

Increasing productivity and sustaining the rice based production system through Farmer FIRST approach

S K Mishra*, Lipi Das, V P Chahal, S Lenka, B S Satapathy, S C Giri, G C Acharya, Swatee Prangya, K B Jena and Sonali Jethy

ICAR-National Rice Research Institute, Cuttack, Odisha 753 006

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Location and selection of area

Villages namely, Biswanathpur, Satyabhamapur, Laxminarayanpur and Ganeswarapur of Salipur block, Cuttack district, Odisha were selected for undertaking the ICAR-sponsored Farmer FIRST Programme since 2016-17. The main reason behind the selection of the villages under NRRI-Farmer FIRST Programme (FFP) was that the four cluster villages had huge potential of adoption of rice-pulse cropping system along with vegetables. But the farmers usually cultivated paddy only as the solo major crop using seed of local varieties and following age old traditional cultivation practices due to lack of knowledge and awareness about the scientific method of cultivation and appropriate technologies.

solutions available in the institute and outside aiming at doubling farmers' income, conduct participatory trials and transfer the refined technologies and approaches to the similar agro-ecosystems

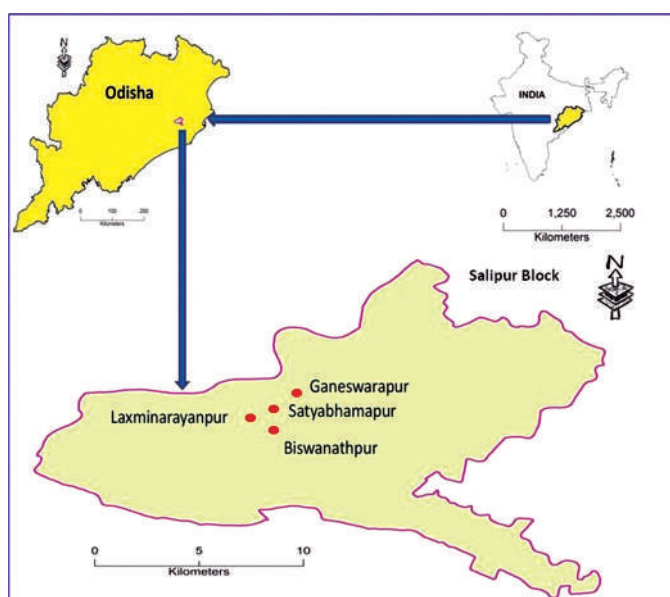
technologies on changes in knowledge, skill and adoption level of farmers and overall productivity gains.

INTERVENTIONS

Crop-based module (rice, pulses, mechanization)

Introduction of high yielding and hybrid rice varieties

Crop planning meeting were conducted at least twice a year before *kharif* and *rabi* with key farmers and farmwomen stakeholders from the cluster villages. Accordingly, varietal demonstration of over 25 newly released high yielding rice varieties including two hybrids (Rajalaxmi and CR Dhan 701) suitable for all the available ecologies with complete package of



Cluster comprising four adopted villages

Number of farm families

Out of total over 1,800 families in these four villages, 800 farm families were selected proportionately for technological interventions in the cluster as per the objectives of the programme.

OBJECTIVES

- To assess the problems, needs and opportunities of the farmers in rice-based production system through farmers-scientists interface.
- To identify the technologies/

through e-enabled knowledge sharing.

- To enhance technological and economic empowerment of farm women and strengthen gender relations in the production systems for sustainable agriculture.
- To ascertain the operational constraints as perceived by the farmers and farmwomen in adoption of technologies during experimentation as feedback for refinement.
- To study the impact of these

practices were conducted for three years during wet seasons involving over 450 selected rice farmers of the four adopted villages. As critical inputs, farmers were provided with seed mini kits of 10 kg each and partial amount of fertilizers and pesticides. They were trained and motivated particularly in seed treatment with Carbendazim and *Trichoderma viride* (bio-agent), nursery bed management, line transplanting with young seedlings, fertilizer management, seed



Sri Bhima Charan Das, 52 years old of Laxminarayanpur village, is one of the beneficiary rice farmer under NRRI-Farmer FIRST Programme (FFP), Cuttack. He cultivated improved high yielding rice variety Maudamani -a super rice. With this the net return has increased from ₹ 32,230/ha during pre-FFP period to ₹ 90,045/ha during post-FFP period with an increase in income by over 179% among the beneficiary rice growers (Table 1).

production technologies for preserving quality seeds for future and post-harvest technologies. Other interventions included application of need-based pesticides, pest monitoring and surveillance using pheromone traps, Tricho-cards, Drachon-cards (both bio-agents), NRRI-developed 24×7 solar powered light traps, nitrogen management with NRRI-developed customised Leaf Colour Chart (LCC) and green menuring with sesbania (dhaincha), training and capacity development programmes, continuous monitoring and technical backstopping.

Introduction of rice-pulse cropping system

To make use of residual soil moisture after *kharif* rice, high yielding black gram (var. PU-31, IPU-02-43) and high yielding green gram (var. IPM-02-03) were introduced in the rice-fallow and rice-local pulse system for additional family income and maintaining soil health.

Field days and farmers meets: Farmers' Field Days at various stages of crop growth, and Crop Cutting

Table 1. Average net return of value from adoption of new rice production technologies

Items	Avg. value of paddy during pre-FFP period (in ₹/ha)	Avg. value of paddy during post-FFP period (in ₹/ha)
Seed*	1000	0
Fertilizer	3990	2980
Agricultural Operation	15630	3310
Machinery (tractor and thresher)	3500	3100
Marketing	2000 (₹1000/trip)	2200 (₹ 1100/trip)
Total input	26,120	11,590
Outputs (return)		
Main produce (grain)**	55,860 (@3.8 t/ha)	98,875 (@ 5.65 t/ha)
By-product (straw)	2490	2760
Gross return	58,350	1,01,635
Net return	32,230	90,045

Experiments (CCEs) at the time of harvesting were organized in the presence of both beneficiary and non-beneficiary farmers, local line department officials and project staff. These CCEs were followed by Farmers Meets for experience sharing and participatory evaluation of the performance of introduced rice varieties and demonstrated technologies.

Introduction of high-yielding variety

Rationale of the intervention: Maudamani variety (a super rice, high yielding rice), was introduced among the rice farmers of the adopted village cluster. The farmers in the adopted villages usually cultivated various old varieties having poor market demand and low returns as they had lower yield potential and were prone to various biotic and abiotic stresses.

Outcome: Introduction of high yielding rice varieties, having yield potential of 11.0 t/ha and the grain yield advantages of about 30-60%, in farmers' fields, an incremental income of 50-300% (depending on the land type, varieties, crop management practices and market price) was obtained over previously grown varieties.

Rice farm mechanization

To reduce-cost of production, drudgery of farmers, effective farm operational time-extensive training -cum- demonstration programmes were conducted on over 20 different types of implements.

Intervention: Mechanization of rice farm through introduction of

various tools and implements among the rice farmers of the adopted village cluster.

Rationale of the intervention:

Rice is a labour intensive crop, requires 800-900 man hr/ha, hence farmers manually perform farm operations mainly due to – lack of awareness about farm machineries, the skills required for their maintenance and operations–, increasing farm operational time, drudgery of farmers and thereby cost of production. Power Thresher-cum-Winnower, 6-row Drum Seeder, Finger Weeder, Cono Weeder, Power Tiller etc., were introduced to reduce the cost of production, minimize wastage of input, improve quality of farm produce, reduce drudgery of farmers, have effective farm operational time and make



Sri Udhav Charan Padhi, 43 year old of Biswanathpur village, District-Cuttack, Odisha has successfully adopted mechanization of rice farming under NRRI-FFP

agriculture more environment friendly through mechanization of rice farm.

Outcome: Mechanization of rice farm helped in reducing about 60-70% of the cost of production. Thus, the farmers can save ₹ 16,000/ha i.e. about 45.71% on the labour cost and a lot of time.

Drawbacks and lesson learnt

The major constraints with the adoption of new improved varieties are the lack of (i) timely availability of quality farm inputs, (ii) awareness about the scientific cultivation practices, (iii) interest among the farmers for mechanization of rice farm as not aware about the available farm machineries and the skills required for their maintenance and operations. Power operated thresher cum winnower is well accepted among the farmers due to its farmer friendliness.

Horticulture-based module (vegetables, fruits, poly house)

Introduction of hybrid vegetables

Some farmers grew all types of vegetables as the land and climate is suitable for vegetables before and after rice crop but were ignorant about suitable high yielding and hybrid varieties, scientific package of practices, management of nutrients, pests and diseases, post-harvest care and packaging for marketing. Therefore, introduction and demonstrations of hybrid vegetables like okra (var. Nirmal, Arka Anamika, Samrat F1, Radhika), brinjal (var. VNR-B-5), tomato (var. BSS-1004, Samrudhi F1, KSP 1306 Bahubali, Rohit), bitter gourd (var. Nakhara Special, Akash), ridge gourd (var. Rama F1), pumpkin (var. VNR-14, VNR-11, Arjun F1, BSS750), papaya (var. Red Lady), banana (var. Bantala), drumstick (var. PKM-1, PKM-2), broccoli (var. Pocha), cauliflower (var. Namdhari NS-60), cabbage (var. Rare Ball), bean (var. Royal Somani, Bush Shravani) and cowpea (var. Sangita B.S) have been extensively carried out in the cluster. Under the horticulture-based modules, over 150 farmers and farm women were provided with quality

vegetables seeds as critical inputs.

Outcomes: With the introduction of hybrid vegetables varieties among the farmers of the adopted village cluster, there is increase in average gross return of ₹ 75,000/ year and the average net return is ₹ 45,800/ annum.

Relay vegetable cropping in trellis

Some farmers have been growing one or two vegetables in trellis made of bamboo twigs in their backyard kitchen garden as a traditional practice. Therefore, efforts were made to make the trellis more scientific and to grow 4-5 climber vegetables crops in relay. Accordingly, crop calendars were prepared and capacity of about 50 selected relay vegetable growers having suitable piece of lands was developed. The most acceptable relay sequence of climber vegetables is: (i) bitter gourd (Feb-May), (ii) cucumber (May-Aug), (iii) cow pea (Aug-Nov), (iv) Lab-lab bean/French bean (Nov-Feb). With the same trellis structure 4-5 crops are harvested in a year.

Outcome: Farmers started commercial vegetable production by growing 4-5 climber vegetable crops in relay on scientific trellis structure using high yielding and hybrid seed varieties and earned an average gross return of ₹ 1,260,000 /ha in just three years of adoption. The average net return was found to be ₹ 975,050/ha per annum, while the Benefit:Cost (B:C) ratio was worked out to be 3.42 on the basis of net return and cost of cultivation as given in Table 2.

Demonstrations on nutritional kitchen garden

Farmwomen of the cluster were made aware about the nutritional values of various crops. Accordingly, over 150 farmwomen were trained and provided with nutritional-vegetable seed kits as critical inputs, consisting of over ten types of vegetables, namely tomato (KSP 1306 Bahubali), beans (Shravani), radish (Palak Patta), koshala (Red Kanka), coriander (Royal Green), pumpkin (Rana BSS-749), amaranthus (All Green), cucumber (Supriya), French Bean (Harith), and

okra (Amba). Now, they have adopted the scientific practices of growing nutritional kitchen gardens at their home backyards.

Protected cultivation in polyhouse

In order to meet the demand of fruit saplings and high value vegetable seedlings for the entire cluster, a polyhouse (16 m × 8 m) was constructed during 2018-19 in Satyabhamapur. Healthy vegetable seedlings are being grown in pot trays using coco peat for local distribution and sale. In addition, training on raising grafted saplings of mango and guava has been imparted. This has helped the farmers in growing off-season vegetables and thus can earn additional profit. The vegetables are grown under controlled environment throughout the year, thus increasing the productivity and superior quality of produce can be obtained. The diseases and pests are better controlled under the enclosed area. The fruit saplings are also produced and maintained in this controlled environment.

Introduction of hybrid fruits

Based on the farmers' demand, hybrid fruit saplings of mango (var. Amrapali, Dasherri, Arka Nilachal Keshari), papaya (var. Red lady) and tissue culture banana (G-9, Bantala) were introduced in the cluster.



Sri Siba Narayan Samal, 54 year old of village Satya-bhamapur under NRRI-FFP, Cuttack, is one of the successful farmer cultivated vegetables of hybrid varieties along with suitable scientific package of practices.



Shri Braja Kishore Jena, aged about 39 of one adopted village cluster Biswanathpur, District-Cuttack, Odisha cultivate vegetables in 0.2 ha earned an average gross return of ₹ 2,52,000 and average net return of ₹ 1,95,010 per annum in just three years of adoption

Capacity building:

Capacity building is an integral part for any innovative technology to get adopted and popularized. Accordingly, training and continuous technological backstopping on commercial vegetable production, trellis system and marketing were provided.

Drawbacks and lessons learnt:

The major problem lies with the adoption of new scientific cultivation practices as the farmers of the adopted village cluster used traditional cultivation practices and were more convenient with that. The scientific trellis structure for commercial vegetable production has gained an enormous acceptance among the vegetable growers of the adopted village.

Livestock-based module (poultry, duckery and fishery)

Introduction of dual purpose improved poultry breeds

Training cum demonstrations on scientific production of backyard poultry and duckery were conducted for mostly women members of the selected families for last three years. As critical inputs, chicks (strain Vanaraja), ducklings (strain Khaki Campbell and Improved Native Breed), feeder, drinker, immunization, poultry feeds for

Table 2. Comparative analysis of economic returns between pre-intervention and post-intervention period under NRRI-Farmer FIRST Programme (FFP)

Parameters	Pre-FFP period (2016-17)	Post-FFP (2019-20)
Cropping pattern/sequence	Bitter gourd - Cow pea (two vegetables with locally available seeds and traditional package of practices)	Bitter gourd-Cucumber-Cow pea-Lab-lab bean/ Dolichos bean (4 vegetables with hybrid/ HYV seeds and scientific package of practices)
Cost of production per ha (₹)		
a) Seeds	5,000	33,500
b) Fertilizers	12,000	19,000
c) Plant chemicals (pesticides and hormones)	10,850	22,450
d) Trellis structure	40,000	60,000
e) Labour	70,000	150,000
Total cost	137,850	284,950
Total value of produce (Gross income per ha)	480,000	1,260,000
Net profit/ha	342,150	975,050
Benefit:cost ratio (B:C)	2.48	3.42

initial 3-weeks vital period, multivitamins and need-based antibiotic medicines were provided to the adopted women members of the selected families.

Outcomes: Introduction of dual purpose improved backyard poultry Vanaraja breed among the farmers of the adopted village has resulted in the diversification of their livelihood and earned an average gross return of ₹ 5,230 and the average net return was found to be ₹ 3,825 per annum



Smt Nirmala Pradhan aged about 47 of village Satyabhamapur, has successfully adopted dual purpose improved backyard poultry Vanaraja breed and gained an additional income

in rearing 20 birds (Table 3).

Demonstrations on scientific management of freshwater aquaculture

Although the cluster is having about 25 pond owners, mostly half to one acre size, but no one was advocating scientific fish production technologies at the time of project implementation. Therefore, training cum demonstrations on management of pond-based freshwater aquaculture were conducted for the pond-owners. They were made aware about the water quality parameters, cleanliness of pond, fish predators, stocking density, stocking ratio of various carps, artificial and natural feed management, fish health management and growth monitoring etc. As critical inputs, they were provided with fries, fingerlings of Indian major carps (IMC) namely rohu, catla and mrigal, floating feeds and plankton nets.

Drawbacks and lessons learnt

The major problem lies with the traditional mindset of the farmers of

Table 3. Economic analysis of poultry rearing (Vanaraja breed)

Investment (in ₹)	Chicks (20 Nos.)	Feed (₹)	Feeder (1 no. in ₹)	Drinker (1 no. in ₹)	Medicine (In Rs)	Total Cost (in ₹)	
	340	800	140	100	25	1405.00	
Outcome	No. of egg Sold	Egg Price (₹/egg)	Income from egg (in ₹)	Total weight of meat sold (in kg)	Meat Price (₹/kg)	Income from meat (in ₹)	Total income from poultry farming (₹)
Gross return	257	10	2570	19	140.00	660	5230.00
						Net return	3825.00
						B:C ratio	3.72

the adopted village cluster for diversifying their livelihood. The farmers of the village were lack in knowledge and awareness in technologies for scientific poultry production, balance feeding, handling of feeder and drinkers etc, thereby have less affinity for adoption of poultry.

Enterprise-based module (mushroom, vermi-composting)

Introduction of mushroom farming (paddy straw and oyster) and vermicomposting (strain Eudrilus eugeniae)

Introduction of mushroom farming (paddy straw and oyster) and vermi-composting (strain *Eudrilus eugeniae*) have been introduced and propagated as enterprises in adopted village cluster for promoting entrepreneurship and ensuring family nutritional security. Intensive training cum demonstrations were conducted for over hundred such women and youths and as critical input to learn and start production, they were provided with 10-20 spawn bottles each, gram floor, polysheds etc. Similarly for vermi-composting, adopted farmers were provided with ready-to-use vermi-compost pits and required quantity of earthworms @ 1 kg/pit.

Rationale of the intervention:

Majority of farmers were bound to cultivate paddy-pulse as the major crops round the year. The productivity and profitability of paddy-pulse as main cropping sequence was very poor and no other livelihood opportunity was available. They wanted to diversify their livelihood and improve their social economic condition. But lack of resources and exposure acts as a prime constraint for them. Therefore, under NRRI-Farmer FIRST

basis of net returns and cost of cultivation was 1.83, which was a remarkable achievement for a one-month crop.

TRAINING

Under four modules of NRRI-Farmer FIRST Programme, training cum demonstrations and capacity building programmes were conducted by the scientists of ICAR-NRRI and other coordinating institutes from Bhubaneswar, namely ICAR-CIWA, ICAR-CARI and ICAR-CHES. Training cum demonstrations were provided on improved rice varieties, mechanization of rice farm, quality seed production technology; scientific cultivation practices and improved production technologies of vegetables, fruits and protected horticulture; freshwater aquaculture and backyard poultry; and mushroom cultivation and vermi-composting.



Mechanical rice transplanting of Hasant variety in farmers' field

Programme (FFP) farmers started mushroom cultivation as an enterprise for extra income generation and livelihood security.

Outcome: Farmers adopted mushroom cultivation and earn an average gross return of ₹ 93,500/month, while the average net return was ₹ 60,500/month. The benefit: Cost (B:C) ratio worked out on the

IMPACT

Economic impact

Overall impact of FFP interventions and farmers' income gain in the adopted cluster with regard to doubling farmers' income has been depicted in Table 4.

Adopted farmers' income has increased by 144% in an average by

Table 4. Farmers' income gain in the adopted cluster with regard to doubling farmers' income

Major inter-ventions	Approx. no. of total farm families	Approx. land area of interventions or no. of units	Pre-FFP avg. net returns per ha or unit (in ₹)	Post-FFP avg. net returns per ha (in ₹)	% increase in net returns or income
HYV rice	450	90 ha	32,230/ha	78,665/ha	144.07
Pulses	200	50 ha	11,350/ha	13,543/ha	19.32
Rice+pulses	200	50 ha	43,580/ha	92,208/ha	111.58
Vegetables	200	20 ha	3,43,950/ha	12,89,969/ha	275.05
Poultry	70	1600 chicks	3,000/family	7,650/family	155.00
Duckery	30	900 ducklings	2,000/family	3070/family	53.50
Fisheries	20	20000 fish fingerlings	15,000/family	51,250/family	241.67
Mushroom	100	2500 bottles	Not applicable	3,000/family	Additional family income
Mushroom as enterprise	4	500 beds	Not applicable	4,20,000/family	New Agri-preneurs
Vermi-composting	20	40 vermi-pits	Not applicable	4,000/family	Additional family income



Shri Ranjan Kumar Behera, aged 37 of one adopted village Biswanathpur has adopted mushroom cultivation as an enterprise earns an average gross return of ₹ 93,500/ month while the average net return is ₹ 60,500/ month.

adopting HYVs of rice alone with ranges from 15-63% grain yield advantage (highest being for super rice variety CR Dhan 307 (Maudamani) with 63%) and 50-300% per hectare incremental family income (Table 4).

Social impact

So far the overall impact in the cluster was found – significant increase in knowledge, skill and awareness of farmers, farmwomen and youths about new crops, vegetables, animals, fisheries, use of farm implements, and related crop-stress management practices apart from substantial increase in income for the beneficiary farmers, expansion of gross cropped area of

the cluster by 20-25% and significant increase in farm income up to 275% based on type of enterprises were observed.

WAY FORWARD

- Establishment of Mushroom Spawn Production Unit and starting of Mushroom Spawn Production.
- Establishment of Rice Seed Processing unit and starting quality seed production in the adopted cluster to meet seed demands of the locality.
- Demonstration of Mini Integrated Farming System models (selected farmers).
- Demonstration and Expansion of Poultry/Duckery/Fisheries/Vermi-

composting.

- Commercial fish fingerling rearing and selling (selected farmers).
- Formation of FPO/FPC and starting Custom Hiring activity of already supplied Farm Implements.
- Capacity building activities (Training/Exposure Visit on all aspects of interventions).
- Impact assessment studies for all interventions.
- Value addition of horticultural produce and market linkage.
- Devising an appropriate exit plan to sustain the rice-based production system.

*Corresponding author's email: skmishra.icar@gmail.com



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