

Livelihood improvement of hill farmers

through sustainable farming system in north eastern hill region

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Location and selection of area

Marngar village cluster, Ri Bhoi district, Meghalaya, divided into two clusters. Marngar cluster (Borgang, Purangang, Lalumpam, Borkhatsari,

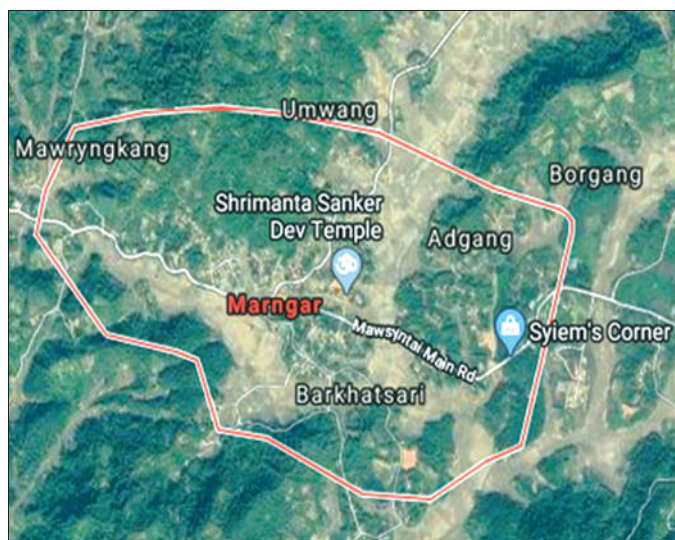
Nalapara-Joigang) and Sarikhusi cluster (Umtham, Nongagang, Sarikhusi, Mawtnum, Mawphrew). Agriculture is the major source of livelihood of farmers in the selected villages. Despite the favourable climatic conditions and abundant natural resources, the productivity, profitability and sustainability of agriculture and allied sectors in the Marngar cluster is very low due to lack of knowledge about scientific farming, recent

technologies, financial and infrastructural support.

Number of farm families: 773 (10 adopted villages).

OBJECTIVES

- Technology development, assessment and validation based on the feedback with the participation of the different stakeholders for enhancing productivity.
- Conducting technologies demonstration suitable under farmers' resource base system for sustainable development of hill farming system leading to livelihood security.
- Technological, socio-economic and environmental impact assessment of demonstrated technology for the livelihood development of hill farmers of NEH Region under different agro-ecological settings.



Marngar, Ri Bhoi, Meghalaya (25.914144, 91.916781)



Construction of raised and sunken beds



Demonstration on nursery raising



Cultivation of vegetables



Jalkunds in Ferdinand Barka, Purangang village

- To develop a network of linkages with different partners of technologies, viz. research institutions, line departments, KVKs, input supplying agencies, marketing organizations, credit institutions, etc. for facilitating access of technology, database management and marketability of produce for better returns to farmers.

INTERVENTIONS

Natural resource management (NRM) based module

Intervention applied was preparation of raised and sunken bed for cultivation of crops.

Rationale of the intervention: In the farmers' field, there was the problem of water logging due to which they are not able to take up a second crop after paddy cultivation. Temporary raised beds were made after *kharif* rice harvest, to cultivate vegetables. The width of the beds was 1-3 m and height of the raised beds varied from 0.3-0.6 m depending upon the standing water. Water from the raised area drains into the sunken area and during dry periods it is used for irrigating the crops.

Outcome: Highest net return was obtained from broccoli cultivation



Line transplanting

followed by pea and potato (Table 1).

Construction of Jalkund for water storage

Rationale of the intervention: To fulfill the need of water for agriculture and allied activities during the period of water scarcity, Jalkunds (3 nos., 25×25×7 feet) were prepared for storage of water before the onset of monsoon. The water stored in the Jalkund was used for irrigating crops, cleaning poultry/pig sheds, fish rearing etc.

Outcome: Construction of Jalkund during monsoon season helped the farmers to utilize it during water scarcity period very successfully. Table 2 shows the additional income obtained from fish rearing in Jalkund.

Table 2. Income generated from fish rearing in Jalkund

Beneficiary	Income
Ferdinand Barka	₹ 6,000 (20 kg fish @ ₹ 300/kg)
Dominic Syiem	Harvested 10 kg fish/year (approx.)
Mrinal Sohkhwai	Released 800 fish fingerlings

Crop based module

Popularization of line transplanting of rice with recommended spacing and package of practices was one more intervention that was selected for the area.

Rationale of the intervention

This intervention was carried out for the farmers who were practicing rice cultivation with local cultivars following indigenous practices.

Demonstrated in the farmer's field and compared the yield between the conventional and the improved methods. Improved method requires less quantity of seed, 2-3 seedlings/hill, reduces cost of cultivation and makes easy intercultural operations like manual/mechanical weeding, application of fertilizers, insecticides, harvesting, etc.

Outcome

Farmers practice: Average grain yield = 1.5-1.8 t/ha

Recommended practice: Average grain yield = 2.3 t/ha

Demonstration of no-till/minimum till cultivation of French bean in maize fallow

Rationale of the intervention

This was adopted because farmers

Table 1. Income generated from vegetable cultivation in raised and sunken bed

Crop	Yield (q)/acre	Market price (₹/q)	Expenditure/acre (₹)	Gross income/acre (₹)	Net return/acre (₹)
Pea	12.14	3,000	18,218.62	36,420	18,201.38
Potato	33.5	1,500	33,394.33	50,250	16,855.67
Broccoli	20.12	2,600	28,524.45	52,312	23,787.55



Cultivation of French bean in maize fallow

left their field fallow unused after the harvest of maize crop.

Intervention helped in the effective utilization of land without much investment on land preparation. Maize stalks cut about knee height, leaving the lower stalk about 0.75 m as support for vining French bean.

Outcome: Growing of no-till/ minimum till French bean increased the income of the farmers as well as fulfilled the nutritional requirement of the people. Average yield: 7 t/ha.

Horticulture based module

Promotion of second cropping through dissemination of package of practices of improved technologies in rice and maize fallow.

Rationale of the intervention

Post paddy cultivation (November onwards) is an off-season and low employment period.

Broccoli (*Brassica oleracea* var. *italica*) was adopted as one of the main crops in horticulture component for proper utilization of paddy fallow land and creating employment during the off-season.

Outcome: Thirty-three beneficiaries adopted broccoli cultivation on regular basis since 2017 covering an area of 7.5 ha. The economics of broccoli cultivation is shown in Table 3. Several other farmers in and around the cluster villages adopted the cultivation of this crop, notably, Mrs Angela Rangad, a farmer from Umden, adjacent to the cluster villages grow

about 0.35 ha area under broccoli, fetching remuneration price of ₹ 13,500. Scientific interventions of broccoli cultivation, proved to be successful and today broccoli has

Table 3. Economics of cultivation of broccoli by farmers

Particular	Value
Area (ha)	7.5
Average head weight (g)	378
Market price (₹/kg)	25.00-30.00
Expenditure (₹)	274,420.00
Gross income (₹)	928,800.00
Net return (₹)	654,400.00

Table 4. Income generated by poultry farmers having 100 chicks

Name	Village	Poultry chicks (No.)	Live birds (₹)	Income Eggs (₹)	Total (₹)
Saila Maharana	Borkhatsari	100	64,600	—	64,600
Soity Damlong	Umtham	100	16,900	5,000	21,900
Olina Barka	Borkhatsari	100	22,260	—	22,260
Jiten Sohkhwai	Nalapara	100	28,500	6,000	34,500
Robert Maring	Mawtnum	100	13,398	—	13,398

Table 5. Income of pig farmers

Name	Village	Piglets (Nos.)	Piglets/ Adult pigs sold (₹)	Income (₹)	Expenditure (₹)	Net profit (₹)
Elvis Syiem	Borgang	2	2	24,000	10,000	14,000
Midot M. Binong	Purangang	2	14	1,59,800	77,500	82,300
Eling Majhong	Purangang	1	5	15,000	9,000	6,000
Ruwol Binong	Lalumpam	1	1	15,000	8,000	7,000
Durga Binong	Lalumpam	1	6	18,000	3,000	15,000
Gambir Syiem	Lalumpam	1	1	11,500	5,000	6,500
Brojen Majhong	Borkhatsari	1	1	9,000	4,000	5,000
Saila Maharana	Borkhatsari	1	1	12,000	6,000	6,000
Unoh Binong	Nongagang	1	1	8,000	3,000	5,000
Udes Syiem	Nongagang	1	1	22,000	9,000	13,000
Mukut Syiem	Nalapara	6	1	3,750	800	2,950
Uswi Barka	Purangang	2	2	20,000	8,000	12,000
Humin Rabha	Purangang	1	1	12,000	5,000	7,000

*Piglet sold @ ₹ 2,300-3,700/piglet; **Adult pig @ ₹ 9,000-24,000/pig.

overtaken garden pea as the most important commercial vegetable crops in the cluster villages.

Livestock based module

Adoption of scientific poultry farming

Rationale of the intervention:

Scientific backyard poultry farming for improving livelihood was proposed because farmers usually practice poultry farming with indigenous birds having low production potential (meat/egg). Improved breeds of backyard poultry (Vanaraja/ Srinidhi) introduced, knowledge disseminated regarding feeding, vaccination, health care management etc.

Outcome: Successful poultry farmers sold eggs @ ₹ 10/egg, live birds (3.5-4 kg) @ ₹ 200-300/kg body weight. Income of successful farmer is shown in Table 4.

Adoption of scientific pig farming

Rationale of the intervention:

Scientific pig farming was adopted for increasing pig productivity. Low production potential (growth rate/ litter size) of indigenous pig breed, hence, crossbred pigs (Hampshire × Local Khasi) introduced in the



Improved breeds of piglets



Distribution of bee boxes and related accessories

Table 6. Income from pig breeding unit

Piglets received from ICAR	No. of piglets born	No. of piglets and adult pigs sold (Nos.)	Rate per animal (₹)	Total revenue generated (₹)	Expenditure (₹)	Net Profit (₹)	B:C ratio
8	80	Piglets: 65 Adult pig: 11 Piglet: 2,300-3,500 Adult pig: 9,000-24,000	328,000	135,000	193,000	1.42	

village, knowledge disseminated regarding feeding, artificial insemination (AI), healthcare management, etc.

Outcome

Adult pigs were sold @ ₹ 9,000-24,000/pig depending on size and weight. Pigs were sold @ ₹ 2,300-3,700/piglets. The income generated by few successful farmers is shown in Table 5.

Enterprise based module

Development of pig breeding cluster

Rationale of the intervention: Development of pig breeding cluster in the village was adopted because

improved breed of piglets are not easily available in the market.

Pig breeding unit: Mr. Mrinal Sohkhwai, an unemployed youth (34 years) from Borkhatsari village developed pig breeding unit. He received 8 (4 male, 4 female) crossbred piglets (Hampshire × Local Khasi) from ICAR, Umiam.

Outcome: Sustainable pig farming improved the livelihood of the farmer. Table 6 shows the income generated from the pig breeding unit.

Scientific bee keeping

Rationale of the intervention: Integration of scientific beekeeping for enhancing income of the farmers

because traditionally farmers in Meghalaya have been adopting local techniques of rearing bees, which are less economical and non-scientific.

A total of 33 farmers were trained for scientific rearing of Indian bee *Apis cerana*. Modern bee box Type B (55 nos.) and excluder sheets distributed among the farmers.

On-site demonstration on queen separation, colony establishment and maintenance of bee colonies.

Outcome: Average honey production per box per season was 2.53 litre. Net monetary benefit from honey production ranged from ₹ 1,200 to ₹ 9,600 depending on the colony status, with an average benefit of ₹ 3,040/farmer.



On-site demonstration on queen separation, colony establishment and maintenance of bee colonies

Oyster mushroom cultivation

Rationale of the intervention:

Oyster mushroom cultivation for enhancing farmer's income was adopted because many farmers depend on their crop produce as source of income year after year. And this income is not continuous and generally insufficient to take care of their daily needs, or the produce is just sufficient to fulfil their family food requirement due to their small land holdings.

Mushroom cultivation is a safe alternative since it is an indoor activity and can provide earnings almost round the year. Farmers were trained about the mushroom cultivation and spawn making process under FFP.

Outcome: Farmers harvested 1,473 kg of oyster mushroom from the mushroom spawn distributed under FFP. Fresh mushrooms sold @ ₹ 150/kg have in the local markets and earned ₹ 220,950. Net profit was ₹ 199,360.

Integrated farming system (IFS) based module

Intervention and its rationale: Horti-livestock-fishery based integrated farming system (IFS) was adopted because many farmers were doing conventional farming with indigenous breeds of pigs, poultry, grow local variety of paddy, vegetables etc.

In order to increase farmers' income, ICAR, Umiam under FFP developed Horti-Livestock-Fishery based IFS model in their farms. The major components of the IFS model are mentioned below.



1. Fishery unit: Fishery pond of 1000 m², fishes like rohu, mirgal, grass carp, common carp, silver carp, catla, bighead, gonius, pangasius and



Farmer's Innovation: Use of plastic buckets

pacu reared.

2. Poultry unit: Poultry shed with bamboo and woods are constructed above the ponds. Improved breeds (Vanaraja / Srinidhi) were introduced.

3. Duckery unit: Improved duck breeds (Khaki Campbell) introduced, constructed shed with low cost materials.

4. Piggery unit: Improved breeds of piglets (Hampshire cross) introduced.

5. Dairy unit: Two adult Jersey cows given under FFP.

6. Other components: Rabbitry and crop component (paddy in *kharif* season; cole crops, cucumber, capsicum etc. in *rabi* season).

Outcome

Income generated from IFS is shown in Table 7.

Table 7. Income generated from IFS

Component	Year	Revenue generated (₹)	Expenditure (₹)	Net profit (₹)
Fishery	2017-18	118,000	16,000	102,000
	2018-19	250,000	46,000	204,000
	2019-20	300,000	85,000	215,000
Poultry	2017-18	34,000	10,950	23,050
	2018-19	78,492	25,800	52,692
Duckery	2017-19	22,500	9,580	12,920
Piggery	2019-20	80,500	45,500	35,000
Dairy	2018-19	178,000	174,370	3,630
	2019-20	671,000	453,000	218,000
Rabbitry	2019-20	2,100	500	1,600
Crop	2017-18	46,000	13,000	33,000
	2018-19	47,900	15,000	32,900

Table 8. Economics of fish farming in Marngar cluster under FFP

Name and village	Year	Investment (₹)	Revenue (₹)	Net profit (₹)	Angling (contribution) (₹)
Bipul, Umtham	2017	6,000	18,000	12,000	-
Jiten Sohkhwai, Nalapara	2017	16,000	118,000	102,000	88,000
	2018-19	46,000	250,000	204,000	110,000
	2019-20	85,000	300,000	215,000	95,000
Pilor Syiem, Borkhatsari	2018-19	10,000	70,000	60,000	40,000



Low cost poultry shed

Fishery based module

Intervention and its rationale:

Composite fish culture was adopted as almost 90% farmers in the adopted villages were not aware about the scientific fish culture techniques and most of the ponds were kept idle despite of the fact that there are 167 nos. of ponds (72 nos. small ponds (<0.02 ha), 58 nos. medium size ponds (0.02 – 0.05 ha), 37 nos. large ponds (>0.05 ha)).

Outcome: Knowledge of scientific fish culture had enormously enhanced the fish production and profitability (Table 8).

Farm mechanization based module

Intervention and its rationale:

Farm mechanization for reducing the cost of cultivation was adopted as most of the agricultural activities

IMPACT



farmers to shift from manual labour to improved farm machinery, eventually reducing the labour cost for farming activities. Distributed power tiller, grass cutter, manual thresher, post hole digger, adjustable row marker, conoweeder, single wheel trolleys, water pumps, etc.

Outcome: More than 100 farmers registered and opened their savings bank account (Table 9).

TRAINING

Under FFP, training programmes organized– Nursery raising demonstration-cum-seed distribution of vegetable seeds; management practices for agro-forestry based Integrated Farming system; improved rearing practices of backyard poultry and piggyery; improved dairy farming at ICAR-NDRI, ERS, Kalyani, West Bengal; micro rain-water harvesting techniques and improved farm machinery for drudgery reduction in farm operations; and scientific beekeeping.

IMPACT

Social impact

- Mrs. Saila Maharana, Borkhatsari: Increased her income from mushroom cultivation and backyard poultry farming. Constructed one poultry shed.
- Mr. Mrinal Sohkhwai, Borkhatsari village: Improved his livelihood through sustainable pig farming. He donated three piglets to his neighbours.
- Mr. Jiten Sohkhwai, Nalapara village: IFS increased his income. Constructed poultry shed, fish pond and purchased crossbred cows (6). His success influenced other farmers to adopt IFS in his village.

LESSONS LEARNT

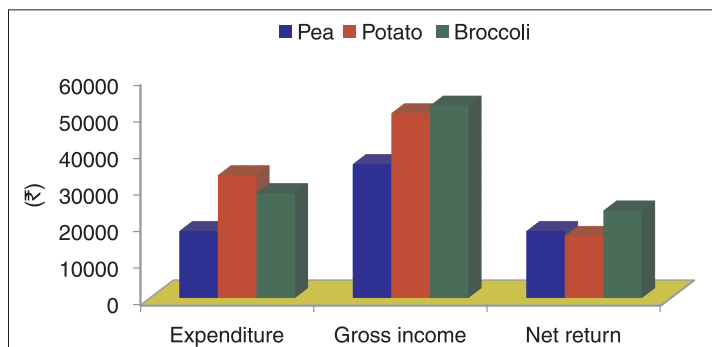
- Broccoli as second crop in rice

from land preparation to harvesting are being done manually and hence, labour cost becomes the major cost in all the activities.

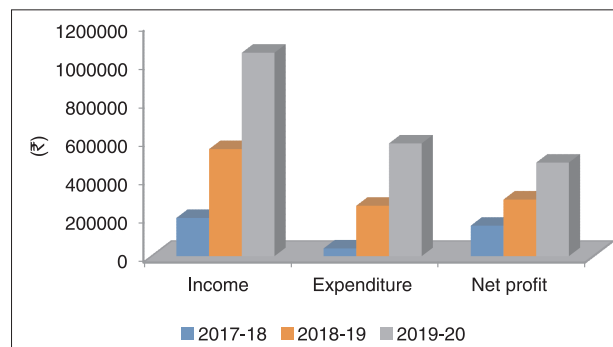
Under FFP, ICAR RC NEH, Umiam developed a Custom Hiring Centre in the village. It helped

Table 9. Income generated from Marngar Custom Hiring Centre

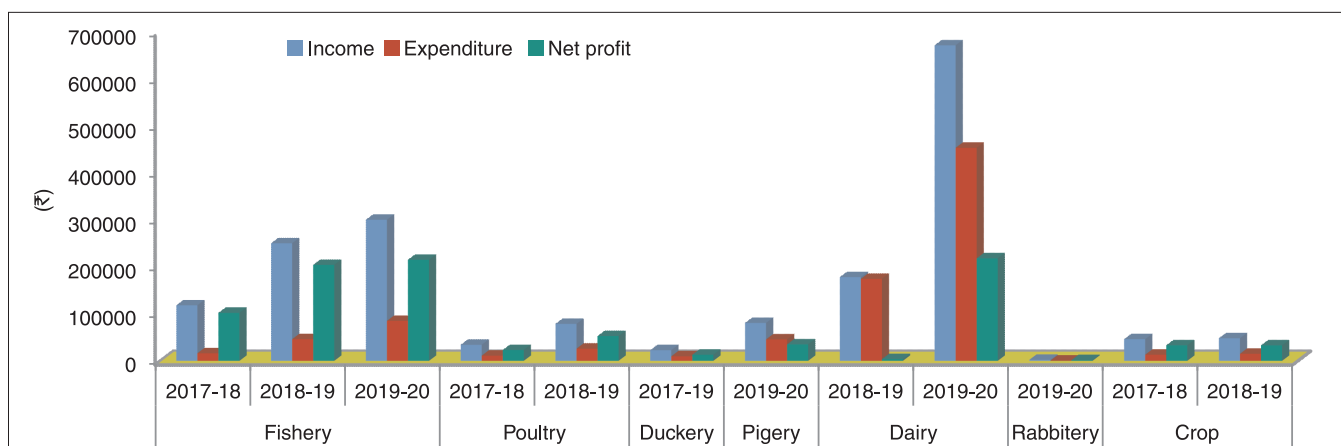
Implement/ machinery	Rate/ hour (₹)	No. of farmers		No. of hours used		Revenue generated (₹)	
		Year		Year		Year	
		2018	2019	2018	2019	2018	2019
Power tiller	270	71	128	61.11	508.43	16,500	137,278
Brush cutter	200	10	30	16.50	22	3,300	4,400
Total		81	158	77.61	530.43	19,800	141,678



Income generated from vegetable cultivation in raised and sunken beds



Year wise Income generated from IFS, Nalapara



Income generated from Integrated Farming System (IFS), Nalapara (2017-20)



Poultry shed constructed

fallow land performed well in the farmer's field.

- Fish farming proved to be highly profitable. More than 40 new large ponds have come up in just 2 years.
- Scientific backyard poultry farming

is the best for small and marginal farmers. Income can be earned within short period of time with minimum input cost.

- Pig breeding clusters made easy availability of improved breeds of

piglets in the village.

- Integrated Farming System (IFS) is the best module for generating income throughout the year.

WAY FORWARD

- Demonstration of nursery fish rearing and seed production units.
- Establishment of small poultry hatchery unit in the village cluster.
- Development and improvement of poultry and pig value chain.
- Entrepreneurship development through postharvest processing of horticultural crops.
- Demonstration on rice transplanter will be a new intervention for the farmers through Custom Hiring Centre.

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Sustainable and fair agri-food system

A sustainable agri-food system is one in which a variety of sufficient, nutritious and safe foods is available at an affordable price to everyone, and nobody is hungry or suffers from malnutrition. The shelves are stocked at the local market or food store, but less food is wasted and the food supply chain is more resilient to shocks such as extreme weather, price spikes or pandemics, all while limiting, rather than worsening, environmental degradation or climate change. Sustainable agri-food systems deliver food security and nutrition for all, without compromising the economic, social and environmental bases, for generations to come. They lead to better production, better nutrition, a better environment and a better life, leaving no one behind.