on an area of 500 sq. m. The three treatments were- T_1: Farmers' Practice (FP), T_2: FP + recommended doses of Potash (MOP), $T_{3:}$ FP + recommended doses of Potash + Zinc sulphate. The results revealed that treatment T_3 provided highest yield (3.4 t ha^{-1}) followed by T_2 (3.4 t ha^{-1}) and T_1 (3.2 t ha^{-1}). The application of potash and potash + zinc in rice resulted in increase in yield by 6.9% and 9.7%, respectively over the farmers' practice. Cost of cultivation of both improved practice (IP) and farmers' practice (FP) of rice was worked out. The results revealed that with an additional expenditure of ₹ 1100/- in form of potash, there was an increase in net return of ₹ 5940/- per hectare in improved practice over the farmers' practice. As regards benefit cost ratio, it was 2.06 in IP as compared to 1.97 in FP. In case of application of potash and zinc, the results revealed that making an additional expenditure of ₹ 2100/- in form of potash and zinc, there was an increase in net return of ₹ 7820/- per hectare in improved practice over the farmers' practice. As regards benefit cost ratio, it was 2.07 in IP as compared to 1.97 in FP.

Food support through kitchen gardening

Forty four farmers of Alipur and Madarpur villages were provided seeds of vegetables Spinach, Radish, Coriander, Fenugreek and Onion for kitchen gardening to cater to the daily needs of households. The trials are in progress.

Mineral mixture feeding improved the milk yield and conception rate in milch animals

Fifty dairy animals (cows & buffaloes) were fed with mineral mixture @ 40 g/day/ animal in adopted villages to improve the milk yield and conception rate. The milch animals which were fed with the mineral mixture showed increase in milk yield by 150-250 ml/day/animal with an average milk yield of 8-12 lit./day/animal. The animals in heat got conceived during the first service itself as a result of feeding of mineral mixture.

It can be concluded that through improved technological interventions crops yield can be increased by 4 to 15 percent and system profitability (crop-dairy) can be increased by 14 to 25 percent.

Project title **:** Capacity building of stakeholders in integrated farming systems through training

Project code **:** NRMAPDFSRSIL201000300109

Funding Agency **:** Institute based

Duration **:** 2010-2014

Project Personnel **:** *B. K. Sharma and Anil Kumar*

Off-campus training on plant protection on mango was conducted on 20-3-2013 in Madarpur village of Sardhana block in Meerut district in which 20 farmers/owners of mango orchards participated. Off-campus training on plant protection on mango was conducted on 20-9-2013 in Madarpur village of Sardhana block in Meerut district in which 15 farmers/owners of mango orchards participated.

Off-campus training on plant protection on mango was conducted on 23-11-2013 in Madarpur village of Sardhana block in Meerut district in which 16 farmers/owners of mango orchards were participated.

Control of fruit borer, white grub and twig blight in mango

One hundred demonstrations on control of fruit borer and twig blight in mango trees were conducted in adopted villages through a spray schedule of monocrotophos, copper oxychloride, mancozeb and carbendazim during 2013.

Agricultural Statistics & Information Technology Unit

Project title **:** Digitization of database of on-station and on-farm experiments of cropping systems under AICRP on IFS

Project code **:** NRMAPDFSRSIL200800300094

Funding Agency **:** Institute based

Duration **:** 2008-2015

Project Personnel **:** *G. C. Sharma and Vipin Kumar Choudhary*

Database was structured, architected and designed under Structure Query Language Program for digitizing various observations on different treatments, soil characteristics, plot size, planning details; nutrients applied and yield parameters of on station experiments conducted during 2012-13 in respect of twenty one centers. The experiments covered were, "Identification of need based cropping systems for different agro-eco systems", Long range effect of continuous cropping and manuring on soil fertility and yield stability".

Under the On Farm research experiments, “Diversification and Intensification of cropping systems” and, Response of Nutrients” conducted at ECF centers of AICRP-IFS during 2012-13, the data of twelve centers were architected, designed , structured and digitized yield wise for different treatments.

Project title **:** Digitization of database of network project on organic farming experiments

Project code **:** NRMAPDFSRSIL201001200118

Funding Agency **:** Institute based

Duration **:** 2010-2014

Project Personnel **:** *Vipin Kumar Choudhary and G. C. Sharma*

Database on Organic Farming Experiments under Network project is being developed in GUI mode (Graphical user interface) initially Visual basic programming language is using as front end while SQL server /MS Access as back end. The Relational Database approach is used to design the database. The fundamentals of Normalization theory have been used to normalize the different tables of the database. Thirteen master tables for the network centers have been created to setup the entity-relation among them. At present system is standalone but in future the system will be a web-based application. It is based on client-server three tier distributed structure technology. Can be accessed from any node on the Internet through a web-browser.

Password Validation, Main Menu and few data entry forms have been created so far. Initially data is being entered in MS-Excel spread sheets for convenience in data entry later on these sheets will be exported to this software.

Externally Funded Projects

Project title **:** Precision nutrient management using GIS-based spatial variability mapping under Upper and Middle Gangetic Plain Zones of India

Project code **:**

Funding Agency **:** ICAR National Fellow Scheme

Duration **:**

Project Personnel **:** V.K. Singh (PI)

In order to assess the spatial variability of physicochemical properties and native nutrient pools in agricultural soils across selected soil types and cropping systems farmers' participatory survey and collection of soil, plant and water samples from Bhabar and Terai Zone (BTZ), Mid-Western Plain Zone (MWPZ) and South Western Plain Zone (SWPZ) were done during 2012-13. During 2012-13, 07 districts each in South Western Plain Zone and Mid-western Plain Zone and 03 district of Bhabar and Tarai Zone were surveyed and also soil water and plant residue samples were collected using "Proportionate Area Method". During survey Predominant crops/ cropping systems of BTZ, MWPZ and SWPZ were characterized for following parameters:

- Biophysical features (Geographical situation, agro-climate, soil, irrigation, crops and cropping systems, fertilizer and organic manure use, residue management and productivity level etc.).
- Socio-economic profile (Demographic features, literacy rate, operational holding, mechanization and livestock population etc.)

Analysis of the data revealed wide variations in fertilizer use in different cropping system in the surveyed districts. The fertilizer use was in general skewed in favour of N, whereas nutrients like K, S and micronutrients were generally neglected. Soil samples were analysed for macro- and micro-nutrients, revealed marked variability across the districts and cropping systems. Such variability in soil fertility status was also mapped using Ordinary Exponential Kriging with the help of ArcGIS 10.1.

In the view of developing precision nutrient management zone for different cropping system domain in Western Plain Zone using soil fertility parameters (N, P and K), surface maps were generated. In order to generate these homogenous fertility management zones, different fertility parameters were classified into low, medium and high categories using the user defined ranges. The ranges used for classification of N, P and K in low, medium and high classes were < 120, 120-160 and > 160 for N, <13, 13-16 and > 16 for P and <150, 150-250 and > 250 for K, respectively. The per cent area falls under different management zone are given in Table 24 and depicted in Figs. 31 to 33. Based on the developed homogenous fertility zones, the fertilizer recommendations can be developed for its

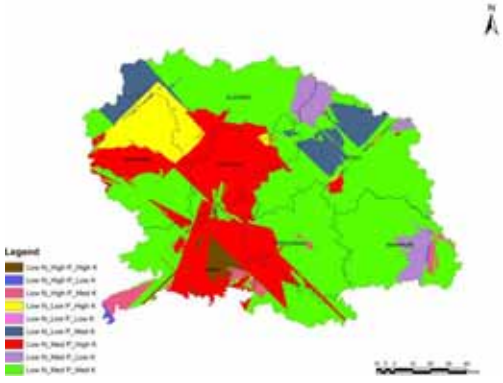


Fig. 31. Homogenous fertility management zones in South-Western Plain Zone

Fig. 32. Homogenous fertility management zones in Bhabar and Tarai Zone

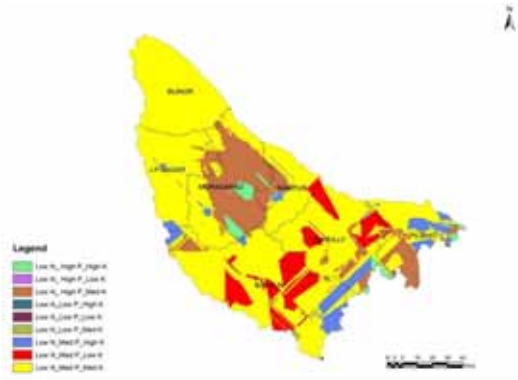


Fig. 33. Homogenous fertility management zones in Mid-Western Plain Zone

Table 24. Predicted area (%) under different fertility management zones

Fertility management zones	South-Western Plain Zone	Mid-Western Plain Zone	Bhabar and Tarai Zone
Low N_Med P_Med K	56.29	67.70	62.86
Low N_Med P_Low K	4.13	8.60	1.54
Low N_Med P_High K	22.80	5.43	4.57
Low N_Low P_Med K	6.70	0.24	1.81
Low N_Low P_Low K	0.03	0.03	-
Low N_Low P_High K	6.34	16.08	-
Low N_High P_Med K	1.89	-	-
Low N_High P_Low K	0.20	0.02	22.63
Low N_High P_High K	1.61	1.89	6.59
Total area (km^2)	22457.56	20379.64	16590.87

practical significance for farmers and policy makers in the recommendation domain.

Project title **:** Precision farming technologies based on microprocessor and DSS for enhancing input application efficiency in production agriculture

Sub Project **:** Effect of drip irrigation for improving nitrogen and water use efficiency in rice-wheat system

Project code **:**

Funding Agency **:** NAIP (ICAR)

Duration **:** 2009 to 2014

Project Personnel **:** Dr. S.S.Pal (PI)

Rice-wheat is the predominant cropping system in Indo-Gangetic Plain. Rice is generally grown under puddled water logged soil under transplanting while wheat is grown under aerobic culture with assured irrigation. The experimental site is sandy clay loam with high infiltration rate and low water and nutrient holding capacity due to unfavourable soil condition resulting in low water and N use efficiency. The region falls under arid and semi–arid region with high evapotranspiration rate during kharif season. In this region at least 30 irrigations are applied during rice growth stage and at least 5-6 irrigation in wheat. Due to indiscriminate use of ground water, the hydrological balance in this region is being disturbed and there

is a need for alternate irrigation system. Drip irrigation system was introduced in rice-wheat system as an innovative water saving device.

Four doses on nitrogen viz 0, 80, 120 and 160 kg N ha^{-1} with 60 kg of P_2O_5 and 40 Kg of K_2O were applied for both rice and wheat out of which 50% N and full doses of P and K were applied as basal during sowing and rest 50% N was top dressed during tillering and milking stage of rice in two equal splits while for wheat the N splits were crown root initiation and at flag leaf initiation stages. Drip irrigation in rice at the rate of 4 liters/ hour, 40 cm spacing and 2.33 hours/ irrigation, 30 times at every alternate day were applied while in wheat at the rate of 4 liters/ hour, 40 cm spacing and 2.33 hours/ irrigation in 5 times at crown root initiation, tillering, grand growth, flag leaf initiation and milking stages.

Highest grain yield of rice and wheat (5.79 and 5.52 t ha^{-1}) were recorded under 160 kg N ha^{-1}. The system yield was also highest (14.1 t ha^{-1}) in this treatment compared to flood irrigation (13.7 t ha^{-1}), the yield increase under this treatment was 1.2 and 3.8 % respectively for rice and wheat and 2.7 % in REY. Highest water use efficiency of rice and wheat were recorded at 0.85 and 2.76 kg grain m^{-3} water under 160 kg N ha^{-1}. However highest nitrogen use and uptake efficiency in rice were recorded under flood irrigation at 28.3 and 37.7 kg grain per kg of N applied and N uptake respectively while for nitrogen use and uptake efficiency in wheat were recorded 21.2 and 28.6 kg grain/kg N applied kg grain/ kg N uptake in and under flood irrigation respectively. The mean performance of drip irrigation followed the same trend over years (Table 25).

Table 25. Effect of Drip irrigation on yield, water and nitrogen use efficiency in rice –wheat system

Treatments	Year	Grain yield (t ha^{-1})		REY (t ha^{-1})	NUE (Kg grain/ kg N)		NUE (Kg grain/kg N uptake)		WUE (kg grain/ m^3 water)	
		Rice	Wheat		Rice	Wheat	Rice	Wheat	Rice	Wheat
Control no N	2012-13	2.32	2.78	6.5	0.00	0.00	0.00	0.00	0.34	1.39
	Mean	2.37	2.58	6.2	0.00	0.00	0.00	0.00	0.35	1.29
80 Kg N	2012-13	3.98	3.69	9.5	20.75	11.38	27.87	22.03	0.58	1.85
	Mean	4.24	3.73	9.8	23.44	14.42	29.03	26.16	0.62	1.87
120 kg N	2012-13	4.25	4.62	11.2	16.08	15.33	29.61	31.85	0.62	2.31
	Mean	4.47	4.60	11.4	17.51	16.80	30.93	31.15	0.65	2.30
160 kg N	2012-13	5.79	5.52	14.1	21.69	17.13	33.65	26.83	0.85	2.76
	Mean	5.85	5.35	13.9	21.78	17.29	33.00	28.98	0.86	2.67
Flood Kg N	2012-13	5.72	5.32	13.7	28.33	21.17	37.68	28.60	0.79	2.09

Project title **:** Precision farming technologies based on microprocessor and DSS for enhancing input application efficiency in production agriculture

Project code **:**

Funding Agency **:** NAIP (ICAR)

Duration **:** 2009 to 2014

Project Personnel **:** Dr. S.S.Pal (PI)

Rice-wheat is an important cropping system in Indo Gangetic Plain (IGP) covering an area of about 10 million hectare in diverse agro-ecological situations. Traditionally rice is grown under flooded condition with continuous submergence whereas wheat is grown in aerobic condition with assured irrigation. For producing one kilogram of grain approximately 5000 and 1000 litters of water is needed for rice and wheat respectively. Per capita water availability has decreased from 6000 m^3 in 1947 projected to 1600 m^3 in 2017 and water table has also gone down considerably in IGP due to over exploitation and non-judicious use of this resource. Pressurized irrigation systems is one of the water saving irrigation device in many crops but it's use is limited to rice and wheat system in various countries. The potential for adoption of sprinkler irrigation to rice and wheat has not been evaluated in details in IGP barring a few attempts. The study was thus under taken in an *Ustochrept* of IGP in Meerut district at PDFSR research farm.

The present investigation was conducted in an *Ustochrept* of IGP having sandy clay loam in texture, pH 8.2, O.C. 0.48%, available N, P and K 175, 13.5 and 325 kg ha^{-1} respectively and high infiltration rate during *kharif* 2012 in rice and wheat 2012-13 respectively. Sprinkler irrigation system of M/S Jain Irrigation System was used for irrigating rice and wheat at sprinkler distance of 12 meters among laterals. Five N doses viz. 0, 80, 100,120 and 140 N ha^{-1} was applied in large plots 1000 m^2 for each treatment. In addition to these treatments, one plot which received recommended dose of N, P and K (120, 60 and 40) and flood irrigation was kept for comparing the efficiencies of sprinkler system. The 50% N was applied at the time of sowing / transplanting of crops and the remaining 50% was top dressed during CRI and flag leaf stage for wheat whereas for rice it was grand growth and milking stages. Circular area covered by each sprinkler nozzle was taken as the actual experimental area. The water was supplied through an overhead tank at 25 meters height to achieve a pressure of 4 pounds/ $inch^2$. Daily crop water requirement was computed. The discharge from sprinkler was calculated using the formula $q_s=29.82C_dD^2\sqrt{p}$ where q_s= discharge (gpm) and latter converted into litters, C_d= discharge coefficient for the nozzle and sprinkler H" 0.96, D = inside diameter of the nozzle (inches), P = water pressure at the nozzle (psi). The sprinkler was operated as per daily water requirement. The rainfall during the crop growth period was recorded and the total water requirement during the crop growth period was computed.

Highest grain yield (5.85 t ha^{-1}) of rice was recorded under 140 kg of N

Table 26. Effect of sprinkler irrigation on yield, water and nitrogen use efficiency in rice-wheat system

Treatments	Year	Grain yield (t ha^{-1})		REY (t ha^{-1})	NUE (Kg grain/ kg N)		NUE (Kg grain/kg N uptake)		WUE (kg grain/ m^3 water)	
		Rice	Wheat		Rice	Wheat	Rice	Wheat	Rice	Wheat
control no N	2012-13	2.11	2.33	5.6	0.00	0.00	0.00	0.0	0.35	1.05
	Mean	1.98	2.46	5.7	0.00	0.00	0.00	0.0	0.37	1.45
80 Kg N	2012-13	4.17	4.12	10.3	25.73	22.38	38.19	28.59	0.62	2.08
	Mean	4.14	4.12	10.3	26.99	20.83	38.78	27.45	0.62	2.11
100 Kg N	2012-13	5.18	4.65	12.2	30.74	23.20	39.78	32.50	0.70	2.59
	Mean	5.08	4.73	12.2	31.01	22.69	40.07	32.27	0.71	2.39
120 Kg N	2012-13	5.28	5.12	13.0	26.43	23.25	37.02	37.71	0.77	2.64
	Mean	5.21	5.01	12.7	26.92	21.26	37.45	33.87	0.75	2.47
140 Kg N	2012-13	5.85	5.88	14.7	26.71	25.36	36.61	35.18	0.89	2.92
	Mean	5.63	5.43	13.8	26.05	21.27	36.76	30.81	0.82	2.76
Flood Kg N	2012-13	5.52	5.72	14.1	28.45	28.25	36.76	39.86	0.79	2.76
	Mean	5.41	5.42	13.5	27.32	24.67	38.53	36.45	0.75	2.28

compared to 5.52 t ha^{-1} (Table 26) under conventional method of irrigation. The water use efficiency was highest 0.89 kg grain/m^3 water under this treatment. Highest grain yield of wheat 5.88 t ha^{-1} was recorded under 140 kg N ha^{-1}. The N use efficiency and N uptake efficiency were highest under flood irrigation being 28.45 kg grain/kg N applied and 36.76 kg grain/kg of N uptake in rice and 28.25 and 39.86 kg grain/kg N uptake respectively. While in wheat the highest water use efficiency 2.92 kg grain/m^3 water was recorded under 140 kg N ha^{-1} in sprinkler irrigation in contrast to 2.76 under flooding. Sprinkler irrigation saved 47.55 and 41.80 % water in rice and wheat respectively and 24.3% yield increase in wheat but the same treatment recorded 5.1 % yield reduction in rice over conventional method of irrigation. Thus the present study, though preliminary in nature, clearly demonstrated that sprinkler irrigation may be a viable option for reducing the total water requirement in rice-wheat cropping system.

Rice-wheat is an important cropping system in India covering about 10 m ha. Farmers in many areas in IGP in India often apply N doses much higher than the blanket recommendation to ensure high crop yield. Large temporal and location to location variability of soil N supply restricts efficient use of N fertilizers when broad based recommendations are used. In such cases, in -season site specific N management can effectively replace the blanket fertilizer N recommendation for higher N use efficiency. Green seeker which is an optical hand held instrument, can mesure the reflectance of crop canopy in the visible (VIS) and near infrared region, NIR, based on sufficiency index defined as SPAD critical value. The objective of this study was to compare the yield and N-use efficiency of Green seeker and SPAD-based N fertilizer application with recommended fixed-schedule N fertilizer (splits application) applied at key growth stages of rice and wheat grown in a sequence.

A field experiment was conducted on an *Ustochrept* of IGP with having initial soil pH 8.2, E.C. 10.5 c mol p^+ kg^{-1} soil., O.C 0.45% available N 180.2, P 35.5, K 380.8 Kg ha^{-1} during 2012-2013 in rice-wheat system in randomized block design of large plot size 5m X 35m with 12 treatments and replicated thrice. The treatment consisted of N application based on SPAD critical values of 35 and 40 for rice and wheat respectively and two more SPAD values for each crop, below and above critical levels, the values were 32 and 38 for rice and 38 and 42 for wheat respectively. A preliminary experiment was carried out to determine the SPAD critical values for rice and wheat. SPAD reading for both the crops were taken at 10 days interval and when the values falls below the fixed SPAD values, 20, 30 and 40 kg N ha^{-1} were applied. Green seeker based N-application, recommended blanket dose of N and control plot without any fertilizer or manure were also included in the treatments. Algorithm for N application using Green Seeker was developed for each crop by establishing a reference strip and target strip to calculate sufficiency index, SI=Target reflection/ reference-reflection. N application algorithm for rice and wheat were developed using the equation. N application rate = $317\sqrt{.97 - SI}$, Where: SI= Sufficiency Index.

Highest grain yield of rice and wheat were recorded at 5.75 and 5.63 t ha^{-1} under Green Seeker based N application compared to blanket application of N. Rice equivalent yield (REY) was highest 13.90 t ha^{-1} under green seeker based N application which was 11.0% higher than RDF. Total N application in SPAD based N application in rice and wheat ranged between 280 to 330 kg of N based on fixed SPAD values of crops. But the total N application based on Green seeker was lowest at 230 kg N ha^{-1} and 240 kg N $ha^{-1}$for rice and wheat respectively. The average N application rate in rice and wheat were recorded at 115 and 113 kg ha^{-1} compared to 120 kg ha-^{1} in each crop under RDF and net saving of 12 kg ha^{-1} of N ha^{-1} in the cropping system. The nitrogen use efficiency (NUE) in rice and wheat were highest at 29.2 and 49.8 compared to 23.03 and 37.9 kg grain kg^{-1} N under RDF. The available N, P and K and O.C. were also improved under Green Seeker based N application. The study also confirms that N application based on fixed SPAD threshold value requires higher rate of N with lower NUE than RDF or Green Seeker based N application. Thus the present study clearly demonstrate that Green seeker based N application is superior for need base N application or SPAD based N application which also exhibited highest N use efficiency than other treatments (Table 27).

Rice-wheat is an important cropping system in India covering an area of about 10 mha. Temporal and spatial variability of soil and climate is a common consequence which accounts largely for variation in crop yield in this cropping system. For attaining uniform higher yield over larger areas, production inputs like seeds, fertilizers, pesticides *etc.* are to be applied as per site specific need rather than applying recommended

Table 27. Effect of various precision N management options for yield and nitrogen use efficiency in rice-wheat system

Treatments	Rice				Wheat				Rice equivalent Yield (t ha^{-1})	Total N applied in Rice (2012)	Total N applied in Wheat (2012-13)
	Grain yield (t/ha)	Harvest Index	NUE (Kg grain/ kg N)	NUE (Kg grain/kg N uptake)	Grain yield (t/ha)	Harvest Index	NUE (Kg grain/ kg N)	NUE (Kg grain/kg N uptake)			
S1-20	4.53	2.74	16.4	30.4	3.8	2.4	26.9	27.5	10.9	130	140
S1-30	4.87	2.69	16.5	31.1	4.6	2.6	30.8	29.9	11.8	150	150
S1-40	5.04	2.67	17.6	32.9	4.54	2.6	32.4	28.7	12.2	150	140
S2-20	5.26	2.70	20.4	32.7	3.8	2.6	23.8	23.8	12.7	140	160
S2-30	5.40	2.68	23.1	31.5	4.2	2.7	23.2	26.6	13.0	130	180
S2-40	5.37	2.69	21.2	31.8	5.1	2.7	28.2	29.2	12.9	140	180
S3-20	5.04	2.72	18.8	31.3	3.5	2.8	22.1	20.9	12.2	140	160
S3-30	5.23	2.69	18.8	31.2	4.5	2.5	24.8	29.8	12.6	150	180
S3-40	5.39	2.70	21.3	31.9	4.5	2.8	32.1	25.8	13.0	140	140
RDF	5.16	2.68	23.0	30.4	4.6	2.7	37.9	25.7	12.5	120	120
GS	5.75	2.73	29.2	32.0	5.6	2.9	49.8	30.2	13.9	115	113
Control	2.40	2.50	0.0	0.0	2.3	2.8	0.0	0.0	9.5	0	0
SEM ±	0.02	0.005	0.6	0.8	0.07	0.01	0.9	0.7	0.1	3.4	4.1

blanket doses. Creation of management zones using remote sensing data and GIS is being applied in larger areas for assessing and managing soil and yield variability to achieve higher yield over the entire area. But its application is limited to small fields around one ha, the average land holding size for small farmers in India. In the present study, an attempt was made to delineate management zones using remote sensing data and GIS to formulate site specific nutrient management for attaining yield target on an experimental field (less than one hectare) in rice-wheat cropping system on an *Ustochrept* of Indo Gangetic Plain in India.

Management zones were created on the basis of false color composite (FCC) using LISS-III data. The data was superimposed on an area 6050 m^2 in the 29^0 04' 59.88'' N and 77^0 41' 38.91'' E coordinate having history of continuous rice-wheat cropping system located at P.D.F.S.R, research farm Modipuram, Meerut, U.P. Using this data and visual image interpretation keys, FCC was generated and three management zones were delineated with ArcGIS software (version 9.3.1) as low, medium and high productivity with estimated area being 2000, 2900 and 1150 m^2 during *kharif* 2012 and employing the same technique low, medium and high productivity zones were delineated having estimated areas 1820, 1280 and 2950 m^2 during *rabi* 2011-12. The same management zones for respective seasons were also tested for site specific fertilizer application.

On the basis of management zones created in the respective years, site specific N, P, K management was carried for *kharif* rice 2012 which correspond to N_{101} P_0 K_{22} for low fertility zone while for medium and high fertility zones the fertilizer doses N_{78} P_0 K_{14}; N_{51} P_0 K_0 respectively. Likewise, site specific N, P and K recommendations were N_{133} P_{45} K_{62} for low fertility zone while for medium and high fertility zones the fertilizer doses

Table 28. Fertilizer recommendation for various management zones in rice-wheat system

Management Zones	Fertilizer recommendation					
	Rice			Wheat		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Low 2012-13	101.2	0	21.9	132.95	44.6	61.7
Medium 2012-13	78.2	0	13.9	101.7	19.7	28.1
High 2012-13	53.7	0	0	68.4	0	0

Table 29. Yield of crops in various management zones in rice-wheat system under precision nutrient management

Management Zones	Actual yield (t ha^{-1})		Yield achieved (%)		REY (t ha^{-1})
	Rice	Wheat	Rice	Wheat	
Low					
2012-13	5.4	5.51	88.89	91.83	12.94
Medium					
2012-13	5.8	5.65	96.56	94.17	13.53
High					
2012-13	5.7	5.83	94.74	97.17	13.68
SEM±	0.033	0.022	-	-	0.061

were N_{101} P_{20} K_{28} and N_{68} P_0 K_0 respectively (Table 28). Rice equivalent yield (REY) were 12.94, 13.33 and 13.68 t ha^{-1} under low, medium and high fertility zones. Thus the present study clearly demonstrate that remote sensing data and GIS can be used for delineating management zones in small holding size in rice-wheat cropping system. Site specific nutrient management packages for various management zones also helps in attaining higher yield levels than target (Table 29).

Project title **:** Strengthening Simulation Approaches for Understanding, Projecting and Managing Climate Risks in Stress-prone Environments Across the Central and Eastern Indo-Gangetic Basin

Project code **:**

Funding Agency **:** AgMIP through ICRISAT

Duration **:**

Project Personnel **:** B. Gangwar (Team Leader), N. Subash (PI), Harbir Singh (Co-PI)

Agricultural Model Intercomparison and Improvement Project (AgMIP) consortia has approved PDFSR led project entitled "Strengthening simulation approaches for understanding, projecting and managing climate risks in stress prone environments across the central and eastern Indo-Gangetic Basin" with ICARNEH, BARC, NARC and CIMMYT-Nepal as partners through competitive call basis. This AgMIP-ICAR collaborative international project apply simulation tools in the major production ecologies of the central and eastern Indo-Gangetic Basin (India, Nepal, Bangladesh) in order to understand the integrated assessment of climate change impact on agricultural productivity. It will also assess the value of adaptation strategies under current and projected climatology by considering whether simulation tools and approaches and adequately capture the potential of different strategies for building resilience. The effort aims to fortify anexisting network for agricultural simulation modeling while broadening it to include stronger linkages to climate and socioeconomic scientists.

Linking climate, crop and economic modeling will provide an insight into the

integrated assessment of impacts of projected climate change on agricultural productivity of the region. The preliminary results of one site, Meerut (29^0 4' N, 77^0 46' E, 237 m ASL), of the Upper Gangetic region of the IGP, India based on AgMIP methodology is explained here. To capture the yield variability, 76 farms were surveyed in 2009-10. Sugarcane-wheat and rice-wheat are the most predominant cropping system followed in this region. The important observed variability of farms are viz., wide variability in dates of sowing - 17th October to 3rd January, Date of Harvest – 10th April - 17th May, Five cultivars – PBW223, PBW243,WL502, PBW343, UP232, No. of irrigations – 3,4 & 5, variability in N, P and K applications. Based on the interactions with different stakeholders of the district, representative agricultural pathways (RAPs) - provide an overall narrative description of a plausible future development pathway, and also contain key variables with qualitative storylines and quantitative trends, consistent with higher-level pathways – were developed for the district. The interaction meeting with different stakeholders of the district was held at PDFSR on 18th July, 2013.

Stakeholders meeting for Development of RAPs at PDFSR

Climate analysis results

All GCMs predicted higher monthly mean maximum and minimum temperatures during the mid-century period 2040-2069 under RCP8.5 compared to baseline (1980-2010). All the five targeted GCMs (CCSM4, GFDL-ESM2M, HadGEM2-ES, MIROC5, MPI-ESM-MR) predicted more or less same nature of projections. However, as far as rainfall projections are concerned, there is a lot of uncertainty among the GCM predictions, particularly during the monsoon months. Since 80% of the total annual rainfall is received during the July-September monsoon season, decrease of rainfall will affect the groundwater level

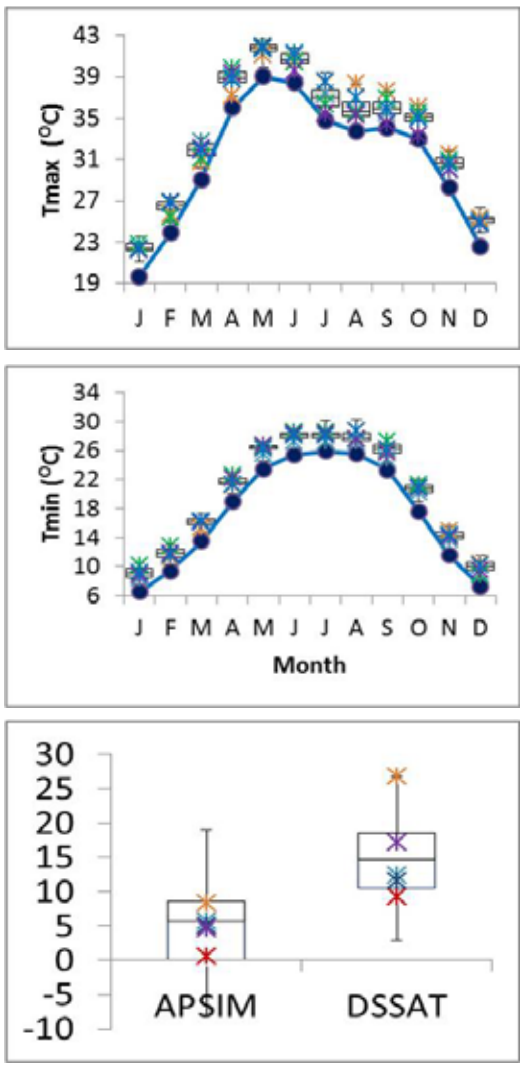


Fig. 34. Baseline (blue line and dots) and future (box-and-whiskers) monthly and seasonal mean maximum and minimum temperature for Modipuram, India, in the 2050s under RCP8.5 for twenty GCMs.The stars (different colors) represents five GCMs (CCSM4, GFDL-ESM2M, HadGEM2-ES, MIROC5, MPI-ESM-MR) used in the integrated assessment

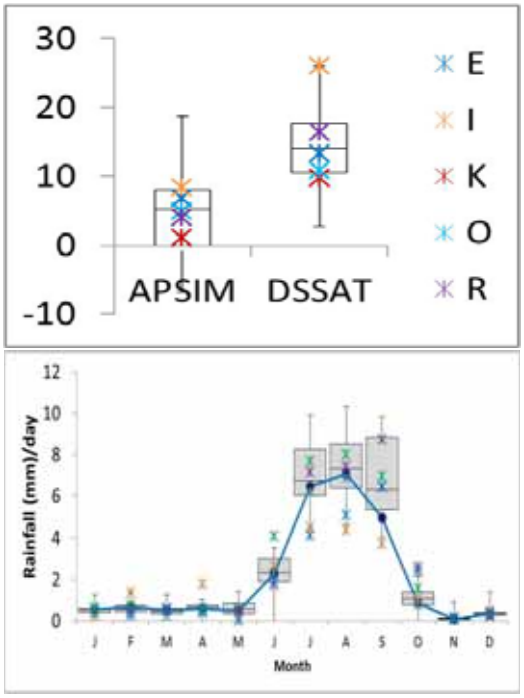


Fig. 35. Baseline (blue line and dots) and future (box-and-whiskers) mean monthly mean precipitation for Modipuram, India, in the 2050s under RCP8.5 for twenty GCMs. The stars (different colors) represents five GCMs (CCSM4, GFDL-ESM2M, HadGEM2-ES, MIROC5, MPI-ESM-MR) used in the integrated assessment

and therefore require more energy for pumping water.

Crop model analysis results

DSSAT simulated higher yields under projected climate change scenarios compared to APSIM (Figs. 34 & 35). This may be due to difference in sensitivity of DSSAT and APSIM with changes in CO_2 and temperature. The mean and variability scenarios are not different compared to mean only scenarios.

Box-and-whisker plot showing distribution of mean yield changes (%) from 20 GCM-based scenarios using (right) mean-only "delta" scenarios, and (left) scenarios including both mean and variability changes. It also compares the results from APSIM & DSSAT simulation outputs. The five models that are the focus of the core simulations are represented as different colored stars.

Preliminary integrated assessment results

The estimated TOA-MD model output (for APSIM and DSSAT) indicates a wide variation in production efficiency at the farm level. The farm-simulated yields from APSIM and DSSAT are 31 and 57 percent higher than observations, respectively. The gap in observed and simulated farm yields is higher for DSSAT as compared to APSIM. Using the crop models with the climate change scenarios, the TOA-MD analysis shows that climate change would result in 2-9 percent decline in wheat yield by mid-century (APSIM: 2-5% reduction), except in one case (APSIM: 1% reduction) that shows a marginal gain (1.06%) in yield under the changed climate. In contrast, DSSAT (1-5%) shows a 19-28 percent increase in wheat yield under climate change by mid-century. Thus, multi-model estimates for future yield under climate change vary widely.

On the basis of the predicted yields, the percentage of gainers from climate change would vary from 44-50 percent (APSIM; Climate scenarios: 1-5) to 58-61 percent (DSSAT; Climate scenarios: 1-5). While gains in mean net farm returns (INR 5334 per farm in 2012; 1USD = 55 INR) will be 24-30 percent, losses in net farm returns will be 31-36 percent, implying a net loss in mean net farm return varying from 4 to 12 percent (except, under climate scenario 1 which shows a marginal gain of 0.75%) with APSIM. For DSSAT, climate change would result in gains in mean net farm returns varying from 42-47 percent and losses would be 26-27 percent, implying that climate change will result in overall gains (15-21%) in mean net farm

returns. The estimated gains and losses under five different climate scenarios using multi-models present contrasting results, which require further research.

Project title **:** Global Yield Gap and Water Productivity Atlas (GYGA)

Project code **:**

Funding Agency **:** Bill & Melinda Gates foundation through ICRISAT

Duration **:**

Project Personnel **:** N. Subash (PI)

Bill & Melinda Gates foundation funded University of Nebraska-Lincoln-ICAR collaborative International Project "Global Yield Gap and Water Productivity Atlas" (GYGA) started with the inception workshop held at Wageningen University, Wageningen, Netherlands during 10-12th September, 2013. GYGA aspires for global coverage of yield gaps for all major food crops and countries that produce them, first phase of the project (2012 and 2013) focuses on maize, rice, wheat, sorghum and millet in 20 countries spread over all the continents. In south Asia, during the first phase India and Bangladesh are participating in this project. The main aim of this project is to assess the yield potential (Yp) or water-limited yield potential (Yw), yield gap (Yg) and water productivity (WP) using a bottom-up approach based on actual data and robust crop simulation models. Long-term meteorological data from 30 stations, spread over different agro-climatological zones of India were identified for creating the climate buffer zones of India as per the GYGA protocols. Based on the mean area ending the triennium period ending 2011-12, predominant rice, wheat, maize, sorghum and pearl millet growing districts in India were identified and maps were created for *kharif* and *rabi* seasons (Fig. 36). After overlapping the maps with the climatic buffer zones, major areas for each crops will be identified and yield gaps will be estimated based on GYGA protocols.

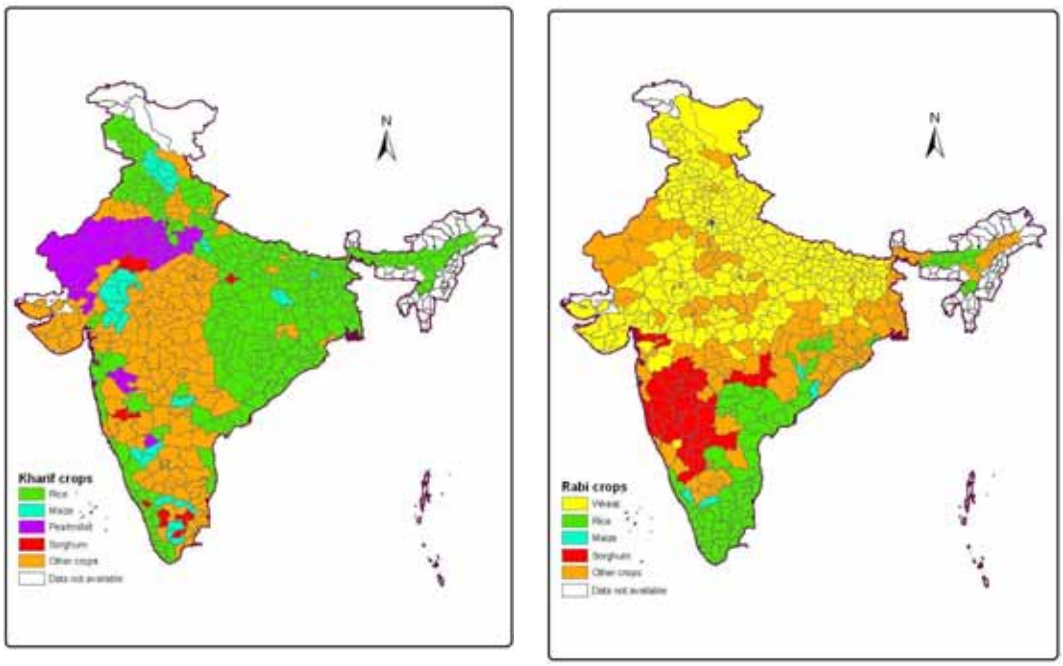


Fig. 36. Distribution of predominant rice, wheat, maize, sorghum and pearl millet growing districts in India

Project title **:** Early Estimation of Sugarcane Acreage at State Level using remote sensing data Under Forecasting Agricultural output using Space, Agrometeorology and Land based observations (FASAL))

Project code **:** NRMAPDFSRCOP201100100119

Funding Agency **:** SAC, Ahmedabad

Duration **:** 2011-14

Project Personnel **:**
SAC, Ahmedabad: Sujay Dutta, Smt. Nita Bhagia, S. P. Vyas, Gajendra Patel, and K R Manjunath,
PDFSR: N. Ravisankar, N. Subash and B. Gangwar

Sugarcane is one of the priority crops identified under FASAL. District level estimation using single date LISS III data acquired during October are used to estimate the sugarcane acreage is done operationally. The current aim is to develop procedure to estimate acreage at state and national level for early assessment of acreage by July using multidate data. Development of procedure for early and multiple estimation of sugarcane crop acreage at state level using multidate remote sensing data acquired from March to June is one of the main component of the current exercise carried out. The classification accuracy vis a vis critical data set requirement and identification of ratoon and freshly plated crop was also attempted.

A total of 28 districts having greater than 10 thousand ha of sugarcane growing areas in the UP state were selected based on statistics of Department of Agriculture (DoA). The 28

Fig. 37a. Selected Sugarcane districts (yellow) in UP

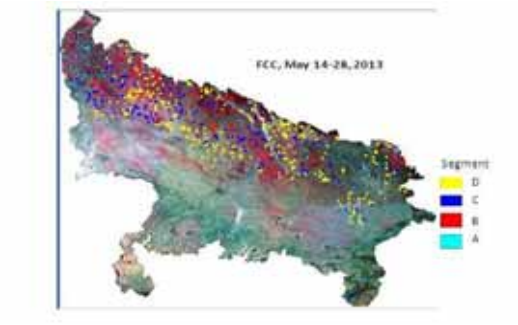


Fig. 37b. Selected sample segments in seleceted districts UP

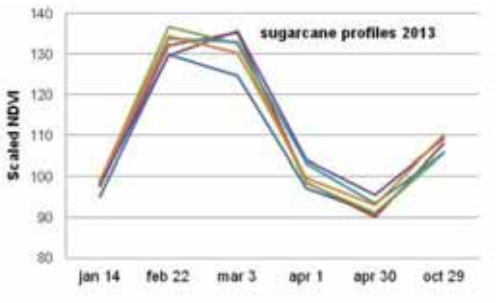


Fig. 38. Spectral profile based on NDVI of sugarcane during the season in eastern UP

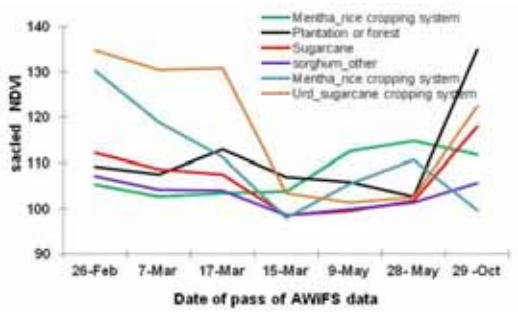


Fig. 39. Spectral profile based on NDVI of sugarcane and rice crop grown during the 2013 season in western UP

major districts contribute 98.7 percent of the state sugarcane acreage in UP.Remote Sensing multi-date data of Resourcesat-2 AWIFS from Mar. 2012 – May/June 2012 and of October was used for analysis. The collateral data of crop statistics weather data and yield information were collected from various sources. The groundtruth was collected during July/August and October months.Multi-date AWiFS data of 2013 used. Dates of multi-date AWiFs data used in UP are given below:-

Eastern UP	Jan. 14, Feb. 21, Mar. 3, Apr. 15, Apr. 30, May 9, Sep. 6 and Nov. 3, 2013
Western UP	Feb. 26, Mar. 7, Mar. 17, Apr. 15, May 9, May 28, Oct. 29 , 2013

Network Project on Organic Farming

Project Directorate for Farming Systems (PDFSR), Modipuram is operating a Network Project on Organic Farming (NPOF) from 2004-05 with 13 co-operating centres representing 9 agro-climatic regions, 13 NARP zones and 12 states. Analysis of 8 years yield data from various locations indicates, the relative yield between organic over inorganic was found to be higher in basmati rice, maize, sorghum and pea.The relative yield of wheat (102, n=55), cotton (113, n=17), sunflower (120, n=8) and potato (117, n=32) was found to be higher under integrated over inorganic production system as organic over inorganic registered less than 100 % inferring sustainable yield under integrated production system for these crops. After 8th cycle also, integrated practice recorded higher yield (1.1 t/ha) in irrigated areas while organic practice recorded higher yield (0.5 t/ha) in rainfed areas. The identified nutrient, pest, disease and weed management packages at various locations are given in Table 1 to 3.

Table 1. Identified nutrient packages for various locations

Centre	Cropping System	Sources
Jabalpur	Basmati rice-wheat-berseem (seed)	VC + FYM + NEOC @ 1/3 N
Coimbatore	Cotton-maize-GM Chillies-sunflower-GM	FYM + NEOC @ ½ N each + PG
Raipur	Rice-chickpea	EC + CDM + NEOC @ 1/3 N each + BD+PG
Calicut	Ginger-fallow	FYM + NC + 2VC + PG + biodynamic + RP
Dharwad	Groundnut-sorghum Maize-chickpeaChilli +onion	EC + VC + GLM + biodynamic spray @ 12 g/ha with PG spray
Karjat	Rice-red pumpkin Rice-cucumber	FYM + rice straw + gliricidia @ 1/3rd each of N during kharif and FYM + neem cake + vermicompost @ 1/3 each of N during rabi along with spray of PG
Ludhiana	Maize-wheat-summer moong	FYM + PG + biodynamic practices in maize, FYM +PG in wheat and FYM alone in moong

Centre	Cropping System	Sources
Bhopal	Soybean-wheat Soybean-chickpea Soybean-maize	OM+PG + BD
Pantnagar	Basmati rice-wheat Basmati rice-chickpea Basmati rice-vegetable pea	FYM + VC + NC + EC @ ¼ N each + BD + PG
Ranchi	Rice-wheat Rice-potato	VC+ KC + BD+ PG
Umiam	Rice-maize Rice-toria	FYM + VC + PG

Table 2. Identified weed management packages for various locations

Centre	Cropping System	Best performing practice
Raipur	Rice-mustard	Conoweeder with square planting for rice
		Stale seed bed for mustard
Coimbatore	Rice-blackgram-GM	2 hand weeding + spray of aqueous leaf extract at 3-4 leaf stage of weeds
Jabalpur	Rice-wheat	2 hand weeding + spray at 3-4 leaf stage aqueous spray of weeds
Dharwad	Groundnut	Spray of cassia and *Prosppis juliflora* as post emergent
Ludhiana	Basmati rice-wheat	High density planting + hand weeding at 25-30 DAT
Pantnagar	Basmati rice-wheat-sesbania	one hand weeding at 25-30 DAT during kharif and 2 hand weeding at 25-30 and 45-50 DAS during rabi
Umiam	Maize (GC)-mustard	Mulching with fresh eupatorium/ambrosia @ 10 t/ha (after earthing up)

Table 3. Identified pest and disease management packages for various locations

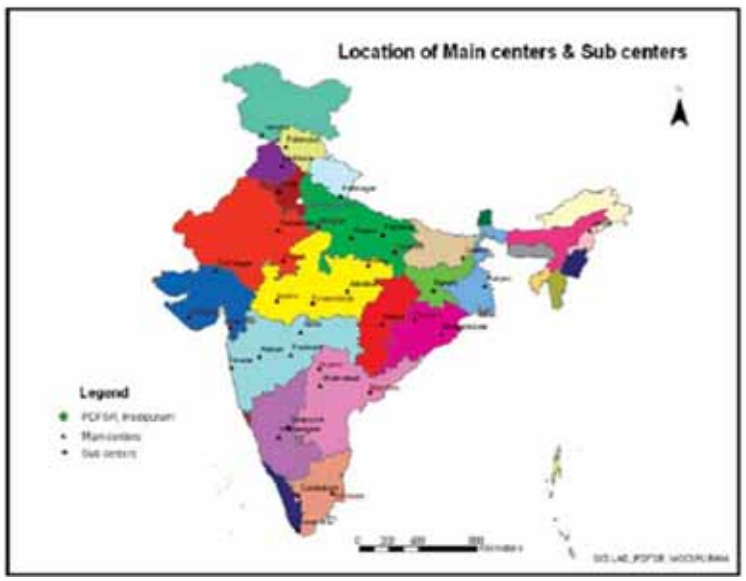
Centre	Cropping System	Pest/disease	Best performing practice
Modipuram	Basmati rice-chickpea Basmati rice-mustard	-	Summer ploughing + green manure incorporation
Calicut	Gninger-fallow	Shoot borer	GEB 17 & 18, GRB 57
Bajaura	Cauliflower-peas-tomato	Fruit borer & Fruit rot	Karvi (Roylea cinerea) @ 10% aqeous leaf extract + cow urine (3%) + tween-80 (0.05%) as emulsifier
Umiam	Maize +Soybean	Monolapta Mylloceros Ephilechma Leaf folder	Derisom (3 ml/l) + PG @ 10% and cow urine 3% Anomin 3 ml/litre or PG @ 3%.
		Rust	PG @ 3% + lantana @ 10% + vermiwash @ 10%

Package of practices were developed for organic farming of different crops and cropping systems and uploaded in PDFSR website (www.pdfsr.ernet.in). The details of package of practices available on the website are as follows. The practices are being continuously updated also.

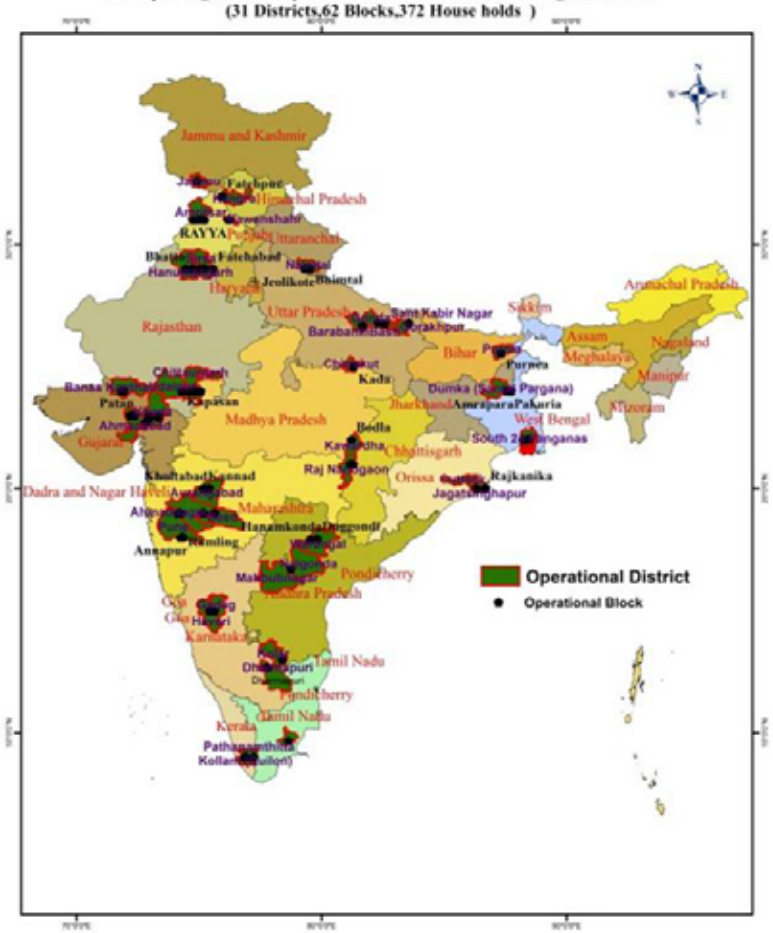
1. Organic package for maize-potato-okra system (English)
2. Organic package for maize (cob)-mustard+radish system (English)
3. Organic package for basmati rice-wheat system (English)
4. Organic package for rice-barley+mustard-summer moong system (English)
5. Organic management package for cropping systems in selected agro-climatic regions (English)
6. Organic farming package for pigeon pea (Hindi)
7. Organic farming package for Chickpea (Hindi)
8. Package of practices for cole crops (English)
9. Organic farming package for durum wheat (Hindi)
10. Fasal suraksha Hetu jaivik Vidhiya (Hindi)
11. Organic farming package for Isabgol (Hindi)
12. Organic farming package for mustard (Hindi)
13. Organic black pepper (Malayalam & Hindi)
14. Organic farming package for Ginger (Malayalam & Hindi)
15. Organic turmeric (Malayalam & Hindi)
16. Package of practices for organic production of important crops in NEH region (English)
17. Package of practices for groundnut, soybean, sorghum, rainfed wheat, cotton, chilli, potato, chickpea and maize in Karnataka (English)
18. Vermicomposting production and practices (English & Hindi)

AICRP on Integrated Farming Systems

All India Coordinated Research Project on Integrated farming Systems (AICRP-IFS) is an integral part of PDFSR with 31 on-station IFSR centres, 11 on-station CSR centres and 32 on-farm research centres spread throughout the country in all the agro-climatic regions to develop location specific farming system technologies. Under the aegis of AICRP-IFS, the experiments of Identification of need based cropping systems for different agro-ecosystems, Tillage and planting management in different cropping systems, Long range effect of continuous cropping and manuring on soil fertility and yield stability, Development of organic farming packages for system-based high value crops, and development of region specific integrated farming system models were taken up in on-station while 3 experiments viz., On-Farm crop response to application of major plant nutrients in predominant cropping



OFR: ON- FARM Evalution of Farming System Modules for Improving Profitabilty and Livelihood of Small and Marginal Farmers (31 Districts,62 Blocks,372 House holds)



systems, On-Farm evaluation of new diversified cropping systems under irrigated/rainfed conditions and On-Farm evaluation of farming system modules for Improving profitability and livelihood of Small and Marginal Farmers were taken up under on-farm research besides conducting of 50 FLD's on cropping systems involving oilseeds.

The salient findings from on-farm experiments are given below.

- Across the various NARP zones and cropping systems, farmer's package resulted in lower yield compared to recommended package owing to the 36.2, 20.5, 67.8 and 80.1 % lower application of NP_2O_5 K_2O and micronutrients.

- On-farm system yield gap between recommended dose of N P_2O_5 K_2O + micronutrient and farmer's package was found to be 1933, 2215, 2996, 1790 and 727 kg ha^{-1} in rice- rice, rice- wheat, maize- wheat, pearlmillet – wheat and rice greengram systems respectively.

- Application of micronutrients based on soil test resulted in additional yield of 535, 286, 393, 243 and 345 kg ha^{-1} in rice – rice, rice- wheat, maize-wheat, pearlmillet – wheat and rice - green gram systems respectively.

- In all the NARP zones and systems, application of recommended NP_2O_5 K_2O alone or NP_2O_5 K_2O + micronutrient resulted in higher yield and use efficiency of nutrients. Suboptimal application in terms of number and quantity resulted in significantly lower yield and useefficiency of nutrients especially nitrogen.

- Across the locations and systems, the best performing diversified system registered net returns and total calories of Rs. 1, 69, 270 ha^{-1} $year^{-1}$and 35273x1000 kcal ha^{-1} $year^{-1}$ compared to the existing system (1,00,718 ha^{-1} $year^{-1}$ and 24213x1000 k cal ha^{-1} $year^{-1}$). On an average, it was found that, the net returns and total calories production per hectare can be increase by 68 and 46% respectively through diversification of existing system with location specific identified alternative systems.

- The total cost of interventions in all the modules of farming system was found to be Rs 7774 for 0.92 ha area.

- The increase in net returns over variable cost of interventions in improved farming systems was found to be 6.8 times.

- The value of household consumption increased by 51.4 % due to the improved farming systems.

- The per day profit of marginal and small households can be increased by 69.2 % through low cost interventions in farming systems perspective.

- An additional employment of 53.6 man days/year can be generated through interventions in various modules such as crop, livestock, processing and optional in farming system mode.

TECHNOLOGY TRANSFER, WORKSHOPS, TRAININGS AND FARMERS MEETS

Training programmes of the Institute

The Directorate offered several short-term training courses during the year for capacity-building of field-level functionaries, who in turn would transmit advanced technical know-how to the end-users. Courses were demand-driven and the delivery was based on the principle of 'learning by doing' with adequate background in theory.

Besides, extension officers in the state line department of agriculture, college/university teachers, students, entrepreneurs and NGO officials were also benefited from the courses. Training programmes conducted this year are presented in Table 30.

Table 30. Training/workshop/schools organized during 2013-14

Sl. No.	Organizer	Participants	Title of Training/ workshop/schools	Venue	Period
1	Harbir Singh	OFR Agronomist and field assistants of AICRP-IFS, OFR center, Pakur (Dumka)-Ranchi	Training on characterization Survey methodology	AICRP-IFS OFR Center at Dumka-Ranchi (Chhatisgarh)	18-19 Oct., 2013
2		SMS of KVKs Zone-III, Barapani (Meghalaya)	Integrated Horti Based Farming System for Higher productivity in NEH Regions	CIFRI, Regional Station Guwahati (Meghalaya)	17-18 Sept., 2013
3		Scientists from ICAR-NEH, NARC, BARC & CIMMYT-Nepal	Camp workshop of AgMIP-ICAR Collaborative Project jointly organized by PDFSR and ICRISAT	ICRISAT	24-28th June, 2013
4		Farmers of Adopted villages	Training on Value addition of agricultural produce under THDC sponsored project	Kumarda, Kyari, Alli Talli	18-21st Dec., 2013
5	Shamim, M.	B.Sc/B.Tech students from the SVPAU&T, Modipuram	Agro-met observatory instruments and their methods of taking observations	PDFSR, Modipuram	
6	J.P. Singh	Agricultural Officers of different states of the country	Model training Course on, " Good Agricultural Practices"	PDFSR, Modipuram	4-11 Mar., 2013
7	Subash, N. and Harbir Singh	Scientists, university teachers and Officers from State agricultural deptt.	Brainstorming meeting on 'Development of RAPS'	PDFSR, Modipuram	18th July 2013

Agricultural Technology Information Centre (ATIC)

The Agricultural Technology Information Centre as a sub-component of the "Innovations in Technology Dissemination" under National Agricultural Technology Project (NATP) has been established at the Directorate to provide technology products, services and information through a single window system to farmers and entrepreneurs. During the year more than 200 visitors comprising farmers, entrepreneurs, students etc. visited the centre. A large number of pamphlets/booklets were also distributed to the visitors.

Table 31. Field days conducted by the Directorate during 2013-14

Sl. No.	Date	Nature of Participants	Gender of participants	
			Male	Female
1.	17.02.2013	Farmers	200	117
2.	16.03.2013	Farmers	147	56
3.	02.06.2013	THDC area	76	34
4.	10.10.2013	Farmers	266	104
5.	21.10.2013	Farmers	335	165
6.	14.02.2014	Farmers	152	-
7.	11.03.2014	Farmers	323	-

Field Days

A total of 7 Field Days were organized for the farmers of various districts of Uttar Pradesh and other states covering many small and marginal farmers including farm women. The field days include integrated farming systems, farm visits, laboratories and other facilities. The farmers visit the learning stations which include Vermicompost unit, mushroom production unit, fish ponds, horticultural components of the integrated farming systems and other components like various cropping systems, resource conservation technologies etc.

Exposure visits to PDFSR

The Directorate organised 10 group visits comprising students, practicing farmers, farmwomen, extension workers and others. Duration of the visits was mostly one day. Visitors were taken around the farm facilities, Technology park, selected laboratories and ATIC. For farmer groups question answer sessions were also organised for addressing to variety of queries.

Table 32. Details of the group visits organized

Sl. No.	Date	Participants	No. of participants
1.	04.01.2013	Coordinators, BIF	2
2.	02.03.2013	ATMA group of MP farmers Bagpat, U.P.	25
3.	04.03.2013	ADOS from different states under training programme	20

Sl. No.	Date	Participants	No. of participants
4.	18.03.2013	Farmers group under ATMA programme, Muzaffarnagar, U.P.	41
5.	05.04.2013	U.P. State officer teams	8
6.	16.08.2013	Agricultural graduate under training, NCOF Ghaziabad	30
7.	22.08.2013	M.Sc students team from SVPUAT, Modipuram	13
8.	25.11.2013	Trainees from Afganistan	4
9.	14.12.2013	Trainees from CSWCRIT Dehradun, UK	21
10.	12.02.2014	Student biotechnology MIET, Meerut	38

Radio/Televisions talk

Name of speaker	Topic	Broadcasted/telecasted in	Date
Dr Dushyant Mishra	*Aam ke bago ka jeernodhar*	Krishi DarshanLucknow Doordarshan	24th August 2013

Statement of Understanding (SoU)

As a follow up action on the recommendation of interaction meeting held with Director's of all the division during 15 & 17 July 2013 at NASC, New Delhi, PDFSR developed Statement of Understanding (SoU) with 10 ICAR institutes and 6 AICRP's for partnership in knowledge, technology, material and resource sharing for Integrated Farming Systems Research which is being carried out across the country through 74 centres (on-station and on-farm) under the aegis of AICRP on IFS. The gist of the SoU developed with various institutes are briefly given below.

Institute/ Directorate/ NRC/ AICRP	Major area of R&D partnership	State (s)/ Areas of cooperation	Date of signing SoU
CARI, Izatnagar, Bareily	Diversified poultry germplasm for marginal and small farmers Low cost poultry housing Training on preparation of salted egg for improving keeping quality	Bihar, Jharkhand, Odisha, Uttarakhand and Uttar Pradesh	13/09/2013
IIHR, Bengaluru	Micro nutrient enriched vegetables for selected farming systems Hybrid seedling technology to on-farm centers Papaya hybrids for farming systems research Dryland horti based systems	Karnataka, Tamil Nadu, Andhra Pradesh, Kerala and Goa	25/10/2013

Institute/ Directorate/ NRC/ AICRP	Major area of R&D partnership	State (s)/ Areas of cooperation	Date of signing SoU
NIANP, Bengaluru	Area specific mineral mixture to dairy animals for selected farming systems Area specific mineral mixture to small ruminents Low cost azolla production technology and silage making Ration balancing using local feed resources	Karnataka	26/10/2013
CISH, Lucknow	Identifications of options for fruit module Rejuvenation and management of existing fruit plants Supply of planting materials and capacity building	Bihar, Gujarat, Haryana, Jharkhand, Madhya Pradesh, Maharashtra and Uttar Pradesh	20/11/2013
NRC on Pig (Guwahati) including AICRP on Pig	Pig germplasm for livestock module Scientific rearing of pig	A&N Islands, Assam, Chattisgarh, Goa, Jharkhand, Meghalaya and West Bengal (Bali Island)	04/12/2013
DWSR, Jabalpur (including AICRP on Weed control)	Sharing of expertise in the field of weed management and weed dynamics Utilization of weed biomass for mulch and vermicompost preparation	Madhya Pradesh, Andhra Pradesh, Assam, Chattisgarh, Himachal Pradesh, Jharkhand, Odisha, Punjab, Tamil Nadu, Uttar Pradesh and Uttarakhand	20/12/2013
AICRP on Nematodes	Study on nematode behavior in various farming systems Nematode management techniques and capacity building	Assam, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh and West Bengal	23/12/2013
IGFRI, Jhansi (including AICRP on Forage crops)	Improved fodder varieties in farming systems Knowledge sharing and capacity building	Punjab, Madhya Pradesh, Himachal Pradesh, Assam and Andhra Pradesh	03/01/2014
NRCAF, Jhansi (including AICRP on Agroforestry)	Supply of improved MPTS planting materials and knowledge sharing Carbon sequestration study in agroforestry systems	Gujarat, Punjab and Odisha	04/01/2014
DWM, Bhubaneswar (including AICRP on Water Management)	Water budgeting for agriculture and fish production system Multiple water use based farming systems Runoff management in farming systems	Meghalaya, Odisha, Maharashtra, Jammu and Kashmir, Himachal Pradesh, Tamil Nadu and Gujarat	08/01/2014
CIFA, Bhubaneswar	Collaborative on-station and on-farm studies in farming system perspective Collaboration in Bali Island under TSP for farming systems research and development Refinement of farming system model at CIFA in collaboration with PDFSR	Assam, Odisha and West Bengal	09/01/2014

Besides the above institutes and AICRPs, the PDFSR is already having the linkage with ICAR RC NEH, Umiam, ICAR RC for Goa, ICAR RC for ER, Patna and CARI, Port Blair for characterization of existing farming systems and developing need based IFS models for the region through AICRP on IFS.

The other highlight of SoU is that PDFSR will also extend need based expertise/capacity building activities in Farming Systems Research to IGFRI, CIFA and CISH. Nodal Officers at PDFSR and at all the partner institutes have been identified for effective implementation of partnership at the ground level. It is expected that convergence of technologies/resources will happen due to the SoU among the institutes and will directly benefit the farming community with visible R&D efforts. Further strengthening of partnerships with zonal units of KVK's through Extension Division of ICAR is in progress.

Memorandum of Understanding (MoU)/ Statement of Understanding signed for partnership in IFS research

As a follow up action on the recommendation of interaction meeting held with Director's of all the division during 15 & 17 July 2013 at NASC, New Delhi, PDFSR developed Statement of Understanding (SoU) with 10 ICAR institutes, 6 AICRP's and 1 ZPD for partnership in knowledge, technology, material and resource sharing for Integrated Farming Systems Research which is being carried out across the country through 74 centres (on-station and on-farm) under the aegis of AICRP on IFS. The gist of the SoU developed with various institutes are briefly given below

Institute/ Directorate/ NRC/ AICRP	Major area of R&D partnership	State (s)/ Areas of cooperation	Date of signing SoU
CARI, Izatnagar, Bareily	· Diversified poultry germplasm for marginal and small farmers · Low cost poultry housing · Training on preparation of salted egg for improving keeping quality	Bihar, Jharkhand, Odisha, Uttarakhand and Uttar Pradesh	13/09/2013
IIHR, Bengaluru	· Micro nutrient enriched vegetables for selected farming systems · Hybrid seedling technology to on-farm centres · Papaya hybrids for farming systems research · Dryland horti based systems	Karnataka, Tamil Nadu, Andhra Pradesh, Kerala and Goa	25/10/2013
NIANP, Bengaluru	· Area specific mineral mixture to dairy animals for selected farming systems · Area specific mineral mixture to small ruminents · Low cost azolla production technology and silage making · Ration balancing using local feed resources	Karnataka	26/10/2013
CISH, Lucknow	· Identifications of options for fruit module · Rejuvenation and management of existing fruit plants · Supply of planting materials and capacity building	Bihar, Gujarat, Haryana, Jharkhand, Madhya Pradesh, Maharashtra and Uttar Pradesh	20/11/2013
NRC on Pig (Guwahati) including AICRP on Pig	· Pig germplasm for livestock module · Scientific rearing of pig	A&N Islands, Assam, Chattisgarh, Goa, Jharkhand, Meghalaya and West Bengal (Bali Island)	04/12/2013
DWSR, Jabalpur (including AICRP on Weed control)	· Sharing of expertise in the field of weed management and weed dynamics · Utilization of weed biomass for mulch and vermicompost preparation	Madhya Pradesh, Andhra Pradesh, Assam, Chattisgarh, Himachal Pradesh, Jharkhand, Odisha, Punjab, Tamil Nadu, Uttar Pradesh and Uttarakhand	20/12/2013
AICRP on Nematodes	· Study on nematode behavior in various farming systems · Nematode management techniques and capacity building	Assam, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh and West Bengal	23/12/2013
IGFRI, Jhansi (including AICRP on Forage crops)	· Improved fodder varieties in farming systems · Knowledge sharing and capacity building	Punjab, Madhya Pradesh, Himachal Pradesh, Assam and Andhra Pradesh	03/01/2014

Institute/ Directorate/ NRC/ AICRP	Major area of R&D partnership	State (s)/ Areas of cooperation	Date of signing SoU
NRCAF, Jhansi (including AICRP on Agroforestry)	· Supply of improved MPTS planting materials and knowledge sharing · Carbon sequestration study in agroforestry systems	Gujarat, Punjab and Odisha	04/01/2014
DWM, Bhubaneswar (including AICRP on Water Management)	· Water budgeting for agriculture and fish production system · Multiple water use based farming systems · Runoff management in farming systems	Meghalaya, Odisha, Maharashtra, Jammu and Kashmir, Himachal Pradesh, Tamil Nadu and Gujarat	08/01/2014
CIFA, Bhubaneswar	· Collaborative on-station and on-farm studies in farming system perspective · Collaboration in Bali Island under TSP for farming systems research and development · Refinement of farming system model at CIFA in collaboration with PDFSR	Assam, Odisha and West Bengal	09/01/2014
ZPD, Kolkata	· On station and OFR centres of AICRP-IFS working in various districts in Zone-II to be linked to the respective KVKs for demonstration of identified IFS modules and models · Synthesis of IFS modules and models for all the districts in the zone · Analysis of technological, financial, policy and institutional impediments in up scaling IFS models to be done jointly by the AICRP-IFS centres and KVKs · Organizing regional meetings with KVKs and AICRP centres for identifying/synthesizing the suitable IFS modules/models based on constraint analysis and demonstration of the same through KVK	States covered in Zone-II	25/01/2014

EDUCATION AND INFORMATION SYSTEM

Library

The Central Library has a good collection of books and journals on Agriculture in general and Integrated Farming Systems in particular. It has around 2000 books back volume journals and other reference materials. It has more than 140 members viz., scientists, technical officers and research scholars. Besides the 80 internal users (which includes Scientists, Technical Officers & Research scholars) of the library, 60 visitors from outside organisations utilised the library resources. The Library subscribed to 12 1 International and 16 Indian Journals for the year 2013-14 (Foreign Journals Rs 12.0 lakhs; Indian journals Rs. 0.5 lakh)

The users of the Library extensively used the Consortium of E-resources on Agricultures (CeRA). A user awareness programme on the CeRA was organized by the library during the year. In addition to above online access in CeRA, the library is providing Document Delivery services to various institutions (including the SAUs) under the NARS. To keep abreast the current developments, it also provides monthly 'Current Contents' service by compiling content pages of current journals received. The library also provides the photocopy facility. The library provides services to the Scientists and Technical Officers, Research Scholars, trainees, students and officials of Directorate.

AKMU

Agricultural Knowledge Management Unit (AKMU) is well equipped with modern computer facilities along with local area network (LAN), Wi-fi connectivity and high speed broad band internet facility with dedicated Linux based server. The unit is also equipped with statistical software like SPSS and SAS for data analysis. It also supports development and maintenance of database, website management, expert systems and data warehousing.

AWARDS AND RECOGNITIONS

Recipient/s	Awards/Recognition	Venue
Sunil Kumar, B. Gangwar, Harbir Singh and S.P. Singh	2nd best poster presentation award entitled "Impact of farming systems on household income of Meghalaya farmers".	International conference on Impact of Technological Tools on Food Security under Global Warming Scenario (ITTFS-2012) held at Shobhit University, Meerut on11-12 May, 2013
Chanderbhanu	Dr. Rajendra Prasad Puraskar of ICAR 2012	ICAR Awards Ceremony, New Delhi on July, 2013
A.K. Prusty,	1st prize in Hindi debate competition	organized on the eve of Hindi Pakhwada, 2013
B. Gangwar, V.K. Singh and N. Ravisankar	Dhiru Morarji Memorial Award (2013)	Fertilizer Association of India, New Delhi
S.P. Singh	SRDA Gold Medal- 2012" by 'Society for Recent Development in Agriculture'	International Conference on 'Impact of Technological Tools on Food Security under Global Warming Scenario (ITTFS-2012)'.

RESEARCH COORDINATION AND MANAGEMENT

Research Advisory Committee

The 3rd meeting of 6th Research Advisory Committee (RAC) of PDFSR was held on 15-16 April 2013 at Modipuram under the chairmanship of Prof. Panjab Singh, former Secretary DARE (GOI) and Director General ICAR. Dr R.P. Singh, Dean, Institute of Agricultuaral Sciences, BHU, Varanasi. Dr K.K. Vass, Ex-Director, CIFRI, Barrackpore, Dr Shyam Singh, Ex-Director, NRC Citrus, Nagpur, Dr Suresh Pal, Head, Division of Agri. Economics, IARI, New Delhi, Dr A.K. Yadav, Director, National Centre on Organic Farming, Ghaziabad and Dr B. Mohan Kumar, Asst. Director General (Agron. & A.F.), ICAR, New Delhi participated in the meeting as members.

Dr B. Gangwar, Project Director while welcoming the chairman and members, presented the salient achievements of the directorate during the year. He highlighted that national level information on farming systems research is being compiled in the form of book which will serve as status report on farming systems research in India. Further, he mentioned that two success stories from on-farm research have been developed and placed in public domain. In his introductory remarks, Dr Panjab Singh highlighted that farming system has got flagship role in reducing poverty, malnutrition, unemployment etc and the directorate should be upgraded to a full-fledged institute (IIFSR) and responsibility of developing region and resource specific farming system models should be priority. All the issues of farming needs to be addressed in holistic manner. Enthusiastic inputs of scientist are must but everyone should keep the farmer in mind while developing technologies. Later RAC also visited the field experiments. Dr Kamta Prasad, Principal Scientist and Member secretary proposed the vote of thanks.

Institute Management Committee

The 31st Meeting of Institute Management Committee (IMC) of the Directorate was held on 14th September, 2013 under the chairmanship of Dr. B. Gangwar, Project Director. Dr. H. S. Gaur, Vice Chancellor, SVBPUA&T, Modipuram, Shri K. K. Sharma, Ex-President, District Board, Bulandshahar (UP), Dr. S. K. Chaudhari, Head- Division of Soil & Crop, CSSRI, Karnal, Dr. A. K. Chakravarty, P.S., Breeding Research Centre, NDRI, Karnal and Sh. A. P. Sharma, F&AO, IASRI, New Delhi attended the meeting as members of IMC

while Shri Tara Chand Sharma, F&AO and Shri H. S. Chauhan, AAO, PDFSR attended the meeting as special invitees. At the outset, Dr. B. Gangwar, Project Director and Chairman of the IMC welcomed the Hon'ble Members and special invitees. Action Taken Report of 30th IMC was presented by Sh. Sushil K. Singh, SAO, PDFSR and Member Secretary, IMC and the same was accepted *in toto* by the house. Shri T. C. Sharma, F& AO presented the budget and utilization under Plan / Non-plan heads and other projects during current financial year of the Directorate. The Chairman presented the progress and achievements of the Directorate since last IMC meeting which included the human resource development, infrastructural developments, research dimensions, timely assessments & probation confirmation of the scientists/ staff, important publications, various events organised by the Directorate and Vision 2050 document of the directorate. The house expressed satisfaction on the progress and significant achievements made during the period by the Directorate. The issues related to purchase of DG set and Air Conditioners for laboratories and Construction of one poly-house was also discussed and necessary recommendations were given by the house. The house fully endorsed up-gradation of status of PDFSR from Directorate to the Institute (IIFSR) as already approved by Governing body of ICAR. Sh. Sushil K. Singh, SAO and member secretary IMC proposed the vote of thanks to the Chair.

Priority Setting, Monitoring and Evaluation (PME) cell

The PME works as nodal point for priority setting, monitoring and evaluation of the projects of the directorate. Besides, it has facilitated the conduct of 27th meeting of Institute Research Committee (IRC) from 17-20th February 2014. Altogether, 26 on-going research projects and 1 exploratory study have been discussed out of which 12 projects and 1 exploratory study was concluded. One project dropped. Out of 18 new project proposals discussed, 11 proposals are approved as Projects and 4 as exploratory study for one year. One proposal was merged with the other proposal. Two proposals were not approved for the lack of proper technical programme. All the projects have been given project code for the first time. Further, the new research project proforma has been implemented for the on-going and new projects. Documents of the Directorate *viz.*, Annual Report, News Letter, preparation of reports to the council like Quarterly target/ performance review, Half yearly target/ performance review, DARE report, report for result-frame work document (RFD) and performance indicator were prepared during the period. It has coordinated and processed the publishing of research articles, technical bulletins, folders, abstracts submitted by Scientists. Also processed the proposals of Memorandum of Understanding received from various organizations. During the year, the on-going experiments at PDFSR experimental farm and on-farm research projects were monitored and evaluated effectively by constituting two committees. The report submitted by the committees was discussed and follow up action were taken.

Institutional Monitoring

A committee comprising of Dr Kamta Prasad as Chairman and Dr J.P. Singh, Dr V.K. Singh, Dr R.S. Yadav, and Dr N. Ravisankar as members was constituted for monitoring of on-going research experiments at PDFSR research farms. The committee visited the experiments

at PDFSR farms on 08-09 October, 2013 and appraised all the field experiments and expressed satisfaction over the maintenance of field experiments. The committee also felt certain general point's *viz.* timely arrangement of inputs and other logistics by farm office, identification of seed production blocks with required standards, proper maintenance of irrigation channels, maintenance of sanctity of organic block and timely servicing of farm machinery etc. to be addressed for effective conduct of experiments.

Result Frame-work Document (RFD)

The RFD Committee and Resource Centre of the Directorate functions with the following team.

1. Dr B. Gangwar, Project Director and Chairman, RFD Committee
2. Dr Kamta Prasad, Pr. Scientist & Nodal Officer, RFD
3. Dr N. Ravisankar, Pr. Scientist & Co-Nodal Officer, RFD Committee
4. Dr N. Subash, Sr Scientist & Member Resource Centre
5. Dr Brij Mohan, Technical Officer & Member Resource Centre

The RFD committee prepare the annual action plan, monitors the progress and reports achievements to the headquarters. The approved annual total composite score of the directorate for the last two years are given below.

Year	Approved Annual Total Composite Score	Approved Rating
2011-2012	96.00	Excellent
2012-2013	96.73	Excellent

The 27th meeting of IRC of the Directorate was held during 17-20 February, 2014 at PDFSR, Modipuram in which review of action taken report of 26th meeting of IRC, results of on-going institute funded projects and proposals of new projects and observational trial were discussed. The meeting was chaired by Dr B. Gangwar, Project Director, PDFSR and attended by all the members of IRC. List of participants are given in Annexure. The meeting started with ICAR song followed by introduction of 9 members who have joined after the 26th meeting of IRC. Dr N. Ravisankar, Member Secretary, IRC presented the brief achievements of the PME cell while welcoming the Chairman and all the members of IRC. Important achievements include web publication of Vision 2050, preparation of Performance Indicator for the Directorate as per ICAR guidelines, timely publication of Annual Report and Newsletter of the Directorate and implementation of the "E-Publishing and Knowledge Systems in Agriculture (EPKSA)" under NAIP component-I. He also mentioned that 3 members (Dr K.K. Singh, Dr K.P. Tripathi and Er Monolisha Pramanik) have left the Directorate while 11 members have joined the group which is significant achievement of the Chairman. Member Secretary also thanked Dr K.K. Singh, previous in-charge, PME cell and his team who have made significant contribution in the PME activities and introduced the new team of PME cell and activities assigned to each one.

Dr B. Gangwar, Chairman, IRC in his opening remarks congratulated all the

newly joined members of IRC and asked them to come up with the good project proposals in farming systems perspective guided by QRT and RAC recommendations. He also felt that more time should be devoted for discussing the new project proposals. While briefing the QRT recommendations, he said, PDFSR is likely to be upgraded as IIFSR and EFC memo has been submitted for the same. He asked all the members to give constructive comments for the improvement of on-going and new project proposals. Chairman also pointed out that Statement of Understanding with 10 ICAR institutes, 6 AICRP's and 1 zonal unit of KVK have been signed for strengthening inter-institutional linkage.

The presentation of Action Taken Report of 26th meeting of IRC, institute project coding, status of RPP, Annual Report and review of on-going projects of Cropping Systems and Resource Management (CSRM) and Integrated Farming Systems Management (IFSM) programme was taken up on 17 February 2014.

HUMAN RESOURCE DEVELOPMENT

Training received by the staff members of the Institute as part of the human resources development initiative

Name of participants	Title of training	Venue	Period
V.P. Chaudhary	Travelling seminar on Conservation Agriculture	CIMMYT & BISA locations at Ludhiana, Jabalpur and Patna, Pusa (Bihar)	
Shamim, M.	MDP workshop	NAARM, Hyderabad	19-23 November, 2013
Chanderbhanu	13 days training course on Developing Human Resource for Teaching core Course in Plant Nematology	CCSHAU, Hisar, Haryana	23rd December, 2013 to 4th January, 2014
V.K. Singh	Special Training Course on "Geoinformatics for Meteorology and Climatology Applications		18-29 November, 2013
Subash, N.	Appropriate technologies and Innovative approaches for Agriculture knowledge sharing	ICRISAT, Patancheru, Hyderabad, AP	9-14th December, 2013
V.K. Singh	Management development programme leadership development (pre-RMP programme)	NAARM, Hyderabad	26th August to 6th September, 2013

Participation of Scientists/Technical Officers in Workshops/Seminars/Symposia/ Conferences/ Meeting in India and abroad

Participants	Title of seminar/symposia/workshop	Venue	Period
Shamim, M.	2nd International conference on emerging food safety risk: challenges for developing countries	NIFTEM Sonepat, Haryana	09-10 January, 2014
V.K. Singh	Foresight and future pathway of agricultural research through youth in India	NRSC complex, N. Delhi	1-2 March, 2013
V.K. Singh	Interactive workshop on nutrient expert for rice organized by IPNI and International maize and Wheat improvement centre (CIMMYT)		19th December, 2013

Participants	Title of seminar/symposia/workshop	Venue	Period
V.K. Singh	Precision Agriculture-Concept, tools and implementation road map in smallholder systems in South Asia	Punjab Agriculture University, Ludhiana	13 November, 2013
V.K. Singh	14th ESRI India user conference organized by ESRI India	Karkardooma, N. Delhi	11-12 December, 2013
N. Subash	GYGA Workshop	Wageningen University, Netherlands	10-12th September, 2013
J.P. Singh	SMD wise interaction Meeting for Institutional Linkage with PDFSR, Modipuram for IFS Research.	NASC Complex, New Delhi and NCAP, Pusa , New Delhi	15 and 17July, 2013
Shamim, M.	Brain storming meeting on Agro-meteorological Research for food security in India	Assam Agricultural University, Jorhat	15-16 November, 2013
Amit Nath	National Conference on Bioactive Compounds and Functional Foods in Health and Diseases Management (BFHDM-2013 at NIFTEM, Kundli, India	NIFTEM, Kundali	15-16 November, 2013
A. K. Prusty	SMD-wise interaction meeting for strengthening of inter-institutional linkages for IFS research.	NASC complex, New Delhi	15-17, July, 2013
Subash, N.	NICRA Annual workshop	IARI, New Delhi	17-19th June, 2013
Harbir Singh	Brainstorming on 'Development of RAPS'	PDFSR, Modipuram	18 July 2013
Amit Nath	NSURE-HEALTHY FOODS (Nutritional Security through Sustainable Development, Research & Education for Healthy Foods)	CFTRI, Mysore	18-21 December, 2013
A. K. Prusty	Brain storming on farming systems scenario under climate change.	PDFSR, Modipuram	18th July, 2013
J.P. Singh	National Consultation Meet on Agroforestry	NASC Complex, New Delhi	19 N\ovember, 2013
Dushyant Mishra	National Consultation Meet on Agroforestry Research and Development in India	NASC Complex, New Delhi	19th November 2013
Subash N. and Harbir Singh	AgMIP Mid-Term Workshop	Kathmandu, Nepal	22–26 July 2013
Harbir Singh	National Group Meeting of AICRP on IFS	ICAR Research Complex for NEH Region, Umiam	2–4 December 2013
J.P. Singh	Group Meeting of AICRP-IFS	ICAR Research Complex,Barapani, Umaim, Meghalaya	2-4 December, 2013
Harbir Singh	AgMIP Indo-Gangetic Basin (IGB) Team Bootcamp Meeting	ICRISAT, Patancheru (AP)	24–28 June 2013

Participants	Title of seminar/symposia/workshop	Venue	Period
Subash, N.	AICRP-IFS Group Meeting	ICAR-NEH, Umiam	2-4 December, 2013
Harbir Singh	Farm Innovators Day	PDFSR, Modipuram	25 September 2013
Harbir Singh	Hindi Karyashla	PDFSR, Modipuram	26 September 2013
Subash, N.	4th AgMIP Global Workshop	Colombia University, New York, USA	28-30th October, 2013
Harbir Singh	AgMIP TOA-MD Workshop	Dubai (UAE)	29 April–3 May 2013
J.P. Singh	Sensitization Workshop on Enhancing Water Use efficiency in Yamuna Basin	NASC Complex, New Delhi	30 August,2013
Harbir Singh	AgMIP Regional Research Team Finish Line Workshop	Arusha, Tanzania	30 January – 4 February 2014
Subash, N.	AgMIP Special Session of Perspectives on Climate Effects on Agriculture: The International Efforts of AgMIP in ASA-CSSA-SSSA International annual meeting "Water, Food, Energy & Innovation for a Sustainable World"	Tampa, Florida, USA	4th November, 2013
Subash, N.	GYGA Special Session on "Crop Yield Gap Assessment for Global Food Security" in ASA-CSSA-SSSA International annual meeting "Water, Food, Energy & Innovation for a Sustainable World	Tampa, Florida, USA	5th November, 2013
V. P. Chaudhary	AGRIEVOLUTION 4th World Summit on Agriculture Machinery	FICCI, New Delhi, India	6 December, 2013
V. P. Chaudhary	EIMA Agrimach India 2013-conference	FICCI jointly with the deptt. of Ag. & Cooperation, Ministry of Agriculture, Govt. Of India, ICAR, and FEDER UNACOMA, Italy	7 December, 2013
Subash, N.	GYGA Workshop	University of Nebraska, Lincoln, USA	7-12th November, 2013
P. Kashyap, B. Gangwar, A. K. Prusty, M. P. Singh, V. K. Singh and V. P. Choudhary	World Congress on Agroforestry, New Delhi, India.	New Delhi	Feb 10-14, 2013
V. P. Chaudhary	Participated in the Brain Storming Session on 'C economy in Indian Agriculture	NASC complex, New Delhi	Feb. 01, 2014

Participants	Title of seminar/symposia/workshop	Venue	Period
R. S. Yadav	Brain Storming Session on 'C economy in Indian Agriculture organized by NAAS, New Delhi and convened by IISS, Bhopal	NASC complex, New Delhi	Feb. 01, 2014
R. S. Yadav	National Level Consultation Meet on 'Soil Health Assessment' organized by IISS, Bhopal.	IISS, Bhopal	Feb. 26, 2014
K.K. Pramanick, K. K. Jindal, Poonam Kashyap, Y.P. Sharma, Santosh Watpade and A. K. shukla	ISTS-IUFRO Conference on Sustainable resource management for Climate Change and Mitigation and Social Security organized by Indian Society of tree Scientists and International Union of Forest Research Organization.		March 13-15, 2014
Chanderbhanu	International conference on 'Impact of Technological Tools on Food Security under Global Warming Scenario ', organized by Hi-Tech Horticulture Society, Meerut- 250 110	Sobhit University, Modipuram	May 11-12, 2013
V. P. Chaudhary	78th Annual Convention of Indian Society of Soil Science and National Symposium on Developments in Soil Science	CAZRI, Jodhpur	Oct. 23-26, 2013
R. S. Yadav	78th Annual Convention of Indian Society of Soil Science and National Symposium on Developments in Soil Science	CAZRI, Jodhpur	Oct. 23-26, 2013
V. P. Chaudhary	National Travelling seminar on 'conservation agriculture'	Organized jointly ICAR, CIMMYT & BISA	September 16-25, 2013



EXHIBITIONS

The Institute participated in the following exhibitions during 2013-14.

Sl. No.	Exhibition	Venue	Period
1.	Kisan Mela	Modipuram	10-12 April, 2013
2.	Kisan Mela	Modipuram	20-22 February, 2014

C. Technology/product assessed and transferred to clients

Technology Developer/s	Technology/products assessed and transferred
Amit Nath	Optimized lemon squash
Amit Nath	Prepared spiced lime pickels
Amit Nath	Developed lemon grass tea
Shamim, M., B. Gangwar, Sudhir Kumar and Vipin Kumar	Importance of flowering and grain filling duration phenophases in relation to grain yield of rice
Shamim, M., B. Gangwar, Devendra Singh, K.K. Singh and Vipin Kumar	Performance of timely sown wheat genotypes under irrigated conditions
Subash, N., V.K. Singh, Shamim, M. and B. Gangwar	*Simulating* the effects of different irrigation regimes on rice-wheat cropping system
Sudhir Kumar, V.P. Choudhary and Shamim, M.	Physiological evaluation of rice under various crop establishment methods

D. Academic Accomplishments/ Recognitions

- Dr. Dushyant Mishra was nominated as member in Organizing Committee of "National Seminar on Protected Cultivation of Horticultural Crops and Value Addition" held at Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad during 29-30 November 2013.
- Dr. Dushyant Mishra, nominated as member in editorial board of *Journal of Food Science and Packaging*
- Dr. Harbir Singh acted as Rapporteur in one Technical Session in the National Group Meeting of AICRP on IFS at ICAR Research Complex for NEH Region, Umiam
- Dr. Harbir Singh served as referee for Legume Research – An International Journal.
- Dr. Harbir Singh was nominated by SAARC Agriculture Centre (SAC), Dhaka as a focal point expert to prepare a country status report of India on 'Popularizing multiple cropping innovations as a mean to raise productivity and farm income.

PDFSR Annual Day

The 2nd Annual day of PDFSR celebrated on 23rd February, 2014. Dr. H. S. Gaur, Vice-Chancellor, SVPUAT, Modipuram, Meerut was the chief guest. Dr A.K. Mathur, Acting Project Director Project Directorate on Cattle, Meerut and Dr. S. P. Singh, Director (Extension), NDUAT Faizabad also graced the occasion. Dr B. Gangwar, Project Director, PDFSR in his welcome address categorically stated that only farming system approach can raise the productivity and profitability for 86 % of marginal and small farm households in the country. Further, he elaborated the past year achievements and new initiatives taken by the Directorate which includes thrust in research on secondary agriculture (processing and value addition) and carbon accounting in farming system models being developed at on-station and on-farm programmes of AICRP on Integrated Farming systems. He also called upon all the staff to dedicate them to the farming systems research. Dr. H.S. Gaur, chief guest in his address, emphasized the need for co-ordinated effort among the agricultural institutions located in the Meerut. He precisely pinpointed the advantages of co-ordinated effort in teaching, research and extension which will lead to efficiency of all the organizations. He also emphasized that Scientists of PDFSR and faculty of the university should interact regularly.

To celebrate the day, a series of events like Annual Day Lecture, Friendly sports, Quiz competition and tambola were organized. There were friendly sports and quiz competitions with the staff of Project Directorate on Cattle (PDC), Meerut. In sports, the PDC team won the tug of war game. In Quiz competition, there were 8 teams out of which 3 teams were given first, second and third prizes based on the total scores obtained by them in the competition. The main attraction of the programme was Tambola game in which almost all the staff of PDFSR and the participants of PDC participated. The retired persons of the Directorate were also felicitated on this occasion by the Project Director. The whole day programme was enjoyed by all age group of people.

Mr Rajkumar, Progressive farmer and ICAR awardee also shared the problems being faced by farming community's especially marginal farmers. The distinguished retired scientists namely Dr. Sewa Ram, Dr. Devendera Singh, Dr. S.S. Khokhar, Dr.

S. D. Dhiman were felicitated during the event for their contribution in research and development in the early days of the Directorate. Friendly sports and cultural programmes were also organized during the day. Prizes were also distributed to the winners of various events. Dr. Prem Singh, Principal Scientist, Co-coordinator of the Annual Day proposed the vote of thanks.

Regional Training cum Workshop for Northern region

Regional level training cum workshop on "Methodology for OFR experiments with special emphasis for On-Farm Integrated Farming Systems" for Agronomists, Associated Scientists and Field Assistants of On-Farm Research (OFR) centres from Northern region comprising of Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajasthan (only Fatehpur centre), Uttar Pradesh and Uttarakhand during 4-6 April 2013 in collaboration with CSK Himachal Pradesh Krishi Vishwa Vidyalaya, Palampur (Himachal Pradesh). Dr. B. Gangwar, Project Director in his address explained to the chief guest that the on-farm research programme is entirely different from normal work. The Project Director also clarified that the on station IFS models are created for education and components optimization point of view. In order to have impact study, GPS based observations are also taken in the on-farm research. Dr. S.P. Sharma, welcomed the participants and and complimented the PDFSR for bringing out the success stories in IFS. He highlighted success story of farmers from Kendrapara district of Odisha. Dr. S.K. Sharma, Vice Chancellor in his chief guest address said that only few people think about farmers and real problem faced by farmers. He also emphasized that cost of cultivation should be brought down to greater extent. Dr. Sharma was of the firm opinion that, AICRP-IFS should have more centres than existing one. In the next 10-15 years, there should be a scientifically developed linkage among different components. The training of field staff is appreciable. The new methodology should be learned and more importantly, they should be practiced. Practical exercise on characterization of farming systems, technical programme preparation for all the OFR experiments and field visit to the OFR experiments were carried out as part of the training cum workshop.

Annual Group Meet of NPOF

The Directorate is operating a Network Project on Organic Farming (NPOF) from 2004 with 13 co-operating centres representing 9 agro-climatic

regions, 13 NARP zones and 12 states. Annual Group Meeting of Network Project on Organic Farming was organized at ICAR Research Complex, Sikkim Centre, Tadong, Gangtok during 26-27 April 2013.

Dr. H. Kalita, i/c Joint Director of the Centre welcomed the dignitaries and participants and mentioned that the meeting is at right place and on right time looking into the fact of Sikkim state going to be declared as organic state by 2015. Dr. Kamta Prasad, Programme Facilitator, Coordination Unit, PDFSR while delivering his opening remarks highlighted that in order to develop package of practices for organic farming in different cropping systems, NPOF was conceived and implemented at 13 centres. Mr. P T. Bhutia, Additional Director, H&CCDD, Govt. of Sikkim informed that Sikkim state shall become fully organic by the year 2015, which would cover nearly 50,000 hectares. Human resource development in organic farming is vital for the state to progress and achieve the targeted production and he was of the firm opinion that, extension functionaries of the Sikkim state should be trained at PDFSR, Modipuram. Mr. D. K. Pradhan, Additional Director, Fisheries, Govt. of Sikkim told that in Sikkim there are nearly 750 trout fish producing farmers. Thus a substantial quantity of organic feed is also required for trout farming. Dr. P.K. Shrivastava, Dean, CAEPHT, Ranipool, explained that agricultural engineering has a very crucial role in increasing productivity and value addition including food product processing. Shri B. Swaroop MD, SIMFED and chief guest of the inaugural session told that out of 69000 ha of cultivable area, 18000 ha has been certified as organic, while the remaining areas are under C1, C2 and C3 certification stages.

The demand of organic produces from Sikkim has been increasing day by day worldwide. Organic seed production is an avenue for Sikkim and should be emphasized which is mostly dominated by European countries. Dr. B. Gangwar, Project Director and Chairman of the session informed that in India, Sikkim and Uttarakhand are leading states in organic farming. He felt, it is very important to compile the information on organic farming packages developed through NPOF and elsewhere.

On this special occasion, the publications of the project *viz.,* Annual Report 2011-12 and Consolidated Report (2004-2011) of NPOF brought out by PDFSR was released by the Chief Guest and Chairman of the Session. All the 13 centres have presented their salient achievements. New technical programme was formulated after through discussions.

Dr J.S. Samra, Chief Executive Officer, National Rainfed Area Authority, New Delhi also attended the group meet for short period and gave valuable ideas about organic farming which also included his experience of recent interaction with the farmers especially women in Sikkim.

Dr Samra pointed out that, priority should be given to high value cash crops like large cardamom, ginger, turmeric and cherry pepper in sikkim. Dr S. Ayyappan, Director General, ICAR upon his visit to ICAR RC Sikkim centre also interacted with participants of annual group meet. Dr N. Ravisankar, National PI, NPOF proposed the vote of thanks.

The recommendations from annual group meet are given below.

Research

- The farming condition (irrigated or rainfed) in which the experiments are conducted should be mentioned clearly in the reports and presentations by all centres.
- Experiment 1 on "Evaluation of organic, inorganic and integrated production systems" and Experiment 2 on "Evaluation of response of different varieties of major crops for organic farming" should be conducted by all the centres. All the critical observations like type and level of insect and disease incidence, weeds etc should be reported from both the experiments.
- Experiment 3 on "Evaluation of bio-intensive complimentary cropping systems under organic production systems" is to be conducted by Dharwad, Pantnagar and Umiam centres while experiment 4 on "Development of Integrated Organic Farming System models" is to be taken up by Calicut, Coimbatore, Dharwad and Umiam centres.
- Experiment 5 on "Evaluation of Farm waste recycling techniques for organic farming" is to be taken up by Dharwad and Modipuram centres.
- Cluster based demonstration of Organic Farming Package under Tribal Sub Plan is to be taken up by Dharwad and Umiam centres.
- All the centres should prepare balance-sheet of nutrients as influenced by organic source of nutrients and cropping systems. The centres should also initiate study on micro-flora of the soil in relation to nutrient availability.
- A common cost effective protocol for vermi wash should be prepared and followed by all the centres. Dr A.B. Singh, PI, NPOF from IISS, Bhopal will prepare the protocol and submit to PDFSR for its circulation to all centres.
- The okra can be taken as effective trap crop for shoot weevil in cotton and the caterpillar trapped in okra

may be used as poultry feed under organic farming.

- The cropping systems for the whole year should be specified and in the case of a single crop in a year eg. Turmeric-fallow may be written instead of turmeric only.

- Centres can explore of the possibility of organic honey production wherever mustard is included in the cropping system under organic production system.

- System productivity should always be expressed in kg/ha/unit time.

Administrative

- All the centres should create multi-disciplinary team of scientists for the NPOF. Centres should inform the PDFSR regarding composition of team by 30 June 2013.

- Vacant positions of SRF's in the project should be filled by all the centres at the earliest otherwise financial allotment under contractual services will not be made. Ranchi centre should fill up the post of SRFs immediately as the project activities are suffering and performance of the centre was observed to be not up to the mark.

- All the centres should submit their data sheets and annual report by 30th September of every year.

- All the centres should submit atleast 5 good quality objective oriented photographs from each season for the digital photo library of the project to be created at PDFSR.

- Hard and soft copy of all the publications arising from the project should be forwarded to PDFSR for record.



Agricultural Education Day Celebration 2013

The Agricultural Education Day was celebrated by PDFSR on June 25, 2013 in order to improve the visibility of the Directorate among the students of local schools and colleges, and to sensitize them about the problems and prospects of agricultural education India. The programme was inaugurated by Dr. Arvind Kumar, DDG (Education), ICAR who was the Chief Guest of this function. In his inaugural address Dr. Arvind Kumar stressed the need to spread the agricultural education among the masses, particularly the youth. He emphasised the importance of agriculture, and the scope and opportunities of agricultural education in India.

The inaugural session was attended by other distinguished guests like Dr. Babu Ram, Director Extension, SVBPUAT, Modipuram, Dr. DV Rai, Registrar, Shobhit University, Modipuram, Dr. Arjava Sharma, Project Director, PDC, Meerut, and Dr. NC Upadhyay, CPRIC, Modipuram. The inaugural session was followed by Debate competition for college/university level students, Quiz competitions for school level students of 9-12 standards and Painting competition for school level students of 6-8 standards.

These competitions were followed by valedictory session in which prizes were distributed to the winners of different competitions by Dr. B. Gangwar, Project Director, PDFSR, Modipuram. A total of 18 prizes were given, 3 each in debate and painting competitions and 6 in quiz competition, besides 6 consolation prizes. The programme ended with vote of thanks by Dr. Anil Kumar, Principal Scientist (Agril. Extension) who coordinated all the events of the programme.

Agricultural Industry Day

The Agricultural Industry Day was celebrated by PDFSR on February 22, 2013 in order to improve the visibility of the Directorate among all the stakeholders of agriculture. The programme was inaugurated by Dr. Birpal Singh, Director, Central Potato Research Institute, Shimla who was the Chief Guest of the programme. On this occasion, Dr. Birpal Singh delivered Industry Day Lecture on the topic “Role of potato in the emerging farming systems in India”. In his address Dr.

Birpal Singh suggested the strategies for crop intensification and also to study the entire soil biota for developing appropriate farming system in a given situation. Earlier, Dr. B. Gangwar, Project Director, PDFSR welcomed Dr. Birpal Singh on this occasion and explained about the mandate and activities of PDFSR.

The inaugural session was followed by technical session in which there was scientist-entrepreneur-farmer interface meeting consisting of thematic areas like conservation agriculture, agro-processing, farm machinery, and sustainability of farming system. In this session different stakeholders presented their technologies/ products and also highlighted the market demand scenario. There were 2 representatives from fertilizer industries, 2 from food industries, 4 from farm machinery, and 6 from pesticide industries. A total of 65 progressive farmers participated in the programme. The programme ended with vote of thanks by Dr. Anil Kumar, Principal Scientist (Agril. Extension), who coordinated the programme.

Farm Innovators Day

The Directorate celebrated its first "Farm Innovators Day" on 25th, September, 2013. The programme was attended by all the staff of PDFSR, progressive farmers of the Meerut district and invited dignitaries like Dr. A. K. Sikka, DDG (NRM), ICAR, New Delhi, Dr. A. Sharma, Project Director, PDC, Meerut, Dr. Baburam, Director Extension, SVPUA & T, Meerut, Dr. Rambir Katara, Deputy Director (Agriculture), Meerut Division. In his welcome remark, Dr. B. Gangwar emphasizes the need and importance of integrated farming systems in changing farming scenario especially in the 'Green Revolution' belt. He also felt strong anticipation for the Directorate to become 'Indian Institute of Farming System Research' in short time. He also expresses his concern for the livelihood security of small and marginal farmers and took responsibility to carve out suitable farming system models for small and marginal farmer. Dr. Baburam advocated scientist - extension worker - farmers' collaboration in the development of location specific, need based and affordable agricultural technologies. Dr. A. Sharma emphasized for exploiting indigenous technical knowledge (ITK) for increasing and sustaining farm productivity. Sh. Raj Kumar, a progressive and ICAR awardee farmer of the region, emphasized the involvement of policy makers into all kinds of scientist-farmer meets of NARS system. Sh. Amit Tyagi, an agricultural entrepreneur, owning NGO named *Sajag Mahgila evom Gramouthan Sansthan* in Meerut, explained the simple methodology of vermi-compost preparation to farmers and advocated for compulsory application of vermi-compost for better soil health and higher productivity. While delivering the Chief Guest's remarks, Dr. A. K. Sikka, emphasize the innovative ways of

applying the agricultural technologies for enhancing farm productivity and income. He strongly convinced for the involvement of policy makers in scientist-farmers' interface and advocated for the multifaceted refinement of technology before inclusion into the policy.

67th Independence Day

The Directorate celebrated 67th Independence Day on 15 August 2013. On this occasion, Project Director, Dr B. Gangwar hosted the national flag. In his address to the staff of Directorate, he narrated the achievements of past one year and emphasized the importance of Farming System Research for the nutritional and livlihood security of ever increasing population of small and marginal farmers of the country. Bestowing the responsibility, he called upon the staff to pursue the research and development in farming systems perspective which is considered to be the way forward for the future of Indian agriculture. The event was attended by the children, family members, staff of the directorate and media persons.

Parthenium Awareness Week

Parthenium awareness week was celebrated by the Directorate during 16-22 August, 2013 through lectures to the staff of Directorate in which problems caused by the weeds, its effect on future generations and health hazards were explained. Dr B. Gangwar, Project Director inaugurated the week by leading the staff to uproot the grass in the campus. All the staff of Directorate was involved in removing the parthenium grass in the entire campus of the Directorate with a view to minimize the menace in the campus.

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Annual Group Meeting of AICRP on IFS

The group meeting of ‘AICRP on Integrated Farming System (IFS)’ was organized at ICAR Research Complex for NEH Region, Umiam, Meghalaya during 2-4th December, 2013. Dr. Celistine Lyngdoh, Parliamentary Secretary for Agriculture and Food processing, Government of Meghalaya inaugurated the meeting. He expressed that due to continuous fragmentation and economic non-viability, many rice fields

in Meghalaya have been converted into fish ponds. He also highlighted the need for integrating indigenous technology knowledge (ITK) and environment-friendly technologies into IFSs, being developed for small and marginal farmers. Dr. K.M. Bujarbaruah, Vice Chancellor, AAU, Jorhat and Guest of Honour of the programme, expressed his satisfaction over the progress made in IFS by the ICAR and emphasized upon the integration of household resources and recycling of farm waste to make small farm household economically viable. While delivering the Chairman’s remarks, Dr. A.K. Sikka, Deputy Director General (NRM), ICAR emphasized upon the location-specific integration of best available technologies, which can minimise the risks under IFS. He said that adequate emphasis needs to be laid out by PDFSR on the characterization of farmers’ resources and synthesis of scientifically designed, farmer-centric, location-specific IFS modules and models for all the agro-climatic regions.

Dr. B. Gangwar, Director, PDFSR presented the research achievements of the ‘AICRP on Integrated Farming

System' during last one year and stressed that this programme is mainly focussed on small and marginal farmers who constitute about 86% of the total farm households of the country.

Earlier, Dr. S.V. Ngachan, Director, ICAR Research Complex for NEH Region, Umiam welcomed dignitaries and emphasized upon the necessity of IFS research under climate-change scenario. The programmes of on-station, on-farm and tribal sub-plan being carried out at different centres were thoroughly reviewed and several vital recommendations emerged out. Technical programmes to address location specific IFS modules were finalized during the workshop. Scientists and agronomists associated with AICRP-IFS participated in the meeting. Dr. A.S. Panwar, organizing secretary of the meeting proposed the vote of thanks.

AgMIP-ICAR Collaborative Project stakeholders meeting

Under AgMIP-ICAR Collaborative project, to develop the representative agricultural pathways (RAPs) of the study region, a stakeholders brainstorming session was organized at PDFSR on 18th July, 2013. The meeting was chaired by Project Director and team leader of the AgMIP-ICAR collaborative project. The stakeholders include researchers from SVPUA&T, CPRS, PDC, Shobhit University, PDFSR, Modipuram, officers from district agricultural/horticultural office and progressive farmers. Based on their inputs and discussions, RAPs for the study site was developed.

The narrative of RAPs- *To combat adverse impacts of climate change on the farm sector, government adopts long-term and short-term policy measures. Wheat production costs increase substantially, resulting in decline of wheat production. Lower farm production drives labor outmigration to non-farm sector. However, the non-farm sector cannot absorb all the excess farm labor due to their low skills. Therefore, farm-labor productivity declines. Imports are inadequate to meet domestic demand, and policy support in the form of minimum support price is provided to offset higher production costs. But the price support measures are inadequate to raise the wheat production to meet domestic demand, hence government liberalizes wheat imports. At the same time, research and development for developing new wheat cultivars and investment in food-chain logistics is increased to boost domestic production.*

Events organized (Kishan Gosthi / Farmers day / Field visits/ Exhibitions)

- A.K. Prusty organized field visits for 8 member delegations of Afghani students under the leadership of. U. K. Behera, Principal Scientist, Dept. of Agronomy, IARI, New Delhi on 25th November, 2013.
- A.K. Prusty organized field visits for Dr. P. P. Chakraborty (Pr. Scientist) and Dr. R. N. Mondal (Sr. Scientist) from CIFA during 10th-12th April, 2013.
- A Kisan Gosthi was organized by A.K. Prushty, M.P. Singh, V.K. Singh

and R.P. Mishra at Kandisour, New Tehri on 01-10-2013 under THDC sponsored project.

- A Kisan Gosthi was organized by A.K. Prushty, M.P. Singh, V.K. Singh, R.P. Mishra and V.P. Choudhary at Koteshwar, New Tehri on 21-10-2013 under THDC sponsored project.

- A *Kisan Gosthi* on "Integrated Farming Systems" was organized by the Directorate under "Livelihood improvement through Integrated Farming Systems" project funded by Tehri Hydro Development Corporation (THDC) on 1st October, 2013 at Kandisaur and on 21st October, 2013 at Koteshwar in the New Tehri District of Uttarakhand. At Koteshwar, Hon'ble, Agriculture Minister of Uttarakhand, Sh. Harak Singh Rawat inaugurated the Kisan Gosthi as Chief Guest while at Kandisaur Hon'ble M.L.A. Dhanolti Sh. Mahavir Singh Rangarh was the chief guest of the occasion.

- Sh. Rawat expressed his happiness for the efforts being made by the ICAR Scientists to demonstrate the integrated farming systems approach of livelihood improvement for small holders especially in the remote areas of Uttarakhand. He also emphasized that for improving the productivity of crops and livestock more number of families should be covered with integrated farming systems in the state through critical interventions. During the discussion, Dr B. Gangwar, Project Director, PDFSR, Modipuram highlighted the major constraints and critical technological interventions like introduction of improved crop varieties, balanced nutrition using SSNM, efficient weed and insect-pest management, management of old orchard, livestock health management using mineral-mixture, kitchen gardening, skill development programme through awareness campaigns and field days.

- Later on, Sh. Rawat also inaugurated the IFS exhibition organized on the

reiterated that IFS modules suited for hilly areas needs to be replicated throughout the Uttarakhand for deriving the maximum benefits. Most significantly, the low cost implements for day to day use were distributed to all the participating farmers (496) besides supply of special implements to self help groups in the adopted villages. Vegetable seeds suitable for Kitchen Gardening in hilly areas were also distributed in the Kisan Gosthi. The Gosthi was attended by more than 500 farmers from the area.

Field-Day on Plant Protection in Mango Orchard

Two field days were organized on 20 September, 2013 and 23 November, 2013 in Madarpur village of Sardhana block in Meerut district to make the farmers aware of plant protection measures in mango orchards. During the benchmark survey, it was found that the mango orchards of the farmers were heavily infected with twig blight due to which the farmers had to remove many of the trees or tree branches leading to very low productivity. A spray schedule of Mancozeb, Carbendazim, Copper oxychloride, Dimethoate and Phorate were formulated and accordingly, the first spray of the affected trees was done on 20 March, 2013. The results were highly encouraging and those results were shown to the farmers on 20 September, 2013 during the second spray. The third spray was done two months after the second spray on 23 November, 2013 so that sufficient time should elapse for observing the effect on emergence of new leaves and flowers during January 2014. The farmers of the adopted village are highly convinced with the impact of the spray schedule and many more of them are now coming forward to take up this plant protection measure.

A. Provision from the ICAR (2013-14)

Sl no.	Sub head	Non-Plan						Plan	
		Govt. Grant	Allocation internal+ Additional amount provided by Hqrs out of council's share	Total Allocation (col 3+4)	Exp. Out of Govt. grant	Exp. Out of revenue generated	Total Exp. (col 6+7)	Allocation	Exp.
1	2	3	4	5	6	7	8	9	10
1	Capital Expenditure	-	-	-	-	-	-	-	-
a	Land	-	-	-	-	-	-	-	-
b	Building	-	-	-	-	-	-	-	-
c	Equipment's	4.00	-	4.00	1.00	-	1.00	1.35	1.35
d	Furniture/Fixture	3.00	-	3.00	2.97	-	2.97	3.00	2.90
e	Info. Tech.	-	-	-	-	-	-	-	-
f	Library Books	-	-	-		-	-	15.65	8.62
2	Revenue Exp.	-	7.00	7.00	-	-	-	-	-
a	Estt. Charges	675.00	36.05	711.05	704.99	-	704.99	-	-
b	Wages	39.00	10.30	40.30	40.20	40.20	-	40.20	-
c	OTA	0.25	-	0.25	0.25	-			
d	Pension and Other Retirement benefits	13.00	10.00	23.00	18.49	10.00	28.49	-	-
3	Loan & Advance	-	5.00	5.00	5.00	-	5.00	-	-
4	TA	5.00	-	5.00	5.00	-	5.00	8.00	8.00
5	Other Charges	-	-	-	-	-	-	-	-
a	Res. Expenses	4.00	5.00	9.00	4.06	4.51	8.57	6.00	5.93
b	Operational Expenses	5.00	2.00	7.00	4.94	1.36	6.30	15.00	14.27
c	Admin. Expenses	61.00	20.00	81.00	61.00	19.52	80.52	40.00	34.11
d	Misc. expenses	2.50	-	2.50	0.91	-	0.91	3.00	1.32
6	HRD	0.50	0.25	0.75	0.73	-	0.73	3.00	2.89
7	NEH	-	-	-	-	-	-	-	-
8	TSP	-	-	-	-	-	-	-	-
	Total	790.25	95.60	898.85	848.54	35.39	884.68	95.00	79.39

DISTINGUISHED VISITORS

- Dr Panjab Singh, Ex Director General, ICAR and Secretary, DARE visited on 15-16 April 2013
- Dr A.K. Sikka, DDG (NRM) Visited on 12 May 2013

- Dr (Ms) Indu Sharma, Director, DWR, Karnal and Dr J.S. Sandhu, Agriculture Commissioner, MoA, GOI, New Delhi visited the Directorate on 5 April 2013

- Dr P P Chakraborti, Principal Scientist and SIC,RRC, CIFA, Rahara and Field station Kalyani and Dr R N Mondal, Senior Scientist, CIFA visited the Directorate on 10th to 12th April, 2013

- Sunil Kumar, Head, Crop Production Division and Dr D.R. Palsaniya, Senior Scientist (Agronomy) from NRCAF, Jhansi visited the Directorate on 24 May 2013

- Dr. Guilliermo Baigorria, Assistant Professor, University of Nebraska-Lincoln and AgMIP resource person for IGB project visited the Directorate on 31st July, 2013

- A group of 30 agricultural graduate trainees from NCOF, Ghaziabad visited the Directorate on 16thAugust, 2013.

- Sh. Arvind R. Kaushal, Secretary ICAR and Dr. A. K. Sikka, DDG (NRM) visited the Directorate on 6th July, 2013.
- Dr. M. Swami and Dr. M. Kumaresem from CTRI, Rajahmundry (AP) visited the Directorate on 19thDecember, 2013.
- Dr. U. K. Behra form IARI, New Delhi along with four trainees from Afghanistan visited the Directorate on 25thNovember, 2013.
- Dr. S. N. Puri, Vice Chancellor, CAU, Imphal, Manipur visited the Directorate on ……2013.

- Dr. B. N. Ghosh form CSWCRTI along with 21 trainees visited the Directorate on 14thDecember, 2013.

PUBLICATIONS

1. Research papers: (International)

Bappa Das, Debashis Chakraborty, V.K. Singh, P. Aggarwal, R. Singh, B.S. Dwivedi, R.P. Mishra. 2013. Effect of integrated nutrient management practice on soil aggregate properties, its stability and aggregate-associated carbon content in an intensive rice–wheat system. *Soil and tillage research,* 136:9-18.

Gupta, S. K., A. K. Pal, N. P. Sahu, A. K. Jha, M.S. Akhtar, S.C. Mandal, P. Das and A. K. Prusty (2013). Supplementation of microbial levan in the diet of Cyprinus carpio fry (Linnaeus, 1758) exposed to sublethal toxicity of fipronil: effect on growth and metabolic responses. *Fish Physiol. Biochem*. DOI 10.1007/s10695-013-9805-7.

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Shamim, M. (2013). Presented a concept note on "Microclimate modifications: An adaptive tools for sustaining productivity of rice wheat cropping system" in a brain storming meeting on Agrometeorological Research for food security in India held at Assam Agricultural University, Jorhat during 15-16 November, 2013.

Singh, V.K. (2013). Delivered lecture on topic entitled "GIS based resource characterization mapping in UGP" in Group meeting of 'AICRP on Integrated Farming System' organized at ICAR Research Complex for NEH Region, Umiam, Meghalaya during 2-4th December, 2013.

PESONNEL (As on 31.03.2014)

Project Director: **Dr. B. Gangwar**

S.N.	Name and Designation	Discipline
A. SCIENTIFIC		
1.	Dr. K. Prasad, Principal Scientist	Agronomy
2.	Dr. G. C. Sharma, Principal Scientist	Agri. Statistics
3.	Dr. J. P. Singh, Principal Scientist	Agronomy
4.	Dr. S. S. Pal, Principal Scientist	Soil Science & Agri. Chem.
5.	Dr. K. K. Singh, Principal Scientist	Farm Machinery & Power
6.	Dr. M. P. Singh, Principal Scientist	Agri. Extension
6A.	Dr. M. P. S. Arya, Principal Scientist	Agronomy
7.	Dr. Prem Singh, Principal Scientist	Agronomy
8.	Dr. Anil Kumar , Principal Scientist	Agri. Extension
9.	Dr. K. P. Tripathi, Principal Scientist	Soil Science & Agri. Chem.
10.	Dr. V. K. Singh, Principal Scientist	Agronomy
11.	Dr. N. Ravisankar, Principal Scientist	Agronomy
12.	Dr. Harbir Singh, Principal Scientist	Agriculture Economics
13.	Dr. R. S. Yadav, Principal Scientist	Soil Science
14.	Dr. B. K. Sharma, Senior Scientist	Agri. Extension
15.	Dr. N. Subash, Senior Scientist	Agro. Met.
16.	Dr. V. P. Chaudhary, Senior Scientist	Farm Machinery & Power
17.	Shri Vipin Kumar, Scientist (SS)	Computer Application
18.	Dr. R. P. Mishra, Scientist (SS)	Agronomy
19.	Dr. Chandra Bhanu, Scientist (SS)	Plant Pathology
20.	Dr. Poonam Kashyap, Scientist (SS)	Horticulture
21.	Dr. A. K. Prusty, Scientist	Aquaculture
22.	Dr. Sanjeev Kumar, Scientist	LPM
23.	Dr. Mohd. Shamim, Scientist	Agro Met.
24.	Mr. Sunil Kumar, Scientist	Statistics/Computer Application
25.	Dr. Nand Kishore Jat, Scientist	Agronomy
26.	Dr. Sudhir Kumar, Scientist	Plant Physiology
27.	Ms. Monalisha Pramanik, Scientist	SWC Engineering

S.N.	Name and Designation	Discipline
28.	Mr. Sanjeev Kumar, Scientist	Agronomy
29.	Mr. Chetan Kumar G, Scientist	Soil Science
B.TECHNICAL (Group wise)		
1	Sh. Chet Ram (T-9)	A
2	Sh. Jagpal Singh (T-7/8)	A
3	Sh. Yogendra Singh(T-7/8)	A
4	Sh. D. Tripathi (T-6)	A
5	Sh. S.K. Duhoon (T-6)	A
6	Sh R.B. Tewari (T-6)	A
7	Sh K.V.Anand (T-6)	A
8	Sh Vipin Kumar (T-6)	A
9	Sh. D. K.Pandey (T-5)	A
10	Sh. D.P. Singh (T-6)	A
11	Sh. Naval Singh (T-6)	A
12	Sh Vinod Kumar (T-6)	A
13	Sh. Brij Mohan (T-6)	A
14	Sh Krishan Pal (T-7/8)	A
15	Sh S.P. Singh (T-6)	A
16	Sh. P.P. Mishra (T-6)	A
17	Sh Om Kumar Tomar (T-6)	A
18	Sh. A.P. Dwivedi(T5)	B
19	Sh. Brijesh Sharma (T-5)	B
20	Sh. Krishan Pal (T-5)	B
21	Smt Anju Verma (T-2)	C
22	Sh. Uma Shankar	C
23	Sh. Ashok Kumar	C
24	Sh. Mahendra Prasad	C
25	Sh. Raj Kumar	C
C. ADMINISTRATIVE:		
1	Sh. Sushil Kumar Singh	SAO
2	Sh. H.S. Chauhan	AAO
3	Sh. Anil Agarwal	F.&AO
4	Smt. Alka jain	Assistant
5	Sh. S. K. Gupta	Assistant
6	Smt. Sheela Devi	Assistant
7	Sh. Jata Kant	Assistant
8	Sh. Ravi kant Sharma	UDC
9	Sh. Attar Singh*	P.S.
10	Sh. Rai Bahadur	P.A.
11	Sh. Jailata Sharma	P.A.
12	Sh. S. K. Bansal	P.A.
13	Sh. Brij beer Singh	Jr. Steno
14	Sh. Rajesh Kumar	Jr. Steno
15	Sh. Prem Singh	UDC

S.N.	Name and Designation	Discipline
16	Sh. Rajendra Kumar	LDC
17	Sh. Parmanand	LDC
18	Sh. D.C. Mishra	LDC
D. SUPPORTING STAFF:		
1	Sh. Anand Singh	Skilled Supp. Staff
2	Sh. Prem kumar	- do-
3	Sh. Rakesh Kumar	- do-
4	Sh. Rajendra Singh	- do-
5	Sh. Kripa Shankar Pandey	- do-
6	Sh. Ayodhya Prasad Dubey	- do-
7	Sh. Prem Shankar	- do-
8	Sh. Mahabir Singh	- do-
9	Sh. Siddh Kumar	- do-
10	Sh. Harshnath	- do-

*As per new cadre strength after re-struturing of administrative strength, two posts of P.A. are in excess.

LIST OF APPROVED ON-GOING PROJECTS

Sl. No.	Name of Project	INSTITUTE Code	Name of PI & Co-PI	Date of Start
1.	Integrated nutrient management in rice based cropping systems: Sub. Project: Sustaining rice-wheat productivity through integrated nutrient supply system.	SIL199300100001	Dr. V. K. Singh Dr. R. P. Mishra, Dr. N. Subhash	May1993
2.	Development of sustainable production model for rice-wheat cropping system	SIL199800100006	Dr. R. P. Mishra Dr. V. K. Singh	June1998
3.	Development of organic farming package for maize-potato-onion system.	SIL200300100047	Dr. S. S. Pal	Kharif 2003
4.	Long Term influence of Resource Conservation Technologies and crop Residue Management Practices on Crop Productivity, water requirement and soil health in Rice-Wheat cropping system. (i) Long Term influence of Resource Conservation Technologies on Crop Productivity, weed management, water use and soil health in Rice-Wheat cropping system. (ii) Long Term influence of Resource Conservation Technologies on Crop Residue Management practices on crop productivity and soil health in Rice-Wheat cropping system	SIL200400100058	Dr. V. P. Choudhary Dr. R. P. Mishra	Kharif 2004
5.	NPOF	COL200500100064	Dr. N. K. Jat Dr. Sudhir Kumar Sh. Chetan Kumar	2005
6.	Proven Systems Based Technologies under Demonstration	SIL200701000091	Dr. M. P. Singh	April 2007
7.	Identification of bio-intensive, complementary cropping systems for high productivity and efficient resource use.	SIL200800200093	Dr. B. Gangwar Dr K. K. Singh Dr. M. Shamim	2008
8.	Digitization of database of on-station and on-farm experiments of cropping systems under AICRP on IFS.	SIL200800300094	Dr. G. C. Sharma	Oct. 2008
9.	Characterization and Evaluation of Existing Farming Systems in India	SIL200900100104	Dr. Harbir Singh Dr. Anil Kumar Dr. B. Gangwar Shri Sunil Kumar	Dec. 2009
10.	Precision farming technology based on microprocessor and decision support system for enhancing input application efficiency in production agriculture (funded by NAIP)	COL200900200105	Dr. S. S. Pal	2009

Sl. No.	Name of Project	INSTITUTE Code	Name of PI & Co-PI	Date of Start
11.	Resource conservation and sustaining high productivity through cropping system management and land configuration.	SIL201000100107	Dr.B.Gangwar	Jan. 2010
12.	Development of low-cost multi tillage, multi-crop planter for round grain cereals, legumes and pulses.	SIL201000200108	Dr. V. P. Chaudhary Dr. R. P. Mishra	Jan. 2010
13.	Capacity building of stakeholders in integrated farming systems through training.	SIL201000300109	Dr. B.K. Sharma Dr. Anil Kumar	Jan. 2010
14.	Adoption behavior of different farming system components by farmers of UGP and TGP Zones	SIL201000400110	Dr. Anil Kumar Dr. B.K. Sharma Dr. R.P. Mishra	Jan. 2010
15.	AICRP-IFS	COL201000700113	Dr. J. P. Singh Dr. B. Gangwar Dr. Poonam Kashyap Dr. S. K.Kochewad (On study leave)	2010
16.	Climate Change: Effects on productivity of Rice-wheat cropping system in western plain zones of U.P. and its mitigation by using DSSAT model.	SIL201000800114	Dr. M. Shamim Dr. K. P. Tripathi Dr. Sudhir Kumar	July 2010
17.	Status of organic agriculture in Eastern Himalayan region	SIL201000900115	Mr. Sunil Kumar, Dr. B. K. Sharma, Dr. N. K. Jat Dr. B. Gangwar Dr .Anil Kumar	July 2010
18.	Studies on water and nutrient use efficiency of different varieties of rice-wheat under aerobic conditions.	SIL201001000116	Dr. R.P. Mishra Dr. V.K. Singh Dr.B. Gangwar	2010
19.	Collaboration with SAC, Ahmedabad in FASSAL and Sugarcane based farming systems study as per work plan.	COP201100100118	Dr. N Ravisankar Dr. N. Subash	2011
20.	Development of cost effective and sustainable Integrated Farming System Models for livelihood improvement of small farm holders.	SIL201100200119	Dr. J. P. Singh Dr. B. Gangwar Dr. P. Kashyap Dr. A. Prusty	2011
21.	Productivity and economic evaluation of horticulture based farming systems.	SIL201100300120	Dr. P. Kashyap Dr. Kamta Prasad Dr. Harbir Singh	July 2011
22.	Ensuring Livelihood Security Through Farming Systems Approach in Tehri Garhwal, Uttarakhand.	SCL201100400121	Dr. M. P. Singh Dr. V. K. Singh Dr. R. P. Mishra Dr. V. P. Choudhary Dr. A. K. Prusty Dr. P. Kashyap	2011
23.	National Fellow Project “Precision nutrient management using GIS based Spatial variability mapping under upper and middle Gangetic Plain Zones of India”	SOL201100500122	Dr. V. K. Singh	2011

Sl. No.	Name of Project	INSTITUTE Code	Name of PI & Co-PI	Date of Start
24.	National Initiative on Climate Resilient Agriculture (NICRA)	SOL201100600123	Dr. B. Gangwar Dr. V. P. Choudhary Dr. N. Subash	2011
25.	On-Farm Integrated Farming Systems Management	SIL201100700124	Dr. B.K. Sharma Dr. Anil Kumar Dr. A. K. Prusty	August 2011
26.	Implication of Changing Input Use Pattern for Major Cropping/ Farming Systems in India.	SIL201100800125	Dr. Harbir Singh Dr. G.C. Sharma	Nov. 2011
27.	"Strengthen Simulation Approaches for understanding projecting and managing climate risks in stress-prone environment across central and eastern Indo- Gangetic Basin" under "Agricultural Model Inter comparision and improvement Project"(AgMIP – ICAR Collaborative Project)	COP201200100126	Dr. B. Gangwar Dr. N. Subash Dr. Harbir Singh	2012
28.	Comparative studies of fish and crop based farming systems.	SIL201200200127	Dr. A.K. Prusty Dr. J. P. Singh Dr. P. Kashyap	April 2012
29.	Conservation agriculture based weed management practices in rice-wheat cropping system.	SIL201200300128	Dr. N. K. Jat Dr. R. S. Yadav Dr. Sudhir Kumar	July 2012
30.	Global Yield Gap and Water Productivity (ICAR-UNL Collaborative Project)	COP201300100129	Dr. N. Subash	2013
31.	INFARM	COP201300200130	Dr. N Ravisankar Dr. M. Shamim Dr. Brij Mohan	2013
32.	Assessment of climate change impact on integrated Farming Systems through Modeling	SIL201300300131	Dr. N. Subhash Dr. M. Shamim Dr. A. Prusty Er. M. Pramanik	2013
33.	Carbon accounting of farming systems in Meerut district	SIL201300300132	Dr. R. S. Yadav Dr. Anil Kumar Dr. N. K. Jat	2013
34.	Development of year – round production module of mushrooms for small and marginal farmers	SIL201300400133	Dr. Chandra Bhanu Dr. J. P. Singh	August 2013

LIST OF NEW PROJECTS APPROVED FOR THE YEAR 2014-15

S.No	Project Title	PI	Co-PI
1.	Value addition in farm produces for livelihood improvement and empowerment of small and marginal farmers	Dr. Amit Nath	Dr. M. P.Singh Dr. D. Dutta Dr. R. P. Mishra Dr. P. Kashyap Dr. Nisha Verma

S.No	Project Title	PI	Co-PI
2.	Studies on Persistence of Pesticides Residues in the agricultural produce of intensively cultivated farming situations in peri – urban areas of Western Plain Zone of Uttar Pradesh	Dr. Debashish Dutta	Dr. Prem Singh Dr. Amit Nath Dr. D. Mishra Dr. Nisha Verma
3.	On-farm crop response to plant nutrients in rice-wheat cropping system (RWCS) and their impact on crop-livestock-human continuum	Sh. Raghuveer Singh	Dr. N Ravisankar Dr. S. K. Verma
4.	Comparative study of role of women in predominant farming systems of Western plain zone of UP and Hill zone of Uttarakhand	Dr. Nisha Verma	Dr. M. P. S. Arya Dr. M. P. Singh Dr. P. Kashyap Dr. Amit Nath
5.	System based proven technologies in farming system perspective under demonstration in Technology park	Dr. M. P. Singh	Dr. Prem Singh Dr. R. P. Mishra
6.	Development of fruit crop based high density farming systems for higher productivity and profitability under small farm conditions	Dr. Dushyant Mishra	Dr. Sudhir Kumar Dr. J. P. Singh Dr. M. Shamim Dr. Amit nath Dr. Chandra Bhanu
7.	Diversification of existing farming systems through integration of poultry for improving livelihood of marginal and landless farmers	Dr. S. Malik	Dr. Vinod Kumar Dr. A. K. Prusty
8.	Development of microbial consortia for crop disease suppression, growth promotion and yield enhancement under organic farming system	Dr. Chandra Bhanu	Dr. N. K. Jat Dr. S. S. Pal
9.	Development of suitable resource conservation modules to mitigate the ill effects of climate change	Dr. V. P. Choudhary	Dr. M. Shamim Dr. Sudhir Kumar Dr. Chandra Bhanu
10.	Evaluation of Greenhouse gas emission from IFS models under AICRP-IFS	Dr. R. S. Yadav	Dr. L. R. Meena Dr. J. P. Singh Dr. Vinod Kumar Dr. D.Mishra
11.	Characterization and mapping of Farming Systems in India	Dr. Harbir Singh	Dr. Vinod Kumar Mr. Raghuveer Singh Dr. Nisha Verma Dr. S. Malik Dr. L. R. Meena

Proposals Approved as Exploratory Study for One year

1	Study on suitability of non-traditional high value fruit crops under small farm conditions of Western U. P.	Dr. Dushyant Mishra	-
2	Screening of short duration varieties in sugarcane-wheat cropping system under organic condition for North western plains	Dr. Devendra Kumar	Dr. Sudhir Kumar Dr. Sanjeev Kumar Dr. Chethan Kumar
3	Development of web based integrated information system for Indian farming systems research	Mr. Vipin Kumar Choudhary	Dr. G. C. Sharma
4	Round the year forage production for rabbit based IFS model for marginal farm holders in Western Plain Zone Uttar Pradesh	Dr. L. R. Meena	Dr. Kamta Prasad Dr. N. Ravisankar Dr. R. S. Yadav Dr. G. C. Sharma

Success Stories

http://www.icar.org.in/en/node/5783

http://www.icar.org.in/en/node/6780

CENTRES OF AICRP ON FARMING SYSTEMS AND NETWORK PROJECT ON ORGANIC FARMING

Under the aegis of '*AICRP on Integrated Farming Systems'* on-station research is going on at 31 main canters and 11 sub centers. These centers are engaged in basic an applied research and are located at SAUs or their Regional Research Stations or agriculture colleges of those general universities, or ICAR Institutes where strong agricultural research base is available. Whereas, on-farm research is going on at 32 centers. These centers are engaged in farmer's participatory research. On-farm research Centers earlier known as Experiments on Cultivator's Fields (ECF Centers) are located in Different agro-climatic zones. These centers are shifted from one zone/ farming situation to another zone/ farming situation every 5 years. The locations of the different FSR centers during the year under report are given below. The Network Project on Organic Farming is being operated at 13 cooperative centers. Locations of these centers are given below and depicted in Map-1 and 2.

CENTRES OF AICRP ON 'INTRGRATED FARMING SYSTEMS'

During the year 2013-14 research under the aegis of AICRP-IFS was going on at following centres:

Main Centres (25) – All located in research centres of SAUs and undertaking IFS as well as cropping systems research.

A. ***Sub-centers (12)*** - All located in research centres of SAUs or research centres of general universities having strong set up for agronomic research and undertaking only cropping systems research, except at Varanasi where research on IFS component was also taken up.

B. ***On-Farm Research Centres (32)*** - These centers were engaged in farmers' participatory research and are located in different agro- climatic zones under the jurisdiction of concerned university. These centers are shifted from one zone/farming situation to another zone/ farming situation every 3-4 years.

C. ***Voluntary Centres (5)*** - All located in ICAR Institute and undertaking IFS research component only.

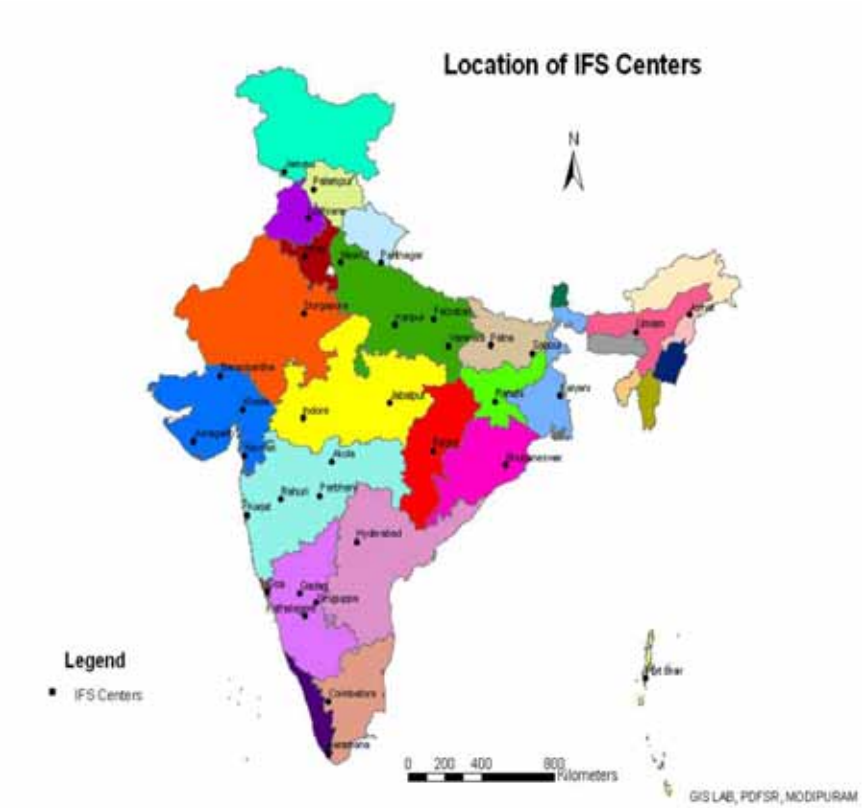
The location of the different AICRP-IFS centers during the year under report is given below and depicted in Map-1.

I. On-Station Research Centres

- ***Arid ecosystem*****:** Hisar (Haryana), S.K. Nagar (Gujarat) and Siruguppa (Karnataka)

- ***Semi-arid ecosystem*****:** Modipuram[$] (U.P.), Ludhiana (Punjab), Bichpuri* (U.P.), Kanpur (U.P.), Durgapura (Rajasthan), Kota*(Rajasthan), Indore*(M.P.), Junagarh* (Gujarat), Akola (Maharashtra), Rahuri (Maharastra), Rudrur*(A.P.), Parbhani (Maharastra), Rajendranagar (A.P.), Kathalagere (Karnataka) and Coimbatore (T.N.).

- ***Sub-humid ecosystem*****:** Faizabad (U.P.), Varanasi*(U.P.), Pantnagar (Uttarakhand), Powarkheda*(M.P.), Jabalpur (M.P.), Rewa*(M.P.), Raipur


Location of IFS Centers
N
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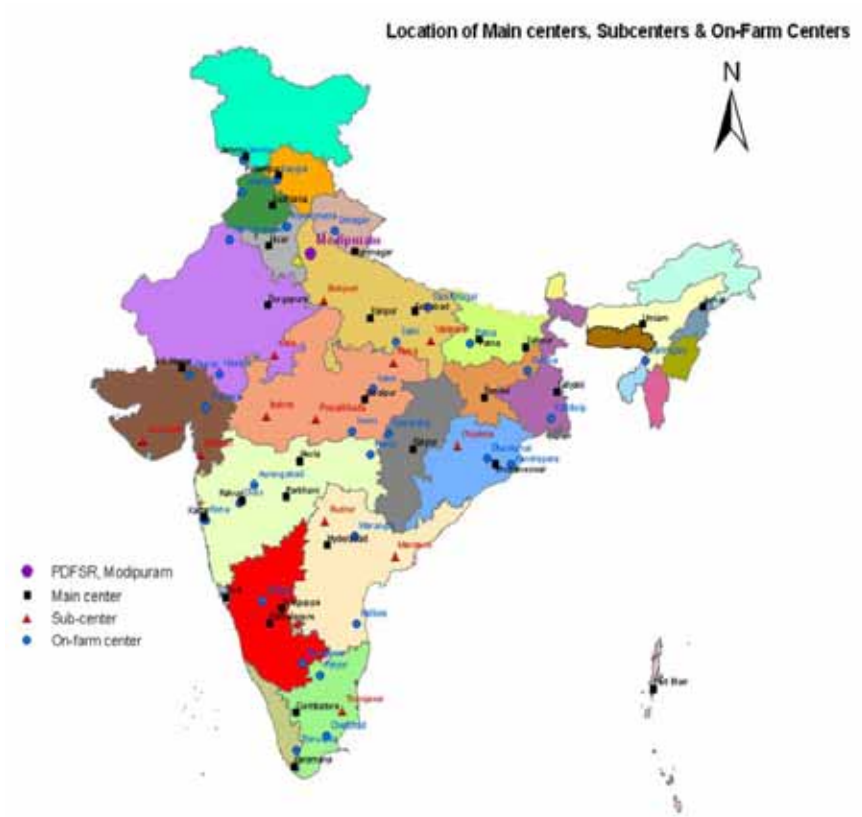
IFS Centers
0 200 400 800
Kilometers
GIS LAB, PDFSR, MODIPURAM


Location of Main centers, Subcenters & On-Farm Centers
N
PDFSR, Modipuram
Main center
Sub-center
On-farm center

(Chhattisgarh), Ranchi (Jharkhand), Chiplima*(Odisha), Bhubaneswar (Odisha), Patna$(Bihar) and Sabour (Bihar).

- ***Humid ecosystem*:** Jammu (J. & K.), Palampur (H.P.), Kalyani (W.B.), Shillong$(Meghalaya) and Jorhat (Assam)

- ***Costal & island ecosystems*:** Thanjavur*(T.N.), Maruteru*(A.P.), Navsari*(Gujarat), Karmana (Kerala), Port Blair$(A. & N. Islands), Ela$ (Goa) and Karjat (Maharashtra)

[Centres marked with (*) are sub centres, and marked with ($) are voluntary centres]

II. On-Farm Research Centers

- ***Arid ecosystem*:** Fathepur (Rajasthan), Mehsana (Gujarat**),** Gadag (Karnataka)

- ***Semi-arid ecosystem*:** Warangal (Telangana), Panchmahal (Gujarat), Sirsa (Haryana), Kolar (Karnataka), Aurangabad (Maharashtra), Pune (Maharashtra), Amritsar (Punjab), Udaipur (Rajasthan), Paiyur Dist. Krishnagiri (T.N.), Chettinad Dist. Sivaganga (T.N.), Kanpur Dehat (U.P.)

- ***Sub-humid ecosystem*:** Purnea (Bihar), Kawardha Dist. Kabirdham (Chattishgarh), Pakur (Jharkhand), Katni (M.P.), Dindori (M.P.), Amravati (Maharashtra), Angul (Odisha), Nainital (Uttarakhand), Ambedkar Nagar (U.P.)

- ***Humid ecosystem*:** Kamrup (Assam), Kangra (H.P.)**,** Dhiansar Dist. Jammu (J. & K.), Kakdwip Dist. 24 Paraganas (South) (W.B.)

***Coastal ecosystem*:** Thiruvalla Dist. Pathanamthitta (Kerala), Kendrapara (Odisha), Thane (Maharashtra), Seethempeta (A.P.)

B. Network Project on Organic Farming

Bajaura (H.P.), Pantnagar (Uttarakhand), Ludhiana (Punjab), Modipuram (Uttar Predesh), Bhopal, Jabalpur (M.P.), Raipur (Chhattisgarh), Ranchi (Jharkhand), Coimbatore (T.N.), Calicut (Kerala), Karjat (Maharashtra), Dharwad (Karnataka), Umiam (Meghalaya).

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1- lLFkku dk uke o irk % df"k i.kkyh vuqla/kku ifj;kstuk fun'kky;] eknhije] ejB ¼mRrj in'k½ 250110

2- ctV ¼2013&14½

d- lLFkkxr ¼: yk[k e½

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ikS/kku 0;;	Lkjdkjh vuqnku	vkrfjd vkoVu$ ifj"kn dk 'kq;j lk e[;kky;s }kjk inku dh xbZ vfrfjDr jkf'k	dqy vkcaVu ¼dkye 3$4½	Lkjdkjh vuqnku lk 0;;	jkstLo ikflr lk 0;; ¼dkye 6$7½	dqy 0;;	
1	2	3	4	5	6	7	8
95-00	79-39	883-30	10-00	893-30	844-23	28-58	873-12

[k- okã Jkr ¼:- yk[k e½

Jkr	jkf'k
ilu vkj vU; lokfuor ykHk	28-49
Hkk-d-vu-i	&
futh _.k vkj vfxe jkf'k	3-19
Okkã for ikf"kr ifj;kstuk,	11-21
dy	44-89

x- jkstLo ikflr ¼2013&14½ ¼: yk[k e½

Jkr	jkf'k
i{k= mRikn	29-97
eRL;] n/k ,o i'k fod;	2-30

Jkr	jkf'k
idk'ku fod;	0-22
ykbl Ul 'kYd@ty 'kYd	7-86
fufonk Qke eY;	0-25
lok inku	0-23
fofo/k	0-45
_.k ,o vfxe jkf'k ij C;kt	4-59
Vh-Mh-vkj- ij C;kt	12-46
vU; ¼jk;YVh vkj lLFkku 'kYd½	1-57
dy	59-9

3- depkfj;ksa dh fLFkfr ¼31-3-2014 rd½

J.kh	eatwjh	fLFkfr	fjDr
oKkfud			
lkfj;kt uk fun'kd	01	01	-
i/kku oKkfud	07	15	-
Okfj"B oKkfud	12	09	03
oKkfud	19	13	06
dy	39	38	&
Rkduhdh depkjh			
{k.kh&III (T-6,7/8,T-9)	02	02	&
{k.kh&II (T-3, T-4 and T-5)	18	18$1*	&
{k.kh&I (T-1 and T-2)	3	3$1**	&
dy	21	23	&
i'kklfud depkjh			
Okfj"B i'kklfud vf/kdkjh	01	01	&
for ,o y[kk vf/kdkjh	01	01	&

J.kh	eatjh	fLFkfr	fjDr
Lkgk;d i'kklfud vf/kdkjh	01	&	01
Lkgk;d	04	04	&
Okfj"B fyfid	02	02	&
futh lfpo	01	01	&
0;fDrxr lgk;d	02	03#	&
dfu"B vk'kfyfid	01	02##	
dfu"B fyfid	03	03	&
dy	16	17	&
Lkgk;d depkjh	10	10	&
vLFkkbZ depkjh	16	16	&
dy	58	60	01

*dUnh; enk yo.krk vul/kku lLFkku] djuky l LFkkukrfjr fd;k x;k vkojfl;j dk ,d in tk Hkfo"; e okfil fd;k tk ldrk gA

**dUnh; enk ,o ty lj{k.k vul/kku ,o if'k{k.k lLFkku] ngjknu l LFkkukrfjr fd;k x;k pkyd dk ,d in tk Hkfo"; e okfil fd;k tk ldrk gA

#&## i'kklfud lox d iuxBu d ckn ; vfrjDr in g tk Hkk-d-v-i- lLFkku d fun'kkulkj ; vxy vkn'k rd cu jgxA

3-1 ubZ fu;qfDr;k

d-l- Ukke	in uke	inHkkj xg.k dju dh frfFk	dgk l	fVli.kh
1 Mk- vfer ukFk	i/kku oKkfud] ¼[kkn; ik};kfxdh½	13-06-2013	iokRrj igkMh {k=k] Hkk-d-v-i- vul/kku ifjlj] ¼df"k jlk;u½	ub fu;fDr
2 Mk- nckf'kl	ofj"B oKkfud] ¼df"k jlk;u½	10-07-2013	df"k foHkkx] tyikbxMh] if'pe cxky	ub fu;fDr
3 Jh Vh-lh- 'kekZ	for ,o y[kkf/kdkjh	01-07-2013	Xkg vul/kku] fun'kky;] djuky	LFkkukrj.k

d-l-	Ukke	in uke	inHkkj xg.k dju dh frfFk	dgk l	fVli.kh
4	Mk- ryl k jke	ofj"B oKkfud] ¼l'; foKku ½	14-08-2013	'kj&b&d'ehj df"k fo'o fo|ky;] tEe	LFkkuk rj.k
5	Mk- n';r fe=k	ofj"B oKkfud] ¼Qy foKku½	31-08-2013	dUnh; mik".k ckxokuh lLFkku] y[kum	LFkkuk rj.k
6	Mk- foukn dekj	i/kku oKkfud] ¼lk'k ik"k.k½	30-10-2013	f'k{kk iHkkx] Hkk-d-v-i- gM DokVj] ub fnYyh	LFkkuk rj.k
7	Mk- ,l- efyd	ofj"B oKkfud] ¼dDdV foKku½	20-11-2013	iokRrj igkMh {k=k] Hkk-d-v-i] f=ijk	LFkkuk rj.k
8	Mk- noUn dekj	ofj"B oKkfud] ¼ikni ituu½	23-11-2013	xUuk 'kk/k {k=h; dUn Hkkjrh; lLFkku] y[kum	LFkkuk rj.k
9	Mk- ,e-ih-,l- vk;	i/kku oKkfud] ¼l'; foKku½	02-12-2013	df"k efgyk vul/kku fun'kky;] Hkou'oj	LFkkuk rj.k
10	Mk- ,y-vkj- eh.kk	i/kku oKkfud] ¼l'; foKku½	01-02-2014	dUnh; HkM vkj mu vul/kku fun'kky;] vfodkuxj	LFkkuk rj.k
11	Jh j/kohj flg	oKkfud] ¼l'; foKku½	14-04-2013		ub fu;fDr;k
12	Mk- fu'kk oek	i/kku oKkfud] ¼,Q-vkj-,e-½	12-04-2013		ub fu;fDr;k

3-2 inkUurh@LFkkukrj.k@p;u

d-l-	Ukke	in uke	inHkkj xg.k dju dh frfFk	dgk l	fVli.kh
1	Mk- d-ih- f=ikBh]	i/kku oKkfud]	27-06-2013	f'k{kk iHkkx] Hkk-d-v-i- gM DokVj] ub fnYyh	LFkkukrj.k
2	Mk- d-d flg	i/kku oKkfud] ¼,Q-,e-ih½	16-09-2013	Hkk-d-v-i-] dc&II] ub fnYyh	ub fu;fDr ¼,-Mh-th-½
3	Ekukfyl k iekf.kd	oKkfud]	05-11-2013	dUnh; enk ,o ty lj{k.k vul/kku ,o if'k{k.k lLFkku] ngjknu	LFkkukrj.k
4	Jh ,p-,l- pkgku	Lkgk;d i'kklfud vf/kdkjh	07-09-2013	jk"Vh; ikni vkuof'kd lLkku C;jk] ub fnYyh	inkUur i'kklfud vf/kdkjh
5	Jh vfuy vxoky	for ,o y[kkf/kdkjh	20-06-2013	Xkg vul/kku] fun'kkyk;] djuky	LFkkukrj.k

4- vul/kku ifj;kstuk,a

¼d½ lLFkku vk/kkfjr %

¼[k½ ckgjh for ikf"kr %

5- if'k{k.k dk;dze vk;kftr

Lrj	dk;dzeksa dh l[;k	ifrHkkfx;ksa dh l[;k
jk"Vh;		
vrjk"Vh;		

6- ekuo lalk/kku fodkl

¼d½ jk"Vh; Lrj ij if'k{kr 0;fDr;ksa dh l[;k %

¼[k½ vrjk"Vh; Lej ij if'k{kr 0;fDr;ksa dh l[;k %

7- dk;l'kkykvk dk vk;ktu

jk"Vh; %

vrjk"Vh; %

8- lxkkf"B;k@lfeukj@dk;l'kkykvk vkfn e Hkkfxnkjh

Lrj	ifrHkkfx;k dh l[;k
jk"Vh;	
vrjk"Vh;	

9- <kpkxr fodkl % 'kU;

10- e[; vuqlU/kku miyfC/k;k %

- NkV fdlkuk }kjk mi;Dr df"k i.kkyh viuku lqmudh [kk|kUu] frygu ,o pkj dh t:jr [kr lgh ijh dh tk ldrh gA e/keD[kh ikyu 5&6 cDlk d lkFk vkfFkd nf"V lqmi;kxh ugh gA ckxokuh }kjk 0-2 gDV;j {k=Qy l:i; 31580 ikIr fd; tk ldr gA 0-1 gDV;j {k=Qy d rkykc e eNyh ikyu }kjk :i; 19300 dk 'k} ykHk ikIr gvkA ck;kxl ;fuV lqifro"k 100 dUry flYV ikIr gbA rkth LyVh e yxHkx 40 ifr'kr ueh] 11-8 ifr'kr thok'k dkcu 0-71 ifr'kr u=tu] 0-43 QkLQkjl rFkk 0-33 ikVk'k ik;k x;kA bl idkj flYV }kjk enk e 42-6 fd0xk0 ikVk'k Mkyk x;kA
- >kj[k.M jkT; e Medk fty e fd; x; ,d ikjfEHkd lo{k.k e Qly$i'k/ku dk lokP; df"k i.kkyh d:i e ik;k x;kA frygu viuk; tk jgh df"k i.kkyh e ikuh dh mi;Dr miyC/krk lcl cMh ck/kk d:i e fo|eku gA
- ie[k [kk| Qlyk] nyguk ,o fryguk dh [krh dju dh ykxr e vkt Hkh ekuo Je dk fgLlk lcl T;knk gA
- df"k i.kkyh e eRL; ,o m|ku df"k dk lfEefyr dju ij lokf/kd ldy ,o 'k} vk; ikIr gku d lkFk&lkFk 100 fnu dk jktxkj ltu Hkh gvkA
- 'k} vk; d ekey e lCth vk/kkfjr Qly i.kkyh lokf/kd ykHknk;d ik;h x;hA budk yxku d nlj o"k e ifr gDV;j lokf/kd 'k} vk; :i; 151640@& lCth vk/kkfjr Qly i.kkyh lqikIr gbA tcfd Qly ,o Qy vk/kkfjr i.kkyh lqlg vk; de'kh :i; 68765@& rFkk :i; 44660@& ikIr dh x;hA

- to&l/ku i.kkyh d vUrxr [kjhQ Jr e pkMh 'k;kvk ij 1%1 d vuikr e HkVV d fy, eDdk rFkk lCth gr ykfc;k rFkk ukfy;k e <pk] jch e ukfy;k e ljlk rFkk pkMh 'k;kvk ij elj dh rhu ifDr;k ,o xh"e e 'k;kvk ij ex dh rhu ifDr;k dh cvkb l lokf/kd /kku lerY; mit ½27-6 Vu@g0½] nku dk mRikn 55-6 fdxk nkuk @g0@fnu ,o ykHk :i; 529@g0@fnu ikIr gvk tk fd vU; Qly dek fuf'pr rkj ij cgrj jgkA

- pkMh 'k;kvk ,o ukyh ;Dr D;kfj;k dk ,d nlj d fy, ykHknk;d iHkko ik;k x;kA D;kfd [kjhQ e T;knk o"kk d le; ukfy;k ty fudkl e lgk;d gkrh g rFkk mue ckb x;h gjh [kkn dh Qly dh gjh Vgfu;k ,o ifDr;k dk 45 fnu dh voLFkk ij ;FkkLFkku i;kx fd;k tk ldrk gA bu ukfy;k e le; l ckb x;h ljlk l 1-08 Vu@g0 rFkk cM ij ckb xb elj l 1-17 Vu@g0 dh mit [kklrkj ij ikIr dh x;hA bl fof/k dk viuku l flpkb uy e 47 ifr'kr dh cpr nt dh x;hA

- doy lLrr ,u0 ih0 d0 dh ek=k d yxkrkj i;kx l /kku ,o xg dh mit l de'k 1-47 Vu@g0 rFkk 0-87 Vu@g0 dh deh ik;h x;hA tcfd x/kd ;Dr mojd 'kkfey dju l 'k:vkrh nkj e u doy mit e Bgjko vk;k cfYd nkuk Qlyk dh mit e le; d lkFk&lkFk de'k 0-31 ,o 0-44 Vu@g0 dh of} gbA

- xg d ekey e ijEijkxr cvkb fof/k dh ryuk e thjk fVyt]jkVjh fVy fMy ,o cM iykUVj }kjk cvkb dju l mit e 8&12 ifr'kr dh of} l 'k} ykHk e 8&19 ifr'kr dh of} iHkkoh ykxr e 8&13 ifr'kr dh deh rFkk Åtk d l{ke mi;kx e 19&26 ifr'kr dh of} rFkk xYoh&MMk [kjirokj e 57&82 ifr'kr dh deh ik;h x;hA

- xg dk vo'k"k dk [kr e feyk nu l /kku dh mit 5-74 Vu@g0 ikIr gb tk fd retrieval ,o tyku dh ryuk e de'k 14 ,o 10 ifr'kr T;knk FkhA ykHk % ykxr vuikr Hkh de'k 7 ,o 4 ifr'kr T;knk ik;k x;kA

- /kku d vo'k"k dk [kr e feyk nu l xg dh mit 6-52 Vu@g0 ikIr gb tk fd retrieval ,o tyku dh ryuk e de'k 9 ,o 5 ifr'kr T;knk FkhA ykHk% ykxr vuikr dh de'k 4 ,o 3 ifr'kr T;knk ik;k x;kA

- fofHkUu d"k.k ,o Qly i.kkfy;k d lkFk&lkFk /kku d vo'k"k dh fo|ou ,o mojd dh [kjkdk d mi;kx l enk dh ih,p ,o fo|r pkydrk e nkuk Lrjk 0&15 ,o 15&30 dh xgjkb rd dkb [kkl iHkko ugh ik;k x;kA nkuk xgjkb;k ij ih ,p Hkkx e 8&27 l 8&57 rd dk vUrj ik;k x;kA

- nkuk Lrjk ¼0&15]15&30 leh½ ij d"k.k fof/k;k] Qly dek ,o /kkj d vo'k"k dk fo/kou d lkFk&lkFk lLrr mojd d i;kx l enk dh itkHkfed fd;kvk ij [kkl iHkko ik;k x;kA ijEijkxr d"k.k dh ryuk e 'kU; d"k.k d vUrxr fMgkbMktu vEoh; ,o {kkjh; QkLQVu bdkb;k dh lfd;rk T;nk ik;h x;hA bld vfrfjDr nkuk d"k.k fd;kvk d vUrxr ,Utkbfed lfd;rk fupyh lrg ¼15&30½ e de rFkk Åijh lrg ¼0&15½ e T;knk ik;h x;h rFkk bue nkuk mipkjk e ekU; vUrj ik;k x;kA

- enk tfod dkcu dk l{e tho tfod Hkkj dkcu ¼0-924½] miyC/k QkLQkjl ¼0-712½] ,Utkbfed lfd;rk] fMgkbMkftut lfd;rk ¼0-704½] vEyh; QkLQkjl ¼0-472½ rFkk {kjh; dEQkVt ¼0-646½ d lkFk vU; ?kukRed lEc/k ik;k x;k A l{etho tfod Hkkj dkcu dk Hkh miyC/k QkLQkjl ¼0-841½ rFkk leLr ,Utkbfed fd;kvk rFkk fMgkbMkftut lfd;rk ¼0-790½] vEyh; QkLQkVt ¼0-583½ rFkk {kjh; QkLQkVt ¼0-614½ d lkFk ekU; /kukRed lglEc/k ik;k x;kA

- tu d rhlj llrkg e jkfir /kku dh ilk lxU/kk&4 itkfr e 15 fdxk ut=u@gDV;j d mi;kx }kjk mPp m"ek bdkb ½2060 fMxh fnol½ fjdkM dh x;h tcfd tykb d rhlj llrkg e jkfir lkdr&4 itkfr e 60fdxk u=tu @gDV;j d lkFk U;ure ¼1625 fMxh fnol½ fjdkM dh x;hA i{k= vkdMk d lkFk xg ,o /kku d lh b vkj bl ekMyk d ijh{k.k d mijkUr ik;k x;k fd ; ik:i bu Qlyk dh of} ,o mit dh Hkfo";ok.kh dju d fy, mi;Dr gA

- vDVcj d pkFk llrkg e ckb x;h ihOMCY;0&343 xg dh itkfr ftle 150 fdxk u=tu@gDV;j dh nj l i;kx dh x;h Fkh] mle mPp thMhMh ¼1975 fMxh fnol½ nt dh x;hA xg dh ihOMCY;0&226 itkfr dh ryuk e ihOMCY;0&343 e vyx&vyx u=tu mi;kx dh nj ,o jkikb dh frFk d ckotn mPp vkj ; b ¼1-73xke ifr exktr oe dh½ rFkk ,p ; b ¼3-4 fdxk ifr fMxh fnol½ nt dh x;hA xg ,o /kku d lh b vkj bl ekMy dk i{k= vkdMk d lkFk ijhf.kr dju ij ik;k x;k fd ;g Qly d nkuk rFkk vU; x.kk dh Hkfo" ;ok.kh d nf"Vdk.k l vPNk gA

- ukyh fudyr le; xg ihOMCY;0&343 e 60 fdxk u=tu@gDV;j d lkFk mPp vkj ,p ¼44-1ifr'kr½ ik;h x;hA tcfd ihOMCY;0&226 e 150 fdxk u=tu@gDV;j d lkFk rkide ¼24-6 fMxh l0x0½ ik;k x;kA

- x/kd yfir i.k;k d lkFk 0-7 ,Vh ,l enk ueh rukko ij xg dh flpkb dju ij vf/kdre ty mRikndrk ifjyf{kr gb tk fd 0-5,Vh ,l ij dh x;h flpkb d lerY; FkhA ty mRikndrk dh ijkl 99-5 l 297-7 fdxk ifr

gDV;j&leh ik;h x;hA tcfd vf/kdre ty mRikndrk 0-7 ,Vh ,l enk ueh yo.k ij dh x;h flpkbZ d lkFk ihOMCY;0&550 itkfr e ik;h x;hA

- ejB tuin e 2-07 gDV;j vklr tkr oky Qke e xhu gkml xlk dk fu"dklu 9-76 Vu ifr Qke ifro"k ik;k x;kA tcfd 'k} fu"dklu 6-16 Vu ifr Qke ifro"k nt fd;k x;kA
- dkcu fu"dklu lkrk e ie[k i'k ¼58-2 ifr'kr½] u=tu mi;kx ¼22-5 ifr'kr½ rFkk d"kd ifjokj ¼11-4 ifr'kr½ Hkkxhnkj ik; x;A
- vDVcj&uoEcj e mxku d fy, e'k:e dh iY;jkVl ltj dkt rFkk lnh d eghu gr iY;jkVl QykjhMk mi;Dr ik;h x;hA
- ijEijkxr :i l yo yxkdj jkfir /kku dh mit 'kU; d"k.k fof/k d vUrxr lh/k ck; x; /kku dh ryuk e 11-0 ifr'kr rFkk [kjirokj fu;=.k {kerk 66-1 ifr'kr T;knk ik;h x;hA
- 'kU; d"k.k rduhd d vUrxr ck; x; xg dh ryuk e ijEijkxr fof/k }kjk ck; x; xg dh mPp mit ¼6-43Vu@g0½ ,o [kjirokj fu;=.k {kerk ¼64-9 ifr'kr½ nt dh x;h] rFkkfir vo'k"k icU/ku d lkFk 'kU; d"k.k d vUrxr vo'k"k icU/ku jfgr voLFkk dh ryuk e xg dh mPp inkokj ,o U;u [kjirokj l?kurk de'k¼ 66-41Vu@g0 rFkk 43-5 ik;h x;hA
- d"kdk }kjk viuk;h tku okyh i}fr dh ryuk e lfCt;k ij vk/kkfjr ¼/kku&QyxkHkh&ykdh½ Qlyde d ,d in'ku d vUrxr vU; Qlydsk dh ryuk e vf/kdre ifrfnu vk; ¼:0412@½ ikIr gbA
- fdlkuk }kjk viuk;h tku okyh /kku vk/kkfjr Qly i.kkfy;k dh ryuk e /kku&yglu&<pk l ifrfnu ifr gDV;j 'k} vk; :0 341@& ikIr gbA tcfd nygu vk/kkfjr Qly i.kkfy;k e 1%1 vuikr e vjgj$eDdk ¼mPphdr D;kfj;k½&xg ¼mPphdr D;kfj;k½$eyh] 2%1 d vuikr e mxku ij ifrfnu ifr gDV;j vk; :i; 305@ ikIr dh x;hA
- xxk d Åijh ,o Vkl enkuh vpyk e 70 ifr'kr d"kdk d }kjk xUuk&xUuk&xg Qly i.kkyh viuk;h tk jgh gA df"k ykxrk dh vf/kd dher lcl cMh ck/kk d :i e ik;h x;h gA
- ik/kj{kk l lEcf/kr 26 i{k= i;kx rFkk mojd ,o l{erRok gr lLrr 23 njk l lEcf/kr vul/kku fd; x; gA

- fdlkuk }kjk xUu dh itkfr;k lh vk ,l&767] lh vk&0238 rFkk lh vk&372 dh [krh d fy, viuk; tk jg rjhd d edkcy lLrr jlk;fud dhV uk'kdk ,o to fu;=d d i;kx l mit e de'k 10-19] 9-54 rFkk 8-33 ,o 11-32] 10-30 rFkk 9-88 ifr'kr dh of} nt dh x;hA bld vfrfjDr mojdk d lLrr mi;kx l mDr itkfr;k dh mit e de'k 11-78] 12-33 ,o 11-06 rFkk tLr d lkFk 14-83] 15-49 ,o 13-79 ifr'kr dh of} ikIr dh x;hA

- cNMk dk dhM ekju dh nok fiyku l mue ijthfo;k }kjk gku oky lde.k d ekeyk e deh ik;h x;h gA

- mUur fof/k;k rFkk lLrr itkfr;k dh cvkb rFkk mfpr ik/k l?kurk viuku l xg dh ihOohOMCY;&550] ihOohOMCY;&226 rFkk ihOohOMCY;&343 dh mit e d"kdk }kjk viuk;h tk jgh fof/k;k dh ryuk e de'k 4-23] 4-84 rFkk 4-87 ifr'kr dh of} nt dh x;hA

- fofHkUu df"k ifjfLFkfr;k e lefdr df"k i.kkyh ij vf[ky Hkkjrh; lefUor vul/kku ifj;ktuk d vUrxr enk d fofHkUu x.kk mit ,o fofHkUu mipkjk e i;kx fd; x; ik"kd rRok l lEcf/kr vkdMk dk digitization fd;k x;kA

- lefUor ifj;ktuk d vUrxr tfod df"k l lEcf/kr fofHkUu i;kxk dk xkfQdy ;tj bUVjQl e MkVkcl r;kj fd;k x;kA

- vk/kkj j[kk vof/k 1980&2D10 dh ryuk e vkj lh ih 8-5 d vUrxr e/;'krkC/kh vof/k 2040&2069 d nkjku lHkh eghuk e leLr 20 th lh ,e u mPp vklr ekfld vf/kdre ,o U;ure rkieku dh Hkfo";ok.kh dhA lkekU;r% tyok; ifjoru dh n'kk e] ,0ih0,l0vkb0,e0 ekMy u0 vklr i{k= vk; 1&12 ifr'kr dh gkfu fdUr Mh0,l0,0Vh0 ekMy u 15&21 ifr'kr dk ykHk gku dh Hkfo";ok.kh dhA

PDFSR IN MEDIA

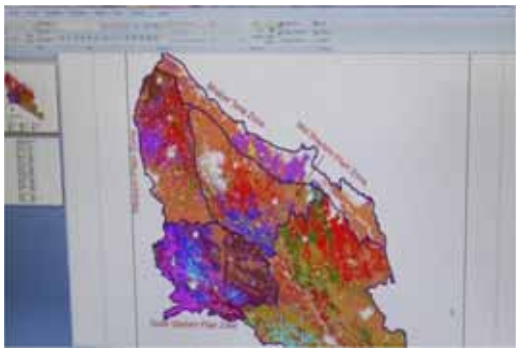
PDFSR: AN APPROACH TOWARDS "FARMERS FIRST"

FACILITIES AT PDFSR

The Directorate has a beautiful main office building housing Director's office, laboratories, library, conference halls, administration, audit and accounts and stores section. The building is well equipped with 24 hours power back up facility.

GIS Facility

The Geographic Information System (GIS) laboratory is equipped with advanced systems and software (Arc GIS, Geomedia, ILWIS, ENVI), scanner, plotter and colour printer. The facility is used to develop thematic maps on farming systems and other natural resources using GIS and remote sensing.



Central Lab

The laboratory is a central facility of the directorate and is equipped with advanced instruments to cater to the needs of all research activities on soil and water chemistry, agronomy, crop physiology, agro-meteorology, micro and macro nutrient analysis, pesticide residues etc. With above facilities there is round the clock working atmosphere in the laboratory.

Farm Machineries

The Directorate has approximately 50 hectares of farm land for its research activities inside the main campus and in Siwaya farm. Various farm implements like tractors, power tillers, threshers, transplanter, laser land leveler, harvester, reaper, bed planter, seed drills (zero-till drills, strip-till drills, roto-till drills) in addition to 2nd generation machines to meet the research needs.

Audio-Visual Aids

Over head multi-media projectors with LCD display, Touch screen board, PA systems, conferencing facilities along with digital and analog photographing facility are available with the directorate.

Weather Station

Directorate has manual as well as automatic weather station with data logging facility where daily temperature, rainfall, sunshine, humidity, wind velocity, evaporation etc. are recorded.

Trainee's Hostel

A trainee hostel with 16 furnished rooms and a common dining hall exists at the directorate equipped with high speed internet and telephone facility.

NOTES

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