

Farming systems approach for ensuring food and nutrition security

An ICAR-IIFSR initiative under Farmer First Programme

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Farmer First Programme, a flagship programme of Indian Council of Agricultural Research (ICAR) funded under ICAR KVK scheme is being implemented by ICAR-Indian Institute of Farming Systems Research (IIFSR), Modipuram in 3 selected villages of Muzaffarnagar district in western Uttar Pradesh. The prime objective of the project is to understand the constraints and opportunity available in the region along with designing and implementation of holistic farming systems interventions for ensuring food and nutritional security through increasing the farm productivity and profitability with small and marginal farmers in focus. Under this programme, 1,036 households in a cluster belonging to 3 contiguous villages i.e. Bhaingi-Bhangela, Satheri and Sonta in Khatauli block of Muzaffarnagar district were chosen for technological intervention in different modules of the farming system. Farming systems intervention proved to be a useful tool for leveraging the small and marginal farmers for their livelihood security.

Key words: Food security, Holistic improvement, Integrated farming systems, Livelihood, Nutritional security

A VAST majority of the population in Uttar Pradesh relies on agriculture for livelihood. Nearly 65% of the total workforce in the state depends on agriculture, mainly represented by marginal and small farmers. Sugarcane, rice and wheat are the predominant crops grown in Western Plain Zone of Uttar Pradesh. The farmers of this region suffice the requirement of cereals through these crops. A large part of the geographical area is cultivated and is well irrigated. Canal, tube well and wells are the main sources of irrigation. Over 70% of the area is sown and nearly 65% of this is irrigated. The major crops grown are wheat, rice, sugarcane, millets, maize, oilseeds, etc. The major cropping systems are sugarcane-wheat system. Other cropping systems are rice-wheat,

sorghum-wheat, maize-wheat, etc. Crop-livestock interaction has been unique feature of the region. The fertile Gangetic plain, with plenty of

water resources is also an important centre for the cultivation of number of fruit plants. However, the agrarian community is facing multi-faceted

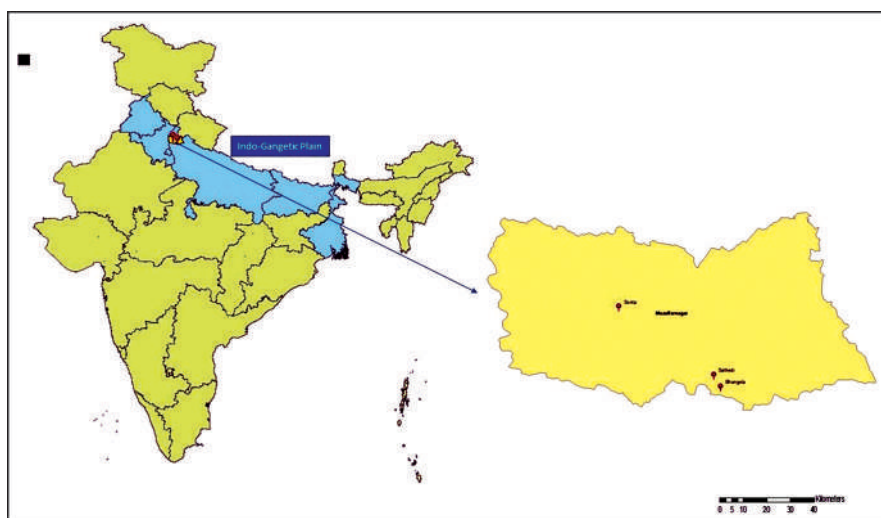


Fig. 1. ICAR-IIFSR, under the FFP, 3 villages viz. Bhaingi-Bhangela, Satheri and Sonta in Khatauli block of Muzaffarnagar district, Uttar Pradesh.

challenges arising from high cost of market inputs, defragmented land holdings making farm operations difficult, depletion in ground water table and climatic vagaries requiring attention to address the intensity of the problem. Farming system can act as a useful tool for maintaining ecological sustainability and bringing out economic viability while enhancing agricultural productivity along with the reduction of negative environmental impacts. The basic need for the farming systems approach is the requirement of homogenous farmer groups. Thus, clustering farm households into homogenous clusters, benefits targeted intervention of integrated set of activities pertaining to different components of farming systems. This also takes the resource constraints into account for optimal use of available resources for achieving the desired goal.

ICAR-IIFSR initiated a project for ensuring food and nutritional security through integrated farming systems approach for meaningful execution of integrated farm enterprises by a multi-disciplinary team of scientists under the flagship of Farmer FIRST Programme (FFP) under KVK scheme in a cluster approach. FFP is a concept in which the farmers participate in the research process with scientists. Research questions were taken with selected farmers, the whole village and villagers' participation in monitoring experiments with scientists. The aim is to find out new ways of doing and bringing in a synergy of the stakeholders. The project was implemented in 3 villages viz. Bhaingi-Bhangela, Satheri and Sonta in Khatauli block of Muzaffarnagar district in western Uttar Pradesh through farmer participatory approach (Fig. 1).

Description of study and location

The study area encompasses farming systems of Western Plain zone of Uttar Pradesh which in Khatauli block of Muzaffarnagar district. The Farming system study locations were purposively selected based on agro-climatic and socio-economic status, landholding pattern,

farming practices and representing western plain zones of Uttar Pradesh. It is characterized by average altitudes ranging 195-268 m AMSL. The Zone is predominated with irrigated agriculture. Based on this, a cluster of 3 villages comprising 238 households of Bhangela village, 400 households of Sonta village and 398 households of Satheri village were selected from Muzaffarnagar District of Western plain zone of Uttar Pradesh.

Farm households of all the 3 adopted villages have been categorized into different category of farmers based on land holding size which revealed significant presence of landless farmers (36.29%) while marginal, small and landless farmers together constitute about 87.45 % of the farming community. Overall percentage representation of medium farmers were very meagre (2.1%) while large farmers were absent in the adopted villages suggesting defragmentation of landholdings. The total sample comprised of 1,036 households for which detailed

benchmark survey was carried out during 2017-18 through baseline survey which could form a basis for identifying the constraints and subsequent planning of module wise integrated farming system interventions.

Major constraints identified in the region were found to be imbalanced crop nutrient application, lack of crop diversification, improper management of insect-pests, scarcity of quality fodder for animals and dearth of improved agricultural practices to name a few. Based on constraint analysis and requirement needs of different category of farmers module wise technological interventions were planned and implemented in the field. For holistic development of farm households' food, fodder and other requirements of households for ensuring food and nutritional security besides enhancing farm income, were considered in the planning of interventions. Module wise detailed technological intervention is listed in Table 1.

Table 1. Module wise technological interventions

Modules of IFS	Technological interventions
Crop and cropping systems	- Cropping intensification and diversification. - Use of improved production technology, HYV, Intercropping, INM, IPM and IWM. - Emphasis on oilseeds and pulses.
Livestock	- Fertility and nutrition management in milch animals. - Livestock health care/vaccination/deworming/calcium supplementation. - Introduction of improved breeds of poultry, goat and swine. - Feed and fodder management through cropping systems diversification.
Horticulture	- Demonstration of improved package of practices in vegetable crop production. - Exotic vegetable cultivation for higher income. - Multi-tier cropping of vegetables and promotion of Nutritional kitchen garden. - Low cost nursery for off season vegetable production/Low cost poly house Secondary Agriculture. - Composting and vermi-composting. - Improved small farm tools for reduction in drudgery of farm-women. - Value addition of farm produce (pickle/jam/jaggery making) and SHG formation for marketing
Capacity building	- Skill enhancement training (Compost/vermicompost preparation/ nursery raising/on-farm processing/ mushroom production/pruning/good agricultural practices, etc. training) - Exposure visits to Agri fair/Krishi unnati mela/awareness programmes/kisan goshthi, etc. - Literature distribution in local languages and agro-advisory services for risk management.

COMPONENTS OF FARMER FIRST APPROACH AND ACHIEVEMENTS THEREOF

1. Technology Assemblage, Application and Feedback

a. Cropping systems diversification/ intensification

Trench planting of sugarcane in autumn with intercropping of mustard

Sugarcane-ratoon-wheat cropping system is predominantly in vogue in western Uttar Pradesh. This intensive cropping system used to include the most popular sugarcane variety Co 0238 for the last couple of years, which is generally planted in May after harvesting of late sown wheat crop leaving only one month for tillering and canopy formation in the first plant of sugarcane resulting in heavy downfall of cane as well as green top yield. Moreover, the most popular variety (Co 0238) is reeling under heavy pressure of pathotypes and biotypes owing to being alone in the vast fray of its cultivation. Therefore, a strategic intervention by introducing a new variety of sugarcane CoPk 05191 along with mustard (RH 749) as an intercrop in autumn planting paired with row trench method was put in place on the six farmer's fields two each in Satheri, Bhangella and Sonta. Autumn planting of sugarcane variety (CoPk 05191) with intercropping of mustard RH 749 with trench planting of sugarcane was carried out. Transplanting of sugarcane (CoPk05191) through trench paired row method and sowing of mustard as an intercrop in between 120 cm of interspace. Results revealed a significant increase in cane yield ranging from 34.69 to 52.55 as well as system yield due to intercropping of mustard. Increase in system yield ranged between 58.89 % to 86.17 % as compared to sole crop of sugarcane farmer practice in summer crop.

Promotion of improved cultivars of wheat for higher productivity and profitability

Technical interventions in terms of 3 improved cultivars of wheat (PBW 550, PBW 658 and DBW 90) along

with farmers practices (PBW-226) as control were taken for field demonstration and evaluation. Performance evaluation of the various cultivars in terms of grain yields and other yield attributing characters like effective tiller no. per plant, length of ear, grains per ear and test weight. Besides these parameters, plant height was also considered for study because this is directly related to the stover yields which are the main components of dry fodder for the livestock components of integrated farming systems prevailing in these villages. Management practices like application dose of N, P and K and number of irrigations applied during each crop season was analysed to know the effect of these parameters on yield improvement of the crop. Results are presented in Table 2 depicting highest grain yield of 5,326 kg/ha.

Coorelation coefficients of important evironmental variables with respect to grain yield revealed imporatnce of temperature during grain filling stage (Fig. 2)

Performance evaluation of HYV of mustard

RH-749 variety of mustard was used for on-farm trial and yield was compared with that of local variety Varuna and Pant. Average yield enhancement upto 25.23% was observed in the cluster

Improved package of practice in wheat

Line sowing of wheat using seed drill and multi crop seed drill was demonstrated at farmers' field. Recommended dose of fertilizer was demonstrated in the package of practice and compared with farmers practice. Weed management in wheat was also included in the improved package through the application of weedicide named "Total" (Sulfosulfuron 75% + Metsulfuron methyl 5% WG) @ 16 g in 150 liters water in wheat was demonstrated at farmer's field.

Intercropping of pulses in sugarcane

For diversification and intensification of sugarcane crop besides soil health management pulse

Table 2. Plant height, grain yield and yield attributes of wheat during *rabi* 2018-19

Treatments	Plant height (cm)	Effective tillers/plant	Ear length (cm)	Grains/ear	Test wt (g/100 seeds)	Grain Yield (kg/ha)
PBW-226	89.9	4.4	5.7	56.6	2.9	4,373
PBW-550	80.4	6.9	7.7	61.7	3.0	4,654
PBW-658	97.4	7.3	8.6	66.4	3.0	5,326
DBW-90	85.2	6.6	9.2	55.8	4.5	4,489
C.D.	1.7	1.1	1.3	6.0	0.3	239
SE(m)	0.6	0.4	0.5	2.0	0.1	81
SE(d)	0.8	0.5	0.6	2.9	0.2	115
C.V.	2.0	17.6	17.4	10.1	10.0	518

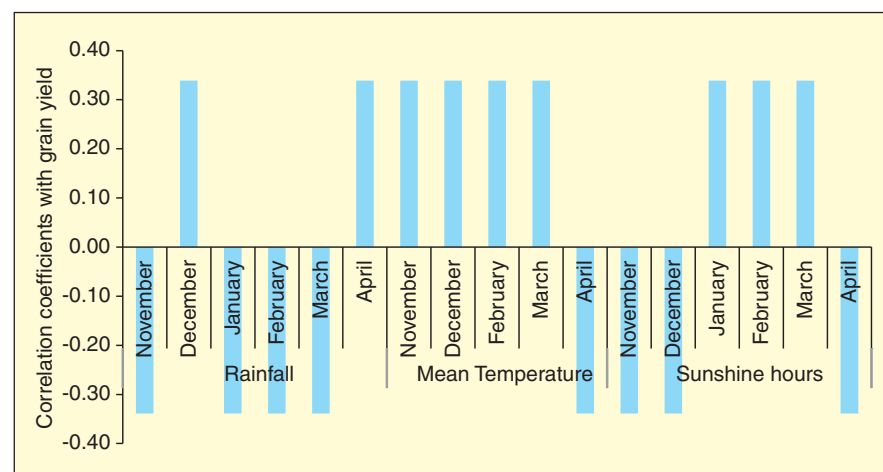


Fig. 2. Correlation coefficients of important environmental variables with respect to wheat grain yield.



Fig. 3. Technological intervention in horticulture crops.

crop viz. chick pea was intercropped in sugarcane.

Balanced fertilizer application and Disease/pest management in sugarcane through IPM

Intervention of Nutrient and pest management in Sugarcane was executed to address the problem of low production due to imbalance fertilizer usage and poor plant protection measures. Critical inputs like fertilizers, plant protection chemicals and tricard, etc were used in the technological intervention. A total of 659 trials were conducted on the management of nutrients (N 175, P 80, K 120, Sulfur 40, Zinc 25 and Boron 5 kg per ha) and plant protection measures (for controlling shoot borer and milli-bug, Trico card was used 3 times in the rainy season and for the control of pokkahboeng disease Carbendazim @ 0.2% sprayed on the crop) for improving the yield and quality of sugarcane. It was found that yield of sugarcane was improved to 15.01, 14.66 and 10.22 % in Sonta, Sathedi and Bhangela respectively, as compared to farmer's practice.

b. Technological intervention in horticultural crops

Awareness about nutritional kitchen gardening and mini vegetable kit for kitchen gardening

Farmers were made aware regarding the significance of fruits, vegetables and kitchen gardening. For this, plantation of improved varieties of fruit plants viz. mango, guava and lemon were carried out

along with trainings on scientific management of different fruits and vegetables. Promotion of nutritional kitchen gardening on bare land nearby house/water sources, etc. was promoted by providing mini kit of seasonal vegetables to the farmers. Cost of these mini kits were ₹ 35-40/kit. With such intervention seasonal vegetable availability for family consumption was ensured which could easily save ₹ 400 to 700/month that are spent by farmers towards the purchase of vegetables. We observed, estimated average saving of 500 to 850 during *kharif* (monsoon) and ₹ 1,000-1,200 during *rabi* (winter) through kitchen gardening. Such interventions were eye opener to many progressive farmers of the study area (Fig. 3).

Intercropping for diversification and intensification

Intercropping of pulses (black gram/green gram/ chickpea) in juvenile orchards of guava and litchi for intensification as well as additional income through intercrops and protein source for household nutrition even when the main fruit plants are in growth stage before fruiting starts. Intercropping of banana in poplar plantation was demonstrated in sylvi-horti system which not only provided added income from intercrops with diversification and intensification but also provided better micro climate suited for banana crops as intercrop.

Exotic vegetable cultivation for higher productivity and profitability

Improved package of practice has been provided to the farmers for

successful cultivation of the exotic vegetables through introduction of exotic vegetables viz., broccoli, Chinese cabbage, Kale and lettuce in vegetables module for enhancing profitability along with boundary plantation of papaya to minimize the risk of heavy dependence on single crop besides generating year round income. With the adoption of diversified exotic vegetable based cropping system, the net return from 0.4 ha has increased to 119 %. The total net returns have been increased from ₹ 92,575 to 2,03,170 with only 9.5% increase in the cost of cultivation. The contribution from animal module to the net income has been enhanced by 26 % in the improved farming system while there was a significant improvement of 219 % from the crop module solely due to diversification by exotic vegetables as compared to existing sugarcane based system. The benefit-cost ratio was enhanced from 2.11 in the existing farming systems to 3.23 in the improved system. Thus, the potential of horticultural crops in enhancing income of the farmers has proved worthy at farmer's field.

Multi-tier cropping for higher productivity and profitability

A multi-tier fruit crop based system comprising of strawberry, sponge gourd and capsicum was field demonstrated in the cluster considering the market accessibility of the NCR region which garnered a lot of interest from the farmers in the locality. With the adoption of multi-tier based system, net return from the system improved to about 2.20 lakhs from 0.60 ha land while B:C ratio

increased from 2.24 to 3.20. In the multi-tier system, strawberry occupies the lowest niche followed by capsicum and then sponge gourd.

c. Technological intervention in livestock

For addressing the problem of infertility, artificial insemination with quality semen was carried out. Supplementation of the mineral mixture along with balanced nutrition was carried out for enhancing milk production in mulching animals. Technological intervention viz. infertility and nutrition management in milch animals, mineral mixture, calcium and vitamin supplements, promotion and improvement of indigenous breed of cattle, deworming disease management, etc. were carried out under livestock module.

Technological intervention for improved fodder production

For a steady supply of green fodder, berseem and oats were evaluated with improved management practices and proper

Table 3. Performance evaluation of fodder crops under improved management practices

Fodder crop	Village	No. of demonstrations	Yield (q/ha) Improved Practice	Yield (q/ha) Farmer's practice	Increase in yield (q/ha) (%)
Berseem (1 kg seed per 400 m ²)	Sounta	35	792.86	613.93	178.93 (29.25%)
	Sathedi		789	613	176 (28.78%)
	Bhayangi-Bhangela		795.9	608.63	187.27 (30.89%)
	Mean		792.6	611.9	180.7 (29.5%)
Oats (Kent)	Sounta	22	474	370	104 (28.17%)
	Sathedi		476.43	367.14	109 (30.21%)
	Bhayangi-Bhangela		466.25	373.75	92.5 (24.97%)
	Mean		472.2	370.3	101.8 (27.5%)

seed rate which resulted in about 27.5% yield enhancement (Table 3).

Impact on milk yield due to animal health management and improved fodder supply

Supplementation of the mineral mixture along with balanced nutrition was carried out for

enhancing milk production in mulching animals along with the improved supply of quality green fodder which resulted in improvement in milk yield (Table 4).

Nutritional and Animal Management

Nutritional intervention was adopted for improvement in growth and milk production in cattle and buffaloes. Farmers were trained on how to make affordable balance ration using local feed ingredients. Ration of the milking animals was also balanced by supplementing mineral mixture, fortified calcium and vitamin mixture (vimeral). For eradicating calcium deficiency in the animals farm households were provided with a fortified calcium supplement. Besides vitamin mixtures

Table 4. Impact of animal health management on milk yield

	Village	No. of demonstrations	Increase in milk yield (ltr)	Increase in milk yield (%)
Mineral mixture supplement	Sounta	345	1.12	17.44
	Sathedi		1.83	23.95
Deworming	Bhayangi-Bhangela		1.52	16.49
Fodder availability				
Calcium supplement	Mean		1.49	19.3%

Table 5. Details of feed supplement used for nutritional management of livestock

Name of feed supplement/ Medicine	Quantity supplied (no.)	Dose per adult animal/ day	No. of animals covered	No. of household covered	Effect on animals
Mineral Mixture (Agrimin forte)	500 (1 Kg. pack)	100 g (milking animals) 50 g (Heifers/ dry animals)	500	460	Improving growth rate, better utilization of absorbed nutrients, increases milk production in animals, improves reproductive efficiency and reduces inter-calving period, improves immunity status.
Calcium	300 (1 Litre Pack)	100 ml (milking animals)	300	275	Sustain milk production, control milk fever and maintain hormonal balance.
Vitamin Mix. (Vimeral)	300 (120 ml Pack)	20 ml	300	300	Removes stress, acts as immune-stimulant, increases milk production, improves growth and egg production.
FENTAS PLUS	500 tab.	1 tab./30 kg B.W.	90	90	Removing Tapeworms, Roundworms, Hookworms and Whipworms
Taktic 5% (Amitraz I.P. (Vet) 50 mg)	200 (6 ml pack)	2 ml/litre in water	200	200	Effective control of ticks, mites, lice.
Flupor (Flumethrin-10 mg)	200 (30 ml pack)	1 ml/10 kg B.W.	200	200	Effective control of Ticks, Fleas & Lice.

were also provided to farm households. Medicines were also given for the effective control of Endo and ecto parasites. The details of the feed supplements and medicines their effects on animals are as follows (Table 5).

The result of the effect of nutritional management on milk production is presented in Table 5. The application of the balanced nutrition resulting in an overall per day improvement in milk yield in different villages was observed 1.03 ± 0.03 litres/day (Table 6), which is an improvement of 12.95% as compared to farmer's practice. The per lactation improvement in milk production is expected 225-250 litres of milk. Not only improvement in milk production but animals expressed also improvement in reproductive cycles and fertility by getting timely pregnant.

Animal husbandry

For ensuring the livelihood security of marginal and landless farmer, animal husbandry based IFS involving piggery, goatary and poultry were carried out and evaluated. Results are presented in the following tables.

i) Promotion of piggery among landless farmers

Landless farmers were provided with large white Yorkshire variety of piglets for enhancing their livelihood through pig rearing. Each farmer was provided with 1 male and 1 female piglet. Results indicated 40% increase (Table 7) in their income from pig rearing.

ii) Promotion of backyard poultry

Landless farmers were provided with backyard poultry for enhancing their livelihood through backyard poultry. Each farmer was provided with 12 birds of CARI Nirbheek. Results indicated 29% increase in their income from poultry rearing (Table 8).

iii) Promotion of goatary

Marginal and landless farmers were provided with Jamanapari goat for enhancing their livelihood through goat rearing. Each farmer

Table 6. Improvement in per day milk production in buffaloes by nutritional management.

Name of the village	Average per day milk production before treatment (lts.)	Average per day milk production after treatment (lts.)	Average per day increase in milk production (lts.)	% increase in per day milk production
Satedi	7.995 $\pm$ 0.31	9.027 $\pm$ 0.29	1.032 $\pm$ 0.04	12.91
Bhangella	7.815 $\pm$ 0.25	8.842 $\pm$ 0.26	1.027 $\pm$ 0.06	13.15
Sonta	8.040 $\pm$ 0.21	9.070 $\pm$ 0.19	1.030 $\pm$ 0.08	12.81
Overall	7.950 $\pm$ 0.15	8.980 $\pm$ 0.14	1.030 $\pm$ 0.03	12.95

Table 7. Income enhancement through pig rearing

Village	No. of Households	Increase in Annual income (₹)	Increase in Annual Income (%)
Large white	15	9,400	48.81
Yorkshire		11,400	30.48
(1 M + 1 F to each farmer)		12,400	41.96
Mean		11066	40.42

was provided with 2 goats. In each village 1 male was maintained, rest being females. Additional income to the tune of 32 % was realized from adoption of goatary (Table 9).

Composting and vermicomposting for residue recycling and pond management

On site input production and management like vermin-composting, nursery of planting material, seed production, residue management, etc. at farmer's level were encouraged. Farmers imparted training for preparation of vermi-composting.

Pond management

In the study cluster, ponds which were otherwise being unutilized and

weed infested were used for water chestnut cultivation. The farmers/ lease were given technical advice on water chestnut cultivation and fish culture for optimum utilization of water resources by utilizing these ponds to provide additional income.

d. Technological interventions under NRM Module

Microclimatic variations in Agri-horti farming System

Four crop environment namely banana sole crop, sugarcane sole crop, poplar+wheat and poplar+ banana were undertaken for quantification of the micro climate influenced by the different crop combinations. To quantify the variation in microclimate, *in-situ*

Table 8. Income enhancement through backyard poultry

Village	No. of Households	Increase in Annual income (₹)	Increase in Annual Income (%)
Nirbheek	24	13,000	31.18
(12 birds to each farmer)		12,500	30.23
		10,800	27.27
Mean		12,100	29.56

Table 9. Income enhancement through goat rearing

Village	No. of Households	Increase in Annual income (₹)	Increase in Annual Income (%)
Jamnapari (2 goats to each farmer)*1 Male and rest female in a village	9	12,200	32.79
		11,080	32.5
Mean		11,640	32.65

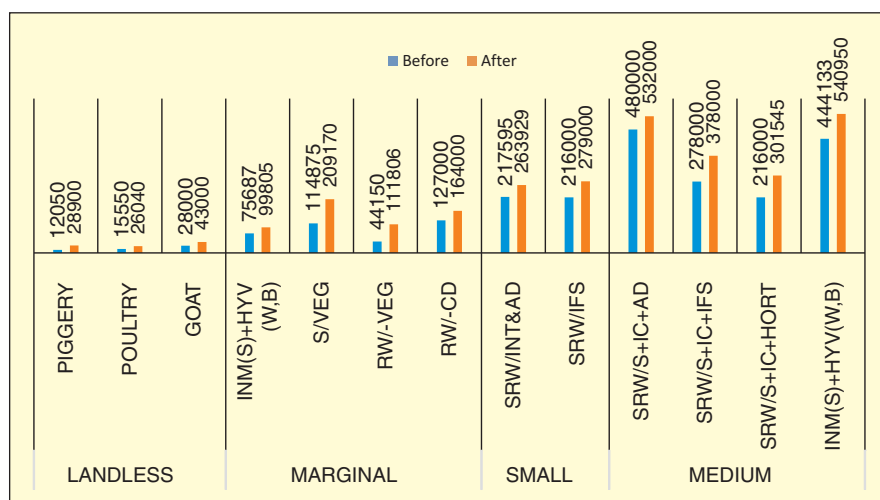


Fig. 4. Economic impact of farming systems approach.

observations of CO₂ (ppm), RH (%) and temperature (°C) were recorded during clear sky mid-day at two height i.e. 50 cm and 100 cm above the ground level. The microclimate condition at 50 cm above the ground in banana sole crop was found to be moderate with 594.2 ppm CO₂, 18.9% RH and 36.9°C temperature in comparison to bare field (592.6 ppm CO₂, 19.3% RH and 35.1°C temperature) and sugarcane sole crop (594.8 ppm CO₂, 19.2% RH and 37.7°C temperature). In poplar-banana system significantly higher concentration of CO₂ (596.0 ppm) was recorded however, RH (18.2%)

and temperature (35.6°C) were found lower than the banana sole crop. At 100 cm above the ground level, the highest CO₂ concentration (599.9 ppm) was recorded in poplar+banana farming systems with 18.4% RH and 35.5°C ambient temperature followed by poplar+wheat with 595.3 ppm CO₂. Better condition of banana crop was recorded under poplar+banana forestry-horti system than the banana sole crop (Fig. 5,6).

Risk management through SMS based agro-advisory services

Farmers of all the 3 villages were provided with weekly weather based

agro-advisory for farm management for different modules of farming systems. Besides weekly advisory, need based advisory on crop specific management depending on weather condition requiring immediate attention were also provided. A SMS based agro-advisory service named IIFSRK was started with technical support from C-DAC under which 1,036 farmers of all the 3 villages were registered. Farmers were given information about rainfall predictions, improved practices, crop specific disease and pest management advisories specific to different season through SMS.

e. Capacity development Module

Drudgery reduction of farm women

Demonstration kit on gender friendly improved tools on drudgery reduction has been developed. Ergonomically designed improved tools for e.g. improved sickle for harvesting of field crops, fodder crops and improved khurpi were distributed to the women and men farmers for improving the working efficiency and comfort during harvesting and weeding operation respectively. Ergonomically designed improved tools for e.g. improved sickle for harvesting of field crops, fodder crops and improved khurpi

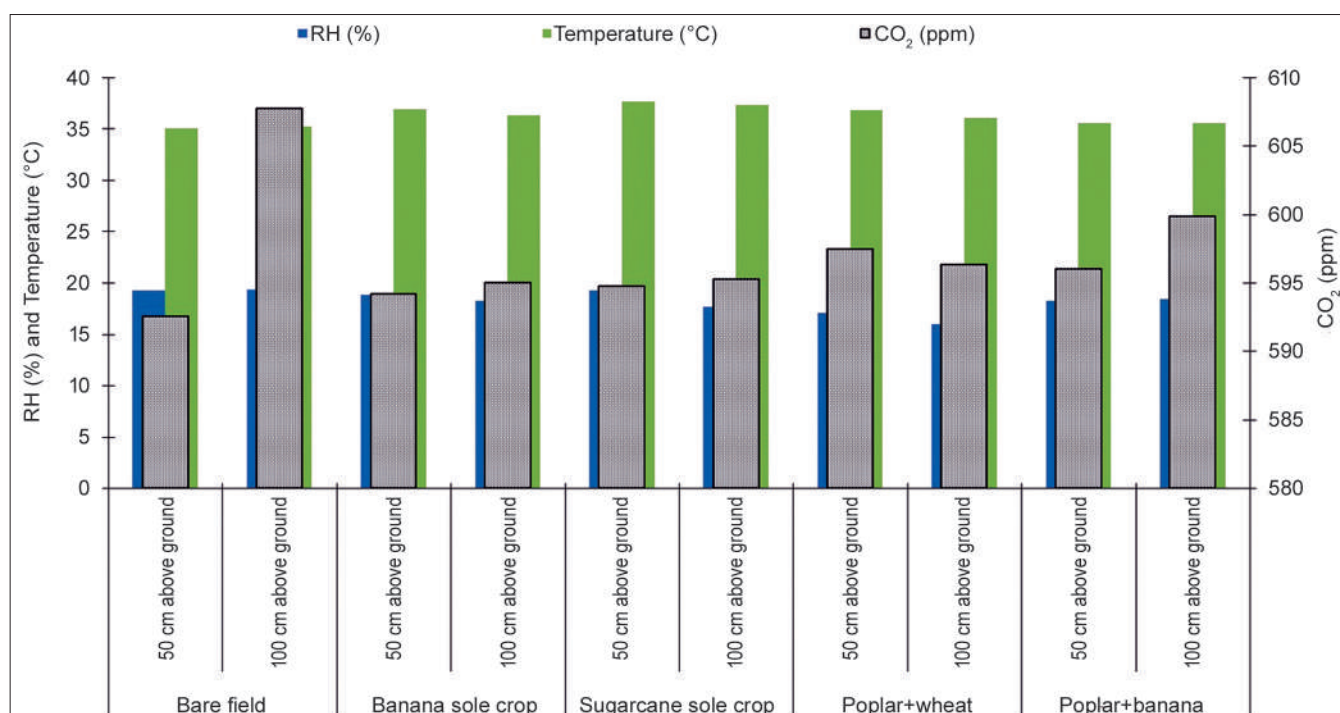


Fig 5. Influence of various crops and its combination on microclimate i.e. CO₂ (ppm), RH (%) and temperature (°C).

Table 10. Farming systems for different category of farmers

Farmers Category	IFS Module adopted
Land less	Cow/ Buffalo improved rearing practices of livestock Nutritional Kitchen Garden Piggery/Goatry/Poultry (Backyard)
Marginal	Sugarcane-ratoon-wheat Rice-berseem Maize-wheat One Cow + one Buffalo Nutritional Kitchen Garden
Small	Sugarcane + Mustard/lentil/chickpea Sugarcane ratoon-wheat Rice-berseem /wheat/mustard 1 cow/2 buffalo Nutritional Kitchen Garden
Medium	Sugarcane-ratoon-wheat Sugarcane+wheat/lentil/chickpea/mustard- ratoon Rice-berseem/mustard Rice-wheat-moong Rice-wheat-sunhemp Maize/jowar-wheat-cowpea 2 cow/2 buffalo Nutritional Kitchen Garden

are well accepted by the farmers as they found the improved tools to be better in terms of saving of time, energy and discomfort. Use of improved small farm tools/ implements with efficient ergonomic efficiency were promoted among farm women for different agricultural as well as horticultural activities for drudgery reduction. Improved sickle for harvesting of field crops, fodder crops to 800 farmers. The working capacity of improved sickle was 403.5 hr/ha which is significantly higher ($p < 0.05$) as compared to the traditional sickle (505.6 hr/ha) by evaluating it through harvesting of wheat. The mean value for strain index by using improved sickle was found to be 18.41 whereas it was 35.78 by using traditional sickle by the farmers and the difference was found significant ($p < 0.05$).

Further, demonstrations of seedling transplanter, direct seed dibbler, improved sickle were conducted through participation of farm women in the study cluster for reduction of drudgery.

Skill development of farm women for value added farm products and women SHG formation

Women Self Help group (*Devanjali Mahila Samuh*) has been formulated in Bhangela village for the skill enhancement in secondary agriculture activities as a diversified income generating avenue. Different trainings on value addition and processing of various products have been delivered to the women's group. The group has gained expertise in the development of different products *viz.* blended squash (guava+orange) and (guava + pineapple + pomegranate) mixed jam (guava + apple + aonla + orange + ramphal) and (guava + pineapple + pomegranate + apple), ginger paste, etc. The mixed jam and ginger products were packed into glass bottles and blended squash were packed into PET bottles. All the products were then labeled with the combined tag of ICAR-IIFSR and Devanjali Mahila Samuh. The group has also gained experience on marketing and maintaining of sale

records by selling the developed products amongst the staff of ICAR-IIFSR through stall organized by ICAR-IIFSR. The profit margin (30%) on the sold products was shared amongst the women group. Further, the group has also gained exposure in value addition of sugarcane through ready to serve (RTS) and jaggary development. During COVID 19 the SHG members also prepared masks for the safety of their families' community.

Training on value addition on farm produces to SHG exhibition cum sale of various products by women SHG

Capacity development and technology dissemination through trainings, kisan gosthi, exposure visits

Capacity building programmes, public awareness campaigns on improved package of practices of different *rabi* crops was carried out during the reporting period. Farmers were also exposed to new age technologies through exposure visits to Krishi melas, exhibitions. Awareness programme on Swachhata hi Seva, Soil health day, etc. were observed in study clusters for cleanliness drive and soil health management.

f. Integrated Farming systems for different category of farmers under IFS module

Based on individual component modules integrated farming systems suitable to different category of farmers were identified and different component technologies were integrated and studied for their impact on economic performance resulting in increased income ranging from 21 to 139%.

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Pradhan Mantri Krishi Sinchai Yojana

This Yojana brings

- Per Drop More Crop.
- Inputs from MoWR and DOLR received.
- Increase in agricultural production and productivity and enhance farm income.