

# Participatory technology application and multi-stakeholder convergence

for market-led agripreneurship and sustainable rural livelihood

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## Location and selection of area

The project interventions were started on 28 October 2016, in a cluster of three villages of Palwal district in Haryana. The different set of farm families were identified for different modules based on their existing production system, potential and interest. The major cropping systems of the region were Paddy-Wheat, Bajra-Wheat, Pigeonpea-Wheat and only vegetables (Brinjal).

The identified villages were Katesara, Dadhota, and Amarapur in Prithila block. The villages in this cluster are near to Delhi and IARI but the technology awareness and adoption was very low. Farmers are still cultivating old varieties and do not have access to quality seed. The soil texture is sandy, loam and clayey. The clusters have problems of soil salinity and soil water, for which technological interventions can be designed. Being in peri-urban situation, there is immense opportunity and potential to make agriculture profitable.

## Number of farm families

A total of 1,043 farm families (477 in Katesara, 314 in Dadhota, 252 in Amarapur) were selected for

the project.

## OBJECTIVES

The specific objectives of the project are as follows:

- To assess and integrate economically viable and socially compatible technological options for profitable cropping systems and

technology, input and market.

- To analyse the impact of the interventions under the project and suggest a strategy for up-scaling and out-scaling.

## INTERVENTIONS

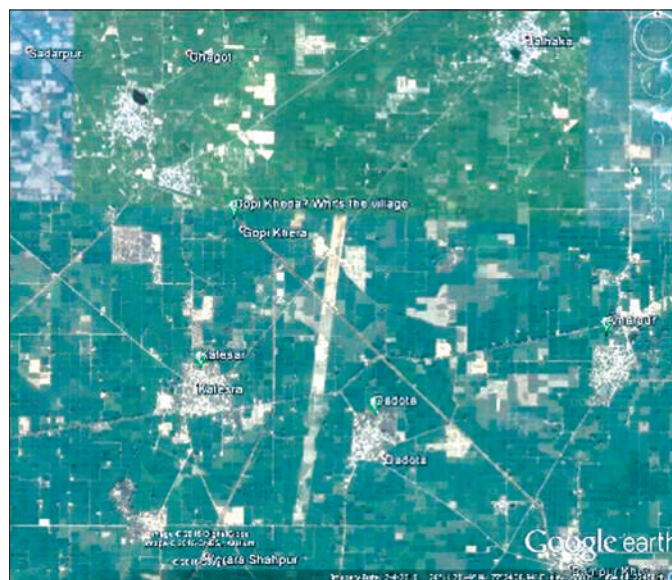
### Crop based module

*Diversification of rice-wheat cropping system through inclusion of summer mungbean:*

Farmer participatory situational analysis revealed that all the farmers practised rice-wheat cropping system. In order to diversify the rice-wheat cropping system, introduction of summer mungbean was opted by the farmers and to accommodate summer mungbean short duration paddy variety PB 1509 and early sown wheat variety HDCSW 18 were also demonstrated. Short duration paddy variety PB 1509 was found very

impressive on all growth indicators compared to PB 1121. Farmers liked PB 1509 for its yield, performance and shorter duration (114-116 days). The benefit accrued from PB 1509 was ₹ 65,040.00 per hectare (B:C ratio 1:2.66), compared to PB 1121 (1:2.36).

HDCSW 18 was found suitable



Satellite map of location of villages.

- integrated farming systems.
- To assess suitable technologies for farm women to address drudgery reduction, income enhancement and livelihood security.
- To design suitable networks, linkages, and convergence models for improving the overall access of farm households to information,

for early sowing and it recorded yield of 53.50 q/ha, over the local check. The benefits from HDCSW 18 were very high (₹ 62,429.80/ha) with a cost-benefit ratio of 1:2.73. HDCSW 18 was found to be quite superior to existing prevalent variety HD 2967 as the incremental income was ₹ 9,896.00/ha. In addition, the special attributes of surviving in severe abiotic stress condition and cultivation with surface residue of preceding rice crop under zero-till situation has ensured sustained production for HDCSW 18. The farmers have accepted and appreciated the variety as it is tolerant to high temperature at seedling stage and escaped rising temperature at maturity due to early seedling.

The maximum net returns were obtained in IPM (₹ 48,469.60/ha) when compared to Farmers practice (₹ 39,389.80/ha). The overall analysis of the study revealed that adoption of IPM technologies in mungbean cultivation results in high profits. Integrated pest management practices of mungbean including seed treatment with Imidacloprid, pesticides (Buprofezin) and Yellow sticky traps were demonstrated. Yield increase was up to 25% with cost-benefit ratio of 1:2.97.

#### Horticulture based module

**Marigold:** Improved marigold varieties (Pusa Arpita and Pusa Narangi) were demonstrated which yielded on an average 119.20 q/ha and 125.55 q/ha, respectively compared to local check (Hazara) 110.85 q/ha. Net returns from IARI varieties were up to ₹ 1,18,099.60/ha and ₹ 1,10,348.50/ha compared to only ₹ 81,344.50/ha from Hazara.

**Bottle gourd:** Bottle Gourd variety Pusa Santushti yielded on an average 175.15 q/ha compared to Anokhi, local check, 156.20 q/ha. The BC ratio of Pusa Santushti was very high at 1:3.38 compared to 1:2.73 of local variety. Better fruit size of average length 16.5 cm and weight 850-950 g got better market price and it was found suitable for both summer and *kharif* season. The fruiting is early, and first picking occurs in 60-65 days. Due to higher production, farmers accepted IARI vegetables varieties.

## SUCCESS STORY

### Augmenting farmers' income by including summer mungbean in rice-wheat cropping system intervention

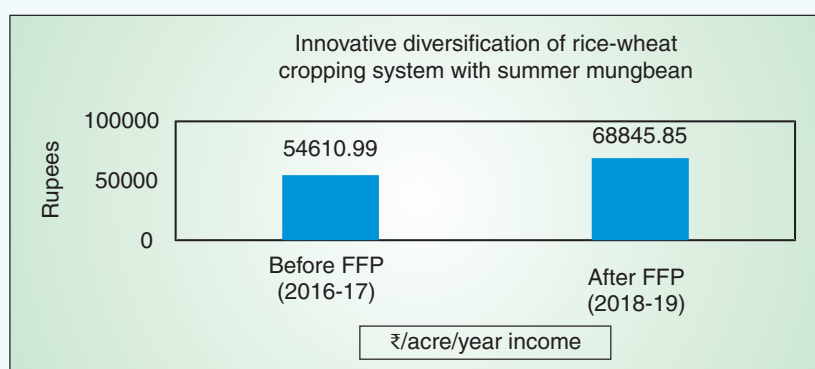
Under the ICAR Farmer FIRST, intervention was made to persuade farmers to grow a pulse crop (after the harvest of wheat crop) –summer mungbean (Pusa Vishal).

**Rationale of the intervention:** The usual pattern followed by the farmers is to grow rice (Pusa Basmati 1121, a long duration variety of about 143 days) in *kharif* and wheat (HD 2967) in *rabi* season. The problem of this cropping system lies in the fact that there is no time left for growing any summer crop as both these popular varieties are of long duration. No green manuring is practiced by farmers. So, soil fertility was declining and designing an innovative cropping system for the farmers has caught the attention of the scientific team to introduce short duration cereal crop varieties with the key aim of enhancing per day productivity, save on the number of days and utilize the saved days to grow another legume crop for enhancing farmer's profits and restoring the soil health and fertility levels of Indo-Gangetic Plains' crop fields.

**Outcomes:** From rice-wheat cropping system, the net income realized was ₹ 54,610.99 per acre but from rice-wheat-mungbean the net income realized was ₹ 68,845.85 per acre. In terms of incomes realized, 26.07% increase was found from the cropping system of rice-wheat-mungbean compared to existing rice-wheat cropping system. The benefits accrued from adopting this innovative cropping system are manifold. Through adoption of short duration cereal grain crops, expensive agricultural inputs were saved and costs were reduced. Cultivation of pulse crop also ameliorates the soil health.

**Lessons learnt:** Through adoption of short duration cereal grain crops, input costs were reduced for farmers.

**Way forward:** Farmers have been taught to take such key decisions as judicious selection of short duration crop varieties in order to save cropping days, save resources and thereby reduce costs of cultivation. Now, many farmers have taken up growing short duration crop varieties, diversifying their existing rice-wheat cropping systems and earning more farm incomes. Shri Omprakash Sharma of Katesra village, was practicing traditional crop cultivation, viz. Rice-Wheat system before inception of project. Now he has grown summer mungbean after wheat by adopting short duration variety of rice and by advancing sowing of wheat (HDCSW 18) to October last week and earned net profit of ₹ 14,234.86.



**Vegetable mustard:** Mustard leafy vegetable variety, Pusa Sag 1 was demonstrated to enhance farmers' income. Net return gained by the farmer was ₹ 59,969.50 and the Benefit Cost ratio was 1:3.20. In a short span of 60-70 days, farmers could get about 2-3 cuttings and earned ₹ 59,969.50/ha. Late sown variety HD 3059 was sown in the same field.

**Carrot:** Carrot (Pusa Rudhira) gave a yield of 190.00 q/ha with average net return of ₹ 1,20,749.50 per hectare, BC ratio 1:3.50. The local check gave a BC ratio of only 1:2.94. Both the improved cultivars were better to the local check on all the growth parameters including plant height, number of branches, root length, root diameter, core thickness and the roots were orange in colour with light orange flesh.

**Onion:** Onion variety Pusa Riddhi yielded on an average 190.00 q/ha compared to local check i.e. 172.00 q/ha. Net returns from Pusa Riddhi were ₹ 1,15,946.20/ha compared to only ₹ 89,320.00/ha for local check.

**Brinjal:** Pusa Uttam (brinjal) was demonstrated which yielded on an average 316.30 kg/100 m<sup>2</sup>. Net returns from Pusa Uttam were up to ₹ 1,883.30. The vegetables provided source of nutrition to the farm families and the marketable surplus was sold to the market, which ensured regular income for the farm families.

#### Livestock based module

Mineral mixture was administered to all lactating cows and buffaloes @40-60 g per animal per day in order to enhance milk yield per animal. This was promoted among the dairy animals of 40 farm families, with excellent results. Milk yield increased from 8.80 kg to 9.75 kg/day/animal, almost 950 g fat and protein per cent also increased from 6.7 to 7.2 and 4.25 to 4.35%, respectively, due to supplementation of mineral mixture during first year. Persistency of lactation curve, was better indicator of higher production in cows. Other components, viz. lactose, total solids, ash and SNF were similar in all the groups, though the increase of the components were within biological range. This

### SUCCESS STORY

#### Augmenting farmers' income by including a vegetable crop in between rice and wheat

**Intervention:** Under the ICAR Farmer FIRST, a new intervention was made by scientists of IARI to persuade farmers to grow a vegetable crop (in between the harvest of rice and sowing of wheat) -mustard leafy vegetable (Pusa Sag 1).

**Rationale of the intervention:** Since rice-wheat farmers were growing long duration varieties (Pusa Basmati 1121 and HD 2967), new short duration rice variety (Pusa Basmati 1509) was introduced to get more cropping days to grow mustard leafy vegetable (Pusa Sag 1) followed by late sown wheat variety (HD 3059). This crop planning was judicious in the effective use of resources of farmers.

**Outcome:** By adopting the new three crops cropping system, farmers could get a net income of ₹ 74,065.00 per acre which was significantly higher than their precious net income of ₹ 54,610.99 per acre from two crops cropping system. Farmers were quite satisfied with 35.62% increase in their net incomes.

**Lessons learnt**

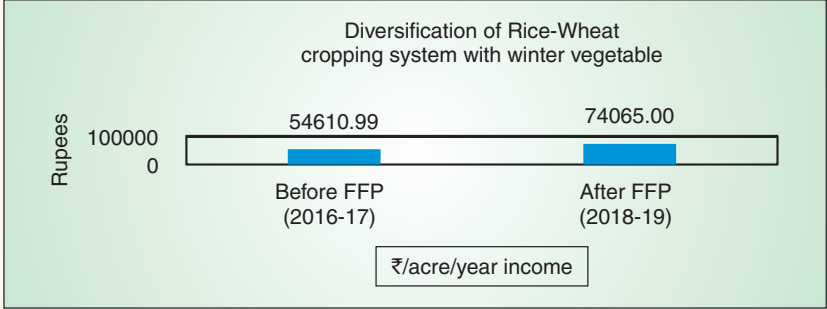
- Judicious crop planning could be beneficial by including short duration rice variety.
- Selection of late sown wheat variety was appropriate.
- Growing a vegetable – mustard leafy vegetable was a great blessing as farmers could get immediate returns.

**Way forward:** Farmers will be careful in judiciously selecting short duration crop varieties for enhancing their farm incomes. Assured of good net incomes, farmers would definitely continue adoption and integration of judicious varietal selection in the farming.

The project also aimed for crop diversification in the traditional cropping pattern which has shown impact on farmers' life. Shri. Hemraj Singh of Amarpur village diversified to vegetable mustard sag after adopting short duration varieties of rice and late sown variety wheat and earned net profit of ₹ 19,454.01 from less than an acre.



Diversification of Rice-Wheat cropping system with winter vegetable



| Period               | Net Income (₹/acre/year) |
|----------------------|--------------------------|
| Before FFP (2016-17) | 54,610.99                |
| After FFP (2018-19)  | 74,065.00                |
| <b>Net Increase</b>  | <b>19,454.01</b>         |

indicates that the physiological ability of the animals was much higher if nutritional requirements are fulfilled. During the second year, performance trend was similar as observed in the first year. Significant improvements were observed in the health of the

treated cattle and buffaloes. Their reproductive health also improved. The milch animals came to heat at proper time allowing for timely artificial insemination. The calving was also observed to be normal. Milk yields increased among all treated

milch animals.

### Natural Resource Management based module

Total 37 soil samples were collected with their GPS coordinates from Katesra, Dadhota and Amarpur villages and were analysed for 12 parameters. The soil map was developed using ArcGIS software. Soil health card based on soil fertility analysis led to reduction (20-25%) in injudicious fertilizer application.

### IFS based module

Under the IFS module promoted by ICAR Farmer FIRST project in Katesra village, fish production yielded an income of ₹ 55,570. The income from all the vegetables and other crops (Baby corn, Sweet corn, Bottle gourd, Brinjal, Sponge gourd, Marigold, Okra, Mustard sag and Pigeonpea) was ₹ 1,23,763. Thus, the total net income from the IFS module reaped by the farmer was up to ₹ 1,79,333.

### Enterprise based module

Early (off-season) cucumber was demonstrated in net houses to earn profits. The net returns were around ₹ 9,600 from 100 sq.m area in three months and the Benefit Cost ratio was 1:3.87. Early (off-season) tomato was demonstrated in net houses to earn profits. The net returns were around ₹ 7,800.00 from 100 sq.m area in three to four months and the Benefit Cost ratio was 1:3.60.

## TRAINING

A total of 935 farmers were trained during 2017-2020. In the year 2017-18, 8 courses and 974 demonstrations (181.35 ha area) were carried out; in 2018-19, 4 courses and 572 demonstrations (149.48 ha area) and in 2019-20, 5 courses and 888 demonstrations (159.72 ha area) were done.

## IMPACT

### Economic impact

- Diversification of rice wheat cropping system with short duration rice (PB1509), wheat (HDCSW 18) sown early, in October 20 onwards under zero

## SUCCESS STORY

### Seed production of cereals for higher income

Usually farmers grow rice and wheat and sell their produce as grain at minimum support prices. Here farmers were persuaded to grow these two crops, rice and wheat for seed production to enhance their farm incomes. Some special skills were taught to farmers to monitor purity of seed in the field.

**Intervention:** IARI scientists have identified one farmer who was provided with special training on the key concern for seed production. The farmer bought breeder seed from IARI for seed production in his field.

**Rationale in the intervention:** One of the best ways to enhance the farmers' income is to train and turn the farmer into a seed producer. IARI has taken up seed production in farmers' fields through IARI Farmer Participatory Seed Production Programme.

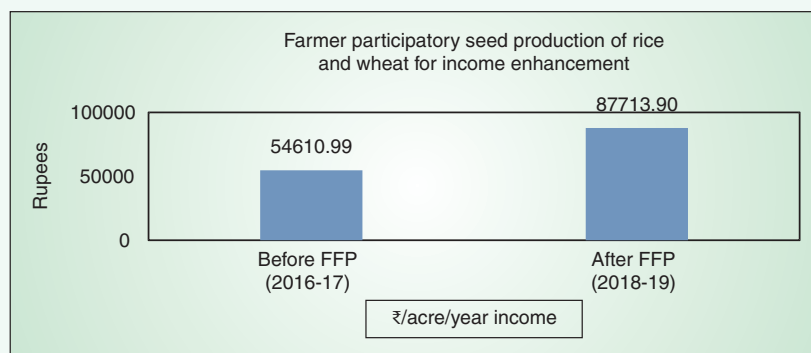
**Outcome:** Seed producer farmer worked hard and he could get higher yields of both rice and wheat in his seed production fields compared to grain crop fields. He could earn ₹ 87713.90 from the sale of seed crop compared to only ₹ 54610.99 from grain crop. The seed producer farmer is very happy as his income has raised up to 60.62%.

### Lessons learnt

- An ordinary farmer can be turned into a good seed producer farmer by providing adequate training to the farmer and through continuous monitoring and supervision of roughing and adhering to standard protocols.
- Farmers could realize higher incomes from seed production after acquiring necessary skills through training and technical guidance.

**Way forward:** Fellow villages have observed the skills and technical aspects of seed production and so are evincing interest to turn themselves into seed producing farmers. Seed production of new and improved crop varieties increases the productivity of various crops under various agro-ecological farming systems.

Shri Shyam Dutt (farmer) of Dadhota has earned ₹ 33,102.91 as additional money from one acre of seed production of rice and wheat.



tillage condition followed by summer mungbean (Pusa Vishal) led to about 28% income enhancement. Farmers in FFP village cluster and nearby villages adopted the diversified cropping system.

- INM (NPK and BGA) in paddy resulted in 11% increase in yield.
- Soil health card based on soil fertility analysis led to reduction (20-25%) in injudicious fertilizer application.
- Farmers who grew PB 1637, PB

**Table 1.** Economic impact of the interventions

| Village | Per cent increase in income |                  |                |                      |                  |
|---------|-----------------------------|------------------|----------------|----------------------|------------------|
|         | Whole village               | Marginal (<1 ha) | Small (1-2 ha) | Semi-medium (2-4 ha) | Medium (4-10 ha) |
| Amarpur | 39.13                       | 32.14            | 31.55          | 43.89                | 48.93            |
| Dadhota | 44.67                       | 30.15            | 45.62          | 48.22                | 54.68            |
| Katesra | 45.72                       | 39.89            | 36.48          | 45.33                | 61.19            |
| Average | 43.17                       | 34.06            | 37.88          | 45.81                | 54.93            |

Among the three villages, maximum impact of ICAR Farmer FIRST project was observed in Katesra village followed by Dadhota village and least was observed in Amarpur.

- 1509 and PB 1609 were directly benefitted by the genetic potential and the yield performance of these new paddy varieties. On the economic front too, farmers' income increased (about 44-87%).
- PB 1509 could help save up to 5-6 irrigations (about 33% saving of irrigation water).
- In terms of income realized, 28.32% increase was found from the cropping system of paddy-wheat-mungbean compared to paddy-wheat cropping system.

- The vegetables provided source of nutrition to the farm families and the marketable surplus was sold to the market, which ensured regular income for the farm families.
- Supplementation of area specific mineral mixture to early lactating dairy animals significantly enhanced milk yield in cow (10.44%) and buffalo (10.68%).
- Marigold being a cut flower used in temples and festive occasion is always in great demand. Farmers in whose field this technology module

was demonstrated were quite happy and received higher incomes through role of Palwal market. Hence the social acceptance was high and small and marginal farmers from the project villages also showed interest.

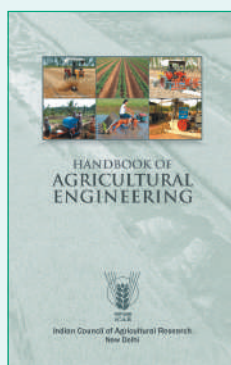
- Increase in income of four categories of farmers in FFP village cluster (Table 1).

### Social impact

The success stories are an evidence that the farmers could see a new ray of hope in enhancing their farm incomes through judicious varietal selection, crop planning and saving resources. All the farmers could see that these interventions have impacted their way of thinking, helped in effective resource utilization, and augmenting the farm incomes.

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## HANDBOOK OF AGRICULTURAL ENGINEERING



Agricultural Engineering interventions have led to significant improvement in agricultural productivity by timeliness of operations, reduction in drudgery, prevention of post-harvest losses and achieving higher cultivation intensity. Timely farm operations with efficient use of inputs, post-harvest processing and value addition to agricultural produce and conservation and sustainable use of natural resources are essential for ensuring higher returns to the cultivators. This is the maiden attempt of the Indian Council of Agricultural Research to publish the *Handbook of Agricultural Engineering*. The handbook comprises 50 chapters under four sections, namely Farm Machinery and Power, Soil and Water Engineering, Energy in Agriculture and Agro-Process Engineering. This publication would be useful to farmers, students, researchers, extension workers, policy makers, entrepreneurs and other stakeholders.

### TECHNICAL SPECIFICATIONS

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