CLIMATE RESILIENT TECHNOLOGICAL INTERVENTION FOR SUSTAINABLE AGRICULTURE PRODUCTION SYSTEM OF ANDAMAN

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Andaman & Nicobar Islands

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FORWARD

The tropical climatic condition of Andaman & Nicobar Islands is unpredictable and known to cause heavy losses in agricultural production. Adverse weather conditions such as heavy rain fall, prolonged dry spell, delayed monsoon, flood, cyclone, and undulating topography are the major challenges for successful farming. The network project 'National Innovations on Climate Resilient Agriculture' (NICRA) of the Indian Council of Agricultural Research (ICAR) was launched during February 2011 with the to enhance climate resilience agriculture through strategic research and technology demonstration which covers agricultural and horticultural crops, fisheries livestock and natural resource management. The technology demonstration component (TDC) of the project has been implemented by ICAR-CIARI-Krishi Vigyan Kendra, South Andaman under the technical guidance of ICAR-CRIDA, Hyderabad through ICAR-Agricultural Technology Application Research Institute, Zone-V, Kolkata.

It gives me immense pleasure to note the significant achievements made under NICRA –TDC from 2011 to 2020 efficiently implemented by ICAR-CIARI-Krishi Vigyan Kendra, South Andaman. This documentation contains information on successfully demonstrated package on natural resource management(tank cum well system,broad bed and furrow (BBF) system, contour bunding and terracing), crop production (salt tolerant paddy, short duration paddy, drought tolerant paddy, CARI Poi selection as saline and drought resistant variety, CARI AMA-Green and CARI-AMA-Red drought tolerant leafy vegetables etc.), livestock production (backyard poultry and pig farming,fodder production,composite fish culture etc.),institutional intervention and custom hiring centres for farm mechanization . I am sure the document would be very useful to farmers, extension personnel, KVKs, line departments, NGOs working in the field of agricultural development in Andaman and Nicobar Islands.

I extend my sincere appreciation to the dedicated efforts of the entire team of ICAR-CIAR-Krishi Vigyan Kendra, South Andaman, who could make it possible to bring out this publication entitled "**Climate Resilient Technological Intervention for Sustainable Agriculture Production System of Andaman".** I express gratitude to Dr. S. K. Choudhari, DDG (NRM), Dr. A. K. Singh, DDG (Agril. Extn.),Dr. A. K. Singh, DDG (Horticulture Science), Dr. Tilak Raj Sharma, DDG (Crop Science), Dr. Vinod Kumar Singh , Director CRIDA, Dr. S. K. Roy, Director ATARI, Zone –V, Dr. F. H. Rahman Nodal Officer, NICRA, ATARI, Zone-V, Kolkata for their support, encouragement and advice to KVK staff for all project activities carried out.

Dr. B. A. Jerard

Director (Acting)

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The ICAR-Krishi Vigyan Kendra , Port Blair was established on 17th July,1993 under the administrative control of the then ICAR-Central Agricultural Research Institute (CARI) now ICAR- Central Island Agricultural Research Institute (CIARI), Port Blair by ICAR, New Delhi under the ICAR - Agricultural Technology Application Research Institute (ATARI), Zone-V, Kolkata formerly known as Zonal Project Directorate(ZPD) of Zone-II, Kolkata . This National Innovations for Climate Resilient Agriculture -Technology Demonstration Components (NICRA-TDC) project was sanctioned in the year 2011 for the selected two villages viz. Port Mout and Badmash Pahad considered as Cyclone and drought prone area under the Chouldari Gram Panchayat, Ferrargunj block, South Andaman district.

The authors acknowledge the kind gesture ,efforts and contributions made by the ICAR, New Delhi, ICAR-CRIDA, Hyderabad, ICAR-ATARI, Zone –V, Kolkata and ICAR-CIARI, Port Blair for sanctioning NICRA-TDC project which has enabled us to undertake the work for agricultural and allied field development in these villages. The authors also acknowledge the support rendered by Andaman Nicobar Administration and its line departments in the endeavors of the KVK, Sippighat.

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1. Introduction:

The Union Territory of the Andaman and Nicobar Islands consists of an archipelago of 319 islands and another about 253 named and unnamed land formations all spread over a total area of 8293 sq kms. These islands are situated between 6^o 45'-13^o 14'N latitude and 92^o 10'-94^o 15' E longitude in the Bay of Bengal. The capital town, Port Blair in Andaman is nearly 1200 km away from major ports like Kolkata, Chennai and Vishakhapatnam.

It is evident that Andaman and Nicobar Islands (ANI), with their unique geo-ecological settings, sit within a 'thick disaster probability envelope'. The 2004 tsunami is a case in point. Climate change risks and uncertainties exacerbate the 'thicknesses' of this envelope and pose additional environmental and developmental challenges for the Island territory.

The impacts may manifest in a variety of ways in the Islands that may range from escalated exposure to external shocks and extreme weather events, sea level rise and associated issues of coastal erosion, increased 'storm surges' and inundation of low-lying areas, salt water intrusion, diminished fresh water supply, coral bleaching and breaching, deterioration in ecosystem functions, reduced opportunities for ecosystem-based livelihoods, excessive dependence on external resource supply, unpredictable crop yields, uncertainty over the functioning of other sensitive sectors such as tourism and fisheries, increased malnutrition and heat stress, etc.

Once climate change impacts start manifesting, the costs for building defence mechanisms against it will be prohibitively high. For instance, upgrading coastal systems and defences against storms and storm surges would require substantial capital investment and ongoing maintenance. As various models predict, at higher levels of warming and increased rates of sea level rise, the risks will become increasingly serious. Infrastructure damage will rise sharply in a warmer world, because of the combined effects of increasing potency of the storms and the increasing vulnerability of infrastructure and growth engines (most of which are located along the coast) to other climate-related events. This situation would be further worsened by the insularity and isolation of the Islands from mainland, associated high transportation and communication costs, expensive public administration and infrastructure

investments, and limited opportunities to create sustainable and self-reliant economies of scale.

One of the central aspects in developing a pragmatic strategy for addressing climate change in ANI is in translating the national climate change policy imperatives to UT-level activities while keeping in mind the contexts, specificities, needs and aspirations of humans, and natural and geo-physical systems existing in the Island territory.

The history of agriculture in these islands is hardly 150 years old. It started with the penal settlement at Chatham Island in 1858. During the initial period of colonization, British Government cleared some 140 acres of land for cultivation which rose to 724 acres in a few years. In 1870, during the rule of Lord Mayo, many convicts were given freedom of movement and were encouraged to marry convict women with the idea of settling them and expanding a self-sustaining agriculture in these islands. With the increase of convict population, food requirement also increased and there was need for expansion of production of vegetables and other foodstuff. However, the growth and development of the islands got the momentum only after settlers started colonizing other areas of these islands. Later on refugee family from other parts of country as well as from outsides like Sri Lanka and Burma were also settled under repatriation scheme. To promote the cultivation and self-supporting agricultural these settlers were allotted free hold of 2 ha of valley land for cultivation of paddy and other field crops and 2 ha garden / hilly land for making house and also to raise plantation and horticultural crops. After the establishment of Department of Agriculture in 1945, the critical inputs for cultivation were supplied to the settlers without any proper technical know-how. During this time many high yielding inputs responsive varieties of different food crops were developed with simultaneous improvement infrastructure facility in mainland India and green revolution was witnessed in 60's which resulted in a quantum jump in the yields of most of the cereals and other food crops. Later on, with the commencing of Oilseed Mission, a significant improvement was made in the production of Oilseed crops also. A substantial progress has been made in Indian mainland during the last 20 years in the field of Agriculture, Horticulture, Animal Husbandry and Fisheries Out of 8.25 lakh ha of total geographical area, only 50,000 ha are under cultivation of crops and other alike agricultural activities. When the production of coconut has done up to 50-60 nuts / palm / year in the mainland, 15–20 nuts/palm/year are being produced in the least managed coconut groves in these islands. Even after 30 years after the advent of green revolution, the rice fields in these islands or dominated by a tall traditional photosensitive variety producing merely 15–20 q of rice/ ha. Mainland India has made a great stride in these years ranking 2nd

in vegetable production in the world. On the contrary, vegetable is a scare commodity in these islands and the demand in made through the shipment from mainland India. This population of these islands has reached to nearly 5.00 lakh crossing the limits of carrying capacity of the islands. Thus there is an imminent need for increasing production and productivity from land and aquatic systems. Apart from isolation from mainland, many of the islands are also distantly isolated from each other. Thus the gap in the accessibility to information system and knowledge between research organization and the farmers has created a barrier for the development of agriculture in these islands. To alleviate this problem a Krishi Vigyan Kendra has been established in the year 1993 in these islands for effectively transfer the technologies to the farmers in well-organized manner and also to develop technical literacy among the farmers / farm women in these islands. KVK also envisages the holistic development of the villages integrating agricultural and other allied activities in their TOT programmes.

2. About NICRA

National Initiative on Climate Resilient Agriculture (NICRA) is a network project of Indian Council of Agricultural Research (ICAR) aims to enhance resilience of Indian Agriculture to climate change and climate variability through strategic research and technology demonstration.

2.1. Objectives of the project

- To enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climate variability and climate change through development and application of improved production and risk management technologies.
- To demonstrate site specific technology packages on farmers field or adopting to current climate risks.
- To enhance the capacity of scientists and other stakeholders in climate resilient agricultural research and its application.

2.2. Core Principles of the Project

2.2.1. Mainstreaming climate change into development of Andaman & Nicobar Islands

Climate change is an externality that needs to be internalized into the policy and development planning of the Island. The impacts of climate change are likely to occur over a longer time frame and are known to be ‘persistent’ and ‘pervasive’ in nature. Further, the risks and uncertainties associated with it are projected to interact negatively with other development challenges and economic social and ecological vulnerabilities.

This necessitates the development of a climate- response strategy that essentially hinges around a multi-disciplinary approach with ample vertical and horizontal linkages and feedbacks across sectors, systems, and people. Further, actions aimed at responding to climate change should not be viewed in isolation; instead they should become an integral part of regular development planning, action, and execution.

It is important to pursue both mitigation and adaptation measures to combat climate change, considering the overall socio-economic and ecological contexts and vulnerabilities, it would be of high importance to focus on adaptation options including Disaster Risk Reduction in the Islands.

2.2.2. Increased focus on adaptation and building adaptive capacity

Adaptation includes strategies, policies, and measures undertaken now, and in future, to reduce potential adverse impacts of climate change. Adaptive capacity in the context of the Island would mean the ability of Andaman administration, sectoral institutions, agencies, local communities, natural systems, and individuals to prepare for and adjust to potential adverse effects (e.g. increased storm surges and coastal erosion) from climate change and take advantage of opportunities that may arise (e.g. some studies suggest that the coconut productivity may increase with marginal increase in temperature).

The challenge is to be dynamic and flexible – constantly review the design, development, and execution of specific adaptation interventions based on the innate and inculcated coping capacity of communities, institutions, and Island Administration.

The adaptation interventions are to be designed and designated to maximize the number of avoidable adverse climate change risks that are to be embedded within the overall ambit of sustainable development.

Further, adaptation options also need to be anticipatory (actions taken in advance of serious climate change effects) and responsive (e.g. disaster response) and can include affected individuals' spontaneous responses to climate volatility and change as well as planned responses by the administration or other public or private institutions (effective public warning systems for storm surges).

2.2.3. Emphasis on enhancing the understanding of climate change and its potential impacts on the Island.

Climate change is an evolving multi-disciplinary science. There is large volume of literature generated on this subject at global and regional levels. However, information is conspicuously scanty at the local level. There is some information available and research is

being undertaken on climate change and its potential impacts on the Island. However, these, as well as climate monitoring systems, would need to be strengthened for enhancing the information base.

There is particular need for undertaking detailed vulnerability assessments in the Island. This will enable the policy planners, agencies, and communities to take informed decisions related to climate change in the Island.

2.2.4. Climate change response and overall disaster risk-reduction and management.

Climate change will increase the frequency and scale of extreme weather events in the Island, including erratic precipitation, storm surges, and tropical cyclones. The Island is already under critical risk of tsunami-genic waves. Though the cause of tsunami need not always be attributed to climate change, it often works in tandem with climate-related risks and increases the overall vulnerability in the Island with implications for the well-being of human and natural systems. Andaman Islands will require an improved information base to better manage the changing risks and uncertainty.

Andaman witnessed the worst incident of tsunami in 2004, causing unforeseen damages to life and property. Andaman already has basic capacities and systems (though these need to be strengthened significantly) to deal with disasters. Climate change threats and uncertainties need to be integrated deeply into that.

3. Selection of NICRA Village

A preliminary survey was conducted at South Andaman for selection of the village which is affected by flood / heavy rainfall / drought and ingression of seawater in the paddy field. The survey revealed that Port Mout and Badmash Pahad (now Gopal nagar) villages in Chouldari Gram Panchayat , South Andaman under Ferrargunj Tehsil is the most effected village by tsunami (2004) and the low lying area is found flooded for a long time during heavy rain and tidal waters. During the summer season (January to April), there is acute shortage of irrigation / drinking water. Most of the time the fallow land found without any cultivation. In the village good numbers of animals are available and during the summer months there is heavy shortage of green as well as dry fodder for the animals. Tsunami effected farmers of the village have been provided with permanent shelter by the government and their paddy field is permanently effected / submerged with seawater. Till recently govt. was supplying free ration to the tsunami farm affected farm families because their means of livelihood was totally destroyed by tsunami (2004), but now the govt. has stopped providing free ration and the families have been asked to identify their own means of livelihood.

The Islands receive an average annual rainfall of about 3080 mm, of that nearly 95% rainfall is received during May–December (2250 mm in May–September during South west monsoon and 683 mm in October – December during the northeast monsoon) and remaining four months from January–April is almost dry period when numbers of rainy days in each month hardly exceed three (90 mm). Despite the fact that these islands get about 2.5 times the average rainfall of the India yet the inhabitants are hard pressed to get water to their requirement for drinking, household chores, livestock and irrigation. During the dry period agriculture suffers badly due to moisture stress. It could be due to the fact that nearly 75% of the rainfall received in the islands is lost because of its proximity to the sea. As rainwater is the only source of the freshwater availability, its harvesting and management forms the most important strategy for natural resource management in these islands. Therefore, planning, augmenting and efficient utilization of water resources is the need of the hour.

Topographically the islands can be divided into three parts (i) valley which have flat paddy lands (ii) mid hills, where seasonal streams flow and have space in their course for construction of small ponds; and (iii) hill tops.

Keeping all the above adverse conditions in mind, it was decided to select this particular village for implementation of project on climate resilient mitigation. The condition of NICRA village before adoption has been given in Figure 1.

Fig 1. Condition of NICRA Village before adoption

4. LAUNCHING OF NICRA PROJECT

Inaugural function of NICRA, held at Badmash Pahad on 29th March, 2011. On the occasion, Dr. R. C. Srivastava, Director, CARI, Port Blair was the Chief Guest and Shri Safik, Up Pradhan, Chouldari Panchayat was the guest of honour. All together 93 farmers were present in the function. On the occasion, Director, CARI highlighted the importance of this project for the villagers and advised them to take active part in the activities of the project and harness maximum benefit from this project sponsored by the ICAR. Earlier, Dr. Nagesh Ram, the PI of the project welcomed the Chief Guest and the gathering and gave brief information and activities of the project to be carried out in the village. The glimpses of village adoption and inauguration of NICRA have been presented in Figure 2 & 3 respectively.

Fig 2. Village adoption

Fig 3. Inauguration of NICRA

5. PARTICIPATORY RURAL APPRAISAL (PRA) REPORT OF BADMASH PAHAD VILLAGE

5.1. Participatory Rural Appraisal (PRA)

The bench mark survey was carried through the multidisciplinary perspectives of Participatory Rural Appraisal (PRA) modules. It is a group of methods/tools/ ways and the most efficient techniques available to assess the real village situations. They are usually visual and used as a discussion means for the people on the condition of their lives and environment. Each PRA technique can be used to study information with different level of depth and scope. The PRA survey has been depicted in Figure 4.

5.2. Specific objectives of the Bench Mark Survey

- To provide an opportunity to KVK experts to interact with the farming community and gain insight into their livelihood.
- To study socio-economic implications and consequences of technologies, products and processes.
- To generate a detailed account of technology products and processes, used by producers with respect to production scenario, problems, opportunities, and futuristic approaches.
- To inculcate culture of teamwork and multi-disciplinary perspective among KVK experts and farming community.
- To provide comprehensive insight in to the role of private industry and other stakeholders in value chain.

Fig 4. PRA survey was conducted by involving the villagers

5.3. Badmash Pahad village

The village selected for the Bench Mark Survey was Badmash Pahad. The village is under Chouldari panchayat of Ferrargunj Tahsil or Blocks.

Key information

The basic information were collected from the secondary sources i.e. ICAR-CIARI, Agriculture officer, Pradhan of Chouldari panchayat, Revenue officer, State Bank of India, Veterinary doctor, Krishi Vigyan Kendra of ICAR-CIARI. The compiled information was depicted below.

Name of the village	:	Badmash Pahad
Name of the village panchayat	:	Chouldari
Name of the Tahsil	:	Ferrargunj

Name of the District	:	South Andaman
Name of the Union Territory	:	Andaman and Nicobar Island

Demographic pattern

Total Population (2011 Census)	:	728
Male	:	384
Female	:	344
Children (0-6 years)	:	91 (M- 40, F- 51)
Literacy rate	:	543 (74.5%)
		306 (79.6%)
		237 (68.8%)

The literacy rate of the villages is higher compare to the national rural literacy rate which is around 68.9 (78.6% - M, 58.8% - F).

Total Household	:	181
Out of total household		
Tsunami shelters	:	99 (55 shelters occupied)
		Out of 99, 50- Tsunami affected families from creekabad.
		31- Tsunami affected families from chouldari
		18- Tsunami affected families from badmas pahar

Climatological data

Mean annual rainfall	:	3180 mm/year (2005)
Mean annual temperature	:	23.9 C
Relative humidity	:	81.9
Wind speed	:	9.58km/hr

Geographical coordinates

Latitude	: 11 38.784'
Longitude	: 92 39 636
Altitude	: 28 m MSL

The land use classification of Badmash Pahad village has been presented in Table 1.

Table 1. Land use classification of Badmash Pahad village

S.No	Classification of land	Area (ha)	Slope / purpose/ fertility
1	P- I (Paddy class I)	34.46	Lowland, More fertile
2	P-II (Paddy class II)	3. 3	Fertile, lowland
3	Hilly area	21. 4	Agro forestry ,plantation crops, steep slope
4	Non-agricultural hilly land	1.08 0.234	House sites, steep slopes Commercial purpose
5	Land for canal	0.53	Nallah
6	Land for road, play ground	4 42	Road, play ground
7	Revenue land (government)	33.750	
	Total land for village	**99.17**	

Coconut – 10 ha

Crop husbandry

Wet season : Paddy

Dry season : Vegetable crops like okra, brinjal, pumpkin, amaranthus and bottle gourd

All round cultivation : Plantation crops like coconut and arecanut

Communities

Hindu - 703

Bengalis - 75%

Tamil - 15%

Others - 10%

Christians - 25

Water source

Open Wells : 9

Bore Wells : none

Farm ponds : 16 (11 – Government & 5 – Loan)

Others

Vermi compost unit : 1

No of SHGs : 4

Rate of daily wage labourer: 250/ day (Private)

Rate of daily wage labourer: 196/ day (Government)

There are four self-help groups according to the report of the State Bank of India officials of Chouldhari. According to them the repaying capacity of the people in Chouldari is considerably good. Presently these self-help groups has taken loan from the SBI an amount of Rs.25,000.00 for the activities like dairy, goatery, running petty shops etc. The rates of the labourers are high compare to the main land. Because of the high wage rate the farmers are facing difficulty in paying high wages to the agriculture labourers.

Besides agriculture, animal husbandry activities are also carried out by the villagers. The available animal husbandry resource of Badmash Pahad village has been shown in Table 2.

Table 2. Animal husbandry resources of Badmash Pahad village

Sl. No	Animal	Breed	No	Purpose
1	Cattle	Non-descript Cross bred Jersey & HF	1 (M) 20 (F) 7 (M) 18 (F)	Milk
		Total	**46**	
2	Buffalo	Graded murrah	1 (M) 1 (F)	Milk
		Total	**2**	
3	Goat	Black bengal	22 (M) 69 (F)	Meat
		Total	**91**	
4	Pig	Large White Yorkshire	**8**	Meat
5	Poultry & ducks	Desi	600	Meat

5.4. Transect walk

Transect walk is one of the PRA tool to assess the general view of the village. The main objective of the transect walk is to know in terms of topography, land use pattern, soil type, crops grown, animal husbandry practices, their problems and opportunities of the particular village. The walk was carried out through the village from one end to other end of the village with the help of the key informants of the village. This would help the PRA team members to identify the scenario of the village in general and the agriculture in particular.

In the Badmash Pahad village the transect walk was carried out with the help of key informant Shri Kasinath Saha and Smti Kumudhini Guha. They helped the PRA team to know the scenario of the village by pointing the area clearly the hilly lands, lowlands, sea bunds etc and different aspects in the village. During this transect walk the PRA team observed not only the agriculture scenario of the village but also the different aspects of the scenario of the village.

With regard to the agricultural scenario of the village the land area is divided into hilly land and low land. The hilly area is having the steeper slope with lowland having minimum slope. The hilly land is of sandy clay soil and the lowland is of clay loam. The farmers depend their water source mainly through rainfed farming where the average rainfall is around 3000 mm. So because of this heavy rainfall and soil erosion the lowland is fertile compare to the hilly land. The crops grown in the lowland are paddy and vegetables.

The hilly area is occupied by two major plantation crops. They are coconut and arecanut. The coconut varieties are king coconut and the Andaman tall. The arecanut varieties are of local. The villages are rich in biodiversity. The other trees the PRA team could observe are mango, papaya, jackfruit, pineapple, sapota, pipal, neem and the green fodder crops.

With regard to the livestocks, the cattle population is less. The goat population was considerable in number. The backyard poultry was present invariably in majority of the households. These poultry mainly used for the household consumption. The lady who is working in the Anganwadi centre and has goat told that the goat population was more compare to now because the human population is increased hence goat going to the residential area will create problem so to avoid that the goat is comparably reduced. And also she was doing piggery earlier but sold all the piglets and looking for the piglets which is in demand.

This agriculture is mainly dependent on the rainfall. The farmers are having farm ponds to conserve the water and utilise for growing fishes, prawns. There are also other sources of water from wells. But there are no bore wells. The perception of the villagers of not having the bore wells is that after certain depth the water will be very salty.

With respect to the social aspect, this village is generally occupied by the Hindus and less Christians. Among the Hindus, the village are mostly occupied by the Bengali speaking, followed by Tamil speaking population. The PRA team members observed the presence of Christian settlements in one area and as per the perception of the villagers the Christians and Hindus live in social harmony with other members of the community. Even one asylum for mentally challenged is located there. There are fisherman community who earn the livelihood

through marine fishing. They are sparsely distributed throughout the village. After tsunami the shelter homes were built in the village where the people from different village under Chouldari panchayat are placed here. This shelter home is located in the hilly area. The details of the land topography, soil type and major crops of Badmash Pahad village have been presented in Table 3.

Table 3. Land topography, soil type and major crops of Badmash Pahad village

Particulars	Hilly land	Low land	Lowland/ Submerged
Topography	Hilly with steep slope	Low land with less slope	Below MSL
Soil type	Sandy clay	Clay loam	Nil
Major crops	Coconut, Arecanut	Paddy, brinjal, bhendi, bitter gourd, bottle gourd etc.	Nil
Minor crops	Vegetables, Mango, banana, papaya, sapota , etc.	Coccinia	Nil
Fishery/ Livestock / poultry	Poultry, goat, duck , pig and cattle	Fishery	Nil
Water resources	Open well	Farm ponds	Nil
Pests	Rhinoceros beetle, Biting midges in cattle and gastro intestinal parasites, Stephanofilariosis (Hump sore)	Brinjal fruit borer, bhendi boll worm, hoppers in bhendi, Gundhi bug	Nil
Diseases	Leptospirosis, swine fever, Ranikhet disease	Brinjal collar rot, BLB in rice	Nil
Problems	Reduction in Arecanut & coconut productivity after tsunami	Pests and disease problem in paddy, vegetable crops	Paddy cannot be cultivated
Opportunities	goat because of the location specific features (fodder trees)	Popularization of high yielding varieties in paddy crops	Brackish water aquaculture

During the transect walk we the PRA team members not only observed but interacted with the different communities in the village. Here the interview with one fisherman cum allied activity of goat and backyard poultry depicts the following picture. The livelihood of the person whose allied activity is goat and backyard poultry are depicted below. The name of the person is Shri Mangal guha. His age is 70.The family size is 8. He has one son and five daughters. He is in Andaman since the age of ten. Now all the daughters are married and presently he lives with his son. Earlier the main occupation is fishing in the marine water. He had the license to do in marine fishing from the fishery department. He had one boat to catch fish. In a month of 4 to 5 days he goes to sea to catch fish which was the main livelihood at that time. On an average the fisherman used to get around 1-2 kg of fish every time he goes in to the sea. The price per kg fish is around rs.500. So he gets a monthly income of 2000- 2500 per month. Before two or three years back of tsunami he left the fishing because of ageing.

In the general transect, along the slope the farmers are growing the plantation crops at the higher elevation, below that the vegetables like gourds are grown to prevent the soil erosion. Next to that, the vegetables like okra, brinjal are grown. Below are the fish pond and the paddy field in the lower elevation. The farmers are not growing the crops across the slopes. The government is also giving the subsidy to the farmers to encourage growing across the slopes.

5.5. Agro ecology map

This PRA tool helps to assess the systems, subsystems and components with respect to the ecology of the village. The meteorological parameter like rainfall, humidity and temperature are depicted and also helps to know the agroforestry of the village and other aspects with respect to agriculture.

This village is surrounded by sea bund, hilly land and lowland. Near the sea bund are the area planted by the mangroves. But some area near the sea bund is not occupied by the mangroves. The government has made projects to cover the sea bund area with the mangroves. The area is completely under rainfed system. The water source is from wells and the farm ponds harvested during rainy season. The advantage in this place is that the water holding capacity of the soil is high in the lowlands and helps to store for a long period. With respect to fauna, the rodents, squirrels are the menace for the coconut growers. There are no forest areas for this village.

5.6. Social Map

Key informants: Mr. Sujit Joydhar, Mrs. Anima Biswas, Mr. Shyamal Mandol, Mr. Gopal Mandol

The social map gives the information to understand and analyze the social structure, stratification, social institutions and availability of social facilities in the context of existing socio-economic condition of the village. According to key informants Badmash Pahad has population of 728 living in 181 households. Out of these 181 households, 99 are Tsunami shelter house, made by Government of India in 2005 after the severe damage by tsunami in 2004. The 99 tsunami shelter houses are distributed among the affected villagers of nearby villages of Chouldari panchayat. The distribution pattern is 50 houses for Craikabad, 31 houses for Chouldari and 18 houses for Badmash Pahad villagers. But only 55 shelter houses are occupied and owners of 46 houses reside in their old houses near to the field/ sea shore. The village population is constituted by 384 male and 344 female. The number of children of below six year age is 91, out of them 40 are male and 51 are female. The total area of the village is 99 hectares. Andaman and Nicobar islands are quite different from main land because during settlements in 1949 by government of India, each settler was allotted 2.5 hectares of low land and 2.5 hectares of hilly land. Thus main occupation of the village was agriculture and livestock. But due to low population, vacancies in government and private service sectors have influenced the scenario. The relief support by government of India, after tsunami of 2004, from 2005 to 2009, significantly influenced the behaviour of tsunami shelter people towards agriculture. Presently, people are involved in services (government or private), agriculture and allied activities and self-help group activities. Some of the notable social features are given below.

5.6.1. Social structure and stratification

In the village 96.6% population belong to Hindu religion with 3.4% Christian religion. Among the Hindus, Bengalis are predominating, followed by the Tamils. All the caste people are living together in the village. Even though there is no caste problem between the castes, the tsunami shelter house people are living in one specific side of village, as the shelter houses were build by government.

5.6.2. Housing pattern

Many houses are brick and tin houses. Many of them are wooden but very few are kaccha houses. At one side of the village, in the up hills, there are 99 wooden new tsunami shelter houses made by government of india. Most of the families are middle class and poor

class, with few rich classes. Joint families dominate in the village and only few families are living as nuclear family.

5.6.3. Government institutions

Badmaspahar has anganwadi, one primary school, one newly constructed primary health centre (on opened) and one veterinary health centre.

5.6.4. Local institution

There is one temple of Lord Krishna in the village and are very famous and festivals of this temple are celebrated in grand manner with all the surrounding villages including all the castes. There is one village committee hall and one khoar (keeping animal for justice).

5.6.5. Educational institution

One primary school (Bengali medium) and anganwadi are functioning to take care of the education of the children. All the parents in the village prefer education to their children. Each and every year the literacy percentage of the village is increasing and at present is around 74.5%. But after 10+2 education, the percentage of girl's education is higher than boy's education. Because of increasing tourism industry in Andaman & Nicobar Islands, the boys often prefer learning car driving and other small courses of tourism for quick income generation. Though there is less choice of collage as compared to main land, there is one general collage and one poly technique collage in Port Blair. There is no collage for studying medical or engineering sciences in Andaman & Nicobar Islands. For higher studies the villagers have to send their children to main land.

5.6.6. Other institutions

Four registered Self Help Groups for women are functioning in the village.

5.6.7. Social awareness

The villagers are aware of polio vaccination, child education and AIDS.

5.6.8. Social evils

Arecanuts with calcium carbonate, with or without vine leaf is a very common addiction not only in males but also in females. Alcoholism is also there as a social evil in the village. Dowry during marriage is common and it does not create any problem in the village. Under age marriage of girl is not very common. There is no child labour in Badmash Pahad village.

5.7. RESOURCE MAP

Key informants: Mr. Golok Sarkar, Mr. Sanjoy Sarkar, Mr. Biswanath Mandol.

The village resource map shows the different kind of natural and man-made resources such as land, vegetation, common land use, soil, livestock, transport and source of communication. Badmash Pahad does not have good transport facility. All the villagers depend on two wheelers and auto rickshaws because government public transport facility (bus) frequency is less, irregular and also for hilly topography. Public bus facility is there for children studying outside Badmash Pahad. The village has communication facilities like television, mobile phones, coin booth and radio. Tractor, power tiller, sprayers, country plough, and water pumps are used by farmers in the village. The drip irrigation system and mechanical paddy transplanter is recently introduced by CARI, which in under trial in farmers field. Paddy milling facility is not available in the village. There is one panchayat tractor available on rental basis, but costly @ Rs. 350 per hour. The villagers get advice from KVK, CIARI, AO and veterinary office. The fishermen, labourers and sometimes farmers during their off season of work/ activity engage in the MGNAREGA scheme introduced in 2005. Due to presence of alternative livelihood for labour class, severe labour shortage problem is presently faced by farmers of the village. All the farmers preferred artificial insemination of the livestock, and get it done at veterinary health care centre located in the village. The villagers get goat breeds form State Veterinary Department, piglets and chicken breeds from CARI and KVK. During the general transect through the village, the different resources found were given in Table 4. The Schematic diagram of resource map of Badmash Pahad village has been depicted in Figure 5.

Table: 4. Resources of Badmash Pahad village

Particulars	Articles
Transport facilities	Auto rickshaw, Motorcycle, Bicycle and Bus
Common/ personal facility	Community hall, Water tank, Open well, Farm pond, Threshing yard, Hand pump.
Communication facilities	Television, Radio, Mobile phones and Coin booth
Health and welfare societies information	Primary health care centre (newly established, not yet open), Veterinary health care centre
Agriculture implements	Tractor, Power tiller, Country plough, Power tiller, Mechanical rice transplanter (on trial), Drip irrigation

	system (on trial), Water pump and Power knapsack sprayer
Animals use for agriculture	Bullocks , Cow, Goat and Pig
Advisory facilities information	Veterinary doctor.
Animal Reproduction	Artificial insemination

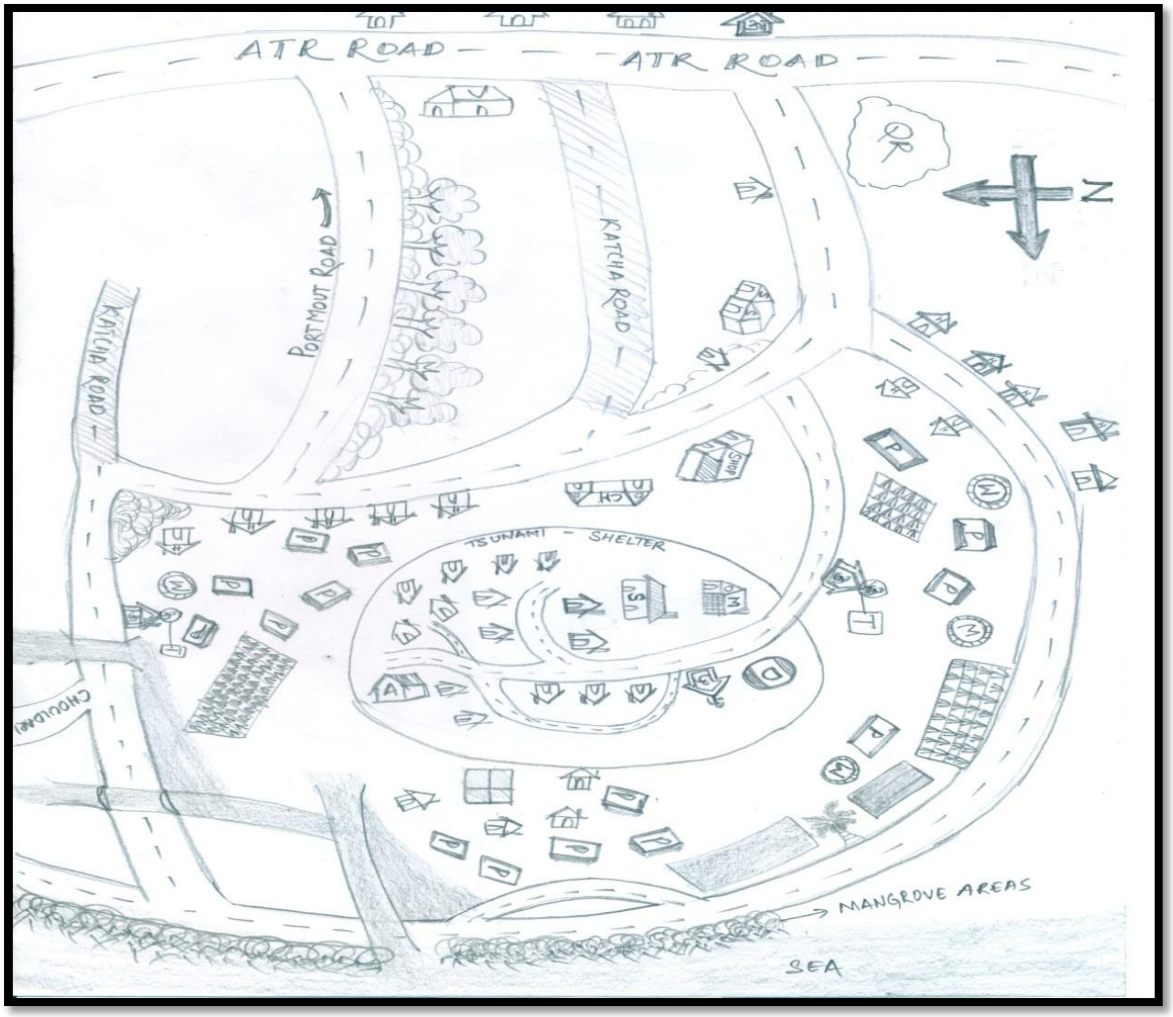


Fig 5. Schematic diagram of resource map of Badmash Pahad village

5.8. Seasonal Calendar

Key informants: Ms. Rita Saha, Mr. Sanjay Saha and Mr. Abhilash

This is a very important PRA technique to know about the seasonal activities. Seasonal analysis is also called as seasonal calendar. This is a calendar, which indicates month wise activities, specialities, threats, problems, abundance, and shortage with regard to agriculture in a diagrammatic way. The items to be included in seasonal analysis must be of those items, which really affect the agriculture and allied sectors. This explores seasonal

constraints and opportunities by diagramming changes, month by month throughout the year. This also helps in finding the spare time which could be utilized for other remunerative activities. Moreover, it helps to identify the months of greatest difficulty, when and which activity and vulnerability which have an impact on people's livelihood.

The main activities, problems and opportunities of Badmaspahar village were identified by using seasonal calendar. It depicts time-to-time crop related operations being carried out in the existing farm situation. The common crop seasons in the village are monsoon and post-monsoon season with rice as the main crop. The farmers are cultivating paddy once in a year during monsoon season which starts from April up to October. Rest of the year, farmers are mostly concentrating on vegetable cultivation. Plantation crop (arecanut and coconut) cultivation is done throughout the year.

Seasonal analysis helps in identifying the period which are critical with respect to season, labour demand, pest and disease problems and availability of fodder. The important problems include disease and pest in rice as well as vegetables, rodent menace in coconut and fodder unavailability. Gundhi bug infestation and Bacterial Leaf Blight (BLB) are of common occurrence in rice while fruit and shoot borer is common in sem and brinjal. Farmers are not interested in using many of the improved crop varieties introduced by the KVK.

All the way through the year, males are involved mostly in agricultural works viz. land preparation, transplanting, spraying and harvesting while females give company in transplanting and weeding operations. The puddling of paddy fields was done using cage-wheel (Figure 6.) Here no remunerable activities like selling of milk and poultry products as livestock rearing is only meant for household purpose. The seasonal calendar for agricultural practices, major crops and their problems and livestock practices in Badmash Pahad village has been presented in Table 5, 6 & 7 respectively.

Table 5. Seasonal calendar for agricultural practices in Badmash Pahad village

Crop	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Paddy	Transplanting	Weeding	Harvesting							Nursery		
			Spraying							Land preparation		

<table>
<tr><td>Coco-nut</td><td colspan="6">Plucking the nuts, Collection in heaps & Extraction of nuts</td></tr>
<tr><td>Areca-nut</td><td></td><td colspan="2">Plucking the nuts, Collection</td><td colspan="3">Extraction and Storage</td></tr>
<tr><td>Brinjal, Lobia, Okra</td><td></td><td>Field Prepn.</td><td>Sowing & Weeding</td><td>Harvesting</td><td>Market-ing</td><td></td></tr>
<tr><td>Sem</td><td colspan="3">Fruiting, Harvesting & Marketing of fruits</td><td colspan="2"></td><td>Land prepn.</td></tr>
<tr><td>Bottle Gourd</td><td></td><td>Field Prepn</td><td>Sowing</td><td>Fruiting & Harvesting</td><td>Market-ing</td><td></td></tr>
<tr><td>Amara-nthus</td><td colspan="2"></td><td>Sowing & Harvesting</td><td colspan="3"></td></tr>
</table>

Fig 6. Puddling of paddy fields using cage-wheel in the village

Table 6. Seasonal calendar of major crops and their problems in Badmash Pahad village

Crop	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Paddy			Gundhi bug infestation									
		Bacterial Leaf Blight										
Sem			Fruit & Shoot Borer									
Brinjal						Fruit & Shoot Borer					Damping-off	

Table 7. Seasonal calendar of livestock practices in Badmash Pahad village

Animal	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Cow	Breeding (A.I.)											
	Calving Season							Calving Season				
Buffalo	Breeding season (NS, A.I.)								Summer Anestrus	Breeding season		
	Calving season					Non-Calving season		Calving season				
Cattle Buffalo								Pre-monsoon Vaccination (FMD, HS)				
Cow Buffalo		Deworming				Deworming				Deworming		
Poultry	De-worming			De-worming				Deworming			De-worming	

In livestock sector, major problem found was low milk yield. Majority of the farmers are ignorant about the significance of balanced feeding, use of green and leguminous fodder. Livestock diseases are comparatively rare because of the inherent genetic make-up as well as regular disease control programmes in the village. Major problems in large animals include parasitic infections and biting midge infestation (Figure 7). The seasonal calendar for livestock health problems has been shown in Table 8.

Table 8. Seasonal calendar for livestock health problems in Badmash Pahad village

<table>
<tr><th>Species</th><th>Jul</th><th>Aug</th><th>Sept</th><th>Oct</th><th>Nov</th><th>Dec</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th></tr>
<tr><td rowspan="2">Crossbred Cattle</td><td colspan="6">Biting Midge infestation & Humpsore (Stephanofilariosis)</td><td colspan="4"></td><td colspan="2">Biting Midge infestation</td></tr>
<tr><td colspan="12">Repeat Breeding</td></tr>
<tr><td rowspan="2">Large Ruminants</td><td colspan="12">Leptospirosis</td></tr>
<tr><td colspan="8">Fasciolosis, Amphistomosis & other round worm infections</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Buffalo</td><td colspan="8"></td><td colspan="2">Summer Anoestrus</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Poultry</td><td colspan="7">Salmonellosis & Coccidiosis</td><td colspan="5"></td></tr>
<tr><td colspan="12">New Castle Disease & Eye worm Infestation (Oxyspora mansoni)</td></tr>
</table>

Fig7. Biting midges infestation and subsequent development of wound lesions in crossbred cattle

5.9. Gender disaggregated activities

Key informants: Ms Uma Saha and Mr. Abhilash

Men are mainly involved in field activities mainly land preparation, spraying and harvesting (Figure 8). Additionally, they also take the livestock for grazing, vaccinations, artificial insemination and as well as selling of milk. Women in the said village concentrated mainly on various activities including sowing, harvesting, livestock management (feeding of livestock and milking) and home management. The gender disaggregated seasonal calendars (Agricultural practices and livestock practices) have been presented in Table 9 & 10 respectively.

Table 9. Gender disaggregated Seasonal Calendar (Agricultural practices)

<table>
<tr><th>Crop</th><th>July</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th></tr>
<tr><td rowspan="3">Paddy</td><td rowspan="3">Transp lanting (M, F)</td><td colspan="2">Weeding (F,M)</td><td colspan="2">Harvest-ing (M,F)</td><td colspan="5" rowspan="3"></td><td colspan="2" rowspan="2">Nursery (F)</td><td rowspan="2"></td></tr>
<tr><td colspan="3">Spraying (M)</td><td></td></tr>
<tr><td colspan="10">Land preparation (M)</td></tr>
<tr><td>Coco-nut</td><td colspan="12">Plucking the nuts (M), Collection in heaps (M,F) & Extraction of nuts (M)</td></tr>
<tr><td>Areca-nut</td><td colspan="3"></td><td colspan="3">Plucking nuts (M) Collection (M,F)</td><td colspan="6">Extraction and Storage (M,F)</td></tr>
<tr><td>Brinjal, Lobia, Okra</td><td colspan="3"></td><td>Field Prepn (M)</td><td colspan="2">Sowing (M,F) Weeding (F,M)</td><td>Harve sting (F, M)</td><td>Mark eting (M)</td><td colspan="3"></td></tr>
<tr><td>Sem</td><td colspan="7">Fruiting, Harvesting (F,M) & Marketing of fruits (M)</td><td colspan="4"></td><td>Land preparation (M)</td></tr>
</table>

Bottle Gourd		Field Prepn (M)	Sow-ing (F,M)	Fruiting Harvest-ing(F,M)	Mark eting (M)	
Amara-nthus			Sowing & Harvesting (F)	Mark eting (M)		

Fig 8. A farmer involved in agricultural field activities

Table 10. Gender disaggregated seasonal calendar for livestock practices

	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
Milking	Men/Women											
Grazing	Men											
Disease management	Men/Women											
Cleaning	Men/Women											

5.10. TIME LINE

Key informants: Mr. Ravi Kumar and Mr. Kashinath Saha

Time line is a tool of PRA technique used to know the history of major remembered events in community and their significance. It indicates the causal link between past and present major events occurred in a village in a chronological way with regard to a specific

phenomenon like agriculture development, animal husbandry, transport, means of communication, social aspects, entertainment and panchayat raj etc. The purpose of this tool is to obtain historical account of changes in demography, socio-economic condition, communication, social relationship and interaction, technology diffusion and adoption etc.

Timeline is often a good starting point of further PRA activities and exercises. Information regarding the important events like the development in agriculture, animal husbandry are collected from the key informants, preferably elderly people of the village and presented in Table 11. From the time line of Badmash Pahad village, it is evident that the village had adopted some of the modern technologies related to mechanization of agriculture. Use of tractor started in mid 1980's. The village has started applying chemical fertilizer only before ten years, even though adoption of pesticides started in early 90's. Artificial Insemination (A.I.) is a widely accepted and successful reproductive biotechnology which was introduced around two decades back in the village. Village faced the disastrous Tsunami in the year 2004 which had a drastic downbeat impact on livelihood as well as agriculture sector. Later years showed a massive entry of various government and NGO initiatives in the form of relief activities. Various advanced equipments like power tiller and sprayer were introduced in the year 2007.

Table 11. Time line of major events in Badmash Pahad village

SI. No.	Year	Events
1	1942	Free 42 (Jail Release)
2	1949	Settlement
3	1951	No: 8 Rice variety
4	1975	Road
5	1978	Electricity
6	1979	Dwarf Rice Varieties (Jaya,Pusa, Swarna)
7	1980	Radio
8	1983	Veterinary Hospital, Post Office
9	1985	Tractor
10	1986	Artificial Insemination
11	1987	Drainage system
12	1991	Use of pesticides
13	1992	Rural Development Phone
14	1994	KVK
15	1995	Water Tank
16	1996	Gas Cylinder
17	1997	Anganwadi, "10 years" (own settlement)

18	2000	Use of fertilizers
19	2004	Tsunami
20	2005	Self Help Groups
21	2006	Mobile phone
22	2007	Power Tiller, sprayer
23	2011	Primary School

5.10.1. Time trend

Key informants: Mr. Bishwanath Mondal, Mr. K N Saha and Mr. Sujith Sarkar

Time trend is a simple PRA technique, usually depicted in the form of graph (bar/line) to show the trend of crop/animal production, commodity prices, human/cattle population etc. The specific objectives of this tool are to identify the changes/fluctuations that have occurred over a period of time in the variables influencing village life. For the purpose of the present PRA study, the data were collected for rice, coconut and arecanut productivity over the last few years and are presented graphically below.

5.10.2. Time trend for paddy productivity

The trend analysis of paddy shows almost a stable trend from 2004 to 2009 except a noticeable decline in productivity in the year 2005 (Figure 9). This sharp decline in productivity was due to devastating Tsunami in the village in 2004 which resulted in the submergence of many of the paddy fields and resultant depletion of soil quality.

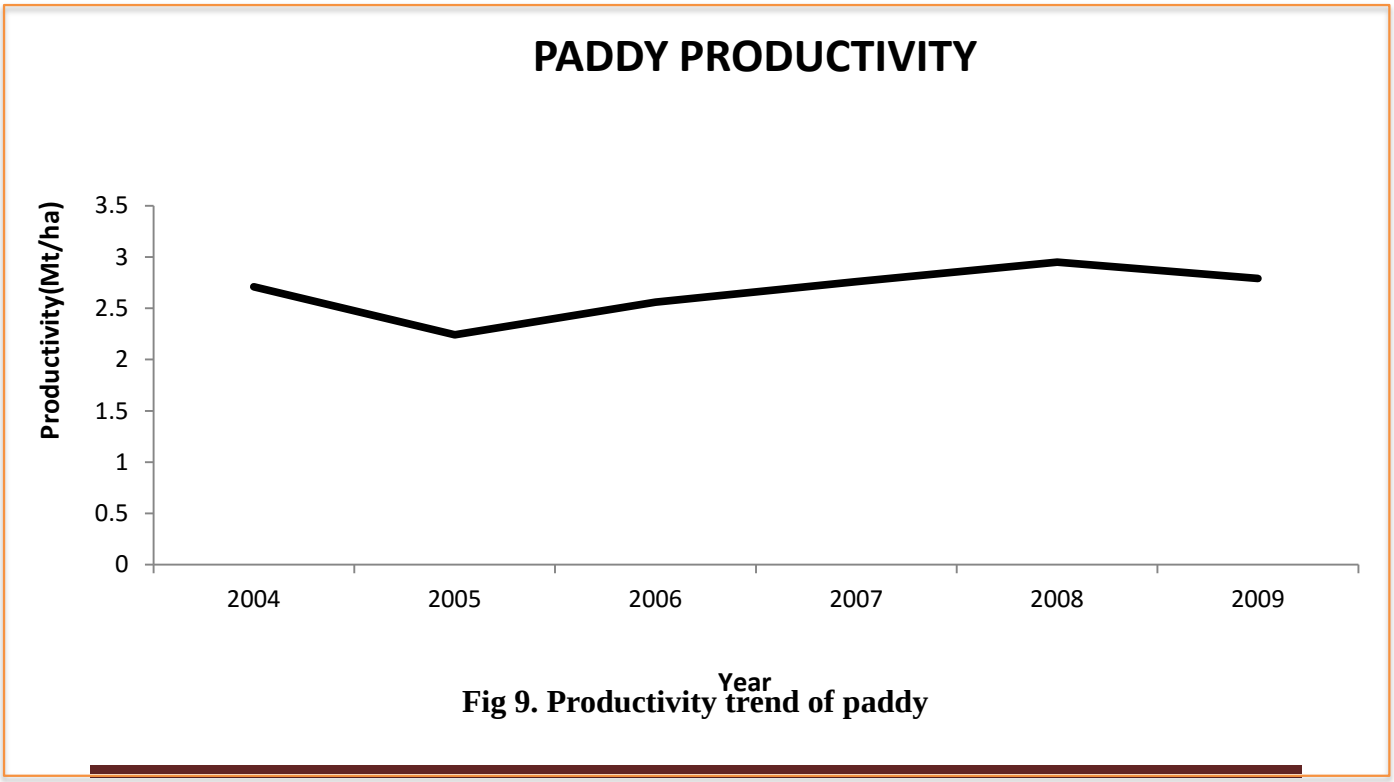


Fig 9. Productivity trend of paddy

5.10.3. Time trend for coconut productivity

The trend analysis of coconut showed more or less a stagnant pattern with insignificant fluctuations from 2004 till 2009. A noteworthy finding is that a comparatively higher productivity was evident following Tsunami in the year 2005-06. Subsequent years showed a slightly lower but steady trend in productivity (Figure 10).

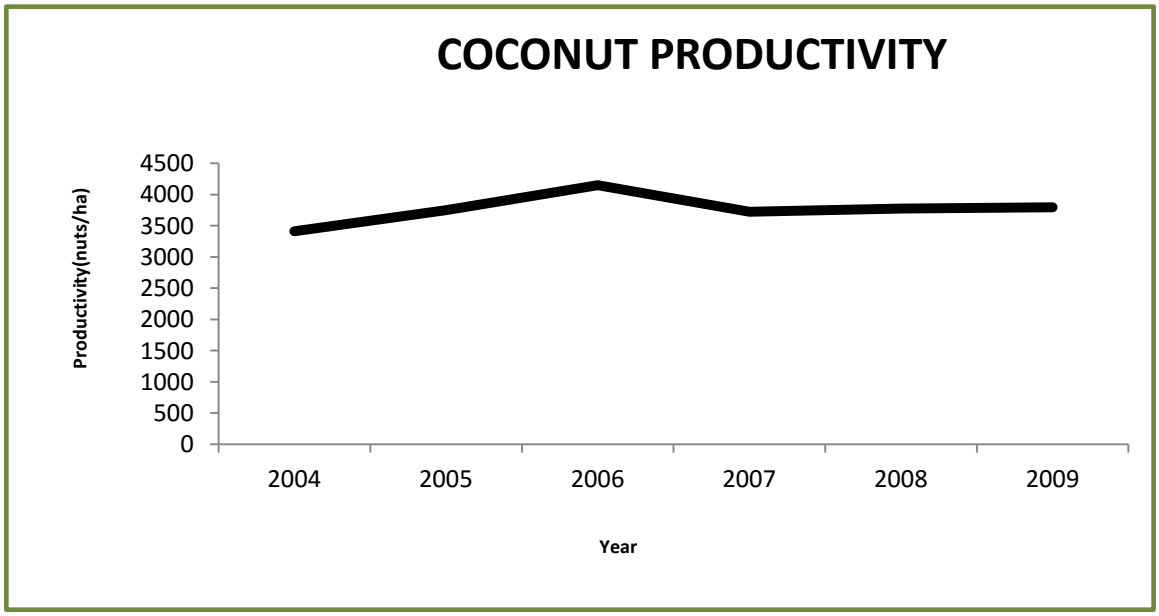


Fig 10. Productivity trend of coconut

5.10.4. Time trend for arecanut productivity

Arecanut productivity declined abruptly following Tsunami from a higher value of 1.08 M nuts per hectare to 0.76 M nuts per hectare. But interestingly, after 2005 various interventions from CARI as well as KVK helped to gain significant productivity level of 1.40 M nuts per hectare. This enhanced productivity was evident till 2009 (Figure 11).

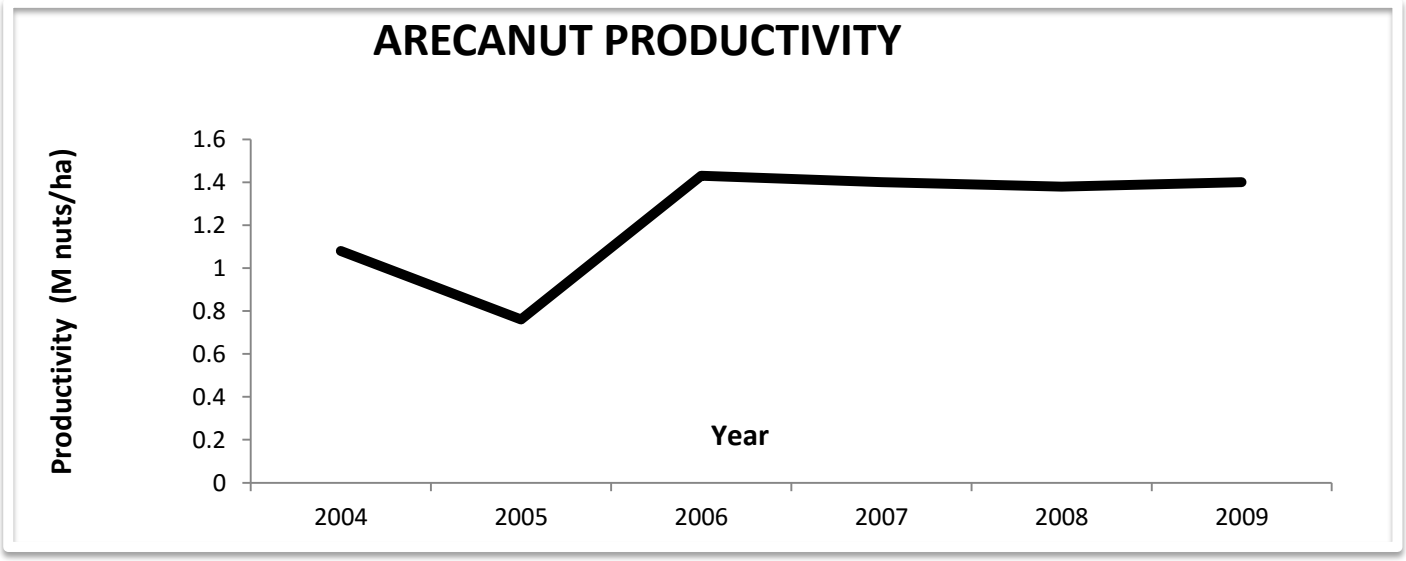


Fig 11. Productivity trend of arecanut

5.11. Technology map

Key informants: Mr. Biswajit Mandol, Mr. Shyamol Mondal and Mr. Surajit Sarkar.

Technology map is a PRA technique, which is used to know different types of behavioural patterns towards technology adoption. Different types of technology behaviour may be of adoption type, discontinuance, rejection and over adoption type etc. Technology map comprise type and frequency of adoption of latest technology through various agencies, related to agricultural research and development. It helps scientist and extension workers to identify the problem of the farmers through the feedback mechanisms.

5.11.1. Technology Diffusion Methods

Technologies developed by various organizations are diffused to farmers' fields through the simplest methods, and as far as possible in the farmer's language. The following diffusion methods in general are adopted for diffusion of any technology

- ✓ Training camps
- ✓ Field demonstrations
- ✓ Farmers meeting
- ✓ Kisan mela
- ✓ On-farm training
- ✓ Distribution of bulletin and leaflets
- ✓ Radio
- ✓ Television
- ✓ Mobile phone
- ✓ Kissan call centre

The different technologies which were adopted, discontinued and rejected were depicted in Table 12 (a, b & c). The farmers of Badmash Pahad village have adopted different varieties of rice, coconut and vegetables. In rice they have adopted Jaya and swarana due to its short duration and resistance to pest and diseases irrespective of other varieties with high productivity. Whereas coconut *viz.,* Andaman tall have excellent nut yield and good market price. Inland fish industry is most popularised because of the assured regular income and protein for household. They have adopted cross bred Jersey cows and HF cross bred cows because of their high milk yield compared to desi cows. Presently they were adapting form machineries and implements because of shortage for labours.

Table 12. The various technologies adopted/rejected/discontinued in Badmas Pahad village

Table 12 a. Technology table for crops

Crops	variety	Status	Technology diffusion	Reasons
Arecanut	Local	Adopted		Suitable for local climate, less pest and disease incidence
Bhindi	Lalteer	Adopted	Private	High yield, less spiny, resistance to yellow vein mosaic virus
Brinjal	Muktakeshi	Adopted	CARI	Attractive colour, high yield, market demand
Chilli	Bullet	Adopted	State department	High yield
	Puja jowla	Adopted	State department	More pungency and high yield
Cow pea		Adopted		Market demand, suitable to trellis system of cultivation
Coccinia		Adopted		High yield, suitable to trail system of cultivation and relay cropping and less disease compare to other vegetable crops
Pumpkin & Bottle guard		adopted		Suitable for slope cultivation, high market demand and resistant to erosion

Table 12 b. Technology table for agricultural practices

Technology	Status	Technology diffusion	Reasons
Multi story cropping	Adopted	Indigenous	Utilize the natural recourses effectively, better land use pattern, assured income

Relay cropping	Adopted	Leased farmer from West Bengal	Reduce the cropping duration and soil erosion, avoid water scarcity in summer
Bund/Border cropping of coconut, banana, sugar cane, pine apple	Adopted	KVK/Agri. Dept	Reduce transpiration of water during summer, prevent silting of ponds, family consumption
Broad bed furrow method	Adopted	CARI	Effective utilization of sloppy land, soil and moisture conservation, bed suitable to vegetables and furrow suitable to fish culture
Technology	Status	Diffusion	Reasons
Paddy cum fish culture	Not adopted		Unaware of technology
SRI cultivation in rice	Trial	CARI	High yield, less amount of water and seed rate is less
Dapog nursery	Trial	CARI	Less seed requirement, less days for nursery, easy to carry seedling bed
Rice transplanter	trial	CARI	No labour requirement, timely operation
Composting	Adopted	Agri. Dept	Quick and well decomposed manure, effective use of agri-waste
Vermi Composting	Discontinued	Agri. Dept	Time taking and tedious
Polyhouse	Not adopted		Lack of awareness

Table 12 c. Technology table for agricultural implements

Technology	Status	Reasons
Country plough	Adopted	Tree availability and suitable for bullock
Tractor	Adopted	less time consuming, no labour problem, available in panchayat on rental basis

Power tiller	Adopted	Suitable to fragmented hilly land and coconut garden, less soil compactness
Paddy harvester	Not adopted	Unawareness and hilly area
Power sprayer	Adopted	Spray for paddy and vegetables, timely operation
Drip irrigation	Adopted	Vegetable crops during dry season to reduce water requirement

5.12. Matrix Ranking

The Matrix ranking of rice varieties, inland fish production, vegetables production and banana varieties have been presented in Table 13 (a, b, c & d respectively).

Table 13. Matrix Ranking

Table 13 a. Matrix table for rice varieties

Indicators	KI	C-14-8	Jaya	Swarna	Pusa
Duration	k1	2	1	4	2
	k2	1	3	4	2
	k3	2	3	4	1
Score		5	7	12	5
Resistant to pest and disease	k1	3	4	1	2
	k2	3	4	1	2
	k3	2	4	1	3
Score		8	12	3	7
Less fertilizer requirement	k1	3	2	1	4
	k2	1	4	2	3
	k3	2	4	1	3
Score		6	10	4	10

Lodging tolerance	k1	3	4	1	2
	k2	2	4	1	3
	k3	4	3	2	1
Score		9	11	4	6
Yield	k1	3	1	4	2
	k2	3	2	4	1
	k3	3	1	4	2
Score		9	4	12	5
Total score		37	44	35	33
Rank		B	A	C	D

Table 13 b. Inland fish production matrix

Indicators	KI	Rohu	Katla	Mrigal	Catfish	Grass carp	Prawn	Puti
Survival rate	k1	1	3	2	5	4	7	3
	k2	2	3	1	6	4	7	3
	k3	1	4	2	5	3	7	4
Score		4	10	5	11	11	21	10
Cost of cultivation	k1	1	3	2	6	4	5	3
	k2	2	4	1	7	5	3	4
	k3	3	2	1	5	6	4	2
Score		6	9	4	18	15	12	9
Market	k1	6	1	7	3	4	5	1

demand	k2	6	1	7	2	4	5	1
	k3	7	1	6	2	5	4	1
Score		19	3	20	7	13	14	3
Profit	k1	2	4	1	5	7	3	4
	k2	1	3	2	4	6	5	3
	k3	3	2	1	5	6	7	2
Score		6	9	4	14	19	15	9
Total score		35	31	33	50	58	62	31
Rank		D	F	E	C	B	A	F

Table 13 c. Vegetables production matrix

Indicators	**KI**	**Bhendi**	**Brinjal**	**Bitter gourd**	**Pump kin**	**Cowpea**	**Lablab**
Duration	k1	1	2	4	5	6	3
	k2	2	1	4	5	6	3
	k3	2	1	6	4	5	3
Score		5	4	14	14	17	9
Less Fertilizer requirement	k1	5	6	1	2	4	3
	k2	6	5	2	1	4	3
	k3	6	5	1	2	4	3
Score		17	16	4	5	12	9
Yield	k1	5	3	6	4	2	1
	k2	6	3	5	4	2	1
	k3	1	4	6	5	3	2

Score		12	10	17	13	7	4
Market demand	k1	1	3	4	5	6	2
	k2	1	4	3	5	6	2
	k3	2	3	4	6	5	1
Score		4	10	11	16	17	5
Less labour requirement	k1	5	4	1	2	3	6
	k2	6	5	1	2	2	4
	k3	5	4	2	3	1	6
Score		16	13	4	7	6	16
Total score		54	53	50	55	59	43
Rank		C	D	E	B	A	F

Table 13 d. Matrix of popular banana varieties

Indicators	**KI**	**Hara Kela**	**Jahazi Kela**	**China Kela**	**Lal Kela**
Less Fertilizer requirement	k1	3	2	4	1
	k2	4	2	3	1
	k3	4	2	3	1
score		11	6	10	3
Pest and disease resistance	k1	2	3	4	1
	k2	3	2	4	1
	k3	2	4	3	1
score		7	9	11	3
Yield	k1	4	3	2	1

	k2	3	4	2	1
	k3	4	3	1	2
score		11	10	5	4
Market demand	k1	3	4	1	2
	k2	3	4	1	2
	k3	4	3	1	2
score		10	11	3	6
Taste preference	k1	4	1	3	2
	k2	4	1	3	2
	k3	4	1	3	2
score		12	3	9	6
Total score		51	39	38	22
Rank		A	B	C	D

5.13. Livelihood analysis

On the basis of the livelihood generation of the villagers, they can be divided as three different professional families- farmer family, fisherman family and daily wage labourer family. The livelihood status of each of the three categories was assessed by selecting three representative houses from each group. The percentage contribution of different income sources and expenditure of all the three categories were represented in Figure12, 13, 14, 15, 16 & 17 respectively.

For the farmer family, the sources of income are totally different from fisherman and daily wage labourer family. Accordingly, the expenditure under different heads is also differed.

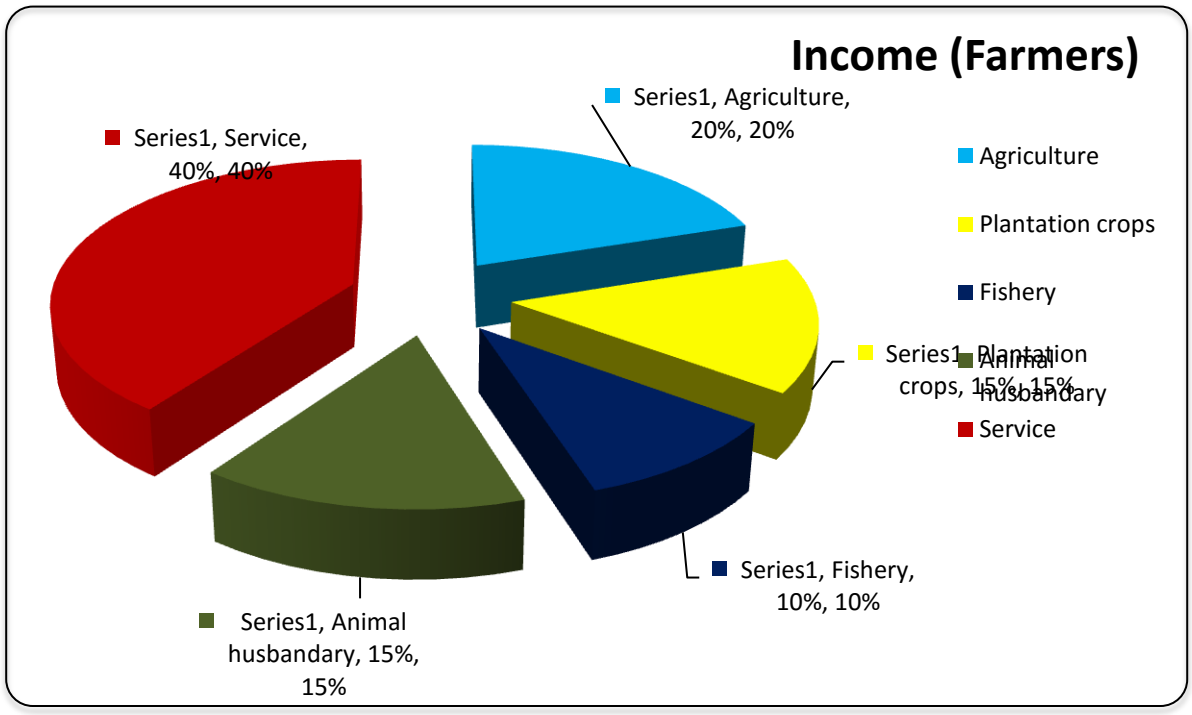


Fig 12. Income source of the farm family

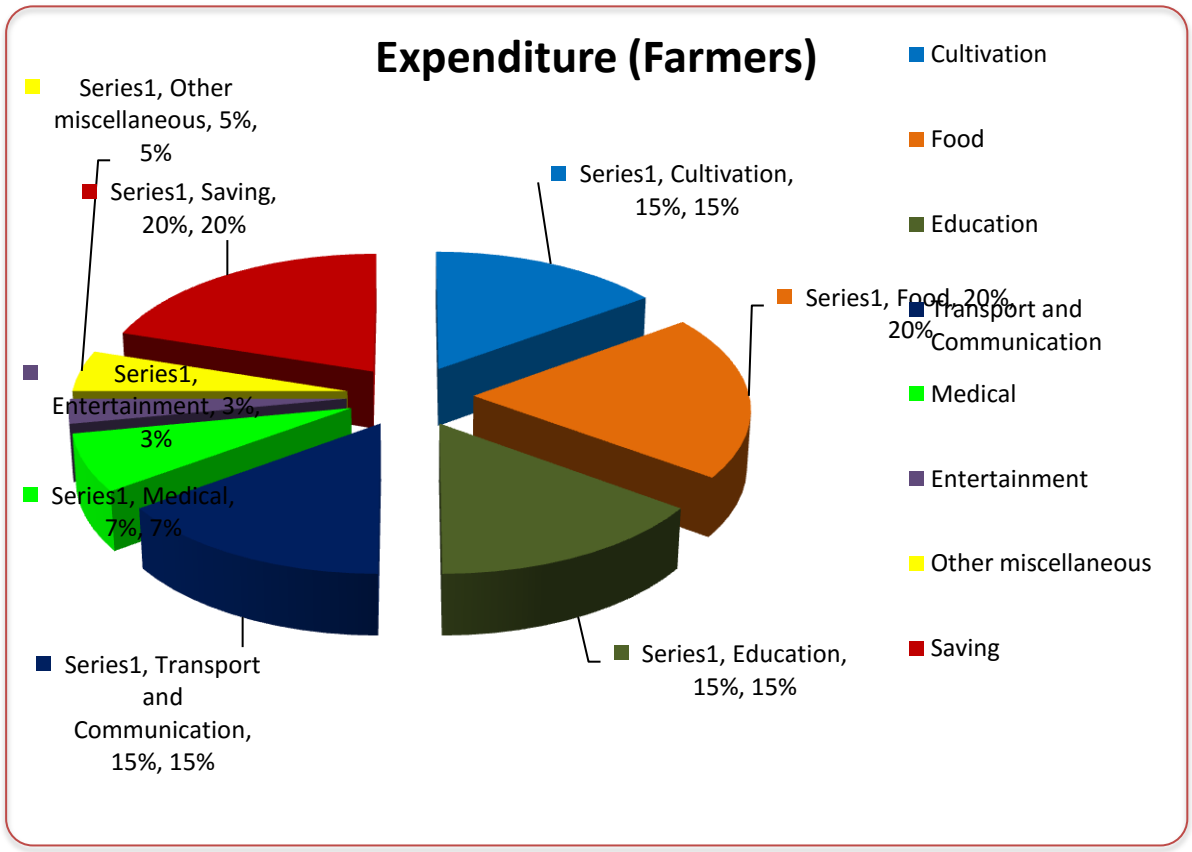


Fig 13. Expenditure of the farm family

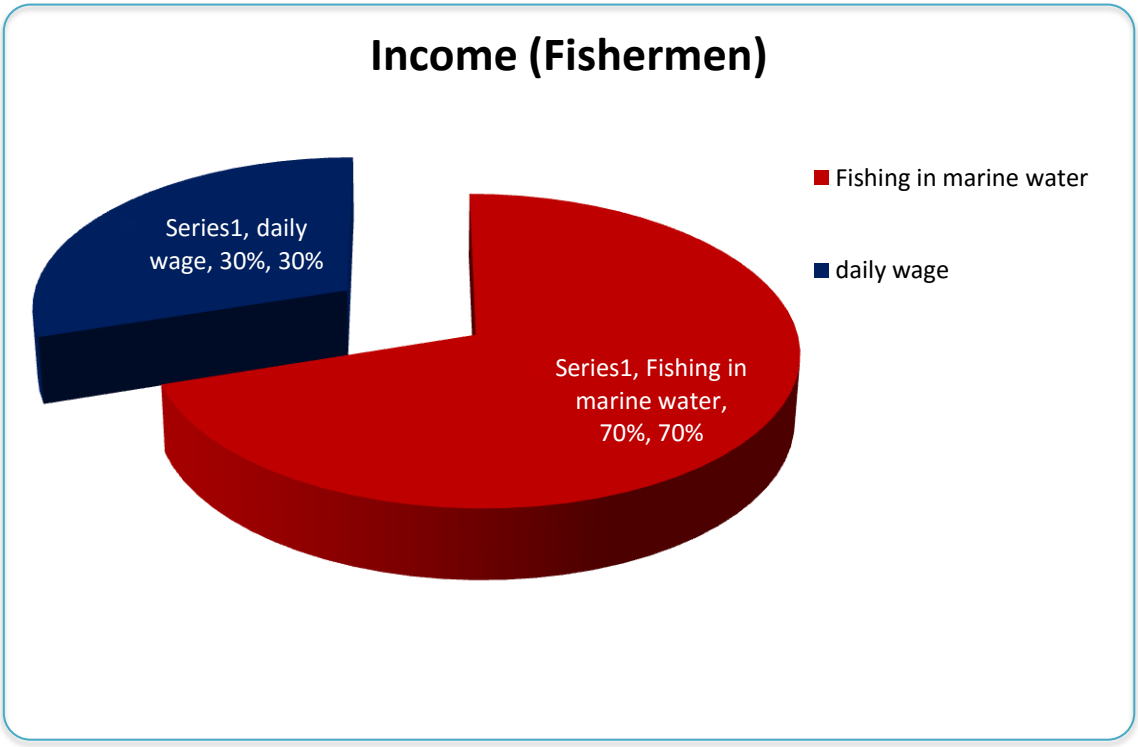


Fig 14. Income source of fisherman family

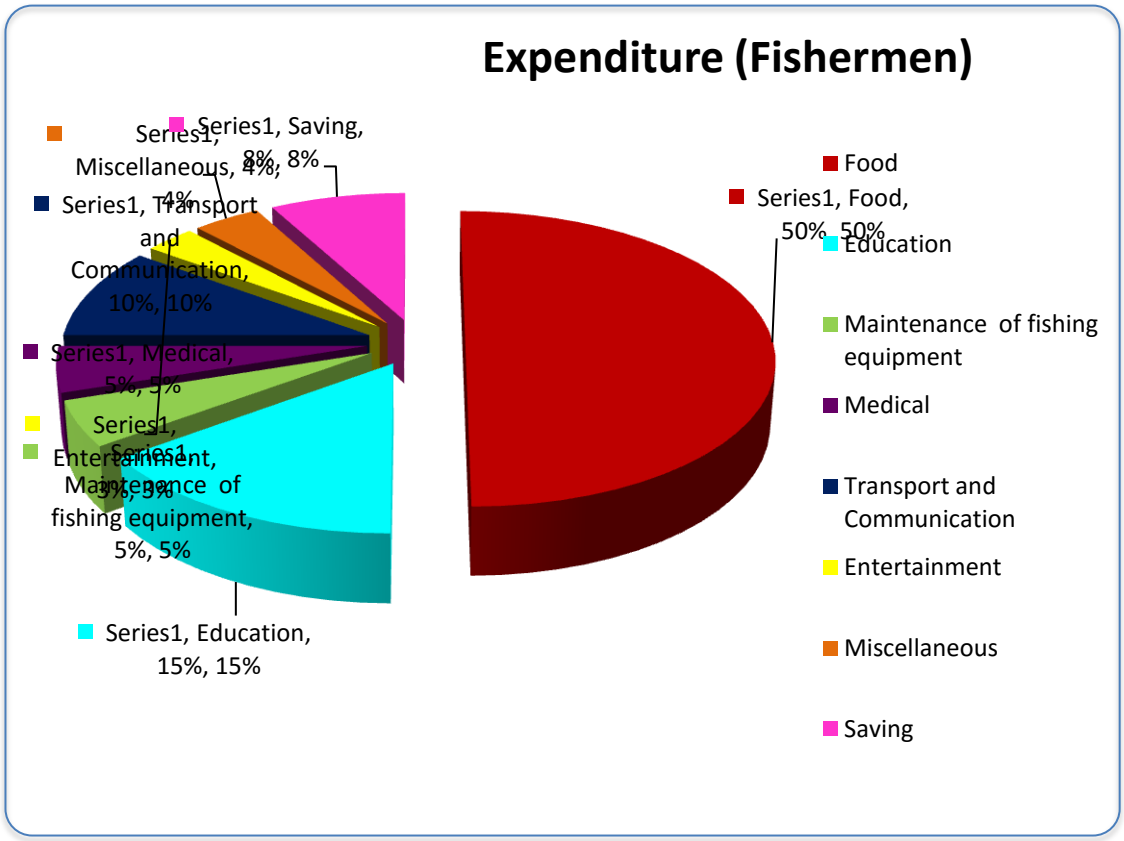


Fig 15. Expenditure pattern of fisherman family

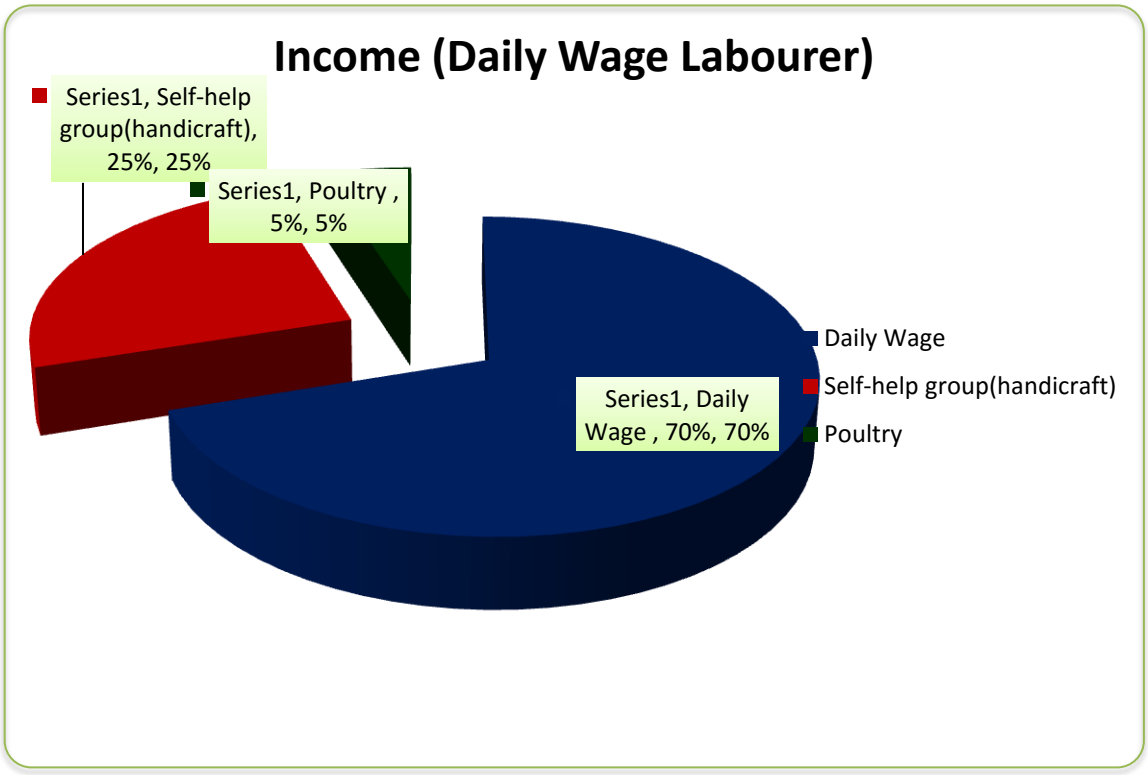


Fig 16. Income source of daily wage labourer family

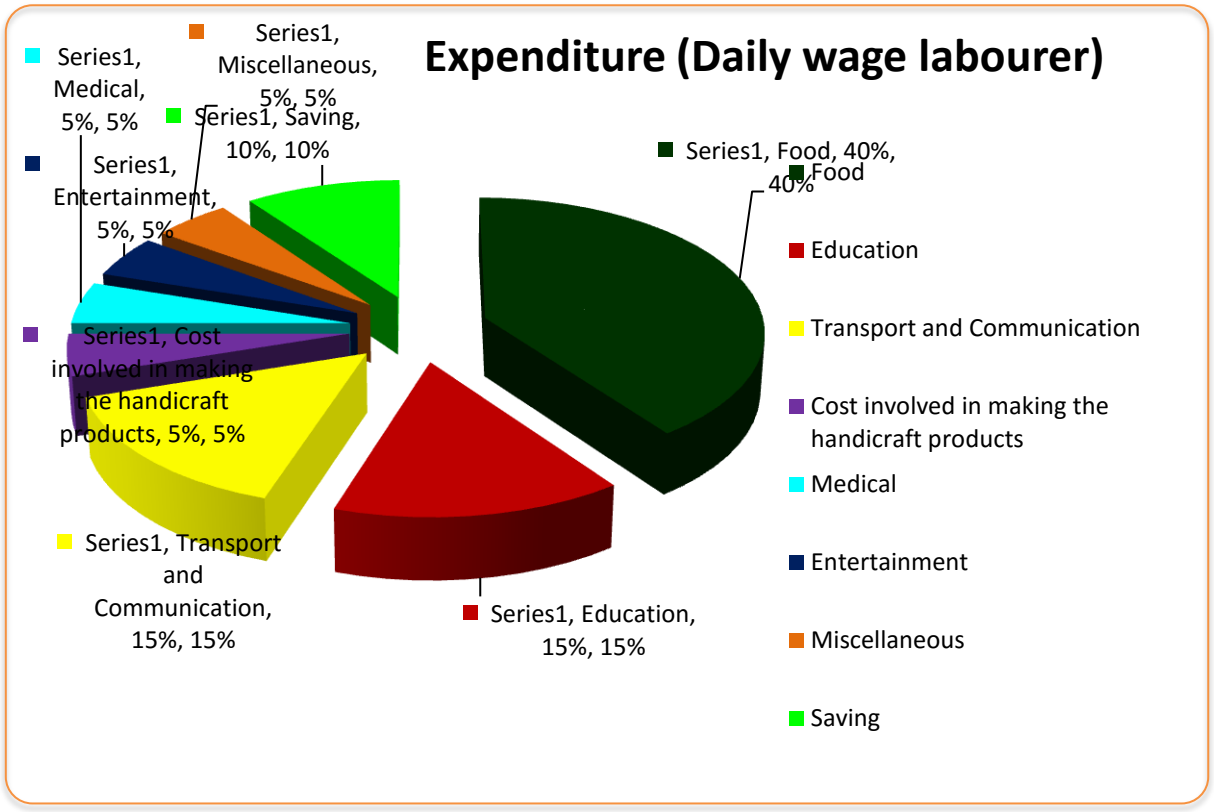


Fig 17. Expenditure of daily wage labourer family

In the Badmash Pahad village, most of the farmers are settlers and they got 2 ha of land from the Government during the settlement time in the year 1949. At the same time, in many cases, one, two or more numbers of the family members are Government employee. So, the maximum portion (40%) of their livelihood comes from this secured source. On the other hand, due to the hike in the labour charge (Rs. ~250-300/day, depending upon the season), the profit out of the cultivation shares only 20% of their total income. But, the fisherman earns 70% out of the fishing in the marine water and rest 30% out of the daily wage basis. This picture is prominent in the season, but during the off season, the picture reverts.

After tsunami, due to the habitat change, the availability of fish in the marine water is somewhat reduces, but, now it is gradually increasing. The livelihood pattern of the daily wage labourer family is somewhat different from farmer and fisherman family. They earn ~70% to ~95% of their total income from the daily wage. Some of their family members (especially women) are associated with the ADRA self-help group preparing some handicraft material out of the coconut shell. They earn 25% of the total income from this source, but, in the season (October to March), when, the tourists come mostly, then the demand will be higher and the income will be more. The mobility map of Badmash Pahad village has been given in Figure 18.

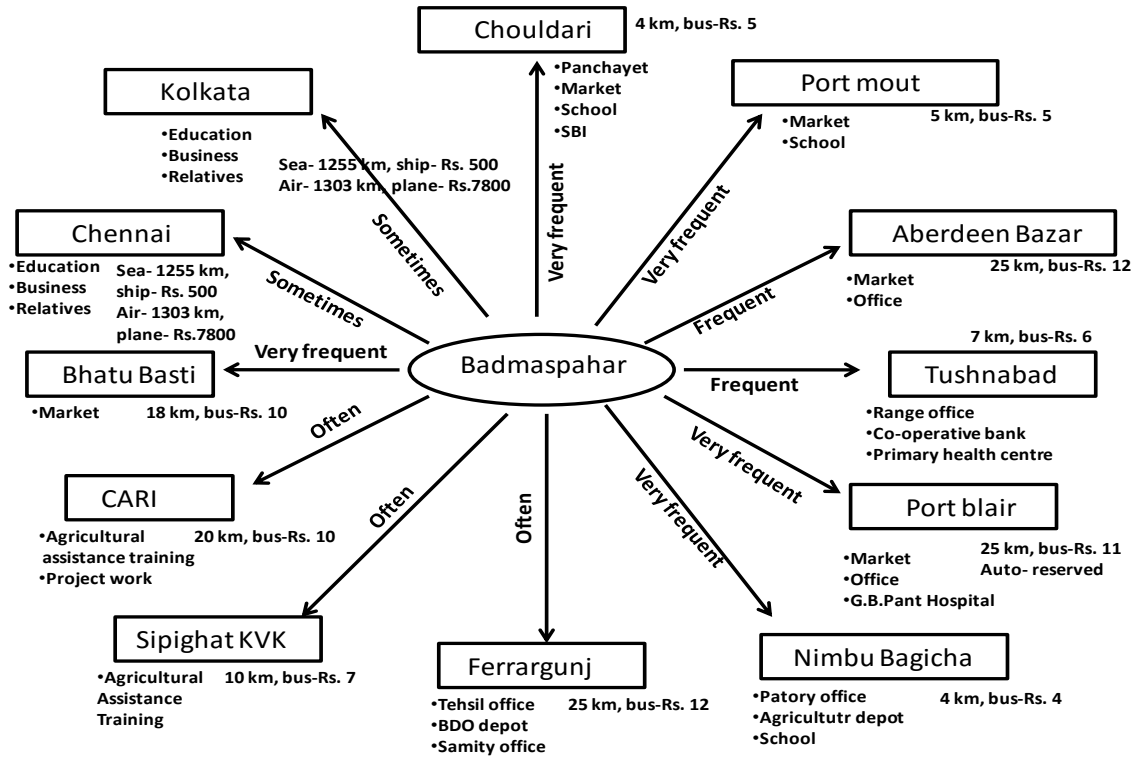


Fig 18. Mobility map of Badmash Pahad village

5.14. Perspectives of problems

Problems identified were categorized as problems arising out of gaps in research in various agricultural disciplines and as problems arising out of gaps in extension activities. Main problems related to extension and research identified has been enumerated as follows:

(i) Extension Gaps and drawbacks

1. Awareness about viral diseases and vectors in vegetables
2. Awareness about moisture conservation techniques
3. Awareness about micro nutrient deficiency solutions
4. Individual settlement pattern hampers the flow of technology to other farmers
5. Poor agronomic practice followed by farmers
6. Knowledge dissemination of salinity reclamation practices
7. Improved cultural practices in Arecanut
8. Co-operative marketing of vegetable produce
9. Rodents control measures

(ii) Research Gap

1. IPM module for Rice pest and disease in A & N condition
2. Performance evaluation of available resistant varieties in A & N condition
3. IPM module for Brinjal pest and disease in A & N condition
4. Brinjal shoot and fruit borer resistant variety
5. Bacterial Leaf Blight resistant variety of rice
6. IPM module for Okra pest and disease in A & N condition

5.15. Conclusion

Badmash Pahad village receiving rainfall around 3000 mm from both south-west and north-east monsoon of seven month duration. The geography of the village is undulating terrain, hence farmers are practicing multistoried cropping system for better utilization of natural resources, such as soil and water. In high hills farmers growing trees (*Glyricidia sp., Albicia sp., Pongamia* sp., neem), in the middle hill coconut and Arecanut are being cultivated and in loe hills, where the slope is very less, farmers go for vegetables (lobia, cucubits, gourds, bhendi, brinjal, chilli etc.). Low land is suitable for paddy because of swampy condition as well as clay-loam soil. Generally they grow long duration paddy variety and don't apply much fertilizer.

Because of labour shortage the weeding and other intercultural operations are very difficult for farmers. After paddy, some farmer grow small amount of vegetable in low land in winter season. But in low hills farmers are growing vegetables in kharif season also. Farmers are also adopting the broad bed furrow system introduced by CARI. To avoid the waster stagnation in low lands, farmers practice fresh water aquaculture and integrated rice water system. The framers are selecting the crops based on the local market demands and technologies perceived from KVK and CARI. It was clearly visible that farmers are not aware of clean cultivation techniques and its importance. Again the lack of knowledge was observed by observing their parallel row pattern in the hills, resulting the removal of fertile top soil and also erosion loss of soil. In this village farmers are also involved in service sectors to make the livelihood better. Several farm women are involved in different self-help group to make their livelihood better.

The village has great potential for goat and poultry farming due to unique environmental conditions of the island. The village with typical tropical humid climate is bestowed with very rich bio-diversity of fauna. Balanced nutrition is the key to effective livestock production which was not followed by the island farmers as a routine. The best possible steps for efficient livestock production include propagation of local feed concentrates and improved fodder varieties for sustainable livestock production, adoption of standard and hygienic practices to improve milk production, and promotion of backyard poultry with suitable crossbreds like Nicorock under island conditions.

Badmash Pahad villagers are not well aware to new technologies; however need timely updated information on all problems. A better mechanism of information dissemination can certainly further increase incomes of the villagers. This PRA exercise has made us more aware of the ground reality and has given us a better understanding of how to approach farmers and empower them to face the days ahead.

6. PARTICIPATORY RURAL APRAISAL (PRA) REPORT OF PORT MOURT

6.1. Profile of Port Mout Village

The village Port Mout is situated in Chouldari Panchayat of South Andaman district. The adopted village is surrounded by village Badmaspahar, Creekabad and Chouldari. The total population of this village is 238, comprising 86 men, 85 women and 67 children making a total of 238 villagers.

The Literacy percentage among the villagers is 63%. The village is well communicated with the urban areas of islands. The information flow into the village on technology is quite good as compare to other villages. The land use pattern of Port Mout village has been given in Table 14.

Climatological data

Mean annual rainfall : 3180 mm/year (2005)

Mean annual temperature : 23.9 C

Relative humidity : 81.9

Wind speed : 9.58km/hr

Table 14. Land use pattern of Port Mout village

Sl.No	Classification of land	Area (ha)	Slope / purpose/ fertility
1	P- I (Paddy class I)	34.46	Lowland, More fertile
2	P-II (Paddy class II)	3.3	Fertile, lowland
3	Coconut	10.0	Red soil, medium sloppy land
4	Hilly area	21. 4	Agro forestry ,plantation crops, steep slope
5	Nonagricultural hilly land	1.314	House sites, steep slopes Commercial purpose
6	Land for canal	0.53	Nallah
7	Land for road, play ground	4.42	Road, play ground
8	Revenue land (government)	33.750	House site, Schools,Panchayat Bhawan, PHC
	Total land for village	**109.174**	

Geographical coordinates

Latitude : 11º 38.813'

Longitude : 92º 39. 214'

Altitude : 28 m MSL (Port Mout, Badmash Pahad, Creekabad, Lal Pahad)

Crop husbandry

Wet season : Paddy

Dry season : Vegetable crops like okra, brinjal, pumpkin, amaranthus and bottle gourd

All round cultivation : Plantation crops like coconut, Arecanut, Cashew

Community:

Hindu - 59%

Christians - 39%

Others - 03%

Sub-Community:

Bengalis - 54%

Tamil - 46%

Water source:

Open Wells : 20

Bore Wells : none

Farm ponds : 10 (6 – Government & 4 – Loan)

Others

Vermin compost unit : 6

No of SHGs : 4

The available Animal husbandry resource of Port Mout village has been shown in Table 15.

Table 15. Animal husbandry resource of Port Mout

S.No	Animal	Breed	No	Purpose
1	Cattle	Non-descript	1 (M) 20 (F)	
		Cross bred Jersey & HF	7 (M) 17 (F)	Milk
		Total	**45**	
2	Buffalo	Graded murrah	1 (M) 1 (F)	Milk
		Total	**2**	
3	Goat	Black bengal	15 (M) 16 (F)	Meat

		Total	**31**	
4	Poultry & ducks	Desi	476	Meat

6.2. Transect Walk

Transect walk is one of the PRA tool to assess the general view of the village. The main objective of the transect walk is to know in terms of topography, land use, soil texture, depth of soil, land slop, soil erosion, water holding capacity, plant species, crops, crop varieties, productivity, fisheries, livestock, source of irrigation, problems, opportunities of the particular village. This gives a broader picture of the resource, enterprises, potential and limitations of the natural resources, enterprises, potential and limitations of the natural resource production system of the village. The walk is carried out through the village from one end to other end of the village with the help of the key informant Sree Charan and Swaran Singh of the village and they helped the PRA team members to identify the scenario of the village in general and the agriculture in particular.

It reveals that the habitation of the villagers are located in upland areas in a cluster with homestead land having livestock sheds as well as fruit orchards. The major plant species in these lands are plantation crops (like Arecanut, coconut) and cultivated vegetables. The villages are rich in biodiversity. The land topography, soil type and major crops of Port Mout village has been depicted in Table 16.

Table 16. Land topography, soil type and major crops of Port Mout village

Particulars	Hilly land	Low land	Lowland Submerged
Topography	Hilly with steep slope	Low land with less slope	Below MSL
Soil type	Sandy clay	Clay loam	
Crops	Bottle gourd, Pumpkin, Okra, Chilli, Cucumber.	Summer- pumpkin, cucumber, Ridge gourd, Brinjal and Bhendi.	Paddy
Plants species	Coconut, Arecanut, Mango, Bamboo, Guava.	Banana, Coconut, Mango.	Lemon, Neem.

Fishery/ Livestock / poultry	Poultry, goat, duck , pig and cattle	Fishery	
Water resources	Open well	Farm ponds	
Pests	Rhinoceros beetle, Biting midges in cattle and gastro intestinal parasites, Stephanofilariosis (Hump sore)	Brinjal fruit borer, bhendi boll worm, hoppers in bhendi, Gundhi bug	
Diseases	Leptospirosis, swine fever, Ranikhet disease	Brinjal collar rot, BLB in rice	
Problems	Reduction in Arecanut & coconut productivity after tsunami	Pests and disease problem in paddy, vegetable crops	Paddy cannot be cultivated
Opportunities	goat because of the location specific features (fodder trees)	Popularization of high yielding varieties in paddy crops	Brackish water aquaculture

The other trees the PRA team could observe are mango, papaya, jackfruit, pineapple, sapota, pipal, neem and the green fodder crops. In medium lands the major activities are vegetable cultivation while in low land, the rice cultivation dominates.

In the general transect, along the slope the farmers are growing the plantation crops at the higher elevation, below that the vegetables like gourds are grown to prevent the soil erosion. Next to that, the vegetables like bhendi, brinjal are grown. Below are the fish pond and the paddy field in the lower elevation. The farmers are not growing the crops across the slopes. The government is also giving the subsidy to the farmers to encourage growing across the slopes.

Name of the contributors

1. Shri. Sree Charan

2. Shri. Swaran Singh
3. Shri. Prem Kisan
4. Shri. Karupaiya
5. Shri. Kamini Saha
6. Smt. Mary Linda

6.3.Agro ecology map

Agro-ecosystem is an assemblage of elements within a boundary related to agricultural ecology, which provides the bridge between the two hierarchies that, is linking the pure ecology of natural living systems with the multiplicity of the disciplines that lie in the broad remit of agriculture. Human ecology provides the bridge between both these hierarchies and hierarchy of the social system –families, kin, group, tribe etc

The following PRA tools are utilized for space, time, flow and decision analyses for understanding the elements and properties of the village ecosystem.

S.No.	Analysis	PRA Tools
1.	Space: Social Mapping Resource Mapping Transect Mapping	 Mapping Transect Map
2.	Time : a. Time line b. Changing Trends c. Seasonality	 I. Focus group discussion (FGD) II. Mapping III. Seasonality Analysis
3.	Flow : a. Venn Diagram b. Livelihood analysis c. Gender Disaggregated Activity Analysis	 I. Chappati Diagram/Triangulation II. Matrix Ranking
4.	Decision: a. Well-being Ranking b. Choice Ranking c. Problem Ranking	 I. Matrix Ranking II. Triangulation

d. Preparation of Intervention Matrix

Participatory Rural Appraisal (PRA) is a flexible, low cost and time saving set of approaches and methods used to enable the scientist to collect and analyze information in terms of the past ,present and future situations to understand about rural populace and the conditions that exist in rural areas which would provide a thorough and comprehensive idea regarding problems, potentials, resources and solutions to formulate realistic developmental programmes by the villagers themselves but facilitated by PRA practitioners feasible within a specific period of time by villagers of rural locality.

Participatory Rural Appraisal: Tools, Process and Results

Space Analysis

The Phenomenon related with the spatial dimensions as important attributes are analyzed through various tools like Social Map, Resource Map and Enterprise Map etc.. The Spatial Analysis is depicted in the form of maps and tables with reference to the space in the village.

6.4.Social Map

Key informants: Shri. Shree Kisan, Shri. Ramakrishna, Shri. Abhilash Mondal and Shri Swaran Singh

The social map gives the information to understand and analyze the social structure, stratification, social institutions and availability of social facilities in the context of existing socio-economic condition of the village.

The village Port Mout is situated in Chouldhari Panchayat, Ferrargunj Tehsil under South Andaman District and having a population of 238, of these 86 are men and 85 women and 67 are children. Out of these population 59% are Hindus and 38% are Christians and 3% are Sikh community in the village. The Village has one Primary and Senior Secondary school and one Anganwadi centre in the field of education. Though there is less choice of collage as compared to main land, there is one general collage and one poly technique collage in Port Blair. There is no collage for studying medical or engineering sciences in Andaman & Nicobar Islands. For higher studies the villagers have to send their children to main land. There is one temple and one church in the village. The distribution pattern of households are scattered all over the village along the both sides of the roads. There is no child labour in Port Mout village.

6.5.Resource Map

Key informants: Shri. Francis, Shri. Naranyan Singh, Shri. Zakarius Kawa, Shri. Ram Nath, Shri. Pratap Singh and Smt. Flora Kandulna

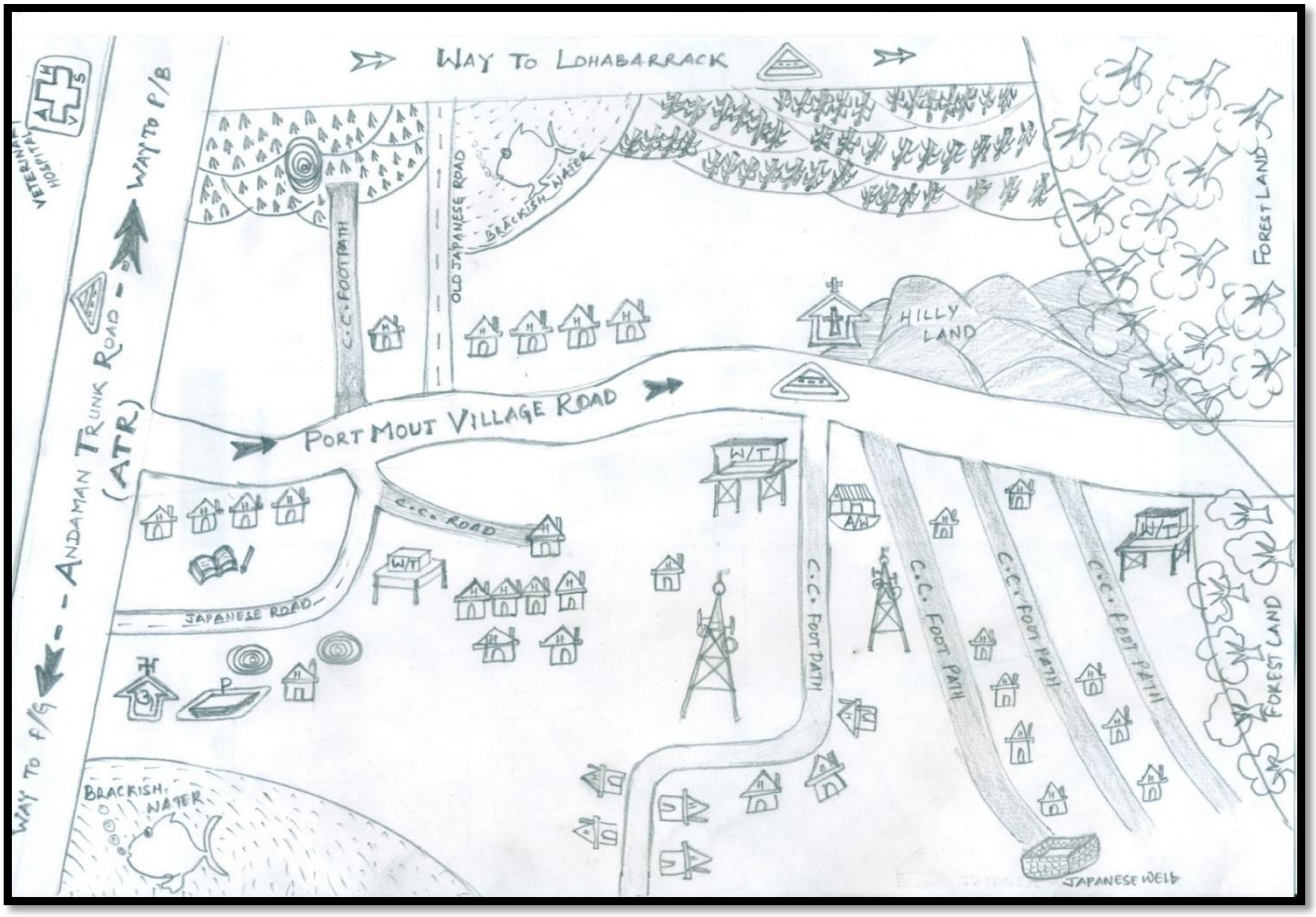
Transect Map was done to know the resources existing in the village relating to agricultural production, fisheries and livestock. The Items covered were crops, animals, soil type, service facilities, input agencies, information supply systems, source of irrigation, communication facilities, agricultural implements and type of lands etc.,. The Village is spread over an area of 30.0 ha. The village level is well endowed with agricultural, horticultural, aquacultural as well as ecological resources. The major crops are paddy, vegetables like brinjal, pointed guard, bottle guard, bitter guard, drum stick, chilly, pumpkin etc., forest trees include Gurjan, Bamboo, Banyan, Casiafirtula and Cajurina. The livestock population comprises of cattle (mostly cow and buffalo), poultry and duck etc. The total of 10 ponds is spread all over the village. The Major fish species grown in these are Catlacatla Sp., Labeo rohita Sp., C. mrigala Sp., Ctienono Farringdon idilla Sp, C. carpio Sp. And H. molitrix etc are grown in Port Mout Village.

The Major sources of irrigation are ponds and tube wells in summer season due to scarcity of water in the village. The Village has mango, orchards, and banana cultivation apart from plantation crops which is also a major source of income in this village. The Major sources of entertainment are Television, Radio and Social clubs. There is only one Local booth and 10% households have the basic telephone i.e. landline connections in their home. The villagers are not endowed with any traditional instruments however but in some areas traditional methods are still preferred, some modern instruments like tractor, pump set etc are not available through Administration Agriculture Deptt. and other small NGO's. Education has given a priority as one primary and one senior secondary school is located in the village but no primary health centre for humans and animals are present. One Veterinary Hospital is also present in the main junction of the village. The drinking water needs are met through govt. tube wells. The resources of Pout Mout village and resource map have been presented in Table 17 and Figure 19 respectively.

Table 17. Resource of Port Mout village

Particulars	Articles
Transport facilities	Auto rickshaw, Motorcycle, Bicycle and Bus
Common/ personal facility	Community hall, Water tank, Open well, Farm pond, Hand

	pump.
Communication facilities	Television, Radio and Mobile phones
Health and welfare societies information	Veterinary health care centre
Education Facilities	one primary and one senior secondary school
Agriculture implements	Tractor, Power tiller, Country plough, Water pump and Power knapsack sprayer
Animals use for agriculture	Bullocks , Cow, Goat and Pig
Advisory facilities information	Veterinary doctor.
Animal Reproduction	Artificial insemination



Seasonal ca

Fig 19. Resource Map of Port Mout Village

Key informants: Shri. Ram Nath, Shri. Pratap Singh and Smt. Flora Kandulna

This is a very important PRA technique to know about the seasonal activities. Seasonal analysis is also called as seasonal calendar. This is a calendar, which indicates month wise activities, specialities, threats, problems, abundance, and shortage with regard to agriculture in a diagrammatic way. The items to be included in seasonal analysis must be of those items, which really affect the agriculture and allied sectors. This explores seasonal constraints and opportunities by diagramming changes, month by month throughout the year. This also helps in finding the spare time which could be utilized for other remunerative activities. Moreover, it helps to identify the months of greatest difficulty, when and which activity and vulnerability which have an impact on people's livelihood.

The main activities, problems and opportunities of Port Mout village were identified by using seasonal calendar. It depicts time-to-time crop related operations being carried out in the existing farm situation. The common crop seasons in the village are monsoon and post-monsoon season with rice as the main crop. The farmers are cultivating paddy once in a year during monsoon season which starts from April up to October. Land preparation was carried out using Desi Plough (Figure 20). Rest of the year, farmers are mostly concentrating on vegetable cultivation. Plantation crop (arecanut and coconut) cultivation is done throughout the year.

Seasonal analysis helps in identifying the period which are critical with respect to season, labour demand, pest and disease problems and availability of fodder. The important problems include disease and pest in rice as well as vegetables, rodent menace in coconut and fodder unavailability. Gundhi bug infestation and Bacterial Leaf Blight (BLB) are of common occurrence in rice while fruit and shoot borer is common in sem and brinjal. Farmers are not interested in using many of the improved crop varieties introduced by the KVK.

All the way through the year, males are involved mostly in agricultural works viz. land preparation, transplanting, spraying and harvesting while females give company in transplanting and weeding operations. There are no remunerable activities like selling of milk and poultry products as livestock rearing is only meant for household purpose. The seasonal calendar for agricultural practices, major crops and their problems and livestock practices in Port Mout village have been presented in Table 18, 19 & 20 respectively.

Table 18. Seasonal calendar for agricultural practices in Port Mout village

<table>
<tr><th>Crop</th><th>July</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th></tr>
<tr><td rowspan="2">Paddy</td><td rowspan="2">Transplanting</td><td>Weeding</td><td colspan="3">Harvesting</td><td colspan="5" rowspan="2"></td><td colspan="2">Nursery</td><td></td></tr>
<tr><td></td><td colspan="2">Spraying</td><td></td><td colspan="3">Land prepn.</td></tr>
<tr><td>Coco-nut</td><td colspan="12">Plucking the nuts, Collection in heaps & Extraction of nuts</td></tr>
<tr><td>Areca-nut</td><td colspan="2"></td><td colspan="3">Plucking the nuts, Collection</td><td colspan="7">Extraction and Storage</td></tr>
<tr><td>Brinjal, Lobia, Okra</td><td colspan="3"></td><td>Field Prepn.</td><td colspan="2">Sowing & Weeding</td><td>Harvesting</td><td>Market-ing</td><td colspan="3"></td></tr>
<tr><td>Sem</td><td colspan="7">Fruiting, Harvesting & Marketing of fruits</td><td colspan="4"></td><td>Land prepn.</td></tr>
<tr><td>Bottle Gourd</td><td colspan="3"></td><td>Field Prepn</td><td>Sowing</td><td colspan="2">Fruiting & Harvesting</td><td>Market-ing</td><td colspan="3"></td></tr>
<tr><td>Amara-nthus</td><td colspan="4"></td><td colspan="2">Sowing & Harvesting</td><td colspan="6"></td></tr>
</table>

Fig 20. Land preparation in Port Mout village

Table 19. Seasonal calendar of major crops and their problems

Crop	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Paddy			Gundhi bug infestation									
		Bacterial Leaf Blight										
Sem			Fruit & Shoot Borer									
Brinjal						Fruit & Shoot Borer				Damping-off		

Table 20. Seasonal calendar of livestock practices

Animal	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Cow	Breeding (A.I.)											
	Calving Season							Calving Season				

Buffalo	Breeding season (NS, A.I.)								Summer Anestrus		Breeding season	
	Calving season				Non-Calving season		Calving season					
Cattle Buffalo								Pre-monsoon Vaccination (FMD, HS)				
Cow Buffalo		Deworming			Deworming				Deworming			
Poultry	De-worming		De-worming			Deworming			De-worming			

In livestock sector, major problem found was low milk yield. Majority of the farmers are ignorant about the significance of balanced feeding, use of green and leguminous fodder. Livestock diseases are comparatively rare because of the inherent genetic make-up as well as regular disease control programmes in the village. Major problems in large animals include parasitic infections and biting midge infestation (Figure 21). The seasonal calendar for livestock health problems has been presented in Table 21.

Table 21. Seasonal calendar for livestock health problems

Species	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Crossbred Cattle	Biting Midge infestation & Humpsore (Stephanofilariosis)									Biting Midge infestation		
	Repeat Breeding											
Large Ruminants	Leptospirosis											
	Fasciolosis, Amphistomosis & other round worm infections											
Buffalo								Summer Anoestrus				
Poultry	Salmonellosis & Coccidiosis											
	New Castle Disease & Eye worm Infestation (*Oxyspora mansoni*)											

Fig 21. Biting midges infestation and subsequent development of wound lesions in crossbred cattle

6.6.Gender disaggregated activities

The gender disaggregated activities pertaining to various agricultural practices and livestock have been collected and presented in Table 22 & 23.

1. **Key informants: Shri. Francis, Smt. Suman Barla, Shri. Naranyan Singh and Smt. Flora Kandulna**

Table 22. Gender disaggregated Seasonal Calendar (Agricultural practices)

<table>
<tr><th>Crop</th><th>July</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th></tr>
<tr><td rowspan="2">Paddy</td><td rowspan="2">Transplanting (M, F)</td><td>Weeding (F,M)</td><td colspan="2">Harvest-ing (M,F)</td><td colspan="6" rowspan="2"></td><td rowspan="2">Nursery (F)</td><td rowspan="2"></td></tr>
<tr><td colspan="2">Spraying (M)</td><td></td></tr>
<tr><td colspan="10"></td><td colspan="3">Land preparation (M)</td></tr>
<tr><td>Coco-</td><td colspan="12">Plucking the nuts (M), Collection in heaps (M,F) & Extraction of nuts (M)</td></tr>
</table>

nut						
Areca-nut		Plucking nuts (M) Collection (M,F)		Extraction and Storage (M,F)		
Brinjal, Lobia, Okra		Field Prepn (M)	Sowing (M,F) Weeding (F,M)	Harvesting (F, M)	Marketing (M)	
Sem	Fruiting, Harvesting (F,M) & Marketing of fruits (M)					Land preparation (M)
Bottle Gourd		Field Prepn (M)	Sow-ing (F,M)	Fruiting Harvesting-(F,M)	Marketing (M)	
Amara-nthus			Sowing & Harvesting (F)	Marketing (M)		

Men are mainly involved in field activities mainly land preparation, spraying and harvesting. Additionally, they also take the livestock for grazing, vaccinations, artificial insemination and as well as selling of milk. Women in the said village concentrated mainly on various activities including sowing, harvesting, feeding of livestock, milking, livestock management and home management (Figure 22). Children especially boys are supporting in outdoor activities and girls in indoor activities. The activities like housekeeping, cleaning, washing etc. are in domain of woman while marketing of produce, business, works involving more physical power are taken up my man.

Fig 22. A farm men and women involved in agricultural field activities

Table 23. Gender disaggregated seasonal calendar for livestock practices

	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
Milking	Men/Women											
Grazing	Men											
Disease management	Men/Women											
Cleaning	Men/Women											

6.7.Time Analysis

This group of PRA tools is used to investigate phenomenon that have temporal dimensions as major characteristics. The events that occur once in the history or periodically or cyclically can be captured through the time line and seasonality analysis.

6.8.Time Line

Time line is a tool of PRA technique used to know the history of major remembered events in community and their significance. It indicates the causal link between past and present major events occurred in a village in a chronological way with regard to a specific phenomenon like agriculture development, animal husbandry, transport, means of communication, social

aspects, entertainment and panchayat raj etc. The purpose of this tool is to obtain historical account of changes in demography, socio-economic condition, communication, social relationship and interaction, technology diffusion and adoption etc. The time line of major events in Port Mout village has been shown in Table 24.

Table 24. Time line of major events in Port Mout village

Sl. No.	Year	Events
1	1942	Free 42 (Jail Release)
2	1949	Settlement
3	1951	No: 8 Rice variety
4	1975	Road
5	1978	Electricity
6	1979	Dwarf Rice Varieties (Jaya, Pusa, Swarna)
7	1980	Radio
8	1983	Veterinary Hospital, Post Office
9	1985	Tractor
10	1986	Artificial Insemination
11	1987	Drainage system
12	1991	Use of pesticides
13	1992	Rural Development Phone
14	1994	KVK
15	1995	Water Tank
16	1996	Gas Cylinder
17	1997	Anganwadi, “10 years” (own settlement)
18	2000	Use of fertilizers
19	2004	Tsunami
20	2005	Self Help Groups
21	2006	Mobile phone
22	2007	Power Tiller, sprayer
23	2011	Primary School

Timeline is often a good starting point of further PRA activities and exercises. Information regarding the important events like the development in agriculture, animal husbandry are collected from the key informants, preferably elderly people of the village and presented in the Table. From the time line of Port Mout, it is evident that the village had adopted some of the modern technologies related to mechanization of agriculture. Use of tractor started in mid 1980's. The village has started applying chemical fertilizer only before ten years, even though adoption of pesticides started in early 90's. Artificial Insemination (A.I.) is a widely accepted and successful reproductive biotechnology which was introduced around two decades back in the village. Village faced the disastrous Tsunami in the year 2004 which had a drastic downbeat impact on livelihood as well as agriculture sector. Later years showed a massive entry of various government and NGO initiatives in the form of relief activities. Various advanced equipments like power tiller and sprayer were introduced in the year 2007.

6.9.Seasonality analysis

Seasonal analysis is the tool to investigate the phenomenon having time dimensions. The phenomena like disease occurrence in agriculture, human, animals etc. can be depicted as bar diagram against the months of the year. The training exercise in the village investigated the human disease, animal disease and fish diseases through this technique. It was done to indicate the various abnormalities and specific activities occur during different months relating to agriculture and allied fields. This analysis helped in knowing the labour crisis, natural calamities etc. The peak months of labour utilization, labour availability, rainfall, disease, festivals etc. are also presented in the seasonal map.

6.9.1. Human diseases

Most of the diseases especially fever, cough, cold, diarrhea, Hypo and Hypertension are common during monsoons while Scabies and Eczema are prevalent in hot summer. Conjunctivitis occurs during August to November. The villagers suffer from chicken pox occasionally.

6.9.2. Livestock diseases

The common diseases occurring in livestock are foot and mouth disease (FMD), diarrhea, Ranikhet, Hump sorearound the year, and parasitic worms as well as lice are common round the year.

6.10. Labour demand/ availability

The rates of the labourers are high compare to the main land. Because of the high wage rate the farmers are facing difficulty in paying high wages to the agriculture labourers. The expenditure pattern of daily wage labourers of port mout village have been depicted in Figure 24.

Rate of daily wage labourer: 250/ day (Private)

Rate of daily wage labourer: 196/ day (Government)

In the month of Baishakh (April – May), Ashadha (June – July), Shrawan (July – August), Aghan (November – December) and Posh (December – January) labour availability is more in comparison to labour demand. But in the month of Kartik (October – November) and Chaitra (March – April) labor demand is quite high.

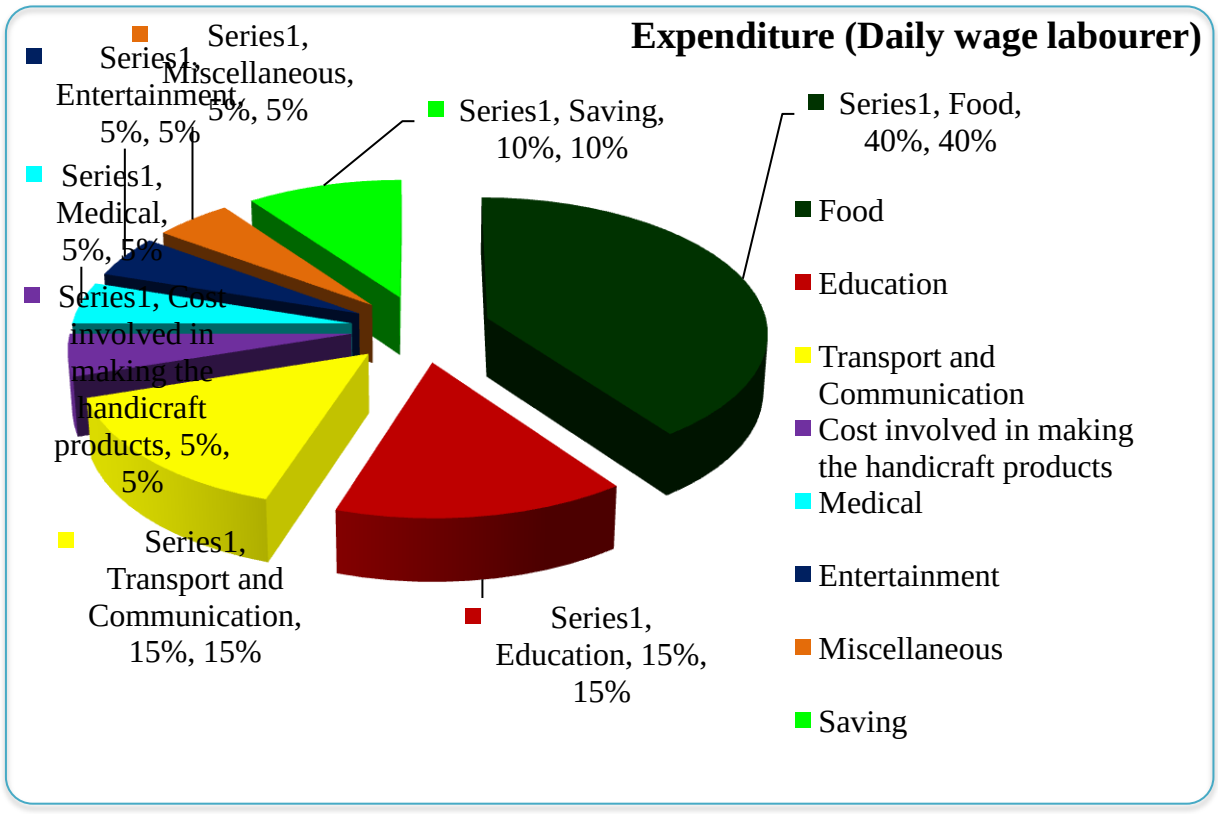


Fig 24. Expenditure pattern of daily wage labourers of port mout village

Rainfall

This agriculture is mainly dependent on the rainfall. The farmers are having farm ponds to conserve the water and utilize for growing fishes, prawns. There are also other sources of water from wells. But there are no bore wells. The perception of the villagers of not having the bore wells is that after certain depth the water will be very salty.

In the month of Ashadha (June – July), Shrawan (July – August), Bhando (August – September) and Aswin (September October) maximum rain occurs, but there is little rain in Baishakh (April – May), Jaystha (May – June), Kartik (October – November) and Aghan (November – December).

6.11. Fuel Availability

Cow dung cake is the main source of fuel in this village. The rainy month villagers find difficult to get dry twigs or leaves for fuel purpose. The villagers feel scarcity of sun light as responsible for not being able to make cow dung cake for fuel in the rainy season.

6.12. Festivals

There are main eight festival distributed over the year. In the three main festivals the involvement of villagers is quite high, these are Durga Puja, Deepawali and Holi which are occurred in month of Aswin (September – October), Kartik (October – November) and Magha-Phagun (February - March), respectively (Figure 25). The labour scarcity also occurs in the month Durga Puja and Deepawali.

6.13. Flow Analysis

Flow analyses are useful to analyze the phenomena significantly characterized as process. Various flow analysis tools are livelihood analysis, Venn diagram, chapatti diagram, gender disaggregated analysis etc.

6.13.1. Livelihood Analysis

The livelihood analysis was done for three groups of villagers namely, agriculturists, daily wage mazdoor and businessmen. The villagers were directly asked about their income and expenditure structure. To reveal the income and its structure or sources is a sensitive matter similar is the case for expenditure. The results of this exercise have some ambiguities and contradictions, which raised questions for its reliability, therefore. The exercise may be considered only as a practical experience and hand on mythological aspects for livelihood analysis in PRA.

The results for agriculturists group revealed only two sources of income daily labour (60%) and agriculture (40%). The expenditure structure revealed maximum share of food at 40% followed by education at 20%, miscellaneous including festival, clothing, house maintenance and other items at 20% and health care at 10%. They revealed saving as 10% of their income.

The carpenters had all the income from carpentry only. They spent half of their income on food followed by education at 20% and 10% each on electricity, health care and other miscellaneous items including clothing and have not reported any saving.

The third and last group of business class carried 80% of their income from their main occupation and remaining 20% from agriculture and vegetable farming. They also have food as the most important component of expenditure with 40% share. Health care and savings each followed it at 20% and education and miscellaneous expenses both at 10% of their income.

The overall results indicated that the villagers had main occupation as major source of livelihood except farmers, who had daily labour as other source of income. In case of expenditure all the villagers spent maximum on followed by health care or education. These figures seemed to be exaggerated at the cost of clothing and expenses on other items.

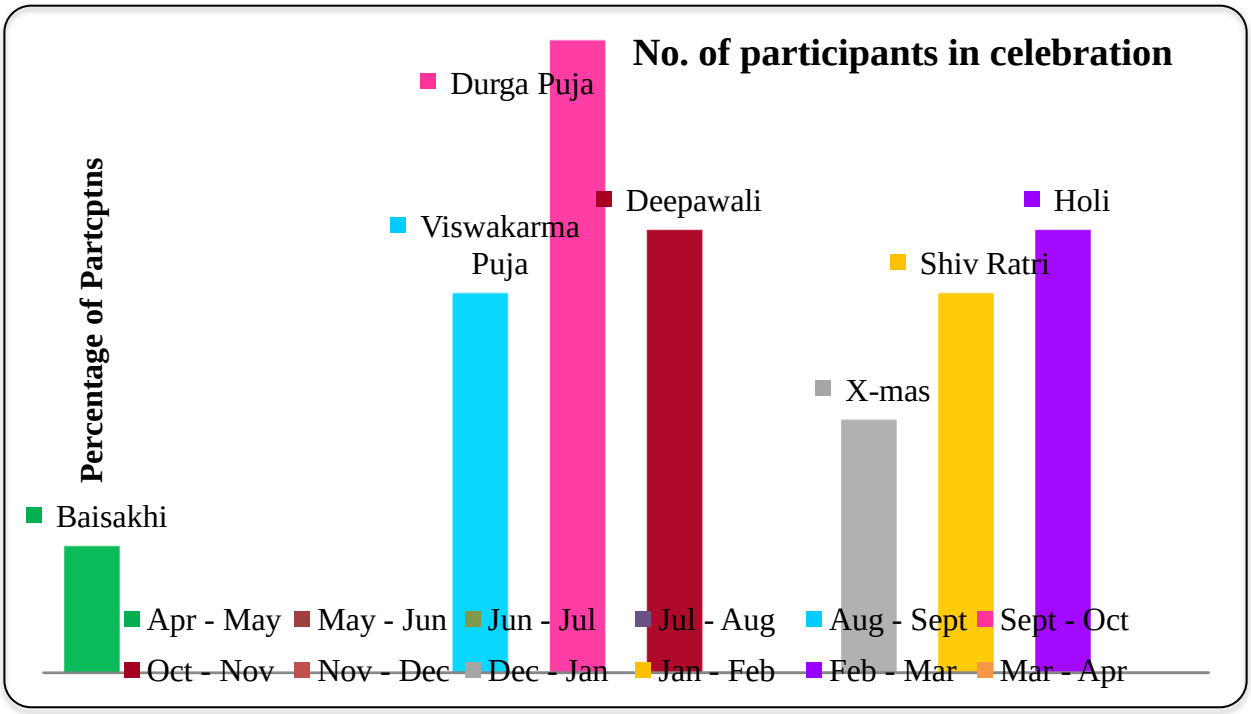


Fig 25. Celebrations of important festivals of port mout village

6.14. Mobility map

Mobility map depicts the spatial movement of the villagers to different places for different purposes like health/medical, marketing, education and entertainment. This also helps us to explore the pattern and cost of communication in the village and the frequency of interaction to the other areas. The KI's were asked to give information on mobility of villagers

and information was collected on the basis of location, purpose, distance, time required, mode of transport and transport cost to each location (Figure 26).

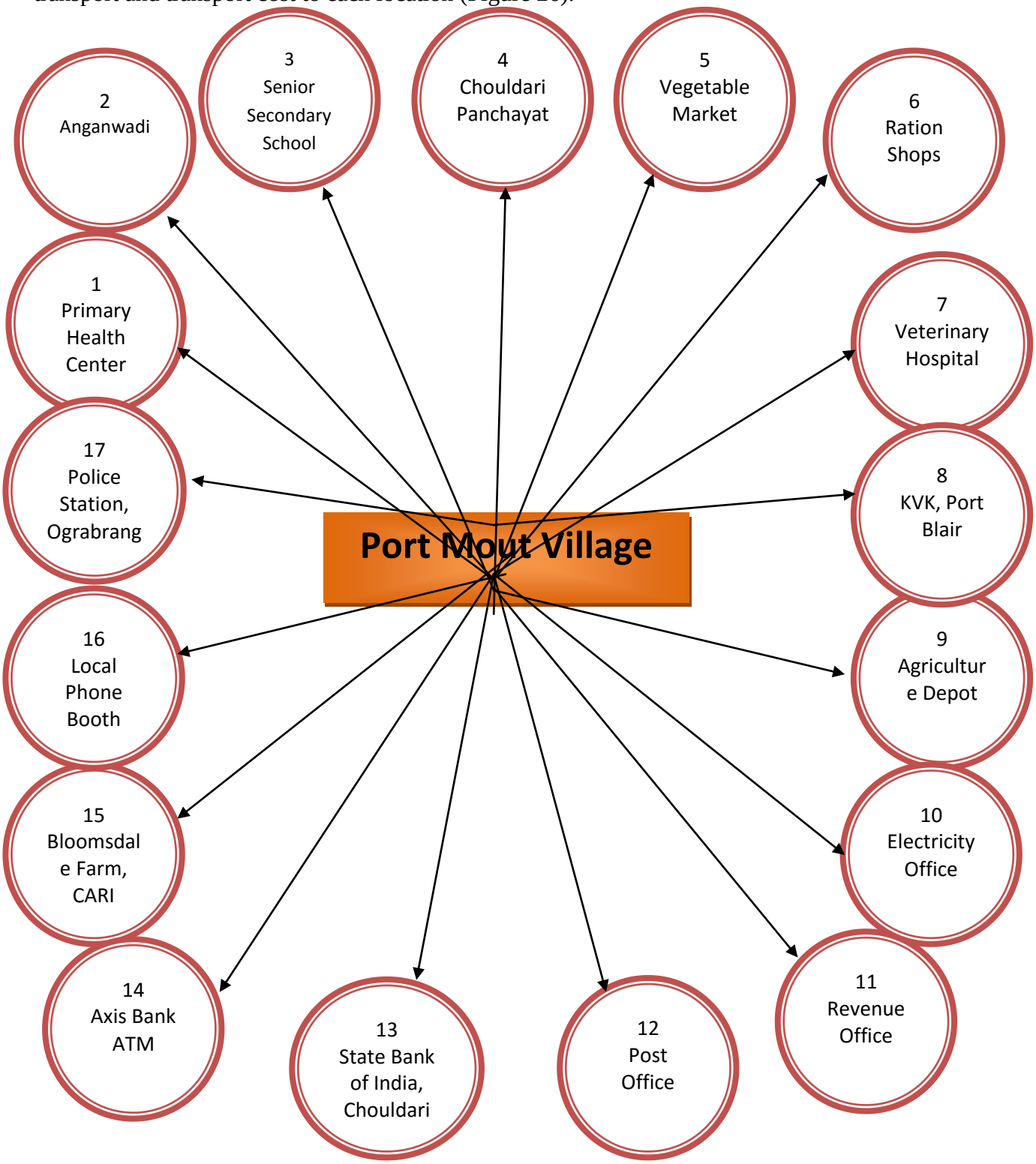


Fig 26. Mobility map of port mout village

6.14. Resource Mobilization

Key Informants: Shri. Naranyan Singh and Shri. Abhilash Mondal

The details of resource mobilization of Port Mout village have been given in Table 25.

Table 25. Details of resource mobilization

Sl. No.	Place	Distance (km)	Mode	Frequency	Fare (Rs.)	Purpose
1	Chouldari	4	Bus, by-cycle, motor cycle	Very frequently	7	Panchayat, market, school, SBI
2	Port Blair	25	Bus, motor cycle, auto-reserved	Very frequently	15	School, market, office, G.B.Pant Hospital
3	Nimbu Bagicha	3	Bus, motor cycle	Very frequently	6	Patwary office, school, agricultural depot
4	Port Mout	2	Bus, motor cycle	Very frequently	5	Market, school
5	Bathu Basti	18	Bus, motor cycle	Very frequently	11	Market
6	Aberdeen Bazar	25	Bus, motor cycle	Frequently	15	Market, office
7	Tushnabad	7	Bus, motor cycle	Frequently	6	Range office, co-operative bank, primary health centre
8	Sipighat-KVK	10	Bus, motor cycle	Often	10	Agricultural assistance, training
9	Ferrurgunj	20	Bus, motor cycle	Often	14	Tehsil office, BDO office, Samity office
10	CARI	20	Bus, motor cycle	Often	14	Agricultural assistance
11	Kolkata	Sea- 1255	Ship	Sometimes	700	Education, business, relatives
		Air- 1303	Flight		~6500	
12	Chennai	Sea-	Ship	Sometimes	700	Education, business, relatives
		Air-	Flight		~6800	

6.15. Conclusion

Port Mout village receiving rainfall around 3000 mm from both south-west and north-east monsoon of seven month duration. In high hills farmers growing trees (*Glyricidia sp., Albicia sp., Pongamia* sp., neem), in the middle hill coconut and Arecanut are being cultivated and in loe hills, where the slope is very less, farmers go for vegetables (lobia, cucubits, gourds, bhendi, brinjal, chilli etc.). Low land is suitable for paddy because of swampy condition as well as clay-loam soil. Generally they grow long duration paddy variety and don't apply much fertilizer. Because of labour shortage the weeding and other intercultural operations are very difficult for farmers. After paddy, some farmer grow small amount of vegetable in low land in winter season. But in low hills farmers are growing vegetables in kharif season also. The framers are selecting the crops based on the local market demands and technologies perceived from KVK and CARI. It was clearly visible that farmers are not aware of clean cultivation techniques and its importance. In this village farmers are also involved in service sectors to make the livelihood better. Several farm women are involved in different self-help group to make their livelihood better.

The village has great potential for dairy farming due to availability of the fodder. The village with typical tropical humid climate is bestowed with very rich bio-diversity of fauna. Balanced nutrition is the key to effective livestock production which was not followed by the island farmers as a routine. The best possible steps for efficient livestock production include propagation of local feed concentrates and improved fodder varieties for sustainable livestock production, adoption of standard and hygienic practices to improve milk production, and promotion of backyard poultry with suitable crossbreds like Nicorock under island conditions.

Port Mout villagers are not well aware to new technologies; however need timely updated information on all problems. A better mechanism of information dissemination can certainly further increase incomes of the villagers. This PRA exercise has made us more aware of the ground reality and has given us a better understanding of how to approach farmers and empower them to face the days ahead.

7. WEATHER REPORT OF NICRA VILLAGE

The year wise details different weather parameters for the last 20 years (2000-2019) have been presented in Table 26 (a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s and t)

Table 26. Details different weather parameters for the last 20 years (2000-2019)

Table 26a. Weather parameters for the year 2000

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max	Min	Max	Min	
January	29.9	22.2	76	76	41.5
February	30.2	21.5	72	75	82.1
March	30.5	22.1	72	73	256.1
April	30.6	22.4	79	76	205.1
May	30.2	24.1	85	82	468.3
June	29.3	24.1	86	84	233.4
July	29.6	24.5	84	81	231.0
August	29.0	23.5	87	85	559.2
September	29.8	23.8	85	81	270.9
October	29.2	23.4	89	83	290.2
November	30.5	24.0	79	73	259.9
December	30.1	23.6	78	75	79.1

Table 26b. Weather parameters for the year 2001

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max	Min	Max	Min	
January	29.4	22.6	78	77	123.3
February	30.5	21.3	70	72	5.1
March	31.2	22.8	76	75	111.0
April	32.5	24.6	75	70	22.4
May	30.4	23.3	87	81	940.5
June	29.7	24.9	84	82	179.1
July	29.8	24.2	84	83	326.1
August	29.3	23.8	86	25	453.5
September	30.0	23.2	87	82	431.5
October	29.8	23.4	87	81	290.4
November	29.6	23.7	78	74	113.2
December	29.8	23.3	81	75	81.5

Table 26c. Weather parameters for the year 2002

Month	*Temperature (°C)*		*RH (%)*		*Rainfall (mm)*
	Max	*Min*	*Max*	*Min*	
January	29.7	23.3	74	71	0
February	30.7	22.7	74	71	0
March	31.7	23.3	72	68	0
April	32.7	24.1	74	69	84.1
May	31.1	24.2	82	79	386.0
June	29.9	24.2	85	84	272.2
July	29.7	23.9	85	82	441.0
August	29.4	23.6	83	82	296.1
September	29.1	22.9	88	85	421.4
October	30.6	23.2	86	77	78.3
November	30.2	23.5	86	81	328.0
December	30.3	23.3	81	75	121.2

Table 26d. Weather parameters for the year 2003

Month	*Temperature (°C)*		*RH (%)*		*Rainfall (mm)*
	Max	*Min*	*Max*	*Min*	
January	29.9	22.0	75	72	21.4
February	31.0	23.2	73	72	0.1
March	31.6	23.8	76	70	142
April	32.1	24.5	72	68	13.3
May	31.3	25.6	80	77	316.2
June	30.2	25.1	83	82	225.2
July	28.7	23.8	89	89	535.0
August	29.3	24.5	86	84	352.6
September	29.6	24.0	87	84	420.2
October	29.9	23.9	87	82	290.0
November	31.3	24.9	78	72	56.8
December	29.9	24.4	74	69	69.9

Table 26e. Weather parameters for the year 2004

Month	*Temperature (°C)*		*RH (%)*		*Rainfall (mm)*
	Max	*Min*	*Max*	*Min*	
January	30.5	24.3	76	71	104.2
February	30.3	22.7	70	69	25.9
March	31.7	23.3	72	67	1.0
April	33.5	25.0	70	66	33.7
May	30.3	24.6	86	83	662.8
June	29.4	24.6	88	84	601.3
July	29.4	24.1	85	83	401.0
August	29.3	24.6	86	84	362.9
September	29.7	24.0	86	83	431.0
October	30.2	24.2	84	80	270.3
November	31.0	24.8	79	75	294.6
December	30.4	24.2	69	65	36.67

Table 26f. Weather parameters for the year 2005

Month	*Temperature (°C)*		*RH (%)*		*Rainfall (mm)*
	Max	*Min*	*Max*	*Min*	
January	30.3	23.6	74.5	69.6	0
February	31.3	22.6	70.7	68.4	0
March	32.1	24.7	71.4	69.4	3.4
April	33.3	25.7	73.6	67.8	51.9
May	31.5	25.2	82.2	76.8	312.4
June	29.5	24.5	86.3	85.2	912.2
July	20.5	24.4	84.4	83.8	547.1
August	29.7	24.4	85.4	82.2	463.7
September	29.3	23.7	84.9	84.9	622.9
October	30.0	24.0	85.5	82.4	207.5
November	30.1	24.2	82.1	78.9	366.7
December	29.1	24.3	81.3	79.0	286.0

Table 26g. Weather parameters for the year 2006

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max	Min	Max	Min	
January	29.9	22.9	72.6	70.1	3.6
February	31.1	24.3	71.2	71.6	1.9
March	30.5	23.7	69.2	70.1	0.9
April	31.9	24.3	74.5	67.9	149.9
May	30.9	23.6	83.0	78.0	403.8
June	29.7	23.8	91.0	89.0	486.2
July	29.9	25.0	87.0	85.0	177.3
August	29.5	24.5	86.0	84.0	314.1
September	23.8	23.2	93.0	90.0	791.7
October	29.9	23.8	87.0	83.0	561.4
November	30.7	24.9	80.0	75.0	79.0
December	30.0	23.5	76.0	71.0	34.4

Table 26h. Weather parameters for the year 2007

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max	Min	Max	Min	
January	30.0	22.2	75.0	72.0	0.9
February	30.8	22.9	72.0	67.0	0
March	31.4	22.2	72.0	65.0	4.0
April	32.6	25.3	75.0	69.0	26.0
May	30.4	24.7	85.0	83.0	136.1
June	30.3	24.7	87.0	84.0	454.6
July	29.6	24.9	86.0	84.0	349.7
August	29.2	24.7	88.0	86.0	291.2
September	28.7	23.9	91.0	87.0	433.6
October	29.7	23.9	88.0	85.0	284.7
November	30.1	23.9	82.0	79.0	323.4
December	29.9	23.5	75.0	72.0	142.2

Table 26i. Weather parameters for the year 2008

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max	Min	Max	Min	
January	29.6	22.8	75.0	73.0	15.8
February	30.1	22.9	74.0	74.0	19.6
March	31.3	23.7	79.0	74.0	114.1
April	31.1	24.2	78.0	77.0	380.4
May	29.9	24.6	87.0	86.0	778.7
June	30.0	25.1	86.0	86.0	355.2
July	21.7	18.4	90.0	90.0	298.4
August	29.3	24.2	89.0	87.0	446.4
September	29.3	24.3	88.0	87.0	442.6
October	26.3	20.6	85.0	81.0	244.2
November	25.1	20.9	84.0	77.0	455.2
December	29.5	22.9	72.0	66.0	2.0

Table 26j. Weather parameters for the year 2009

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max	Min	Max	Min	
January	30.1	23.0	70	65	0
February	31.5	22.0	68	66	0
March	32.7	24.0	76	70	27.2
April	32.5	26.0	80	74	157.4
May	31.4	25.0	86	84	403.1
June	29.1	25.0	90	90	458.6
July	29.9	25.0	87	87	209.5
August	30.3	25.0	87	86	619.8
September	27.8	25.0	83	83	427.0
October	31.0	24.0	88	81	341.6
November	31.5	25.0	80	74	21.8
December	31.0	25.0	79	72	2.8

Table 26k. Weather parameters for the year 2010

Month	*Temperature (°C)*		*RH (%)*		*Rainfall (mm)*
	Max	*Min*	*Max*	*Min*	
January	30.7	24.0	78	77	2.6
February	31.7	23.0	70	68	1.2
March	32.8	24.0	72	69	30.6
April	34.2	26.0	72	69	47.0
May	33.1	26.0	80	77	2.0
June	31.1	25.0	87	86	434.6
July	30.0	24.0	91	91	454.8
August	29.6	25.0	92	90	156.2
September	30.5	25.0	90	85	50.4
October	30.4	24.0	90	86	295.4
November	30.6	25.0	85	81	257.8
December	30.5	24.0	84	79	72.6

Table 26l. Weather parameters for the year 2011

Month	**Temperature (°C)**		**RH (%)**		**Rainfall (mm)**
	Max	**Min**	**Max**	**Min**	
January	30.4	24.0	81	77	123.4
February	31.1	23.0	78	78	279.0
March	30.6	24.0	83	80	525.4
April	32.1	25.0	80	75	52.4
May	31.9	25.0	86	82	501.8
June	30.4	25.0	90	88	518.4
July	29.6	24.0	91	91	777.8
August	29.6	24.0	94	91	535.2
September	29.2	24.0	94	93	643.6
October	31.2	25.0	89	83	150.7
November	32.5	25.0	79	72	71.4
December	30.4	25.0	80	77	240.6

Table 26m. Weather parameters for the year 2012

Month	*Temperature (°C)*		*RH (%)*		*Rainfall (mm)*
	Max	*Min*	*Max*	*Min*	
January	30.4	23.0	74	77	36.1
February	31.1	22.9	76	75	109.4
March	32.4	23.3	72	74	8.5
April	33.6	25.1	71	77	63.2
May	31.6	25.0	84	90	1178.0
June	30.1	25.0	84	87	568.3
July	30.6	25.0	87	88	267.8
August	30.1	25.0	86	89	344.8
September	29.1	23.0	94	95	885.5
October	31.1	24.0	81	88	141.3
November	31.1	24.4	84	87	249.1
December	30.8	24.2	77	79	155.1

Table 26n. Weather parameters for the year 2013

Month	**Temperature (°C)**		**RH (%)**		**Rainfall (mm)**
	Max	**Min**	**Max**	**Min**	
January	30.6	23.8	75	78	28.9
February	32.0	24.9	74	78	0.1
March	33.0	24.2	67	71	5.7
April	24.1	24.9	69	74	21.3
May	32.2	25.2	81	86	659.1
June	29.4	24.7	93	91	615.6
July	29.1	24.0	92	91	595.4
August	30.3	24.5	88	88	237.1
September	29.3	23.9	92	93	490.2
October	31.0	24.0	83	88	268.8
November	30.8	25.3	78	86	350.7
December	29.9	24.0	70	74	133.7

Table 26o. Weather parameters for the year 2014

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max	Min	0830 hrs	1730 hrs	
January	30.0	23.7	66	70	0.4
February	30.6	22.6	70	73	0.0
March	32.5	24.0	67	71	0.0
April	34.3	25.0	64	69	47.3
May	32.3	25.6	78	82	229.9
June	30.6	25.6	84	88	501.7
July	29.8	24.9	88	88	696.6
August	30.1	24.8	85	87	275.2
September	30.0	24.1	85	89	409.4
October	31.0	25.0	82	87	564.9
November	30.8	25.2	78	83	174.6
December	31.0	25.8	73	77	16.0

Table 26p. Weather parameters for the year 2015

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max	Min	0830 hrs	1730 hrs	
January	29.9	23.3	70	73	123.1
February	30.7	24.0	70	72	0.0
March	32.7	24.2	68	70	8.0
April	32.7	25.1	72	76	149.9
May	32.0	25.3	79	82	364.0
June	30.5	25.1	87	86	407.5
July	30.6	25.5	83	86	293.5
August	30.1	24.6	86	90	476.7
September	29.9	24.4	88	88	419.0
October	31.0	25.0	80	88	225.0
November	30.9	25.3	79	85	205.8
December	31.0	24.9	75	79	136.6

Table 26q. Weather parameters for the year 2016

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max	Min	0830 hrs	1730 hrs	
January	30.6	23.6	71	73	71.0
February	31.0	24.0	69	71	0.0
March	32.6	24.7	69	74	29.4
April	33.9	25.8	66	71	7.0
May	33.3	26.7	79	79	234.0
June	30.0	25.1	87	88	491.0
July	30.4	25.1	86	86	421.1
August	32.4	25.4	84	86	332.7
September	29.6	24.0	90	93	991.2
October	31.0	24.0	82	87	302.0
November	31.0	25.1	78	85	168.2
December	30.1	24.2	79	84	493.8

Table 26r. Weather parameters for the year 2017

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max	Min	0830 hrs	1730 hrs	
January	30.1	23.5	77	81	92.6
February	31.0	24.0	69	71	0.3
March	32.9	24.9	66	74	0.0
April	32.9	25.6	73	77	61.5
May	32.5	25.9	76	83	163.3
June	30.4	25.0	86	87	622.3
July	29.9	25.0	91	92	473.5
August	29.9	25.0	87	90	571.3
September	30.3	25.0	83	87	568.6
October	30.7	25.0	81	86	258.0
November	31.1	25.0	76	84	191.9
December	30.1	25.0	75	79	201.9

Table 26s. Weather parameters for the year 2018

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max	Min	0830 hrs	1730 hrs	
January	30.0	24.0	78	80	128.4
February	30.5	24.0	75	75	29.1
March	31.6	24.0	70	73	96.4
April	32.4	26.0	69	76	64.8
May	32.1	25.0	78	85	596.9
June	29.4	25.0	87	89	665.3
July	29.8	25.0	85	86	203.0
August	29.0	25.0	88	90	522.2
September	30.1	24.0	83	88	340.0
October	30.6	25.0	80	86	335.6
November	30.6	25.0	76	82	331.6
December	30.2	24.0	78	83	203.8

Table 26t. Weather parameters for the year 2019

Month	Temperature (°C)		RH (%)		Rainfall (mm)
	Max	Min	0830 hrs	1730 hrs	
January	30.0	24.0	75	77	99.2
February	31.1	24.0	71	74	0.0
March	31.9	23.0	68	72	56.0
April	33.2	25.0	67	73	39.2
May	32.4	26.0	80	82	298.9
June	30.1	24.0	89	89	684.5
July	30.9	25.0	84	84	126.0
August	28.7	24.0	90	92	955.8
September	29.2	24.0	88	90	479.7
October	31.7	25.0	74	83	117.5
November	31.0	25.0	73	82	362.6
December	30.3	25.0	69	72	0.0

The rainfall trend and average rainfall pattern of the district during the period (2011-2019) have been collected and presented in Table 27 & 28.

Table 27. Rainfall trend of the district during the reported period (2011-2019)

Historical Trends in Rainfall		Yearly Average								
		2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
No. of Rainy days		166	157	158	120	136	119	141	148	122
No. of dry spells during *kharif* season	10 days	1	0	0	0	0	0	0	0	1
	15 days	0	0	0	0	0	0	0	0	0
	20 days	0	0	0	0	0	1	1	0	0
No. of intensive rain spells	60 mm per day	16	18	15	11	8	14	8	9	15

Table 28. Average rainfall pattern from 2011 to 2019

Year	Normal rainfall (mm)	Total rainfall (mm) Jan-Dec	Rainy days (No.)	Dry spells > 10-15 days (No.)	Dry spells > 15 days (No.)	No. of highest rainfall intensity events (>60mm)	Water inundation floods > 10 days (No. of events) *	Rainfall (mm)		
								Kharif	*Rabi*	Summer
2011	3074.3	3827.6	166	2	2	16	0	2387.2	520.7	919.7
2012	3074.3	4006.9	157	1	3	18	0	2207.5	549.7	1249.7
2013	3074.3	3406.6	158	4	2	15	0	2207.1	513.4	686.1
2014	3074.3	2915.9	120	1	1	11	0	2447.8	191.0	277.1
2015	3074.3	2808.4	136	0	2	8	0	1821.7	465.5	521.2
2016	3074.3	3541.4	119	0	3	14	0	2538.0	733.0	270.4
2017	3074.3	3296.3	141	0	3	8	0	2493.9	486.7	315.7
2018	3074.3	3517.1	148	4	2	9	0	2327.4	999.4	190.3
2019	3074.3	3219.4	122	3	1	15	0	2544.9	579.3	95.2

*** Flooding rarely occurs due to high land slope (2-10%).**

7.1. Year wise climatic vulnerability (2011-19)

The period 2011-2019 experiences an average rainfall of 3393 mm which is 10.4% more than the annual normal rainfall of the islands with maximum in 2012 (4006.9 mm) and lowest in 2015 (2808.4 mm). Maximum no. of rainy days occurred in the year 2011 (166) and minimum (119) in the year 2016. The duration of dry spells in days was 10 days and above (Table 29 & 30).

Table 29. Year wise climatic vulnerability (2011-19)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019
January	15th to 29th (15 days)	15th to 31th (17 days)	10th Jan. to 29th Jan. (20 days)& 31st Jan. to 4th Mar. (33 days)& 8th Mar. to 13th Apr. (44 days)& 15th Apr. to 26th Apr. (12 days)	Contd. from 18th Dec. 2013 and upto 13th April, 2014	19th Jan. to 26th Mar. (67 days)& 28th Mar. to 13th Apr. (17 days)	Contd. from 27th Dec. to 25th Jan. (30 days) & 29th Jan. to 30th Mar. (62 days)	21st Jan. to 30th Mar. (69 days)	NIL	Contd. from 22nd Dec. to 1st Jan. (11 days) & 22nd Jan. to 26th Mar. (63 days) & 28th Mar. To 28th Apr. (32 days)
February	8th to 25th (18 days)& 27th Feb. to 10th Mar. (12 days)	3rd Feb. to 11thMar. (38 days)& 13th to 30th (18 days)						7th Feb. to 11th Mar. (33 days) & 13th Mar. To 24th Mar. (12 days)	
March									
April	NIL	NIL				3rd Apr. to 1st to 16th May (44 days)	23rd Apr. To 13th May (22 days)	10th to 27th (18 days)	
May	NIL	NIL	NIL	NIL	NIL			NIL	NIL
June	15th to 25th (11 days)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
July	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

August	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
September	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	26^{th} Sep. to 5^{th} Oct. (10 days)
October	NIL	NIL	NIL	NIL	NIL	NIL	NIL	30^{th} Oct. to 8^{th} Nov. (10 days) & 20^{th} Nov. To 30^{th} Nov. (11 days)	27^{th} Nov. to 31^{st} Dec. (35 days)
November	NIL	NIL	NIL	NIL	NIL	NIL	NIL		
December	NIL	5^{th} to 15^{th} (11days)	18^{th} Dec. to 13^{th} Apr., (117 days)	14^{th} to 27^{th} (14 days)	9^{th} Dec. to 19^{th} Dec. (11 days) & 27^{th} Dec. To 25^{th} Jan. (30 days)	NIL	NIL	22^{nd} Dec. to 1^{st} Jan. (11 days)	

Table 30. The year wise high rainfall events occurred during the period 2011 to 2019

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019
January	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
February	NIL	2nd (106.3mm)	NIL	NIL	NIL	NIL	NIL	NIL	NIL
March	17th (163.5mm)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
April	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
May	NIL	1st (153.0mm) 4th (185.0mm) 17th (121.0mm) 22nd (117.0mm) 26th (127.3mm)	26th (202.5 mm)	NIL	24th (119.3 mm)	NIL	NIL	NIL	NIL
June	10th (102.1mm)	8th (170.0mm) 11th (100.0mm)	2nd (118.5 mm)	7th (143.9 mm) 13th (123.8 mm) 16th (104.5 mm)	NIL	7th (109.4 mm)	6th (214.7mm)	NIL	NIL
July	NIL	NIL	NIL	10th (107.9mm) 23rd (120.7mm)	NIL	8th (127.1 mm)	NIL	NIL	NIL

August	27th (100.6mm)	NIL	NIL	NIL		27th (179.0 mm)	NIL	NIL	16th (101.3mm) 30th (131.4mm)
September	NIL	6th (181.8mm) 9th (121.8mm) 15th (104.8mm)	14th (120.1mm)	NIL	19th (105mm)	7th (196.5 mm) 30th (110.9 mm)	NIL	NIL	19th (129.9mm)
October	NIL	NIL	NIL	4th (124.6mm) 8th (204.9mm)	NIL	NIL	NIL	8th (131.6mm)	NIL
November	NIL	NIL	26th (212.9 mm)	NIL	NIL	NIL	NIL	NIL	3rd (101.6mm) 4th (122.8mm)
December	26th (109.8mm)	NIL	NIL	NIL	NIL	7th (121.5 mm) 8th (212.4 mm)	6th (113.5mm)	NIL	NIL
Total	**4 days**	**11 days**	**4 days**	**7 days**	**2 days**	**7 days**	**2 days**	**1 day**	**5 days**

7.2. Tropical Cyclone PHAILIN (8-10.10.2013) and LEHER (25.11.2013)

The very Severe Cyclonic Storm (VSCS) PHAILIN which hit the Odisha coast originated from a remnant cyclonic circulation from the South China Sea. It lay over north Andaman Sea as a well-marked low pressure area on 7th October 2013 as reported by IMD. It concentrated into a depression over the same region on 8th October 2013 near latitude 12.0^0N and longitude 96.0^0E. Moving west-north westwards, it intensified into a deep depression on 9th morning and further into cyclonic storm (CS), '**PHAILIN'** in the same day evening. Accordingly the depression moved north westwards and intensified into a deep depression at 0530 hrs IST of 9th Oct. near 13.0^0N and 93.5^0E. Moving west-north westwards, it crossed Andaman Islands near Maya Bandar at 1430 hrs IST of 9th Oct. 2013. Later it intensified into a Cyclonic Storm (CS), PHAILIN and moved over east central Bay of Bengal (Figure 27).

Another deep depression originated over South Andaman Sea and its neighbourhood about 300 km south-southeast of Port Blair on 25.11.2013 which moved north westward and intensified into a cyclonic storm called *Lehar* (Figure 28). The cyclone crossed Andaman & Nicobar Islands (ANI) between Hut Bay and Long Island, close to Port Blair around early morning of 25thNovember 2013. Then it emerged into southeast Bay of Bengal, gradually slowed down and moved towards northwest of Andhra Pradesh coast. During the cyclone there was heavy to very heavy rainfall of around 20 cm at most places of the South Andaman. Whereas in

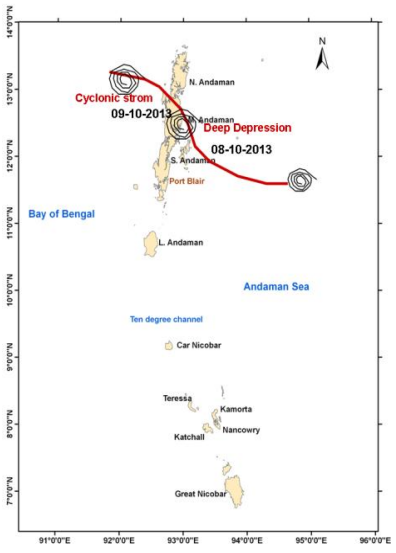


Fig 27. PHAILIN

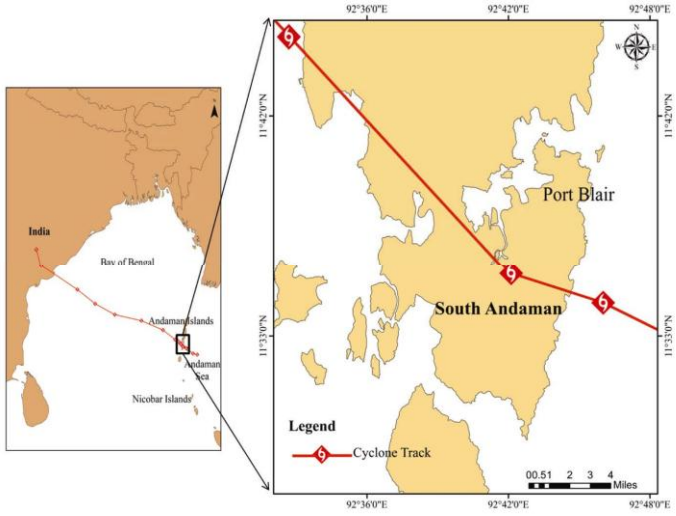


Fig 28. LEHER

the sea condition severe storm surge of about 1–1.5 m height and inundated the low lying areas of ANI. The speed of gale winds was 90–100 km/h, which damaged the huts, thatched roofs, etc.

7.3.Rainfall recorded

The station-wise daily 24 hr cumulative rainfall (7 cm or more) during 8-10 October and 25 November recorded in districts of Andaman & Nicobar Islands at 0830 hrs IST of date were given in Table 31.

Table 31. Station-wise cumulative rainfall data

S. No.	Date	Area	Rainfall (cm)
1	**08-10-2013**	**North & Middle Andaman-** Maya Bandar	24
		South Andaman- Port Blair	9
2	**09-10-2013**	**Middle Andaman –** Long Island	34
		North & middle Andaman – Maya Bandar	34
		South Andaman- Port Blair	07
3	**10-10-2013**	**North & Middle Andaman –** Maya Bandar	16
		Nicobar- Car Nicobar	07
4	**25-11-2013**	**South Andaman**	22

7.4.Damage Assessment

As per the information collected from Directorate of Agriculture, Animal Husbandry and Fisheries and the District Administration by personal contact there was no causality and major damage to agriculture due to *phailin* and *leher* in Andaman Islands. Heavy to very heavy rainfall of around 20 to 34 cm was recorded and wind speed of 40-60 km /hr was forecasted. There was no major damage to standing rice crops except flooding of low lying areas as it coincided with the vegetative phase of rice. There were no reports of loss of livestock except few cases of fowl typhoid (salmonellosis) as proper forecast of the possible disease outbreak has been issued. However, there were very few cases of falling of arecanut trees in the cyclone tract which might account for less than 1% of arecanut plantation areas. In the low lying areas of Middle Andaman

district flooding was observed ranging from one to few hours and erosion of streams (Louki and Rangat Nallahs) and adjoining areas. In addition in the coastal areas of Middle Andaman flooding was reported (300 – 500 ha) for few hours which coincided with the high tide. The major cause was drainage congestion.

C. Tropical cyclone VARDAH (08.12.2016)

The rainfall occurred during the 08.12.2016 of 212.4 mm resulted due to the tropical cyclone (VARDAH) over the Andaman Sea. The cyclone later upgraded as L2 type disaster declared by the Andaman and Nicobar Administration. The depression remained situated 340 km Northeast of Car Nicobar and 240 km West South-west of Port Blair with a wind speed of 65 kmph. There was no major crop damage reported from the villages.

The villages Badmaspahad being situated in close proximity of the sea is experienced the tropical cyclone whereas the village Port Mout is being situated on the top and western direction of the sea experiences more water scarcity during the summer months. The drought like situation in the village Port Mout requires more intervention in creating water resource structures whereas the village Badmaspahad requires to be protected from the sea water intrusion during the cyclone occurrence periods. The majority of the rainfall is received during the SW monsoon spreading from May to September. The percent SW rain of the annual rainfall vary from 57.2% to 79.4%, showing a marginal decrease in the trend with time. The variation of the rainfall indicates the occurrence of more extreme events (11 days of 100 mm and more in 2012) and more dry spell (83 days of 5 times during 2012). The occurrence of extreme events of high rainfall was well taken by the project so that less extent of crop damage occurred. The dry spells mostly occurred during December to April experience the water scarcity to meet the crop water damage sometimes coinciding the crop growth stage. The water resources created in the adopted villages meet the demand of crop water requirement during the dry spells.

COMPONENT –I

NATURAL RESOURCE MANAGEMENT

8. KEY INTERVENTION IN NICRA VILLAGE FOR THEIR SUSTAINABLE GROWTH:

After brief PRA studies NICRA intervention is cauterized into three major components which include:

A. NATURAL RESOURCE MANAGEMENT

B. CROP PRODUCTION

C. LIVESTOCK & FISHERIES

A. NATURAL RESOURCE MANAGEMENT

Natural resource management include the local resource based technological intervention which include management of soil, water bodies and other resources. The main technologies suitable under NRM for better utilization of natural resource present in the village are as follows:

1. Farm mechanization
2. Water harvesting and recycling
3. Contour bunding and trenching
4. Farm pond and BBF construction
5. Aerial vegetable cultivation
6. Micro irrigation system
7. Vermicomposting

Technological intervention at farmer field

The details of various technological demonstrations under NRM component and its economic analysis have been presented in Table 32, 33, 34, 35, 36, 37 and 38 respectively.

A.1. Farm mechanization

Paddy transplanter has been successfully demonstrated through training and operated in 0.03 ha of land where 15 days old seedlings paddy (Swarna) is transplanted by the machine (Figure 29 & 30). Farm women are more involved in the operation and maintenance training was subsequently imparted. The results showed that the total time taken for transplanting by transplanter was reduced by 95 percent but the nos. of missing plants by mechanical transplanting is increased from 0 to 6 when compared with manual transplanting methods. The yield with the BCR 1.3 was at par with the yield data of the line sowing plots.

Fig 29. Demonstration of paddy transplanter

Fig 30. Paddy Transplanter operation

A.2. Water harvesting and recycling

Both villages have received near about 3000 mm rain fall annually but during dry season there is acute shortage of water for irrigation of crop, animals, drinking etc. So harvesting and recycling of rain water is necessary for availability of water in throughout the years under this following technology were introduced:

A.2.1. Tank cum well system

Tank cum well system of irrigation is best suitable for the farmers as the tanks are situated in higher slopes and well is located in downhill within the recharge zone of the tank on the valley areas. The harvested seepage water from the tank is stored in the well and subsequently pumped out and irrigated the vegetable crops like brinjal, okra and bitter gourds during the dry spells (Figure 31). Small irrigation tanks are constructed in the recharge zones of the area and seepage water is harvested and used for providing supplemental irrigation to the summer crops (Figure 32).

Fig 31. Water harvesting structure Tank cum well system

Fig 32. Irrigation of summer crops through Tank cum well system

During the reported period 2 nos. of tank cum well system of irrigation in the fields of Shri Swarn Singh, Port Mout and Shri Kasinath Saha, Badmash pahad were promoted. Under the project, one tank of size 30 m X 22 m X 2.5 m was constructed during March, 2013 to harvest 1194 cum of rainwater. This pond is used as a water source for harvesting the rainwater for efficient utilization during the post monsoon deficit period to meet the crop water requirement for development of one pond based IFS model. This tank along with one well constitute the the irrigation system. The harvested seepage water from the tank is stored in the well and pumped out and irrigated the vegetable crops like maize, cowpea, okra and french beans during the dry spells. IMC fingerlings were supplied under the project. A gross return of Rs 1,40,000/ha was observed against gross cost of cultivation of Rs 59,500/ha with a net profit of Rs 80,500/ha and B:C of 2.35.

Shri Kasinath Saha of Badmaspahar village has two nos. of tanks that are constructed 15 years back and one well of 2 dia and 5m depth. Due to silting the volume of water availability in the ponds is less. Hence under the project, desilting activities was undertaken in the month March, 2015 which enhances the volumetric capacity of the ponds by 20%. In convergence with the NAIP project of CIARI, Port Blair two nos. of BBFs were constructed. To facilitate the dry season crop cultivation, seeds of brinjal, tomato, okra abd fingerlings of IMC are supplied under the project. The irrigation system constitutes 2 nos. of ponds, one well and water availability in the trenches of the BBFs (Figure 33, 34, 35, 36 & 37).

Fig 33. Dr. A. K. Singh, ZPD visits the tank cum well system during the pre-monsoon period

Fig 34. Okra

Fig 35. Well along on the down slope of the tank and the standing crops

Fig 36. Cowpea

Fig 37. Maize

A.2.2. Farm pond

Water harvesting through farm pond

One unit of farm pond of size 30m X 22m X 2.5m was constructed earlier to harvest 1194 cum of rainwater. This pond was used as a water source for harvesting the rainwater for efficient utilization during the post monsoon deficit period to meet the crop water requirement for development of one pond based IFS model (Figure 38, 39 & 40). Inputs supplied were fish fingerlings (freshwater prawn, grass carp and rohu) vegetable, pulses and fodder seeds (maize, black gram (BVN-6), green gram okra, fodder cowpea and agathi) (Figure 41). A gross return of Rs 75,000/- was observed against gross cost of cultivation of Rs 32,000/- with a net profit of Rs 43,000 and B:C of 2.34.

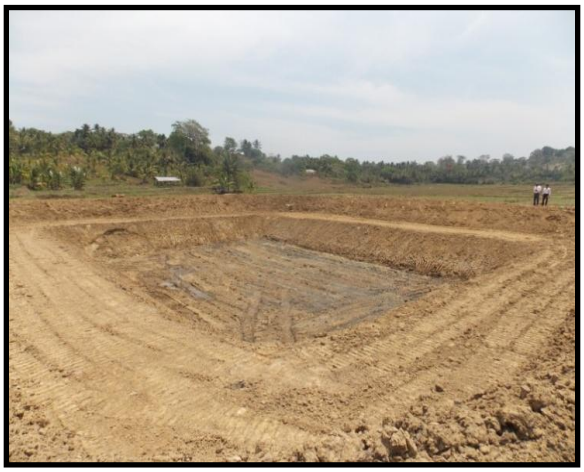


Fig 38. Construction of pond

Fig 39. Pond based IFS Model

Fig 40. Dugout farm pond in the month of March, 2014

Fig41. Post monsoon crops utilizing the harvested rain water

A.2.3. Desilting of farm ponds

- Desilting of 5 nos. of tanks (2 nos. of tanks in Port Mout and 3 nos. of tanks in Badmash pahad) has been carried out during April-May 2015 and another 2 nos. of tanks situated in Badmash pahad during March 2015. Desilting activity able to increase the volumetric capacities of desilted tanks by 15-20% over the original silted tanks (Figure 42,43 & 44).
- An additional 1200 cum of rain water harvested in 5 nos. of desilted tanks during the aberrant monsoon period of 2015-16.

Fig 42. Desilting activities (Ap-May,14)

Fig 43. Original silted tank

Fig 44. Dr. A. K. Singh, ZPD, Zone II inspects the desilting activities (March 2015)

A.2.4. Farm Pond cleaning for storage of Water and ground water recharge:

Fig 45. Water harvesting and recycling through pond and well

As per our advice, six farmers have cleaned their ponds manually for storage of rain water as these ponds were totally unutilized and covered with grasses and other vegetations. The farmers themselves engaged the labourers. After the cleaning, these ponds retained the water in summer months and farmers used this water to irrigate their field crops (app. 3.0 ha) as well as for their farm animals. Fish fingerlings (Av. 50 gms) were also given to the farmers for culture in the month of October, 2012 which now attained the average weight of 350 gms. This season efforts will be taken to dewater the ponds completely so that de-silting could be done for more water storage. Two ponds have been developed into an integrated farm model and remaining will be developing during this year (Figure 45).

A.2.5. Land manipulation and water harvesting through Broad bed and furrow (BBF) system

Three units of BBFs (Broad bed and furrow system) of size 33 m X 30 m were constructed to bring the unutilized lands to cultivation. One BBF is constructed in the brackish water and other two in the fresh waterlogged areas. These BBF systems convert the waterlogged areas to broad beds and furrows (Figure 46, 47 & 48). The broad beds of width 5 m are utilised for cultivation of vegetables and the furrows of depth 1m are utilised for rearing of fishes like singhi, magur, annabus species and cultivation of deep water paddy. Inputs supplied during the year include seedlings (tomato, brinjal, chilli) for the beds and fish fingerlings (grass carp) for the furrows and seeds (maize, black gram, ladies finger, fodder cowpea, agathi) for the bed. A gross return of Rs 23,600/- was observed against gross cost of cultivation of Rs 7,300/- with a net profit of Rs 16,300 and B: C of 3.23.

Fig 46. Broad bed and furrow system

Fig 47. Fish shelter of the BBF

Fig 48. Summer Crops on the bed of the BBF in March, 2014 (summer)

Three bunds of one BBF have been raised by excavating the trenches of one farmer of Badmas pahar during March 2015. The excavation of trenches will lead to the harvest of 252 cum of more rain water and raises the bunds by 0.5m to prevent the crops from submergence during upcoming rainy months.

A.3. Contour Bunding and Trenching:

After the tsunami, drastic changes in climatic conditions is noticed in the islands like unpredicted rains in summer, round the year flowering in some fruit plants and more diseases in crops and animals etc. To overcome the damage of vegetables in summer months due to rains, contour bunding and trenching is recommended in the sloppy land for vegetable cultivation. Across the slope cultivation of vegetables has been practiced in the adopted villages for minimizing the soil erosion and enhancing moisture conservation (Figure 49 & 50). Trenches and bunds are made along the contour lines and vegetables i.e. French beans, cow pea are cultivated on the bunds. This practice is suitable for soil moisture conservation as well as checking soil erosion during field preparation for vegetable cultivation in the sloppy land which also helped the farmers to cultivate vegetables during heavy rain and summer months with aerial mode of cultivation. This practice is followed in 3 farmers' field covering an area of 0.6 ha.

Fig 49. Contour bunds and trenches

Fig50.Cowpea on the contour bund

A.4. Drip Irrigation System

- Most of the plantation crops of the islands suffered and yield has been reduced due to the crop water stress during the dry period from mid-December to April. Some of the intermittent rainfall needs to be harvested and efficiently applied. For this drip irrigation system need to be installed for the plantation crops of the islands.

- Drip Irrigation system in three farmers' field has been installed to provide lifesaving irrigation during 5 months of dry period to 0.6 ha of field crops and 0.2 ha plantation crops and spices. The irrigation system has been installed in convergence with the NAIP project of CARI (Figure 51).

Fig 51. Pumping system with filter of the irrigation system

A.4.21. Mulching:

Mulching with coconut husk and paddy straw on vegetables and plantation crops (Coconut) was introduced for soil moisture conservation, which reduces the total crop water requirement during the dry spells (Figure 52). It reveals that a higher BCR of 1.8 is obtained for vegetable and plantation crops by practicing the mulching technologies. Some of the benefits gained through mulching are as follows:

- It can be incorporated as manures later.
- Influences thermal regime of soil by reducing soil temperature.
- Improves soil moisture storage from rainfall.
- Controls evaporation loss.
- Controls evaporation loss during seed germination.
- Effective utilization of initial soil moisture for crop establishment.

Fig 52. Mulching by Coconut husk, banana leaf and paddy straw

A.5. Aerial vegetable cultivation

- To conserve the moisture in the soil, cultivation of aerial vegetables in the month of November to December was recommended to cultivate aerial vegetables in the sloppy lands. A demonstration was conducted in two farmer's field in 1.2 ha with inputs like seed and fertilizer provided from the project which revealed that cracking of land was minimum and good green fodder (Grass) was available in February for the animals under the vegetable cover. It conserves soil moisture during dry season and reduces direct impact of rain drops on soil particles and controls splash erosion in sloppy land (Figure 53).
- The technology improves the soil texture by decomposing of the plant biomass and enhances the soil nutrients by growing the nitrogen fixing legume crops.

Fig 53. Aerial Vegetable cultivation

A.6. Vermi-composting

- Vermi-compost applications in field crops and vegetable cultivation retain more moisture in soil and create suitable condition for better root growth & proliferation.
- Due to application of vermin compost, crops require less water for irrigation due to conservation of soil moisture and soil microbes increases.
- Farm waste has been utilized for making of vermin-compost. A total of 4 units of vermin-compost units have been promoted and 2500 g of *Eisenia foetida* released in each unit (Figure 54).

Fig 54. Director, CARI visits on Vermi-compost unit

A.7. Intervention of Cost Effective Rain shelters

Crops cultivated in the adopted villages are exposed to high rainfall and high humidity during the rainy months. The occurrence of short duration high intensity rains in June-July 7 Nov.-Dec. resulted the heavy damage to the crops, hence the intervention of rain shelters made up of locally available materials are relevant to the cropping system.

Four nos. of rain shelters (cost effective poly houses) of sizes 10m X 5m each have been erected during the period to facilitate the high value crop production during the rainy months and prevent the crop from heat stress (Figure 55). The materials supplied under the project are shade net (50%), 200 micron UV film, GI Channel, Zig zag spring and insect proof net. The farmers contributed the wooden poles and purlins from bamboo and areca nut trunk and provided labour in the intervention. These rain shelters protect the seedlings from the excess high intensity

rainfall occurred during the month of October in which 46.7% more rainfall observed than the normal rainfall.

Benefits:

Farmers were able to cultivate high value crops like Capsicum, Cauliflower and nursery raising of tomato, chilli & brinjal for Rabi crops without damage.

Fig 55. Cost effective poly houses after the intervention

A.8. Drainage improvement through MNREGA for excess water flow:

About 12 ha area was always flooded either with sea water or freshwater and these land was without any use. KVK approached the Gram Pradhan of the area for improvement of drainage system in the area and the Gram Pradhan has taken initiatives for cleaning of drainage through MNREGA and about 1800 mt long drainage system was improved. This resulted in drainage of excess water and drying of the area. In summer months this area could be used for grazing of farm animals of the villagers (Figure 56).

Fig 56. Drainage improvement through MNREGA

Table 32. Details of technological interventions under Natural Resource Management

Interventions	Technology demonstration	Critical input (Variety, fertilizer/ chemicals doses	No. of farmers	Area (ha)	Measurable indicators of output*	Economics of demonstration (Rs/ha)			
						Gross cost	Gross return	Net return	BC
1	2	3	4	5	6	7	8	9	10
In-situ moisture conservation RCT	Aerial Vegetable cultivation in sloppy land(Bitter gourds)	Nylon rope for machan preparation	08	1.2	Reduced the soil erosion and conserve the moisture during the dry period	52200	192685	140485	3.69
	Mulching with coconut husk	Coconut husk	03	1.4	Conservation of soil moisture and enhance the vegetative growth in brinjal.	47600	52360	4760	1.10
	Paddy straw mulching Contour cultivation across slope	Paddy straw Making of contour lines.	03	0.6	Prevent runoff rain water and soil erosion in sloppy areas	97500	176000	78500	1.80

Interventions	Technology demonstration	Critical input (Variety, fertilizer/ chemicals doses	No. of farmers	Area (ha)	Measurable indicators of output*	Economics of demonstration (Rs/ha)			
						Gross cost	Gross return	Net return	BC
1	2	3	4	5	6	7	8	9	10
Water harvesting and recycling for supplemental irrigation	Tank cum well irrigation system	3 hp diesel pump set/ 2Hp mono block electric pump set, 50 mm dia. PVC pipes with connecting materials and electrical connecting materials	02	1.6	Harvesting of seepage water from tank during deficit period to meet crop water requirement resulted into increase in crop area and yield.	122000	285480	163480	2.34
	Construction of a new dug out pond (size: 30m X 22m X 2.5m)	Cost for hiring of mechanical excavator (March, 2013)	01	0.066	Rain water harvest for summer/rabi crops	163200	-	-	-
	Construction of 2 unit of Broad Bed Furrow system (each	Cost for hiring of mechanical excavator (March, 2013)	02	0.165	Utility of low lying area for vegetable and fish	86400	-	-	-

Interventions	Technology demonstration	Critical input (Variety, fertilizer/ chemicals doses	No. of farmers	Area (ha)	Measurable indicators of output*	Economics of demonstration (Rs/ha)			
						Gross cost	Gross return	Net return	BC
1	2	3	4	5	6	7	8	9	10
	area: 33m X 25m) in fresh water logging areas.								
	Construction of 1 unit of Broad Bed Furrow system (area: 33m X 30m) in saline water logging areas.	Cost for hiring of mechanical excavator (March, 2013)	01	0.825	Utility of low lying brackish area for fish and vegetable	43200	-	-	-
Improved drainage in flood prone areas	-	-	-	-	-	-	-	-	-

Interventions	Technology demonstration	Critical input (Variety, fertilizer/ chemicals doses	No. of farmers	Area (ha)	Measurable indicators of output*	Economics of demonstration (Rs/ha)			
						Gross cost	Gross return	Net return	BC
1	2	3	4	5	6	7	8	9	10
Conservation tillage where appropriate	-	-	-	-	-	-	-	-	-
Moisture stress	Creation of new water harvesting structures through convergence from NAIP Project	Broad Bed and Furrow System (BBF), Paddy cum Fish, Three-tier system (March, 2013)	6	1.24	Fish culture and irrigation	-	-	-	-
	Renovation of old water harvesting structures	One farm pond (March, 2013)	1	0.08	Fish culture and irrigation	-	-	-	-

Interventions	Technology demonstration	Critical input (Variety, fertilizer/ chemicals doses	No. of farmers	Area (ha)	Measurable indicators of output*	Economics of demonstration (Rs/ha)			
						Gross cost	Gross return	Net return	BC
1	2	3	4	5	6	7	8	9	10
	Micro irrigation with drip /sprinkler system	Drip irrigation (March, 2013)	3	0.80	Water use efficiency and yield enhancement during dry spell	-	-	-	-
Shallow soil profile	-	-	-	-	-	-	-	-	-
Flooding	Improved drainage system	Convergence with Panchayat under MNREGA	75	Length1900 mtr, width-5m and depth 1m	Safe disposal of runoff to prevent water logging during high rainfall	-	-	-	-
	A drainage nallah of 100m length, 1.5 m width and 0.5 m	Convergence with Panchayat under MNREGA (February, 2013)	15	0.015	Safe disposal of runoff to prevent water logging during high	-	-	-	-

Interventions	Technology demonstration	Critical input (Variety, fertilizer/ chemicals doses	No. of farmers	Area (ha)	Measurable indicators of output*	Economics of demonstration (Rs/ha)			
						Gross cost	Gross return	Net return	BC
1	2	3	4	5	6	7	8	9	10
	depth was dug to improve drainage in flood prone area in convergence with MNREGA.				rainfall in flood prone areas				
Recycling organic matter	Compost /vermi compost	2500 g of *Eisenia foetida* released in each unit. (December, 2012)	4	0.005	Improvement of soil health and promotion of organic cultivation in the villages.	-	-	-	-
Fodder grass on farm bund	Cultivation of high yielding grass	Fodder grass (Hy. Napier) is planted in pond embankment	02	0.04	Enhancement of milk production	2500	6500	5000	2.60

Table 33. Management of common pool resources (CPRs) through NICRA

Year	CPR	Area (ha) or Numbers	Current status (before start of NICRA)	
			Before	After
2011-12	Pond	05	05 defunct	NA
2012-13	Pond	05	05 defunct	05 renovated
2013-14	Pond	05	05 defunct	02 renovated
2014-15	Pond	04	02 defunct	04 new created
2015-16	Pond	02	NA	02 new created
2016-17	Sluice gate Convergence	02	02 defunct	02 renovated
2017-18	Pond	03	01 defunct	02 new created

Table 34. Measure taken in water harvesting interventions through NICRA in adopted village

Sl. No	Structures/Years of Construction	Category	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1	Community pond /tank	Constructed	-	01	03	-	-	02	02
		Promoted as Tank well system	01	02	02	02	02	02	-
		Repaired/ Renovated/ Desilted	-	-	-	07	07	-	01
2	BBF		-	25	14	05	07	-	-
3	Bund Raising		-	-	-	01	01	01	-

Table 35. Water harvesting and recycling for supplemental irrigation

Technology demonstrated (During 2011-12 to 2017-18)	No. of farmers	Area (ha)/Unit	Output (q/ha)	Economics of demonstration (Rs/ha)		
				Gross Cost	Net Return	BCR
Tank cum well irrigation system 1. 2011- 2012	1	1.3 (irrigated area)	-	15000	33800	3.2
2. 2012-2013	2	1.6 (irrigated area)	-	122000	163480	2.34
3. 2013-2014	2	6.0 (irrigated area)	-	158500	376800	3.38
4. 2014-2015	2	0.0165 (pondage area)	-	59500	80500	2.35
5. 2016-2017	2	0.0165 (pondage area)	-	535300	158500	3.38
Construction of new dug out ponds 1. 2012-2013	1	0.066 (pondage area)	-	163200	-	-
2. 2013-2014	3	0.066 (pondage area)	-	32000	43000	2.34
3. 2016-2017	2	0.165 (pondage area)	-	225000	-	-
4. 2017-2018	2	0.216	-	206100	-	-
Renovation of pond for fish production and irrigation 1. 2012-13	1	0.08 (pondage area)	-	-	-	-
New water harvesting structure in the paddy field (Paddy cum fish , Three tier system) 1. 2012- 2013			-	-	-	-

	6	1.24				
Renovation of old water harvesting structure 1. 2012-2013 2. 2017-2018	 1 1	 0.08 0.0425	 - -	 - 48720	 - -	 - -
Renovation of common pond			-			
Creation of new water harvesting structures through convergence from NAIP Project	6	1.24	-	-	-	-
Desilting of dug out ponds 2014-2015 2015-2016	 7 7	 0.483 0.483	-	 42720 42720	-	-
Broad Bed Furrow 1.2012-2013	 3	 0.99	-	 129600	-	-
2.2013-2014	2	0.165	-	7300	16300	3.23
3.2014-2015	1	0.0495	-	19580	-	-
4.2015-2016	1	0.0495	-	19580	-	-
Bund raising of existing small bund 2016-2017	 1	 0.0187		 32400	-	-
Total	**54**					

Table 36. Performances of demonstration of in-situ moisture conservation technologies

Technology demonstrated (During 2011-12 to 2018-19)	No. of farmers	Area (ha)	Yield (q/ha)	Economics of demonstration (Rs/ha)		
				Gross Cost	Net Return	BCR
Fodder grass on farm bunds	02	0.04		2500	5000	2.6
Mulching (Coconut husk, Paddy straw, Banana leaf) 1. 2011- 2012	19	2.3		48700	131875	3.7
2. 2012-2013(Coconut husk)	03	1.4		47600	4760	1.10
2012-2013 (Paddy straw)	03	0.6		97500	78500	1.8
3. 2013-2014	04	1.2		4250	12750	4.00
Aerial Vegetable cultivation in sloppy land (Bitter gourd) 1. 2011-2012	06	0.9		48700	131875	3.7
2. 2012-2013	08	1.2		52200	140485	3.69
3. 2013-2014	06	3.5		72000	103000	2.40
Total	**51**	**11.14**				

Table 37. Performance of different water saving irrigation methods

Technology demonstrated (During 2011-12 to 2016-17)	No. of farmers	Area (ha)	Output (q/ha)	Economics of demonstration (Rs./ha)		
				Gross Cost	Net Return	BCR
Drip irrigation 1. 2012-2013	3	0.80	-	-	-	-
Vermi-compost from biodegradable wastes	4	0.005	-	-	-	-

Table 38. Performance of other demonstrations

Technology demonstrated (During 2011-12 to 2016-17)	No. of farmers	Area (ha)	Output (q/ha)	Economics of demonstration (Rs./ha)		
				Gross Cost	Net Return	BCR
Small irrigation tanks in the recharge zone	02	0.2	-	10000	29500	3.9
Farm mechananization in paddy transplanting	1	0.03	-	29170	8850	1.3
Renovation of old water harvesting structure (farm pond)	1	0.08	-	-	-	-
Cost effective poly house 2014-2015 2015-2016	04 04	0.02 0.02	-	98060 98060	-	-
Total	**12**	**0.35**	-	-	-	-

COMPONENT II

CROP

PRODUCTION

B. Major intervention in crop Production

(a) SRI method: It recorded 38.1% higher root mass which enhances nutrient and moisture from the rhizosphere. SRI method has obtained higher yield attributes and yield as compared to traditional method of rice cultivation. More number of productive tillers/m^2 (341) was registered in SRI method which was 33.5% higher tiller production than farmer practices. SRI recorded maximum grain yield of 42.95 q/ha and straw yield of 68 q/ha which was 36.4 % higher grain yield over farmers practice. The highest B: C ratio of 2.30 was recorded in SRI method but farmer's practices registered B: C ratio of 1.87 (Figure 57).

Field day was organized on System of Rice Intensification (SRI) at Port Mout village on 25.11.2011. During the field day 30 farmers and farm women participated in the programme. Mrs. Uma Saha , progressive farmer of Badmaspahar shared her experience with fellow farmers of adopted villages of NICRA. She explained the difficulties and benefits of adoption of SRI in the paddy fields.

Fig 57. SRI MAT Nursery, planting and weeding

(b) Salt tolerant paddy (CARI Dhan-5)

Salt tolerant variety was demonstrated in sea water inundation of tsunami affected land in adopted villages. CARI Dhan-5 recorded yield of 3770 kg/ ha which was 25.6 % higher yield as compared to local check (Jaya) (Table 39 & Figure 58).

Table 39. Performance of salt tolerant paddy & local check

Parameters	CARI Dhan - 5	Jaya
Plant height (cm)	141.9	156.7
Productive tillers/m^2	279.0	230
Panicle length (cm)	26.3	24.9
No of filled grains/panicle	156	127
Grain yield (kg/ha)	3767	3002
Straw yield(kg/ha)	6525	5119

Fig 58. Field Day on CARI Dhan-5

(c) Short duration paddy MLT-10

Short duration rice varieties of MLT 10 were introduced in late onset of monsoon season to take advantage of the existing water resources available during the season and early cultivation of vegetable crops during Rabi season. MLT 10 gave grain yield of 3.6 t/ ha as compared to local check (Table 40 & Figure 59).

Table 40. Performance of short duration paddy

Parameters	MLT 10	ADT 45
Plant height (cm)	140.1	161.2
Productive tillers/m^2	18.8	15
No of filled grains/panicle	100.1	92.6
grain yield (kg/ha)	3640	2980
straw yield(kg/ha)	5950	5720


Fig 59. Use of *Vitex trifolia* – An insect repellent plant

(d) Utilization of residual soil moisture and soil enrichment through short duration pulses (Drought resistant black gram and green gram)

Seed hardening of black gram and green gram with 100 ppm $ZnSO_4$ increased germination percentage of 39% as compared to untreated seeds in per sqm which also induces better root development which enables absorption of more moisture. It enhances enrichment of soil by fixing atmospheric N in their root nodules and plant biomass added into the soil Figure 60, 61 & 62).



Fig 60. Control plot

Fig 61. Treated plot

Fig 62. Director visits

(e) Intercropping system in maize.

- Intercropping in maize is practiced in the adopted villages to increase the total productivity per unit land area by judicious utilization of resources such as land, labour and inputs. Various intercropping system like Maize + Radish, Maize + water melon, Maize + Bhendi are followed in the area.
- Among the intercropping system maize + bhendi and maize + radish has exploiting more nutrient and water as compared to Maize + water melon (Figure 63).



Fig 63. Director CARI visits to the Intercropping system

(f) Drought tolerant paddy (Sahbhagi dhan)

In Andaman and Nicobar Islands, rice is cultivated in about 7650 ha and it is a lifeline cereal crop of the area. Continued rainfall for eight months leads to problem of harvesting, drying and processing of short duration varieties during rainy season. Medium duration varieties will come to harvest during low rainy months (October – November). Drought tolerant paddy variety of sahbhagi dhan was introduced in drought prone village of Port Mout in an area of 0.1 ha. *Sahbhagi Dhan* (SD) is known to be a drought tolerant paddy variety which will withstand even up to 12-15 days of drought situation. *Sahbhagi Dhan* (SD) is more suitable for upland condition as well as second crop in Andaman & Nicobar Islands because of it drought tolerant characters. Sahbhagi dhan provides new hope to the farmers in drought prone areas which is responsible for tolerance during the vegetative stage to panicle initiation stage. Among the rice cultivars, number of productive tillers exhibited significant variation due to cultivars. Maximum number of 278 productive tillers/ m^2 obtained with sahbhagi dhan was significantly superior to that of control (232 productive tillers/m^2). Panicle length (22.5 cm), numbers of grains/ panicle (192) were registered higher in drought tolerant paddy. Higher grain (4570 kg/ha) was recorded with sahbhagi dhan followed by farmers variety which led to 18.7 % higher yield than other cultivar. Higher yield under sahbhagi dhan was mainly due to more number of productive tillers/hill and no of grains/ panicle consequently higher uptake of nutrients from soil. Higher gross return (Rs. 45700 ha^{-1}) and net return (Rs. 20950ha^{-1}) with B: C ratio of 1.85 was recorded in Sahbhagi dhan is mainly due to numerically higher grain and straw yield. Performance of sahbhagi dhan is more acceptability by the farmers (Table 41 & Figure 64).

Table 41. Effect of drought tolerant cultivar on growth, yield attributes and economics of rice

Parameters	Sahbhagi dhan	Control (MTU-1010)
Plant height (cm)	104.3	125.7
Productive tillers/m2	278	232
Panicle length (cm)	22.5	20.3
No. of Filled grains/panicle	192	151
Test weight (g)	28.9	25.3
Grain yield (kg/ha)	4570	3850
Cost of cultivation (Rs./ha)	24750	24750
Gross return (Rs./ha)	45700	38500
Net retun (Rs./ha)	20950	13750
B:C ratio	1.85	1.56
Yield increase (%)	18.7	-

Fig 64. Field view on Sahbhagi dhan

g). Salt tolerant paddy varieties (CSR-36)

Salt tolerant variety was demonstrated in sea water inundated tsunami affected land in two farmer's field in an area of 0.4 ha per farmer during the rainy season (July to December, 2013). The results revealed that paddy variety brought significant variation on growth and yield attributes of paddy. Bhavani dhan produced taller plant than salt tolerant cultivars. Significantly higher number of 324 productive tillers/m^2 produced by CSR-36 compared to local check besides it recorded significantly higher panicle length (22.7 cm) and more no of filled grains/panicle (129 Nos). CSR-36 recorded more grain yield of 4620 kg/ha which was 11.3 % higher yield as compared to local check (Bhavani). CSR-36 gave highest net return and B:C ratio (Rs. 24015/- and 1.94) while bhavani was least profitable (Rs.15850/- and 1.62) (Table 42, Figure 65 & 66).

Table 42. Performance of salt tolerant cultivar on growth, yield attributes & economics of rice

Parameters	CSR -36	Control (Bhavani)
Plant height (cm)	112.2	132.5
Productive tillers/m^2	324	285
Panicle length (cm)	22.7	19.8
No of filled grains/panicle	129	105
Grain yield (kg/ha)	4620	4150
Cost of cultivation (Rs./ha)	25650	25650
Gross return (Rs./ha)	49665	41500
Net return (Rs./ha)	24015	15850
B:C ratio	1.94	1.62

Fig 65. Control (Bhavani) Paddy (CSR-36)

Fig 66. Field view on salt tolerant paddy (CSR-36)

(h) Drought tolerant paddy (Naveen dhan)

Drought tolerant paddy variety (Naveen dhan) was demonstrated in drought prone area in one farmer field in an area of 0.1 ha during the rainy season (August to December, 2014). The results revealed that paddy variety brought significant variation on growth and yield attributes of paddy. Swarna dhan produced taller plant than Naveen dhan. Significantly higher number of 284 productive tillers/m^2 produced by Naveen compared to local check besides it recorded significantly higher panicle length (23.6 cm) and more no of filled grains/panicle (194 Nos). Naveen recorded more grain yield of 3280 kg/ha which was 27.6 % higher yield as compared to local check. Even though, Naveen dhan faced moisture stress (48.6% deficit rainfall) during early stage of crop growth. 46.7 % higher rainfall was received as compared to Normal rainfall during October, 2014. At the same time, field was fully covered by eroded soil and suggested to remove excess soil and applied 25 % of excess nitrogen for quick establishment. Naveen dhan gave highest net return and B:C ratio (Rs. 11300/- and 1.55) while Swarna was least profitable (Rs.4200/- and 1.20) (Table 43, Figure 67, 68 & 69).

Table 43. Performance of salt tolerant cultivar on growth, yield and economics of rice

Parameters	Naveen dhan	Swarna
Plant height (cm)	101.2	122.7
Productive tillers/m^2	284	212
Panicle length (cm)	23.6	20.7
No of filled grains/panicle	194	128
Grain yield (kg/ha)	3280	25700
Cost of cultivation (Rs./ha)	21500	21500
Gross return (Rs./ha)	32800	25700
Net return (Rs./ha)	11300	4200
B:C ratio	1.55	1.20

Fig 67. Covered with eroded soil

Fig 68.Moisture stress (Sept.,2014)

Fig 69. Field view of Naveen dhan

(i) Paddy cum daincha

The experiment was conducted in two farmer's field in an area of 0.4 ha per farmer during the rainy season (July to November, 2013). The soil was clay loam with medium organic carbon (0.35%), low in available nitrogen (195.3 kg ha^{-1}), low in available phosphorus (6.5 kg ha^{-1}) and medium in available potassium (225.8. kg ha^{-1}). Pre germinated paddy seeds @ 30 kg ha^{-1} and daincha seeds @ 20 kg ha^{-1} were sown simultaneously by using paddy cum daincha seeder (TNAU, Coimbatore, India) and the field was slightly flooded after 24 hours. The green manuring of daincha incorporation was done at 30 days after sowing by spraying 2, 4-D @ 1.0 kg·ha^{-1} . The recommended dose of fertilizer @ 90: 60: 40 kg NPK were applied as urea, Rock phosphate and muriate of potash as per the schedule (@75%) i.e., 25% N, 100% P was applied as basal; 50% N and 50 % K applied at tillering stage; 25 % N and 50 % K applied at Panicle initiation stage. The predominant weed of experimental field were *Cyperus iria, Cyperus rotantus, Cyperus difformis, Fimbristyllis milliacea, Monochoria vaginalis*, *Marselia quadrifolia etc. adoption of different w*eed management practices significantly variation in yield attributes and yield of rice. Results revealed the beneficial effect of concurrent growing of daincha with rice. Concurrent growing of daincha and its subsequent incorporation significantly increased the yield of rice compared to rice alone. The yield increase was to the tune of and 13.0 %. Growing daincha along with rice and its subsequent incorporation thus can reduce the use of nitrogenous fertilizers approximately by 25%, without affecting grain yield which is due to biomass addition and subsequent increase in the availability of nutrients in the soil.

Significant variations were observed on total weed density and dry weight at 20 and 40 DAP due to adoption of weed management practices. The lowest weed count and dry weight were recorded in plots where daincha incorporated by using 2, 4-D spray without affecting the yield or nutrient content of soil. Higher gross return (Rs. 49500 ha^{-1}) and net

return (Rs. 29375 ha^{-1}) with B: C ratio of 2.46 was recorded in brown manuring plot which is mainly due to numerically higher grain and straw yield. Soil nutrient status in terms of available N was assessed at harvest stage which indicated daincha incorporated plot had significant effect on available soil N status (278.8 kg ha^{-1}) which might be due to incorporation of danicha (Table 44, Figure 70, 71 & 72).

Table 44. Effect of paddy cum daincha on growth, yield attributes and economics of rice

Parameters	Paddy cum daincha	control
Plant height (cm)	119.2	98.9
Root length (cm)	23.3	17.9
Root dry weight (g/hill)	16.3	12.8
Productive tillers/m2	328	284
Panicle length (cm)	21.9	19.2
No. of Filled grains/panicle	89.2	77.8
Test weight (g)	24.6	19.6
Grain yield (kg/ha)	4950	4380
Cost of cultivation (Rs./ha)	20125	24760
Gross return (Rs./ha)	49500	43800
Net retun (Rs./ha)	29375	19040
B:C ratio	2.46	1.77
Yield increase (%)	13.0	-

Fig 70. Field visited by KVK experts

Fig 71. Field view at harvesting stage

Fig 72.Spraying of 2,4-D @30 DAT

(j) Utilization of residual soil moisture and soil enrichment through short duration pulses (Drought resistant black gram)

Seed hardening with 100 ppm $ZnSO_4$ increased germination percentage of 35.7 % as compared to untreated seeds in per sqm which also induces better root development which enables absorption of more moisture (Figure 73 & 74).

Justification: Seed hardening develop a more extensive system, thus enabling them to survive better under drought conditions. It is possible that early radicle emergence in the field and simply give the plant a better start than control. Seed hardening with chemicals found to

increase root growth even at the seedling stage. This will have a favourable influence on dry land and post monsoon season situations. More root dry weight of 0.146 g/plant and root length of 14.2 cm were recorded under $ZnSo_4$ treated plot as compared to control (11.3 cm), which helps in maintaining high moisture status of plant leaf and increase in productivity and also which indicated the drought tolerant nature of the crop (Figure 75).

Fig 73.Control

Fig 74. Treated plot

Fig 75. Effect of seed hardening on root & plant growth of blackgram

(k) Downey mildew resistant maize (CoH (M)-6

Maize hybrid CoH (M) – 6 was sown in IInd week of February, 2015 with a single row using a seed rate of 20 kg ha^{-1} in 60 cm apart rows. Plant to plant distance of 25 cm was maintained by thinning at early growth stages. The fertilizer was applied at 120 kg nitrogen and 50 kg phosphorous ha^{-1} as urea and diammonium phosphate, respectively. Whole of phosphorous and half of nitrogen was side dressed just after sowing, while, remaining

Nitrogen was top dressed with 2nd irrigation. Manual hand weeding was done at 30 DAS when soil was at field capacity. The crop is in flower initiation stage.

(l) Utilization of residual soil moisture and soil enrichment through short duration pulses (Drought resistant black gram)

Blackgram was grown for utilization of residual soil moisture during dry season as fits well in cropping system and provide remunerative price to the farmers. Farmers are normally sown very old variety of T – 9 blackgram which is more susceptible to Yellow Mosaic Virus disease at the same time farmers were getting poor yield and income. Summer sown crops are highly susceptible YMV at the same time the virus spreads through wind-borne viruliferous white fly, *Bemisia tabaci.* Keeping in this view, KVK was introduced yellow mosaic virus resistant blackgram variety (VNB (Bg) - 6) in five farmers field in an area of 0.4 ha per farmer (Figure 76). Seed hardening with 100 ppm $ZnSO_4$ increased germination percentage of 29.5 % as compared to untreated seeds in per sqm which also induces better root development which enables absorption of more moisture. Seed hardening develop a more extensive system, thus enabling them to survive better under drought conditions. It is revealed that early radicle emergence in the field and simply give the plant a better start than control. Seed hardening with chemicals found to increase root growth even at the seedling stage. This will have a favourable influence on dry land and post monsoon season situations.

Fig 76: Black gram crop

(m) CARI Poi selection as saline and drought resistant crop

Poi (*Basella alba* L) variety - CARI Poi Selection with high yield potential and is tolerant to diseases and pests. This variety showed better performance on raised beds in heavy rains conditions and also showed partial tolerance to drought situation in the field. This genotype has the potential to be grown in climate change affected regions for higher primary productivity, field tolerance to abiotic stresses (water logging, drought, low level of salinity and acidic soils) and acceptance among the local communities. CARI Poi selection recorded yield of 5.4t/ha which was 32% higher yield as compared to local check (green pole type) (Figure 77)

.


Fig 77. Field view of CARI Poi selection variety

(n) CARI AMA-Green and CARI-AMA-Red drought tolerant leafy vegetables

Vegetable Crops need to be grown on the raised bunds and also on soils to tolerate the heavy rain and drought conditions to enhance the cropping intensity. Usually, the selection for crop for diversification is not scientific and climate related which leads to poor yield or sometimes crop failure. Relevance of the intervention is the cultivation of Leafy vegetables *var.* CARI-poi and CARI AMA-Green and CARI-AMA-Red drought tolerant leafy vegetables to shows better performance without damage on raised beds in heavy rains and partial tolerance to drought and can be grown on Tsunami affected land having EC 0.25 dSm^{-1}. The island condition is very much conducive to disease and pest in Khariff and Rabi season for vegetable and CARI Poi is resistant to climate vagaries.

The Amaranthus has partial tolerance to drought, partial shade and problematic soils. The improved genotypes CARI AMA-Green and CARI-AMA-Red which were bred for yield and dietary micronutrients also showed better performance for drought tolerance in field situation. These are promising genotypes and showed better performance in field condition. CARI AMA-Green recorded yield of 7.2t/ha followed by CARI-AMA-Red 7.0t/ha which was 21% higher yield as compared to local check (Figure 78, 79 & 80).

Fig 78: CARI AMA-Green crop

Fig 79: CARI-AMA-Red crop

Fig 80. Field view of CARI AMA Green variety

(o) Introduction of Tissue Culture Banana

Local variety of banana like China Kela , Meetha champa and Khata champa are tall varieties and growing wildly in Andaman with almost zero management. Tall varieties are not suitable in open field conditions on pond dyke and orchards, as lodging occurs during the strong wind and heavy rainfall. So dwarf variety of Tissue culture Banana (Grand Naine) found suitable on pond dyke as well as in open field areas with minimum loss and maximum benefits to the farmers in the adopted villages (Figure 81).

Fig 81. T.C. Banana (G-9) in hilly land, plain land and pond dykes

(p) Drought resistant Dhania

False coriander (CARI Broad Dhania-1) is a leafy vegetable spice grown luxuriantly under semi partial area in coconut and arecanut crops round the year. It is a drought resistant variety, grows within short time, fetching good remunerations, checks the soil erosion during heavy rain and has got round the year market demand without price fluctuations (Figure 82).

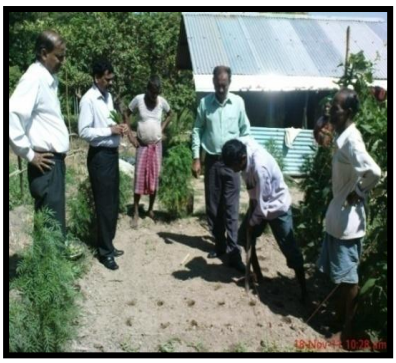



Fig 82 CARI Broad Dhania-1 distribution in village

(q) Brinjal- CARI Brinjal -1 is a variety resistant to bacterial wilt and susceptible in drought prone area recommended in to the project area with a farmer's variety Pusa purple cluster in an area of 1.5 ha for 5 farmers. The yield recorded in CARI Brinjal -1 was 25 t/ha with a BC ratio 4.1 against the local PPC 12 t/ha with BCR 1.6 (Figure 83).

(r) Cow Pea - Creeper long is a resistant to fruit borer and a thick pod suitable during the dry period, good keeping quality and high market price, grown in an area of 1.0 ha. It gives 5.2 t/ha demonstration (Creeper long), 2.8t/ha local (lafa), with the BCR of 3.6 and 1.5.



Fig 83. Brinjal (CARI-I), Cowpea (Chakra) and Okra (Bhendi no-64)

(s) Okra (Bhendi no-64) is a free from yellow vein mosaic and suitable in both kharif and rabi season. It gives 7.5 t/ha with a BCR 4.0 followed by the Arka anamika3.8 t/ha with a BCR 2.2. Non-traditional vegetables like French bean (Arka Komal) performed well during the November to January. It gives 8.1 t/ha with the BCR of 2.5 and fetched high market value.

(t) Elephant Foot Yam C.V. Gajendra : Conducted 6 FLD on organic cultivation of elephant foot yam var.Gajendra in farmers filed at Port Mout, Lal phar, Rangachang, Ferrar Gunj and Guptaphara villages of South Andaman in an area of 0.05 – 0.2ha and recorded the yield of 800- 3400 kg/farmer. Each farmer has earned net income of Rs. 12,000 – 51,200 from elephant foot yam cultivation with B: C ratio ranging from 2.8 to 3.3 (Figure 84).

Fig 84: Elephant Foot Yam cv. Gajendra

(u) Production of Colocasia c.v. Sree Kiran: Conducted six numbers of FLD on organic cultivation of Colocasia c.v. Sree Kiran in farmers filed at Nayapuram, Mucca pahad, Calicut, Bimblitan and Ogra braj villages of South Andaman in an area of 0.12 ha and recorded the yield of 180 - 200 kg/farmer. Each farmer has earned average net income of Rs. 5700 from Colocasia with a B: C ratio of 2.9 (Figure 85).

Fig 85. Field view of Colocasia cv Sree Kiran

B2. Integrated Disease and Pest Management in NICRA village

Introduction:

One of the major challenges facing farmers of NICRA-village is disease and pest management. The losses in agriculture production due to disease and pest can be significant and devastating under favourable conditions. The losses may be caused by varieties of factor such as fungi (*Alternaria* spp., *Cercospora* spp., *Colletotrichum* spp., *Curvularia* spp., *Diplodia* spp., *Fusarium* spp., *Helmitosporium* spp., *Phytophthora* spp., *Pythium* spp., *Rhizoctonia* spp., *Pestalotia* spp., powdery and downy mildew genera etc.,) bacteria (*Erwinia* spp., *Pseudomonas* spp., *Ralstonia* spp., *Xanthomonas* spp., *Agrobacterium* spp., *Phytoplasma* etc.,) viruses (*Cucumber mosaic virus, Tomato spotted wilt virus, Cauliflower*

mosaic virus, Banana bunchy top virus, Bean yellow mosaic virus, Chilli mosaic virus, Papaya ring spot virus, etc.,*)* and insects (*Helicoverpa armigera*, leaf miner (*Liromyza trifolii*), whiteflies (*Bemicia tabacii),* tobacco caterpillar (*Spodoptera lituara),* red spider mites (*Tetranychus urticae),* bbrinjal shoot and fruit borer (*Leucinode orbonalis*), leafhopper (*Amrasca biguttula*), thrips (*Scirtothrips dorsalis*), diamond back moths (DBM) (*Plutella xylostella*), fruit fly (*Bactocera cucurbitae*) etc.,).For the control of these challenging pests a lot of pesticides are used. Concerns over environmental pollution and food quality degradation caused by excessive use of pesticides and fertilizers have prompted to find alternatives for agrochemicals. Integrated pest management (IPM) is a novel approach for pest management that utilizes regular monitoring to determine whether and when management are needed and employs physical, mechanical, cultural, biological and chemical tactics to keep pest populations low enough to prevent unacceptable damage.

A. Major Insect pest and their management in NICRA Village

1. Fruit Borer (*Helicoverpa armigera*)

The adult is stout and medium-sized moth and has a dark circular spot in the centre on the forewing. They lay small, single, and whitish round eggs on the trifoliate leaves beneath the topmost flower cluster. Eggs hatch in about 3-4 days and the first instars larvae initially feed on the leaves and migrate to the developing green fruit later. The larvae bore into the fruits with the posterior end outside the hole. Full grown caterpillars show characteristic whitish and dark brown longitudinal stripes.

Management:

- Effective management can be done by adopting marigold as trap crop.
- Giving sprays of Ha NPV @ 250 LE /ha at 28, 35 and 42 days after transplanting.
- Mechanical collection and destruction of bored fruit at periodic intervals (3-4 times) brings down the borer incidence to less than 2 per cent.

2. Serpentine Leaf Miner (*Liromyza trifolii* Burgess)

The tiny, metallic fly punctures the leaf lamina and feeds on the oozing sap. It lays eggs on the outer margin of leaves. Within 2-3 days, whitish maggots hatch out of these eggs and start mining the leaves and pupate in 6-10 days.

Management

- Often the incidence starts from nursery itself. Hence, remove infected leaves at the time of planting or within a week of transplanting.

- Apply neem cake to furrows (open)/beds (polyhouse) @ 250 kg/ha at planting and repeat after 25 days.
- Spray neem seed powder extract 4% or neem soap 1% at 15-20 DAPS.
- In open conditions, if the incidence is high, remove infected leaves.

3. Whiteflies (*Bemicia tabacii)*

Whitefly is a well-known vector, which transmits tomato leaf curl virus. It has piercing and sucking mouthpart and both nymphs and adults feed on lower surface of the leaves causing deformation of young leaves.

Management:

- Use virus resistant hybrids.
- Raise nurseries in seedling trays under nylon nets or polyhouses.
- Spray Imidacloprid 200 SL (0.3ml/l) or Thiomethoxam 25 WP (0.3 g/l) in nursery at 15 days after sowing.
- Remove the leaf curl infested plants as soon as disease symptoms are expressed. This helps in reducing source of inoculums of the disease.
- Drench the base of the seedlings with Imidacloprid 200 SL (0.03ml/l) or Thiomethoxam 25 WP (0.3 g/l) before transplanting. If protreys are used for raising nursery, drench the protreys with the chemicals one day before transplanting.
- After transplanting give need-based sprays of Imidacloprid 20 SL (0.3ml/l) or Thiomethoxam 25 WP (0.3 g/l) at 15 days after planting and do not repeat after fruiting stage as this may leave harmful residues in fruits.

4. Tobacco Caterpillar (*Spodoptera lituara)*

This is a minor pest under open conditions and assumes severe form under protected cultivation particularly in ill managed playhouses.

Management:

- Collection and destruction of egg masses and gregarious larvae.
- Spray *Spodoptera* NPV 250 LE/ha + 1% jiggery along with sticker (0.5 ml/litre) during evenings.
- Use poison baiting. Mix 10 kg of rice bran or wheat bran with 2 kg jaggery by adding a little water in the morning + Neem oil

5. Red Spider Mites (*Tetranychus urticae)*

Red spider mites thrive under high temperature, dry weather and are more serious under protected conditions.

Management:

- Remove and destroy the affected leaves.
- Under open conditions, spray Dicofol 18.5 EC @ 2.5 ml or wettable sulphur 80 WP @ 3g/l. Spray lower leaves and lower leaf surface thoroughly as mites are generally observed there.
- As an alternative to the chemical acaricides spray neem oil/neem soap/ pongamia soap 1%.
- Under polyhouse conditions spray need-based application of acaricides like Abamectin 1.9 EC @ 0.5 ml/l or Dicofol 18.5 EC @ 2.5 ml/l or Fenazaquin 10 EC @ 1 ml/l in rotation with plant products like pongamia oil or neem oil (8-10 ml/l) or neem soap (10 g/l).
- When incidence is severe, remove and destroy all severely infected leaves followed by a spray of mixture of an acaricide with botanicals mentioned above.

6. Brinjal Shoot and Fruit Borer (*Leucinode orbonalis* Guen)

This pest has developed resistance against all groups of insecticides and management is very difficult. The adult moths lay tiny white eggs singly on flower buds and other plant parts. Eggs hatch into small light brown larvae. Caterpillars feed inside the tender shoots before flowering and cause wilting of the affected shoots.

Management:

- Use nylon net barrier for raising nurseries to eliminate pest incidence coming from nursery to main field.
- Cut and destroy wilted insect damaged shoot tips during pre-flowering and flowering period at weekly intervals.
- Regularly destruction of larvae in swollen damaged flower buds and fruits after each harvest is compulsory.
- Grow all round barrier crops like maize.
- Practice clean cultivation.

Pheromone Trap

- Use of water traps loaded with pheromone @ 30 /Acre can reduce the pest incidence to minimum level.

Botanical and Bioagents

- Apply neem or pongamia cake @ 250-500 kg/ha to ridges at fl owering and repeat 2 more times at 30-45 days interval.
- Spray NSPE 4% or neem oil 2% at 10 days interval.
- Mix Cypermethrin 25 EC (0.75 ml/l) with neem soap @ 7.5g/ l and spray.
- Spray *Bacillus thuringiensis* formulation (1%) at weekly interval followed by release of *Trichogramma chilonis* @ 2,50,000 /ha (50,000 / release -5 times at weekly intervals, starting from fl owering).

7. Leafhopper (*Amrasca biguttula biguttula*)

Both adults and nymphs suck the sap from leaves.

Management

- Soil application of neem cake 250 kg/ha followed by sprays of NSPE 4% or neem soap 1% at 10 days interval.

8. Thrips (*Scirtothrips dorsalis*)

Thrips are minute insects with fringed wings, serious during dry periods of high temperature. Both adult and nymphs suck the sap from young developing leaves. Affected leaves curl upwards along the margin and get crinkled and reduced in size.

Management

- Apply neem cake @ 250 kg/ha to plant beds while planting and repeat after 30 days.
- Fipronil 5 SC @ 1ml/l
- Pongamia oil (2ml) +1 ml sticker in one litre water after emulsifying (shaking thoroughly in a bottle).

9. Aphids *(Aphis gossypii)*

This is a polyphagous pest, feeding in colonies and completely covers the shoot tips, buds and lower surface of leaves. Both nymphs and adults suck the sap.

Management

- Clip and destroy infested shoots
- Thoroughly spray neem or pongamia soap (1%) or pulverized neem seed powder extract (NSPE) 4%.

10. Diamond Back Moths (DBM) (*Plutella xylostella L.*)

Diamond back moths are small greyish brown insects bearing whitish triangular spots on posterior margins of the forewings and while resting the wings comes together and form a diamond pattern. This is a major pest of cruciferous crops, particularly cabbage and cauliflower

Management

- Sow Indian mustard as a trap crop.
- Spray neem seed powder extract @ 4% or neem soap 1% or pongamia soap 1% thoroughly coverage to the crop canopy.
- Install light traps (3-4 with 60 or 100 Watt bulbs / acre) to control adults. For one acre plot use 3-4 light traps (60 or 100 Watt bulbs) by hanging above a bucket half filled with water. Alternatively, hang the bulb above a gunny bag (slating below) smeared with grease or oil. Illuminate the bulbs for full night. Adults of DBM will get attracted to light and get trapped in the water/oil. Use the light traps for 3-4 days for effective control of DBM adults. As this pest has developed resistance against many insecticides, use of effective insecticide currently available in market is essential.
- Follow the detailed IPM package as given at the end of the section of pests of cruciferous vegetables. The adults migrating from neighbouring plots are to be controlled by using light traps spraying an affective insecticide.

11. Field Bean Pod Borer (*Adisura atkinsoni*)

This is the major pod borer in field bean and the larva resembles *H. armigera*. The eggs are laid on tender pods. The young larvae bore into these pods and develop inside and come out after attaining fourth instars, which is a migratory stage.

Management

- Apply neem cake 250 kg/ha at flowering and repeat after 20 days. Spray pulverized neem seed powder extract (NSPE) 4% of neem soap 1% at tender pod formation. Repeat sprays at 10 days intervals.

12. Bugs

Many bugs are known to attack leguminous crops. Of these, *Nezara viridula* and *Coptosoma cribraria* are often serious, mostly on cowpeas and lablab. Eggs are laid on tender plant parts. Nymphs and adults suck the sap from foliage, flower parts and pods and emit characteristic bad smell.

Management

- Apply neem cake 250 kg per ha immediately after germination and repeat at fl owering. Spray neem soap 1% or pulverized neem seed powder extract (NSPE) 4% at 10 days interval.

13. Bean Fly (*Ophiomyia phaseoli*)

Bean flies are the major pest attacking several Legume but mostly attacks beans and cowpeas.

Management

- Apply neem cake 250 kg/ha immediately after germination. Do not delay, particularly during kharif period.
- Monitor the plants for adult activities, puncture marks and petiole mining soon after germination.
- As soon as a few adults are noticed hovering over the crop, spray Acephate 75 WP @ 0.75 g/l or PNSPE 4% or neem soap 1% or neem formulation with 10000 ppm Azadirachtin 2 ml/l. The botanicals get washed away by rain and become ineff ective if it rains within 1-2 days of spray. Give second spray after 12-20 days of sowing if 5 leaves show petiole mining symptoms per 10 leaves.

14. Red Pumpkin Beetle (*Aulacophora foveicollis* Lucas & A. *lewisii* Baly)

The adults are small, elongated yellow and defoliate the leaves immediately after germination. The larvae feed on roots and plant parts.

Management

- Mechanically collect and destroy the pest if incidence is low.
- If the pest incidence is very severe, spray Chlorpyriphos 20 EC2.5ml/l.

15. Fruit Fly (*Bactocera cucurbitae* Coquillett)

This is the major pest of cucurbits. The damage by maggots results in rotting of young and ripened fruits or drying and shriveling of fruits before maturity.

Management

- Use resistant varieties.
- Soil application of neem cake @ 250 kg/ha immediately after germination and repeat at flowering followed by sprays of neem soap 1% or PNSPE 4% at 10 days interval after flowering.

- Crush pumpkin 1 kg and add 100 gm jaggery and 10 ml Malathion and keep in the plot (4-6 places per acre). Adults are attracted to the fermenting pumpkin and lay eggs and get killed.
- Repeat the process 2-3 times in the cropping season. Erect cuelure (para pheromone trap) 3 per acre to attract and trap male fruit flies.

16. Banana Stem Weevil / pseudostem borer *(Odoiporus longicollis)*

Management

- After harvesting the bunch, remove the Pseudostem from ground level and destroy them in order to avoid it serving as a breeding site for the pest.
- Uproot and burn infested plants.
- Use Disc-on-stump or longitudinal Pseudostem traps @ 100/ha for trapping weevils.
- Swabbing with chlorpyripos 2.5ml/l + adjuvant 1ml/l on the stem prevents infestation of banana stem weevil.
- When jelly exudation is noticed, inject 2ml triazophos solution (350 ml in 150 ml water). Two injections per plant at 2 and 4 feet above the ground level till flowering. The injection needle should enter only two or three leaf sheaths and should not touch the central core.

17. Mango Fruit fly *(Bactrocera dorsalis)*

Sting marks and bruising to the fruit skin constitute the external damage that later turn to brownish rotten patches. Injury to fruit occurs through oviposition punctures by females and subsequent larval tunneling. Ripening fruits are more likely to be attacked.

Management

- Affected fruits should be collected and destroyed.
- Rake up the soil below the tree and drench with chlorpyriphos 20 EC@ 2.5 ml/ L.
- Setting up of methyl eugenol traps to lure the males in the orchard @ 10/Ha.

The major insects and pests found in the vegetable crops in NICRA adopted villages was shown in Figure 86.

Fig 86. Major Insect Pest of Vegetable crops in NICRA adopted villages

B. Major Plant disease and their management in NICRA Village

1. Powdery Mildew

Powdery mildews are probably the most common, conspicuous, widespread, and easily recognizable plant diseases. They affect all kinds of plants except gymnosperms. Powdery mildews appear as spots or patches of a white to greyish, powdery, mildew growth on young plant tissues or as entire leaves and other organs being completely covered by the white powdery mildew.

Causative organism

The powdery mildew diseases of the various crops are caused by many species of fungi of the family Erysiphaceae grouped onto several main genera. The details of the disease and causative organism have been presented in Table 45.

Table 45: Powdery Mildew disease and its causative organism

Disease	Causative organism
Powdery mildew cucurbits	*Erysiphe cichoracearum*
Powdery mildew of okra	Erysiphe cichoracearum
Powdery mildew legumes	*Erysiphe polygoni*
Powdery mildew of tomato/Chilli	*Leveillula taurica/oidiopsis taurica*

Management

Powdery mildew can be managed with resistant varieties and regular foliar applications of bio fungicide. It is not possible to escape infection because the pathogen produces many wind-dispersed spores, especially in case of cucurbit crops which are grown widely, and conditions often are favourable for this disease. The powdery mildew fungus tolerates a wide range of temperatures below about 37^0C and it does not need a period of free moisture on leaves to infect, in contrast with other foliar fungal pathogens. Rain is actually unfavourable for disease development. Removing affected tissue is not likely to be helpful because powdery mildew typically does not start in foci and the action of removing leaves could dislodge spores, further spreading the pathogen. Stressed plants are more susceptible.

Management of powdery mildew in organic Agriculture

- Good air circulation ensures lower humidity levels, inhibiting the growth of powdery mildew. Crowded plants will also provide too much shade for the lower leaves, encouraging fungi growth.
- Never use the infected plant leaves or fruit as mulch. Trim off infected leaves and stems and dispose of properly.

- While the water will not encourage mildew growth, splashing the leaves with water will spread the spores. Run a hose to the base of your plants instead of using a sprinkler system.
- Sulfur is a natural product that is very effective at preventing and controlling powdery mildew. Sulfur can be bought as a dust, or as a liquid which can be added to sulfur vaporizers. Follow the dosing instructions closely and wear gloves, eye protection, and a face mask. Avoid inhaling or coming into contact with the sulfur.
- Neem oil is made from the seeds and fruit of the evergreen neem tree. Neem oil works by disrupting the plants metabolism and stopping spore production. *Mix 3 tbs of neem oil to one gallon of water.* Take precautions to avoid sunburn of leaves, and avoid spraying the plant's buds and flowers.
- Foliar sprays of Penconazole @ 0.05% or Carbendazim @ 0.1%, give very good control of the disease.

2. Downy Mildew

Initial symptoms of downy mildew observed as small yellow spots and small irregular black spots with yellow-green border. First symptoms also can be a water-soaked spot. Infection does not expand beyond veins thus spots develop an angular appearance as the spots expand. Sometimes several spots occur together forming a yellow patch that can have an orange tint, especially in pumpkin.

Downy mildew genera

Some of the most common or most serious downy mildew disease with causative organism was listed in Table 46.

Table 46: Downy Mildew disease and its causative organism

Disease	Causative organism
Downy mildew of leafy vegetable	*Bremia lactucae*
Downy mildew of Corn	*Peronosclerospora maydis* and *P. philippinensis*
Downy mildew of Cucurbits	*Pseudoperonospora cubensis*

Management

- Cultural practices include selecting growing sites with good air drainage, full sunlight, and low humidity. Using drip irrigation, or scheduling overhead irrigation to avoid excessive leaf wetness, will also reduce disease incidence. When detected early, disease spread might be slowed somewhat by removing and destroying infected

plants, and by taking care not to transport the disease by hand or on infected tools and equipment.

- Application of a wet powder formulation of *Bacillus subtilis* @ 2g /lit is found effective on management of Downy mildew.
- On the appearance of disease spray the crop with copper fungicide @ 2g/lit at 15 days interval.
- Foliar spray of Mancozeb @ 0.25% at disease initiation stage and repeat next spray at 6-8 days interval.
- One spray for Metalaxyl + Mancozeb @ 0.2% in severe case may be given but do not repeat.
- Use sticker @ 0.1% with fungicide to avoid runoff of droplets.

3. Anthracnose disease

Several species of *Colletotrichum* cause serious anthracnose diseases of numerous important annual crop and ornamental plants. Some of them produce their teleomorph, *Glomerella cingulata*, with some frequency and are sometimes referred to as Glomerella diseases. Such species also causes cankers and dieback of woody plants. Anthracnose disease is widespread and common in areas where moisture conditions is more which help in promote disease development. The detail of Anthracnose disease and its causative organism was shown in Table 47.

Table 47: Anthracnose disease and its causative organism

Disease	Causative organism
Anthracnose of Chilli and ripe fruit rot	*Colletotrichum cpsici*
Anthracnose of Tomato	*C. coccodes*
Anthracnose of Cucurbits	*Colletotrichum laginarium*
Anthracnose of Beans	*Colletotrichum lindemuthianum*
Stem and pod anthracnose of Beans	*Colletotrichum truncatum*
Anthracnose of Spinach	*Colletotrichum spinacicola*
Anthracnose of Yam	*Colletotrichum gloeosporioides*
Anthracnose of Banana	*Gloeosporium musarum*

Cercospora Diseases

Cercospora diseases are almost always leaf spots. The spots either stay relatively small and separate or may enlarge and coalesce, resulting in leaf blights. The diseases are

generally widespread among most cereals and grasses, many field crops, vegetables, ornamentals, and trees. Losses from Cercospora diseases are usually small, but in some hosts, and occasionally in others, they can be significant. Some of the important diseases caused by *Cercospora* spp. were presented in Table 48.

Table 48: Cercospora Diseases and its causative organism

Name of the disease	Causative organism
Leaf spot in Brinjal	*Cercospora melongenae*
Frog eye leaf spot of Chilli	*Cercospora capsici*
Cercospora leaf spot of Cucurbitaceous crop	*Cercospora cucurbiticola, C.memordicae, C.citrullina*
Leaf spot of Elephant Foot Yam	*Cercospora amorphophali*
Cercospora leaf spot of French Bean	*Cercospora cruenta*
Cercospora leaf spot of Dolichus Bean	*Cercospora dolichii*
Cercospora leaf spot of Ladies Finger	*Cercospora abelmoschi*
Cercospora leaf spot of Raddish	*Cercospora cruciferarum*
Cercospora leaf spot of Spinach	*Cercospora beticola*
Sigatoka leaf spot of Banana	*Cercospora musae / Mycosphaerella musicola*

Management of Anthracnose and Cercospora disease in organic agriculture:

- Use clean seed.
- Use hot water treated seed. For cabbage and Brussels sprouts, soak seed for 25 minutes in 50^0C water; soak for 20 minutes for Chinese cabbage, broccoli, and cauliflower. Precise time and temperature control is essential to minimize damage to the seed.
- Use clean transplants.
- In case of cruciferous crops long rotations (three years) without crucifer crops or cruciferous weeds, such as wild mustard, are helpful.
- Destroy cull crop and crop debris after harvest.
- Plant later plantings upwind of earlier plantings.
- Allow for good air movement (e.g., wide spacing, rows parallel to prevailing winds, not close to hedgerows).

- Use practices that maximize air movement and minimize hours of leaf wetness (e.g., good weed control, wide spacing, etc.).
- After harvest, destroy remaining crop, and bury infected debris deeply. A three-year crop rotation is recommended for soil borne pathogens.
- Foliar Spray of Copper oxychloride/Copper hydroxide/Copper fungicide @ 3g/ liter at 12-15 days interval.
- Spray the plants with wet sulphur @ 2-3g/liter

4. Alternaria leaf spot disease

The disease is characterized by the appearance of typical brown mostly circular lesions with concentric rings and reddish borders on affected areas. The lesions may coalesce to form larger lesions and result in extensive defoliation. The fungus survives as mycelium in infected crop residue.

Management of Altenaria leaf spot disease

- Early blight can be seed-borne, so buy from a reliable supplier.
- Hot water seed treatment at 50^0C for 25 minutes is recommended to control early blight on tomato seed. See chlorine treatment procedures under bacterial diseases.
- Provide optimum growing conditions and fertility. Stressed plants (including drought) are more susceptible to early blight.
- In case of early blight disease in solanaceous crop use crop rotations of at least three years to non-hosts (i.e., away from tomato and eggplant).
- Drip irrigation is preferred. If using overhead irrigation, start before dawn, so plants are dry early in the day. The key is to keep the period of leaf wetness to a minimum.
- Stake or cage plants to keep fruit and foliage away from soil.
- Each season; disinfect stakes or cages with an approved product before use. Sodium hypochlorite at 0.5% is effective and must be followed by rinsing and proper disposal of solution. Hydrogen peroxide is also permitted.
- Foliar Spray of Copper oxychloride/Copper hydroxide/Copper fungicide @ 3g/ liter at 12-15 days interval.

5. Damping off and seed rot disease

A soil-borne fungal disease that affects seeds and new seedlings, damping off usually refer to the rotting of stems and root tissues at and below the soil surface. In most cases, infected plants will germinate and come up fine, but within a few days they become water-

soaked and mushy, fall over at the base and die. Several fungi can cause decay of seeds and seedlings including species of *Rhizoctonia*, *Fusarium* and *Phytophthora*.

Management of Damping off and seed rot

- Raise nursery in light soil with proper drainage
- Burning farm trash on the surface of the beds.
- Sowing seed on raised beds of 6-8" high (15cm)
- Using low seed rate of 650 g/cent.
- Seed dressing with Argosan or ceresan or Thiram or captan @ 2-3 g/Kg.
- Soil drenching with 1% Bordeaux mixture or COC@ 0.3% or metalaxyl@0.2%
- Biocontrol with *Trichoderma viride* and *Trichoderma harzianum*

7. Bacterial Disease management

- Resistant varieties, cultivars or hybrids are the most important control procedure.
- Bacteria-free seed or propagation materials.
- Buying seeds produced in dry climates is recommended
- Sanitation, particularly disinfestations of pruning tools.
- Avoid excessive overhead irrigation, especially late in the season.
- Avoid working in the crop when it is wet.
- Pruning of the infected twigs is followed to reduce the inoculums in orchards for citrus canker.
- The destruction of volunteer plants and weed hosts brings down the inoculum level.
- The crop residue may be burnt or ploughed deep into the soil with watering to ensure decomposition, which is helpful for the pathogens which cannot live saprophytic ally in the soil.
- The control of insects is helpful in reducing the soft rot of vegetables (*Erwinia* spp.) and the citrus canker (*Xanthomonas campestris* pv. *citri*).
- The avoidance of cultural mismanagement favorable to disease is important such as water logging in the nurseries (against the bacterial leaf blight of rice), flooding or over irrigation in the field. (against the soft rot disease)
- Prolonged exposure to dry air, heat, and sunlight will sometimes kill bacteria in plant material.
- In case of trellising or caging in tomatoes, stakes and cages should be either new or cleaned and disinfected. Sodium hypochlorite at 0.5% is effective and must be

followed by rinsing and proper disposal of solution. Hydrogen peroxide is also permitted.

- In case of bacterial wilt in solanaceous crop use a three-year crop rotation away from tomato, brinjal and pepper.
- There is some prospect of biological control with the application of organic matter in the form of compost and green manure and even inoculation of antibiotic micro paganism, encouraging antagonism by the application of superphosphate, application of phages in seed plant and soil as well as by inoculating with bacteriocin- producing strains.
- Crop rotation to reduce over-wintering.
- The use of antagonistic or biological control products may also be effective for managing bacterial diseases of plants.
- Foliar sprays with Bordeaux mixture and copper oxychloride against leaf spots and blights.
- Spray copper oxy-chloride @ 3g/liter of water for checking further spread of the disease.

8. Management of Viral Disease in crop plants

No single method is likely to provide perfect control. Nevertheless, by using a combination of the following management options disease control can be successfully implemented.

Exclusion/avoidance

- Plant virus-free seed and seedling transplants
- Grow crops in regions where the disease seldom occurs or during periods when the virus or its vector are at a low level
- Quarantine (international, state and regional).

Reduction in virus inoculum levels

- Control weeds and other virus hosts and insect vectors
- Destroy old crops promptly
- Separate new crops from maturing crops and avoid overlapping crops, especially continuous year-round cropping.

Protection of the host

- Plant virus-resistant or virus-tolerant varieties

- Use highly reflective mulches and oil sprays to deter insects
- Use barrier crops and bare land to reduce vector activity
- There are no chemical sprays or biological control approaches to eradicate viruses, although bio-control products can be used to control insect vectors.

9. Bacterial wilt – *Ralstonia solanacearum*

Sudden wilting and death of infected plants is the characteristic symptom. The petiole of older leaves droop down and the leaves show epinasty symptoms accompanied by yellowing and stunting of whole plant.

Management

- Grow resistant varieties like CIARI brinjal-1, Pant Samrat, Arka Nidhi, Arkas Kashav, Arka Neelakantha, Surya and BB 1, 44 & 49.
- Crop rotation with non solanaceous hosts Green manuring with *Brassica* species (Biofumigation).
- Soil solarization with a transparent polyethylene sheet (125 μm thick) for 8-10 weeks during March-June.
- Biological control with *Pseudomonas fluorescens*, *P. glumae*, *P. cepacia*, *Bacillus* sp. & *Erwinia* sp.

10. Die-back and fruit rot of chilli – *Colletotrichum capsici*

The disease appear as small, circular to irregular, brownish black scattered spots appear on leaves. Severely infected leaves defoliate. Infection of growing tips leads to necrosis of branches from tip backwards and shedding of flowers due to the infection at pedicel and tips of branches

Management

- Collect and destroy all infected plant parts
- Collect seeds only form fruits without infection
- Removal and destruction of Solanaceous weed hosts and infected plant debris
- Seed treatment with captan or Thiram 3-4g/kg
- Spray thrice with captan@1.5% or mancozeb@0.25%. just before flowering, at fruit formation stage and 15 days after second spray.
- Resistant varieties: G3, G4, B61, Lorai, etc.

11. Bhendi Yellow vein mosaic virus

Yellowing of the entire network of veins in the leaf blade (vein clearing) is the characteristic symptom. In severe infections the younger leaves turn yellow, become reduced in size and the plant is highly stunted. In a field, most of the plants may be diseased and the infection may start at any stage of plant growth.

Management

- Tolerant varieties: Parbhani Kranti, Pusa savani, Janardhan, Haritha, Arka Anamika and Arka Abhay
- The disease spread can be restricted by spraying ecofriendly insecticides

12. Sigatoka Leaf Spot of Banana *(Mycosphaerella eumusae)*

Disease appears as small, pale spots on leaves that turn dark purplish black with grey centres. Disease more prevalent on shallow, poorly drained soil. In severe conditions leaves become brunt, poor filling of bunches and Fruits don't mature uniformly

Management practices

- The field must be kept weed free and clean. Follow either hand weeding/ harrowing till 5 months after planting or use herbicide- glyphosate 7-10 ml/ litre of water + 25 g of urea or ammonium sulphate/ tank or by intercropping with cowpea.
- While planting, optimum/ recommended spacing (1.6 M X 1.6 M) must be followed
- Provide adequate drainage facility whenever it is required
- Apply only the recommended dose of fertilizer - N, P, K g/ plant (200:40:400) as per the schedule + 25g azospirilium + 25 g phosphorus solublizing bacteria. Application of Neem cake @0.5 to 1 kg / plant may also be applied. Potash can be applied 10 to 20% more. Micronutrient mixture 10 g / plant in 3rd month and 5th month after planting must be applied.
- Remove of disease infected leaves or part of leaves & destroy it outside the orchard
- No dried leaves should be hanging around the plant
- The following pesticides may be applied as soon as the symptom appears on the leaves. The interval between two sprays may be 20 to 25 days

  a) Mineral oil 10 ml + propiconazole 0.1% (1ml per litre of water)

  b) Mineral oil 10 ml + carbendazim 0.1% (1g per litre of water)

13. Banana Anthracnose *(Colletotrichum musae)*

Disease appears as small, circular, black spots develop on the affected fruits. At the initial stage dark brown patches on immature fruits.Severe infestation leads to shriveled and black coloured rotten fruits covered with pink spore masses, which gradually spreads and affects the whole bunch.

Management practices

- Adopt clean cultivation and maintain proper field sanitation.
- Harvest bunches at correct stage of maturity.
- When all the hands are opened, the distal bud should be removed to prevent infection.
- Transported bunches should be stored carefully at 14^{o}c without causing any bruises.
- Avoid contamination in collecting places, during transport and in ripening rooms.
- Preharvest spray with carbendazim 0.1% two times at monthly interval.
- Postharvest dipping of fruits carbendazim 400 ppm or benomyl 1000 ppm.

14. Banana Bunchy Top Virus *(BBTV)*

The disease starts with yellowing of leaf margin and dark green streaks on the leaves. New leaves emerge with difficulty, are narrower than normal, are wavy rather than flat, and have yellow (chlorotic) leaf margins. Leaves form a bunch at the top. Usually fruiting doesn't occur in severely infected banana plants but if produced, the banana hands and fingers are likely to be distorted and twisted.

Management practices

- Use of virus free planting materials.
- Rouging and removal of infected banana plants.
- Practice clean cultivation.
- Avoid banana cultivation in sugarcane and cucurbitaceous areas as sugarcane mosaic virus or cucurbit mosaic virus can easily spread to banana.
- The diseased trees should be injected with 4 ml of fernoxone solution (50g in 400 ml of water) or insertion of fernoxone capsules (containing 200 to 400 mg of chemical per capsule) into the pseudostem to kill the virus infected plants.

15. Mango Anthracnose *(Colletotrichum gloeosporioides)*

Almost all plant parts *viz*., the young leaves, branches, inflorescence and fruits are affected causing leaf spot/leaf blight, wither tip, blossom blight and fruit rots.

Management practices

- Wider plant spacing, yearly pruning of trees and proper disposal of diseased leaves, twigs and fruits.
- Foliar infection can be controlled by spraying of copper oxychloride (0.3%)/ Bordeaux mixture (1%) / carbendazim (0.1%) / methyl thiophenate (0.1%)
- Spraying of carbendazim (0.1%) at 15 days interval can effectively control blossom infection.

16. Sooty mould of Mango *(Capnodium mangiferae/ Meliola mangiferae)*

The honey dew secreted by some insects encourages mould growth on them giving a black velvety sooty look. The fungus being saprophytic causes no harm by itself but its presence on the leaf surface adversely affects the photosynthetic activity.

Management practices

- Preventing the spread of the disease by pruning of affected branches and their timely destruction.
- Due elimination of sucking pests secreting honeydew.
- Effective control by spraying of 2 % starch.
- Spraying of wet sulphur + gum Acacia

The symptoms of major diseases of vegetable and fruit crops have been shown in Figure 87.

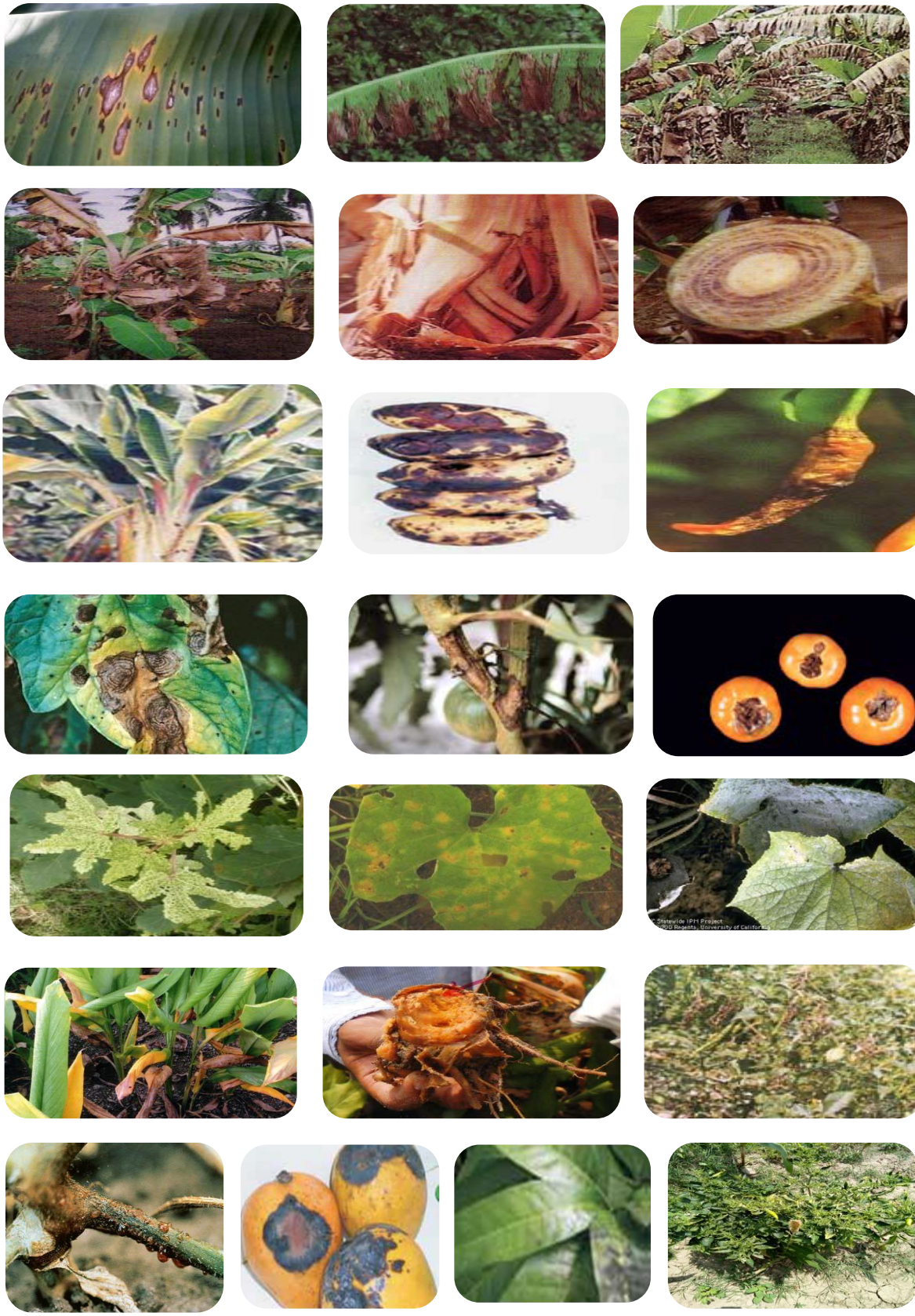


Fig 87. Symptoms of major diseases of vegetable and fruit crops

Component III

Livestock Interventions

C. Details of activities under livestock and fisheries

C.1. Fodder cultivation for sustainable livestock production

Most of the animals depend on the green pastures in open for grazing and these green fodders are scarce during dry period. Heavy rainfall also causes soil erosion. To meet the fodder requirement and to conserve the ecology and top soil, fodder cultivation is relevant under the project for year round availability for Livestock.

To meet the requirement during acute shortage of green fodder; fodder cowpea, maize and Hybrid Napier grass were promoted in the area (Figure 88 & 89). The fodder enhances milk production of livestock through satisfying its nutritional requirement. Agathi as a fodder for goatry has also been demonstrated in the Port Mout village for fodder availability and harnessing the maximum production potential of the animal.

Fig 88. Field view of fodder Bajra-Napier hybrid

Fig 89. Fodder cowpea

Justification: In the adopted village during the summer months, there is an acute shortage of green fodder and hence the present intervention was done in order to mitigate the scarcity of green fodder during summer months. The fodder cultivation of cowpea as cover crop was done along with maize for judicious utilization of soil moisture and land. In addition it also helps in nitrogen fixation for improving the fertility of soil. The fodder in the ration of the milch animals even during the lean period provides sustainable production performances and thereby improving the economy of the farmers.

C.2. Mineral Supplementation to dairy based farming community for higher milk production and goatry based farmers for higher growth rate

Due to heavy rain the soil of slopes are deficient in micro-nutrients. Hence the grasses are also deficient of minerals such as Zn, Cu etc. affecting productivity of livestock. Relevance is the supplementation of mineral mixture to livestock will help in overcoming the deficiency and will lead to improved productivity.

The milk yields in crossbred animals were recorded about 4 litres on average before the supplementation in Port Mort village which was below the potential yield of the animal. The present intervention was done in lactating dairy animals by supplementation of the exogenous source of Ca and P @ 1650mg and 850 mg per 100 ml/ animal / day respectively. The treatment was given to four milch animals for 30 days and the result revealed increase in the milk yield to a tune of about 1.35 litres per animal. The goats were supplemented with Agrimin mineral mixture @ 20g/ day along with feed which reported a higher growth rate as well as improved the reproductive

C.3. Improved shelter management practices with well-ventilated system as a means to resist extreme climatic variables for poultry, goatry and dairy animal

Heat stress is one of the most important stresses especially in hot and humid regions in these Islands which can reduces libido, fertility and embryonic survival in animals. Carryover effects of heat stress during late gestation on postpartum lactation and reproduction are also detectable. Thermal stress lowers feed intake of animal which in turn reduces their productivity in terms of milk yield, body weight and reproductive performance. Accumulation of feacal matters in closed poultry/ Goatry shed producing ammonia causing health hazard & mortality for the animals. Hence providing the management practices of improved shelter with well-ventilated system for animals is relevant under the project.

The different types of improved poultry sheds were shown in Figure 90.

Performance

- Improved Poultry shed with well-ventilated system enabling low mortality rate.
- Developing improved sheds in shady area reduces heat stress.
- Recommended spacing area in improved shed results better performance in poultry and dairy animals.

Fig 90. Improved poultry shed with cross ventilation

The productivity of animal is largely depending upon the type of shelter and local climatic condition mostly influencing the type of housing provided to the animal. The ventilated shelter protect from extreme climatic variable and changing the animal shed with well-ventilated housing system. It enables to reduce the magnitude of heat stress which offers the most immediate and cost effective production system. The ventilated system in poultry enables to low mortality and improved the production performances.

C.4. Backyard poultry production with improved Nicobari and Vanraja birds

Backyard poultry production with improved Nicobari and Vanraja birds: There is an acute shortage of animal protein in farming community and due to mal nutrition child health is not very sound. Desi birds are prone to diseases and incurring loss to the farming community due to heavy mortality in rainy and summer months. To popularize the backyard poultry farming among the villagers, a training programme on backyard poultry was organized and Improved Nicobari fowl were distributed to the farm women to get egg and meat for their children and also to get more income for their family. These birds are natural scavengers, disease resistant and daily feed requirement is minimum.

- A total no. of 120 numbers of Vanraja bird were distributed among the four numbers of farmers along with 20 Nicobari birds were distributed to three numbers of farmers. The Nicobari birds are resistant to common diseases and suitable for backyard poultry farming. The production characteristics revealed that the bird can well thrives in this condition and performed better in terms of egg production as compared to other indigenous bird (Figure 91).
- The rearing of Vanraja was also initiated to improve the condition of the farmer. The bird is of dual purpose and can also attain higher bodyweight if provided the supplemental feed apart from scavenging during daytime (Figure 92).

Fig 91.Nicobari and its crosses

Fig 92.Vanraja birds

Justification: Most of the indigenous poultry birds reported high mortality rate during beginning of monsoon due to change in climate and post rainy season due to increase heat / temperature. Hence the intervention was made to introduce Nicobari Fowl, considered to disease resistant for egg production as well as another birds Vanraja recorded a higher body weight thereby improve the economy of the farming community.

C.5. Promotion of Duck farming with improved Khaki Campbell duck

A total of 5 numbers of farmers having pond to rear duck based IFS model were distributed 150 nos. of day old Khaki Campbell duck for higher egg return from the practice. The demand of duck egg as well as meat is very high. The mortality of ducklings was reported to be low. They sold egg @7/ egg in the local area and also earned a decent amount by selling Rs. 300/ drake (Figure 93).

Fig 93. Improved Khaki Campbell duck

C.6. Backyard pig farming

To utilize the waste and excess of the farm produce and to enhance the family income a training programme on piggery was organized in the village to develop the skill in pig farming and the farmers were supplied white York Shire piglets. Piggery will give support to the farm family during lean period and any unforeseen calamities besides a source of animal protein to the family (Figure 94).

Fig 94. Piggery – for cheap animal protein and income

C.7. Awareness on status & control of FMD and Animal Health Camp in Badmash Pahad village

- A total of one numbers of animal health camp along with vaccination camp for poultry were organized with the collaboration of AH&VS of A&N Administration.

- During the camp a total of 32 animals including cow, goat and 80 poultry birds were thoroughly diagnosed , vaccinated and treated (Figure 95).
- Mouth sore, Mastitis, Humpsore being problem were identified which causing reduction in milk production. The farmers were exposed to prophylactic measure to control the disease.

Fig 95. Animal Health camp at Badmash Pahad village

- Deworming in animals and birds, mineral mixture and vitamin supplements were given under the health camp.
- The programme was covered by Doordarshan, Port Blair for wide publicity.

C.8. Drought Resistant Fodder Grasses

KVK-Port Blair has identified four drought resistant grass *spp.* and one leafy sag (Locally known as Madrasi Bhaji) in the NICRA adopted village, suitable to grow in summer months with the available soil moisture for milch animals, calves and leafy sag for human consumption (Figure 96).

Drought resistant grass *spp.*-

- *Cynodon dactylon*
- *Echinochloa crusgalli*
- *Echinochloa colonum*
- *Digitaria ciliaris*

Fig 96. Drought resistant grass spp.

C.9. Integrated Fish Farming

- **Created water body was put into use with integration of Fish + Duck + Vegetables on the bunds.**
- **Additional income and better livelihood option generated.**
- **Additional Job opportunity created.**
- **Eco – friendly atmosphere created.**
- **In case of disease outbreak due to climate change or failure of any component /crop farmers will not be looser as he can earn something from other component of the**

Six ponds were taken for demonstration of integrated fish farming wherein Fish+ seasonal vegetables + duck (Khaki Campbell) were reared. The total area of 6 Nos. farm ponds was 0.48 ha. In each pond 265 fish fingerlings (40-50gm.), 25 Nos. Khaki Campbell and on the bunds seasonal vegetables were raised. For the demonstration Rs. 23,700/- was incurred towards the culture operation and net return obtained was Rs. 48,670/- with B:C 3.05 over the control with net return of Rs.9,450/- and B:C 1.90.

Fig 97. Field view of integrated fish farming

C.10. Composite fish culture: Fish fingerling of Catla, Rohu and Mrigal was distributed to 24 selected farmers in the NICRA adopted villages. Freshwater prawn seed was not available so could not be provided this year. Other inputs like lime and vegetable seeds (Bottle gourd, Bitter gourd and cucumber) were provided to the farmers for cultivation in ponds' dykes

Fig 98. Fish seed and inputs for composite fish culture

C.11. Crab fattening culture by the rural youth

The pond excavated in the brackish water inundated area under the project during the previous year has been utilised by one rural youth Sri Mandeep Singh of Port Mout village for crab fattening purposes. The cage system of culture has been adopted by him by utilising the locally available material (Figure 99).

Fig 99. Crab fattening in the brackish water pond at Port Mout

COMPONENT –IV INSTITUTIONAL INTERVENTIONS

D. **The details of the various institutional interventions during the period 2011 to 2019** has been presented in Table 49.

Table 49. Details of the various institutional interventions (2011 to 2019)

Interventions	Details of activity			No. of farmers	Unit/ No. /Area (ha)
	Name of crops / Commodity groups / Implements	Quantity(q) / Number / Rent / Charges	Technology used in seed / fodder bank & function of groups		
	Hybrid napier/ fodder maize		Fodder cultivation	4	4/0.5
	Others				
Custom hiring centre	Power tiller	1 no./280/hr	-		
	Pumpset	1 no./100/day	-		
	Knapsack sprayer	1 no./50/day	-		
	Coconut climber	1 no./10/day	-		
	Arecanut dehusker	1 no./ 10/day	-		
	Thresher	1 no./ 30/day	-		
	Drag net	20 no. (1 no/75/day	-		
	Rocker Sprayer	2 nos			
	Pump set	1 no			
	Power Sprayer	1 no			
Collective marketing	Vegetables	10	Andaman Bazar	10	
Climate literacy through a village level weather station	Temperature, Relative humidity, Rain fall, Wind speed and direction	12		60	60
	Rabi crops 2013-2014 2014-2015		Weather information and advice for life irrigation to crops	 21 21	 15 15

	2015-2016 2016-17			21 16	15 08
Others if any	Animal Health Camp	85	Information through PRI members	85	
	Goat farming 2012-2013 2013-2014 2014-2015 2015-2016 2016-2017	1		1 2 2 2 2	1 2 2 2 2
	BBF 2012-2013 2013-2014 2014-2015 2015-2016 2016-2017	6		6 3 3 3 3	0.8 0.6 0.6 0.6 0.6
	Promotion of Poultry and Duckery 2016-2017	775	Improved breeds	60	60
	Drip irrigation 2012-2013	3		3	0.8
	Animal Health Camp	85	Information through PRI members	85	

COMPONENT- V

CONVERGENCE PROGRAMME

E. Convergence Programme

E.1. Sluice Gate: In full moon and dark moon sea water intrusion affected 125 ha paddy land at Port Mout and Badmash Pahad village, new bund and Sluice gate have been constructed to check the sea water intrusion in the paddy fields through convergence with Gram Panchayat, Zilla Parishad and APWD.

E.2. Gabions: Agricultural lands facing the sea shore as well as adjacent land areas were regularly getting damaged by the intrusion of sea water, wave actions. This resulted into damaging the cultivable land areas. To check the intrusion, 0.25 m- 1.5 m diameters hard rocks are tied in a bunch with ropes and are placed alongside of the sea shore of Badmash Pahad village for a distance of stretch of 3.5 Km. The work has been completed on a convergence mode with Andaman Public Works Department (APWD), Port Blair for safe guard of the land areas for cultivation.

E.3. Drainage improvement through MNREGA for excess water flow: About 12 ha area was always flooded either with sea water or freshwater and these land was without any use. KVK approached the Gram Pradhan of the area for improvement of drainage system in the area and the Gram Pradhan has taken initiatives for cleaning of drainage through MNREGA and about 1800 m long drainage system was improved involving an amount of 3.3 lakhs. This resulted in improvement of drainage of excess water and drying of the area. Which helped in summer months and the area could be used for grazing of farm animals of the villagers (Figure 100).

Fig 100. Drainage improvement through MNREGA

E.4. Rain water harvesting by CARI through BBF/ Paddy cum Fish culture: Under the NAIP project of CARI, the fund was utilized for construction of Broad Bed Furrow system and paddy-cum –fish culture system in the adopted village of NICRA with a cost of Rs. 3.5 lakhs for an area of about 0.5 ha. The fellow land developed through this has been under use for vegetable and fish culture giving additional income to the farmers.

E.5. Vegetable Hatt: Chouldari-Gram Panchayat and VCRMC jointly initiated a Sunday market on 30th Sept.2018 with 54 vendors, to facilitate farmers from nearby villages to sell their produce and also customers buy fresh vegetables at reasonable prices, cultivators, farmers and villagers benefit from the Hatt and vendors are required to pay Rs 20/- as a cleaning (Swachta) fee to the Gram Panchayat. The details of the Convergence of ongoing development programmes / schemes in NICRA adopted villages have been presented in Table 50.

Table 50. Convergence of ongoing development programmes / schemes in NICRA adopted villages of South Andaman

Development Scheme /Programme	Nature of work	Amount (Rs.)
Sluice Gate	Construction of sluice gate, Zilla Parishad	7.5 lakhs.
Gabions (3.5 Km length) Lal pahad to Badmash pahad	By APWD, Hard rock's tied with ropes are placed along sea road/bank	25.7 lakhs
Drainage improvement	In convergence with MNREGA for drainage of excess water	3.3 lakhs
Rain water harvesting through BBF/paddy cum Fish culture	Under NAIP project of CIARI	3.5 lakhs
Vegetable Hatt – a Sunday market at Veer Sarvakar Park, Chouldari	Market started from 30th September of 2018 with 54 vendors. Under Gram Panchayat, Chouldari,	A community based, Farmers market Centre,

COMPONENT- VI

CAPACITY BUILDING & EXTENSION ACTIVITY

F. Capacity building and Extension activity

F.1. The various capacity building programmes organized during the period 2011-12 to 2018-19 have been mentioned in Table 51.

Table 51. Capacity building programmes organized during 2011-12 to 2018-19

Thematic area	Topic of the training	No. of Courses	No. of beneficiaries		
			Male	Female	Total
Natural Resource Management	Fish pond management	1	15	08	23
	Management of salt affected soil/Problem soil	1	14	6	20
	Field layout and planting technique	1	18	14	32
Crop Management	Azolla	2	2	0	2
Integrated Crop Management	Scientific cultivation of crop management.	5	83	48	131
	Quality seed pulses production technologies	1	11	11	22
Crop Diversification	BBF	1	19	05	24
	Oyster and paddy straw mushroom cultivation technology	1	22	04	26
	Round the year vegetable production technology	1	13	05	18
	Multi-tier cropping system	2	30	16	46
Resource	Zero Tillage				

conservation Technology	Use of plastic in agriculture	1	16	12	28
Pest and disease management	Integrate Pest Management in paddy	02	38	22	60
	Integrated pest and disease management in solaneceous crops	1	15	07	22
	Animal Health Camp	1	9	13	22
Nursery raising	Establishment of commercial horticultural nursery	1	29	06	35
Repair & Maintenance of farm machinery & Implements	Operation and maintenance of Paddy transplanter	1	11	10	21
	Operation of paddy thresher	1	15	10	25
	Repair and maintenance of power tiller	1	17	01	18
Integrated Farming System	Integrated Farming System	1	07	18	23
Livestock and Fishery Management	Duckery as an additional source of income	1	12	13	25
	Goat management	2	30	29	59
	Dairy management	1	18	12	30
	Fish farming (IMC and Catfish)	2	15	23	38
	Disease management in poultry	02	36	24	60

	Livestock management (Rabbit and pig)	4	38	64	102
	Fish feed preparation from locally available ingredients	1	11	03	14
	Carp breeding and nursery rearing	2	29	0	29
	Care and management of piglets	1	8	19	27
Fodder and feed management	Skill/knowledge development on Fodder and feed management	12	80	56	136
Value addition	Surplus agricultural produce	01	10	15	25
	Small scale Virgin coconut oil production technology	2	12	36	48
NICRA awareness	Swach Bharat Abhiyan	2	28	44	72
Exposure visits	Crab fattening Nursery production Bio-control agents Broiler farming	1 1 1 1	05 03 05 00	00 02 00 05	05 05 05 05

F.2. Extension activities: The various activities such as agro advisory services, exposure visits, field days, awareness programmes related to women health and nutrition, kisan gosthi/kisan mela were organised (Table 52).

Table 52. Extension Activities conducted during 2011-12 to 2018-19

Name of the activity	Number of Programmes	No. of beneficiaries		
		Male	Female	Total

Agro advisory Services	109	171	96	267
Awareness	17	227	143	370
Exposure visits	12	129	130	259
Field Day	10	121	150	271
Group Discussion	19	143	111	254
Method demonstrations	52	201	170	371
Kishan Gosthi/Kisan Mela	03	560	190	750
Woman health and nutrition	08	-	270	270
Scientist visit to field	155	203	117	320
Total	**385**	**1755**	**1377**	**3132**

F.3. Soil Health Cards distribution

A total of 75 Soil Health Cards (SHC) were distributed to the farmers at the NICRA adopted villages during 2011-12 to 2018-19 (Table 53).

Table 53. SHC card distribution at NICRA adopted villages during 2011-12 to 2018-19

KVK	No of soil samples collected	No. of samples analysed	SHC issued	No of Farmers involved
Port Blair	350	75	75	350

F.5. SUCCESS STORIES

F.5.1. CLIMATE RESILIENT INTEGRATED FARMING SYSTEM- A SUSTAINABLE LIVELIHOOD OF ISLAND FARMER

Shri. Ashok Kumar Roy, aged 48, a progressive farmer blessed with an inquisitive mind belonged to Badmas Pahad Village, South Andaman district. He earned his livelihood by backyard poultry farming (desi poultry birds 20nos.), mud crab culture and cultivating traditional vegetables like amaranthus, nalibhaji, okra, brinjal, chilli, bitter gourd, pumpkin and bottle gourd on his leased land (1.5 ha) employing indigenous methods. With this merger income (Rs.80000/-120000/- per annum) he used to sustain his family life (6 family members).From2011he used to have regular contact with the Scientists of KVK, Port Blair for development of his agricultural land for maximum returns and has undergone many

training programmes in the areas of poultry farming, psiculture, vegetable cultivation etc. He meticulously began to put into practice the knowledge, skill in his farming. Initial orientation from the experts of KVK and their frequent visits set him on the pate towards progress. Under the NICRA Research Project of ICAR-KVK, Port Blair he had established Pond based Integrated Farming System on his land. The major components are fish + poultry + vegetables & fruits. He adopted composite fish culture (Catla, Rohu and Mrigal) in his small pond of 0.5 acre and got an average yield of 250 kg fish per year. Besides, ICAR-KVK, Port Blair affords him all the inputs of high yielding and climate resilient vegetable seeds and seedlings [Amaranthus (CARI Ama red and green),Indian Spinach (CARI Poi-1),Spinach c.v. Jinta, Sweet potato (CARI-SP 1), French Bean (IIHR-909), Chilies (LCA-353, KA-2), Pumkin (Ardhaman red), Cucumber (Point set) , Brinjal (CARI Brinjal-1), Bitter gourd (Rakhushi), False coriander (CARI Broad Dhania), Okra (ArkaAnamika), Bottle gourd (Tilalauki) etc.], Marigold (Pusanarangi), perennial fruit plants such as papaya, lime, banana, drumstick and curry leave. The yield of vegetables and fruits was 4.5 ton/year with this small area of land. He has also adopted backyard poultry (Nicobari fowl-50nos) and duckery (Khaki Campbell duck-50 nos) in his pond based Integrated Farming System model (Figure 101 & 102). The total cost of cultivation was Rs.150000/- per annum. However, the gross return obtained was Rs. 350000/- per year with net profit of Rs.200000/- . He also made optimum use of all the farm waste into organic manure and utilized in vegetable cultivation. An award-winning man received many awards from ICAR-KVK and ICAR-CIARI for his relentless efforts towards agriculture under the vulnerable Island ecosystem. He achieved his self-sustainability and livelihood in pond based integrated farming system and also an inspiration for others in this Island.

Fig 101. ADG (Hort Sc.-I), ICAR-New Delhi

Fig 102. Director NAARM, Hyderabad visit

F.5.2. LAND BASED INTEGRATED FARMING SYSTEM IN TSUNAMI AFFECTED AREAS OF LAL PAHAD UNDER TDC- NICRA PROJECT

Shri M. M. Joydhar resident of Lal pahd village of South Andaman district under Ferrargunj block, South Andaman district is a small farmer with 5 family members having only 2.5 ha of land. Till December 2004 the land was used for cultivation of paddy during rainy season and a part of the land for cultivation of vegetables during the dry period using the little water available in his pond. The produce from the land was a means for their livelihood as the gross income was around Rs.35, 000/- per year. The same land was inundated by the sea water in the earth quake followed by Tsunami on 26th December, 2004 and therefore became unsuitable for cultivation. He was forced to move in the temporary shelter (Badmash Pahad now Gopal Nagar) provided by the local administration and was fully dependent on the government aids for family livelihood. He is a son of farming community who believes in hard work and had full confidence to sustain him in adverse situations. Therefore, he kept his believes and faith alive and always was in touch with the different development departments. He could able to increase the size of the pond with the help of the Agriculture department. Primarily the pond size was widened to harvest the excess rain water for giving supplemental irrigation in dry season for vegetable cultivation. As a settler from East Pakistan belonging to the Bengali community he thought of using the pond for cultivation of fish to increase the productivity from the water area and generate additional income. He had the knowledge of fish culture as was in the contact of KVK since 1994 but was not aware of Integrated Fish Farming System and judicious use of existing resources. Meanwhile during April 2014, the KVK personnel on their routine village contact programme interacted with Shri M. N. Joydhar and assessed the available resources in his holdings with long interactions. Pre-adoption resource map and bench mark information was collected to help the farmer. The entire plan was prepared in participatory mode along with farmer, Scientists of KVK, Port Blair and the Director, CARI, Port Blair.

A lay out plan was prepared by the KVK personnel in 1.5 ha of land in integrated approach considering the topography of the land. In the first instance the experts suggested to clean the pond with mahua oil cake for removing the unwanted fishes. After cleaning, the pond was prepared by addition of manure (cow dung) @ 10,000 kg /ha and lime 300 kg /ha. KVK personnel checked the water quality parameter to assess the congenial atmosphere of the water for rearing the fishes. At the onset of the monsoon 600 number of yearlings @ 5000/ha in 4:3:3 ratio (C:R:M) was released in his pond along with 30 number of ducklings @ 300-400 /ha by the KVK personnel. The ducks were introduced to enrich the fertility and

aeration of the pond for better growth of the fish. There were some coconut trees and the KVK personnel gave some saplings of fruit trees like, banana, guava, custard apple, sapota, lemon and pine apple for planting on the pond embankment which will not only give fruits but they will also help to protect soil erosion. Throughout the year he has tried 5-10 types of vegetables using mixed cropping system of various combinations in surrounding of his field by making BBF and ridge and furrow methods. He was advised to grow aerial vegetables by making machan (Nylon fishing wire) furrows, which is giving two fold benefits, it gives shed to the fish when the water temperature increases and also gives the space to the creepers for their growth which in-turn require more space for their growth and fruiting. He was persuaded to construct a compost pit with thatched roof at his backyard where he was disposing the entire farm waste for composting.

Fig 103. Institute QRT Visit

Fig 104. State Senior Officers Visit

Fig 105. School Students Visit

He had four buffalos, 30 ducks and 50 deshi poultry birds under livestock enterprises and also adopted suitable and sustainable farming system with rice – fish- duck - azolla, vegetables, tuber crops during wet season. He was also constructed low cost backward poultry shed to provide the shelters to the birds provided from KVK under TDC-NICRA programmes. For poultry birds and ducks he was using rice grains & husk, residue of the paddy harvest and small unwanted fishes from the pond.

After getting the benefit he has constructed a small house near by the farms, where his elder son along with his family is residing. Housekeeping and nutrition management of family also taken care by the experts. More than six numbers of off campus training program and field days were conducted in his field to show the effectiveness of the technology in the field condition by the ICAR-KVK, Port Blair. Institute QRT-2018 under the chairmanship of Prof. C. R. Kolle and members visited and interacted with him and twenty two numbers of officers from Andaman and Nicobar Administration and students from Govt. Model Senior Secondary School, Port Blair were also interacted on his successful, farming system (Figure 103, 104 &105). His success has attracted media attention on his systematic well maintained farming system was covered by DDK (two times) and AIR (two times), Port Blair. Despite

being some sort of a celebrity in his area, he has not forgotten his earlier struggles and continues to grow and learn. An award-winning farmer (Best Farmer – 2014 received with a case prize of Rs 15,000/- from the Andaman and Nicobar Administration and ICAR- CIARI, Kisan Mela – 2017), he is quite an inspiration for others and a role model in the neighbouring villages. Because of his hard work and successful farming system Shri M. M. Joydhar has been popular one village to village and district to district.

F.5.3. SHRI SURESH ROY – A ROLE MODEL VEGETABLE FARMER IN THE NICRA, ADOPTED VILLAGE

Shri Suresh Roy, S/o Late Kumudh Roy, age 41, resident of Badmash Pahad Village in the South Andaman District – a simple man at first glance, blessed with an inquisitive mind. He earned his livelihood by cultivating traditional vegetables like Okra, brinjal, bitter gourd, pumpkin, cucumber, sweet potato on his small patch of 1.4 ha leased land, using indigenous and age-old practices. In 2011, with the support of Krishi Vigyan Kendra- Central Agricultural Research Institute (CARI), Port Blair, he adopted aerial vegetable cultivation with the technical intervention of mulching from paddy straw, coconut and are canut leaf/ husk for moisture conservation and growing of selected drought resistant crops on scientific methods under NICRA project guidelines in his hilly sloppy land. Always eager to learn, Shri Suresh Roy was one of the first to enroll in the programme.

Armed with the training and inputs**,** Shri Suresh Roy meticulously began to put into practice the entire skills he had learnt. Initial orientation from the Subject Matter Specialists and their frequent visits set him on the path towards the progress. Soon, he had implemented Scientific varietal intervention on his land that maximized inputs from an ingenious system of raising Crops, Sweet potato (CARI-SP 1), French Bean (IIHR-909), Chilies (LCA-353), Pumkin (Ardhaman red), Cucumber (point set) , Brijal (CARI Brinjal-1), Bitter gourd (Rakhushi),False coriander(CARI Broad Dhania) and Marigold (Pusa narangi). As a results, his land yielded crops throughout the year.

He wasted nothing, making optimum use of all the farm waste. Very soon, his farm became a completely self-sustaining entity, where met from within the system itself. His income multiplied to Rs. 0.75 lakh per year from 0.25 lakh.

Shri Suresh Roy is today raping the benefits of having adopted new methods. His success has attracted media attention and his bountiful farm was covered by AIR, Port Blair. Despite being some sort of a celebrity in his area, he has not forgotten his earlier struggles

and continues to grow and learn. An award-winning man (Best Farmer –Kisan Mela - 2012), he is quite an inspiration for others and a role model in the neighboring villages.

F.5.4. SHRI SANJAY KUMAR SAHA – RIDGE AND FURROW VEGETABLE CULTIVATION SYSTEM IN FELLOW LAND

Shri Sanjay Kumar Saha S/o Shri Manoranjan Saha R/o Badmash Pahar is an unemployed educated youth has come in contact of KVK under the NICRA project since its inception in Feb., 2011 and with our continuous efforts and contact, he got motivated for cultivation of vegetables in ridge and furrow method in his low fellow land where he lost his entire vegetable crops last year due to heavy rains during February, 2011. On our advice, he engaged two laborers for making the ridge and furrow under our guidance. Timely availability of quality seed materials is a constraint in Andaman and to encourage the youth, timely supplied of inputs was ensured and the Vegetable seeds, seedlings, pesticides and fertilizers were provided from NICRA fund.

When the seed was sown in January, 2012, heavy rainfall occurs (125 mm) on the 8th day for three days continuously and all the excess water was drained out from his fields without any damage to his newly germinated plants. Again after 25 days of sowing, heavy rainfall (165 mm) occurred in February, 2012 and only because of proper drainage, no damage to the crops was noticed.

Fig 106. Ridge and furrow Vegetable cultivation

In the same area, maximum farmers have lost their vegetable crops because of non-availability of drainage facilities. After seeing the benefits of this method of cultivation and to save the crops five nearby farmers have also adopted the ridge and furrow techniques for cultivation of vegetables in their fellow lands (Figure 106).

G. Custom Hiring Centres for Farm Machinery

(Small farm mechanization)

G.1. Village Climate Risk Management Committee (VCRMC), Port Blair

Details of Village Climate Risk Management Committee (VCRMC) have been presented in Table 54. The VCRMC Bank account passbook scanned copy was enclosed in Annexure-I to indicate the available balance with the committee.

Table 54: Village Climate Risk Management Committee

Designation	**Name of the candidate**
President	Dr. L. B. Singh , PI -NICRA
Secretary	Shri Swaran Singh
Joint Secretary	Shri. Mandeep Singh
Treasurer	Shri Kasinath Saha
Members/ Secretary	Dr. B.K.Nanda, Co-PI of the Project
Members	
1.	Shri. Panchuram Joydhar
2.	Shri. Sanjay Saha
3.	Smti. Vasantha
4.	Shri. Ajay Saojal
5.	Smti. Kholasa Biswas
6.	Smti. Roza Kandulna
7.	Shri. Sri Charan
8.	Smti. Kalidasi Mondal
9.	Shri. Sohan Prasad
10.	Smti. Kunjamol
11.	Smti. Pooja Devi
12.	Shri. Rajender lall
13.	Shri. Ashok Ch. Roy
14.	Shri. Madan Mohan Joydhar
15.	Shri. Gopal Banik
16.	Shri. Biswanath Mazumder
17.	Shri. D.N.Mistry
18.	Shri. Hari Mohan Haldar

19.	Shri Sree Singh
20.	Smti Guria

G.2. Year wise VCRMC meetings

VCRMC meetings were conducted every year (Table 55). The important decisions taken year wise by the VCRMC and implemented in the NICRA programme was enclosed as Annexure-II.

Table 55: Year wise VCRMC meetings conducted

Year	No. of meeting conducted
2011-12	Nil
2012-13	02
2013-14	02
2014-15	02
2015-16	03
2016-17	05
2017-18	01
2018-19	04
2019-20	02

Year 2012-13:-

- ✓ 27.07.12, Opening of Bank Account & hiring of room for keeping the farm machineries.
- ✓ 11.12.12, fixed rate for custom hiring center.

Year 2013-14:-

- ✓ 16.05.13, Power tiller rate of hiring per Hour will be 02 hours @ Rs. 250/- for NICRA village and Rs.300/- for other villages.
- ✓ 01.10.13, any expenditure for maintenance of farm machineries will be taken by VCRMC & Power tiller rate increased Rs. 280/- per hrs.

Year 2014-15:-

- ✓ 20.10.14, major repair of power tiller.
- ✓ 02.03.15, a dug out pond of size 34mX21mX1.5m in the community land of vacant field at Badmas pahad.

Year 2015-16:-

- ✓ 05.04.15, A meeting with Dr. A.K. Singh, ZPD, Zone –II, Kolkata, desilting and water harvesting to be done in the month of March, April & May, demand was for procurement of one 35 hp tractor along with cultivator.
- ✓ 15.06.15, 10% of the total expenditure under NRM activities, & increase members.
- ✓ 20.02.16,survey work for new pond and extension of area.

Year 2016-17:-

- ✓ 20.09.16, proposed for purchasing of tractor & repairing power tiller. (04.11.16) new construction of pond & repair of power spry.
- ✓ 06.01.17, income generation from the machineries discussed and resolved that collection from the defaulters. & any utilization of implements will collect advance from the customers.
- ✓ 31.01.17 and 22.03.17, members decided to set up one market for selling of local produce by the project beneficiaries at the respective villages.

Year 2017-18:-

- ✓ 12.12.17, the members approve an intervention of one check dam & develop of IFS model.

Year 2018-19:-

- ✓ 13.08.18, discussed about inclusion 03 new villages Lalpahad, Craikabad & Humphrey gunj in the project area & renovate defunct wells.
- ✓ 22.10.18, all implements shifted to KVK campus all cost to be taken up by VCRMC, shifting is required for repair of the rented house, power tiller repaired by VCRMC accounts.
- ✓ 05.12.18, after repair of the power tiller painting will be carried out with fund of VCRMC.
- ✓ 23.12.18, the proposal of paddy cum fish culture model & nursery pond.

Year 2019-20:-

- ✓ 31.07.19: it was discussed that how to save the water and conserve it.
- ✓ 21.09.19: process the activities of NRM module under the project that cannot completed last year due to lack of fund. It was decided to nominate Er. B.K. Nanda as member secretary of the committee and signatory for the bank transaction of VCRMC Account.

The revenue generated through custom hiring centre during the year 2011 to 2019 has been given in Table 56.

Table 56: Revenue generated through custom hiring centre year-wise 2011-2019

Name of Implement	Revenue (Rs)							
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Total (Rs)
a)Animal drawn								
b)Tractor drawn/Power tillar			15,075	10,335	2,265	2,275		29,950
Others								32,244
							Total	**62,194**

G.3. Proceedings of the Visit of the NICRA-ZMC to Port Blair KVK, A&N Islands on 15th -18th March, 2016

The ZMC of NICRA team consisting of Dr. H. S. Sen (Chairman), former Director, ICAR-CRIJAF, Barrackpore, Dr. P. Nanda (Member), Principal Scientist, ICAR-IIWM, Bhubaneswar as DDG(NRM) Nominee, Dr. B. Gangaiah, HOD (NRM) CIARI, Port Blair as CRIDA Director's Nominee and Dr. F. H. Rahman, Principal Scientist, ICAR-ATAR Kolkata as Member Secretary visited Port Blair, KVK and NICRA project Sites, in order to develop an overall impression of the agro-climatic conditions of the Island ecosystem in the region, also went across a few surrounding islands during 15-18 March, 2016. The 'NICRA', hereafter referred to as 'project', sites were located in Port Blair, Badmaspahar and Port Mount villages. There are reasoning to believe that the island ecosystem is likely to be the most sensitive than any other ecosystem due to climate change phenomenon. In a rare and all-time tragic incident the Andaman and Nicobar Islands had a devastating toll of 10,136 people dead and hundreds of thousands rendered homeless when the Indian Ocean-triggered earthquake *Tsunami* struck the islands on 26 December, 2004. The islands were just north of the earthquake epicentre, and the *Tsunami* reached a height of 15 metres (49 ft) in the southern Nicobar Islands. The A&N island ecosystems comprise of 572 islands, of which 38 are inhabited by people from the mainland and indigenous tribes. The areas could be characterized as highly stressed due to drought/cyclone/sea water inundation, and the crops susceptible to diseases and pests.

Of the total 181 households spread over different NICRA villages 85 were landless, 76 were marginal (up to 0.4 ha holding area), 44 were small (up to 1.3 ha holding area), and

the rest 20 come under medium and large categories. Overall literacy among 1145 population was about 65 % evenly distributed among male and female.

The climatic pattern, particularly the rainfall, holds the key to suggest future agricultural practices in the island ecosystem. To draw any tangible conclusion on the trend minimum 35 year data are required, however an approximate trend may be drawn from 16 year data provided (2000-2015) for Port Blair. The average (16 years) annual rainfall is 3008.3 mm. The majority of the rainfall is received as SW monsoon (May-Sep including May receive pre-monsoon showers). The percent SW rains of the annual amount varied from 57.2 to 79.4, showing a marginal decrease in the trend with time. Although there was possibly no clear trend of change observed for the SW rains over time, the annual amount showed marginal increase in the amount with minimum 3400 mm rains received in the years 2005, 2008, 2011, 2012 & 2013, and a sharper increase in the trend in case of non-monsoon rains. Number of incidents on flood and breaching of embankments has been reported to decrease over the last about two decades due mainly to various land conservation measures undertaken. The entire island is highly humid ranging from 70–90 % and the temperature varying from 20 to 30˚C throughout the year.

The ZMC (Zonal Monitoring Committee) team during their visits to the sites were accompanied by the project personnel. Following the presentation made initially at the project for an overview of the problems and the activities undertaken in-depth discussions took place with the farmers at individual sites. The team went to Havelock and Baratang areas for an understanding of the problems of ecosystem. Discussion was also held with the VCRMC members & experienced farmers particularly the womenfolk as well as the government officials in each area to share their experience. Following are the salient recommendations intervention-wise emanating from the discussion directly related to the project sites.

Water resource	Provision of irrigation facility and optimal utilization of available water are important interventions for mitigation of climate induced adverse impacts on agro economy in an island ecosystem. Out of the total 68.75 ha net cultivated area 58.75 ha area is rainfed, and negligible area under irrigation. There are scopes to increase the area under irrigation particularly during post-monsoon period. There are at present 36 tanks and 22 bore wells covering 22 and 5 ha area, respectively. There are two patches where drip irrigation systems were

	operating and another 6 rainwater harvesting structures were created which are defunct now. Total 3 tanks and 1 well have been constructed by the project. Among the improved irrigation systems in use are 2 drip systems and 6 defunct rain-water harvesting structures. Among the various activities undertaken by the project to augment the water resources are pond desilting, water stored in Broad Bed Furrow models (BBF) for utilization of degraded land and flooded areas, new pond construction, and low cost rain shelter. There are practically no data available on groundwater status in terms of its use and quality, excepting some sketchy information provided of drawdown of the groundwater by 2-3 m over the last 10 years. As groundwater availability is uncertain and if available will be saline, harvesting of overland runoff and storage is of critical importance. Shallow open dug wells supported by water harvesting structures in the upstream could assure critical irrigation to the crop during drought. Hence more emphasis should be given on creation of water resources through runoff harvesting and recycling and use of pressurized irrigation system (drip and sprinkler) for minimized/optimal use of available water need to be taken up under the project. It is recommended to prepare master plan on increasing water resource use for different islands. Following steps are suggested: (1) Minimum 25 year database of rainfall and ET are required to work out probable availability of excess rainfall water for irrigation. (2) For storing excess rainwater structures and for appropriate crop planning commensurate with the factors like climate, crop water requirement, soil properties & land configuration, water table status, and other relevant factors there are methods/ expertise available in the country. Water may be stored for its exploitation in various water harvesting structures like fresh ponds, re-excavation of existing ponds and canals, BBF or other land shaping measures, etc. It is recommended that the project/ATARI may take initiative to draw the necessary plan. (3) For the use of groundwater for the purpose of irrigation in the island ecosystems being highly fragile in nature there is always a word of

	caution that the equilibrium should not be disturbed. It is recommended to collaborate with the experts (say, CGWB) in relevant fields for hydrological survey of the groundwater for its exploitation through tube wells. The project/ATARI may take initiative for drawing the desired plan.
Minimizing irrigation requirement	This is advisable to mitigate the effect of warming on agriculture by provision of irrigation water and especially its use at critical irrigation under water stress. It appears that no systematic attempt has been made to minimize irrigation requirement for crops, which is obviously a key strategy to mitigate adverse effect. *In-situ* moisture conservation through poly mulch and organic mulching with coconut has been practiced to increase soil moisture conservation and thereby decrease irrigation requirement for *rabi* crops. Attempts have been made sporadically without any systematic efforts so far to minimize irrigation requirement particularly for vegetables and other horticultural crops through, say, trickle, sprinkler or pitcher irrigation. Low discharge- high frequency irrigation methods like drip, sprinkler and pitcher are ideal to increase water use efficiency and cover larger area under irrigation. Drips are particularly useful as well for poor quality water use not otherwise permissible for conventional irrigation. Project/ATARI may work out plans to avail government promotional programmes to implement drip irrigation in selected areas useful for horticultural and plantation crops.
Climate change & crop planning	At the priority it is necessary to work out relevant to the island ecosystem trends of change of the climate for at least 25 years based on the past data available, for which there are a number of useful models suggested. Target should be to predict change of temperature, rainfall pattern (distribution and intensity/storms), wind speed, relative humidity & other related climatic parameters, sea level rise & related hydrological parameters. The study should project on the scope for sea water inundation of the cultivable lands particularly the low lying areas in future. The project/ATARI may organize for a special initiative to be taken up in collaboration with IMD, ISRO and agro-meteorologists

	specialized in this field of activities. Out of 198.6 ha under gross cultivated area, net cultivated area comprises of 78.8 ha (53.1 %), cultivable wasteland 79.9 ha, pasture land 1.5 ha, while rainfed area is 68.8 ha. In the field of crop planning a number of Integrated farming system models, mostly pond water based, were developed and implemented in the NICRA village sites. Organic farming was practiced through compost and vermiculture and use of *Trichoderma harzanium* was implemented to minimize the soil born diseases in this hot and wet climate. Vegetables like CIARI Brinjal-1, CIARI-Amaranthus, CIARI-Poi-1, Sweet potato like CIARI-SP-1 and paddy like Sabhagi are generally recommended against drought conditions prevalent in the island. Promotion of HQPM maize variety was conducted as FLD in two farmers' fields. Following are the recommendations for different types of drought conditions. To combat early season drought (delayed monsoon) vegetables like CIARI Brinjal-1, leafy vegetables CIARI-amaranthus-1 and CIARI-poi-1 are specifically recommended. Besides, it is recommended for this situation broadcasting of seeds (Paddy cv. C-14-8), and preparation of community based nursery near the pond. For normal monsoon followed by 15-20 day dry spell, it is recommended life saving irrigation to the crops, short duration leafy vegetables like amarathus, Indian spinach, low water requirement crops like sweet potato and elephant foot yam, use of coconut/arecanut husk, and leaf and paddy straw mulching to the bed and coconut basin. For mid-season drought with long dry spells of 2 consecutive week rainless period it is recommended to grow CIARI Brinjal-1, leafy vegetables CIARI-Amaranthus-1 and CIARI-poi, broadcasting of seeds (paddy cv. C-14-8), preparation of community based nursery nearby pond. For terminal drought it is recommended to grow short duration green gram cv. CIARI-Mung -1 sown into the fallow land, sowing of perennial red gram (local) and sweet potato. Mass tree plantation is another major programme taken up which should mitigate climate change effect; but the effect through increasing C storage in plants and soil as a result of this practice may

	also be initiated possibly at 5-yearly intervals with respect to more areas covered. One unit of Napier grass fodder unit has developed in the village. Sudan grass and cowpea have been successfully demonstrated as fodder crops in barren or marginal lands. In waterlogged or flood prone areas it is suggested to introduce *Coix lachryma* jobi, for which the project may take the help of CSSRI, Regional Station Canning Town. It is urged upon to prepare the integrated farming module, specific to farmer's needs, in such way as to apportion the area with suitable fodders since there is acute shortage of the same for the cattle and other animals in the islands. The ICAR-IFGRI and NDRI may be collaborated with for this purpose. It is suggested that project may take up programmes to motivate and train farmers on establishing nursery for flower or other commercially important horticultural plants, and if possible, create poly house for round the year planning for which there are financial schemes available with the government and public sector undertakings.
Soil resource	Out of 81 ha area under project sandy loam soils occupies 67.5 %, clay loam 31.1 %, red laterite 4.9 % area. Benchmark survey should be conducted, using NBSS&LUP or any other appropriate agencies having the relevant expertise, to identify representative land situations having distinct land and water availability characteristics. ATARI may organize and oversee that the project, with assistance from CRIDA, may work out 'soil health' indices , which together with benchmark data will help facilitate appropriate crop and water management strategies with focus on mitigating climate change, which will be important basis for crop planning in future. No such programme was initiated so far in the islands. Project has taken initiative to increase soil analyses up to 350 samples for which some facilities have been created in their laboratory. However, it is stressed that some more facilities for soil sampling and analyses may be created for which attention of ATARI is drawn. It is suggested as possibly necessary to extend routine soil analyses

	programmes (N,P,K,C, pH) to few other islands having diverse agro-ecologies like Havelock and Baratang and a few others at one year intervals on rotational basis so as to make an overall impression at the end of, say, 10 years of the impact of climate change on soil and plantations for which concurrent data on forest/plantation and crop yield for each site may also be documented.
Conservation tillage	This is regarded as an important practice to build up soil C and combat adverse impact of climate change, on which there are no studies made so far. Project/ATARI may take initiative to conduct such programmes in selected soils, cropping systems, and land topographies for which zero tillage equipments may be procured. Collaboration with CIMMYT or other appropriate agencies may be sought for this purpose.
Custom hiring of agricultural machineries	There were considerable interests shown by the farmers for custom hiring of agricultural machineries. The existing facility is of good use and may be augmented to provide such facilities like wheat thresher, maize Sheller (bigger size), spray machines, zero tillage equipment, etc. There were large demands for bigger tractors for custom hiring.
Alternate farming practice & roles of women folks	The interest shown by womenfolk in the islands was exemplary as large number of women has always participated and took active part in the discussion. They have been in a number of cases found to own or take active physical part in farming also with inquisitiveness to learn and improve farming practice, a lesson for other areas to follow. The women folk have been taking active interest, get involved in direct farming activities, and take leading role in crop planning, animal husbandry and goatery. They have a desire to learn advance farming practices, input management and marketing of the farm produce. Following could be the areas for entrepreneurship where women also may take significant role. These are: (1) Preparation of feed concentrate as fodder supplement since grass/fodder alone may not suffice to feed cattle and animals, their health condition being in general very poor, for which collaboration may be sought with ICAR-

	NDRI. (2) Entrepreneurship like coconut shell handicrafts and oyster mushroom cultivation. (3) Low-cost rain shelter has been implemented in a few areas, which may be extended to larger areas with improved design to prevent crop damage from high intensity rains and heat stress during off-season, particularly useful for horticultural crops. (4) Establishing polyhouses and nurseries for flower and other commercially important horticultural plants. (5) Construction of cross-ventilated poultry sheds and scientific cultivation of poultry, duckery, piggery and goatery with emphasis on introduction of local breeds resistant to survive under adverse conditions with high yielding ability, (6) Cultivation of ornamental fishes of commercial importance under protected systems. (7) Scientific/composite fish cultivation (including sale of fishlings) in ponds. (8) Frequent health camp of cattles and other domesticated animals including emphasis on AI of cattles, (9) Allied practices like apiary, mushroom, vermin-composting & composts out of local forest falls and other wastes, etc. Model alternate farming practices with agriculture at the epicenter should be introduced location-wise to ensure continuous flow of income on sustainable basis. This will also ensure production and use of more of organic composts for agriculture and build up soil organic C.
VCRMC	VCRMC is advised to organize more awareness meetings among the famers of different land holding categories as well as in adjoining villages. Being a remote and difficultly accessible area the island ecosystem should strive to develop self-reliant technologies, for which a major approach could be to set up small and medium scale industries on value addition of several local products. VCRMC should take a major role towards this, and project/ATARI may lend all possible help for this.
Marketing strategy	It is advisable for VCRMC to form cooperatives and fetch higher return for the farmers themselves by avoiding middlemen. The SHGs may also be useful for this purpose. The project may advise and encourage them.

Introduction of new plant species	The island ecosystem is an extremely rich repository of flora and fauna typical of surviving under these adverse climatic and soil conditions. The project may take special initiative through their own efforts and also encourage & train the farmers to identify new plant species for registration under PPVFRA.
Additional remark	The project personnel are working very hard to develop and implement technologies, but still there is lot of scope to increase its activities with systematic approach in a number of directions. A number of areas for future has been suggested, most of them will require collaboration with other agencies for which attention of ATARI is drawn for special initiatives to be undertaken considering the remoteness and thereby the need to become self-reliant as early as possible to combat extreme vulnerable nature of the islands to climate change, severe stress situations on a multiple of areas under normal circumstances, and extreme hardship under which the farmers and the personnel of the project are working. The soil laboratory at Port Blair should be more equipped as early as possible and personnel trained for this purpose.

G.4. 2nd NICRA, Zonal Workshop of Krishi Vigyan Kendras, Zone II, Kolkata was held at ICAR-KVK, Port Blair from 23-24th May, 2012

ICAR – Krishi Vigyan Kendra Organized 2nd NICRA, Zonal Workshop of Krishi Vigyan Kendras, Zone II, Kolkata held at CARI, Port Blair. Shri Rupesh Kumar Thakur IAS, Deputy Commissioner of South Andaman District was the Chief Guest and inaugurated the work shop at the Conference hall of ICAR- CIARI on 23rd May, 2012 and Dr A. K. Singh, Zonal Project Director, Kolkata Zone II, Dr. Sreenath Dixit , Coordinator, NICRA Project - CRIDA, Hyderabad, Dr. Rajendra Prasad Ratan, Director of Extension Education, Brisha Agriculture University, Ranchi, Dr. D. R. Singh Director CIARI, Port Blair and Dr. S. K. Roy, Principal Scientist , Zonal Project Director , Zone II, Kolkata were the dignitaries of the two days work shop, altogether 15 nos of Principal Investigators of NICRA Project were present from three states and one UT (West Bengal, Bihar, Jharkhand and Andaman and Nicobar Islands). The glimpses of 2nd NICRA, Zonal Workshop was depicted in Figure 107.

		
Chief Guest Lighting Lamp	**Remarks by Dr. A. K. Singh**	**Remarks By Dr. S. Dixit**

Fig 107: Glimpses of 2nd NICRA, Zonal Workshop

G.5. The distinguished dignitaries visited NICRA villages for successful implementation of the Research Project (Table 57).

Table 57: Dignitaries visited NICRA Villages

Name o Village	Name of dignitaries with designation	Date of visit
Port Mout, Badmash Pahad, Lal Pahad, Creekabad under the Chouldari Gram Panchayat , Ferrargunj Block, South Andaman District.	Dr. R.K.Samanta Ex- V.C. BCKV, West Bengal Chairman QRT	04.11.2019
	Dr. R .C. Satapathy Member QRT	04.11.2019
	Dr. R.B. Sharma Member QRT	04.11.2019
	Prof. S. K. Sharma Ex V.C. HPKV, Palampur (Chairman RAC)	06.07.2019
	Dr. W. S. Dhillon ADG, Hort, ICAR	06.07.2019
	Shri V. Mashar General Manager, NABARD, Port Blair	28.05.2019
	Dr. S. S. Singh Director ATARI, Zone-V, Kolkata	03.05.2019
	Dr. P. K. Singh Director ICAR-CIPHET and PC (PRT) , Ludhihana	13.04.2019
	Dr. T. Janikiram ADG (Hort -1)	02.09.2018

	ICAR-New Delhi	
	Shri Kanhaiya Chaudhary Director (Administration) ICAR-New Delhi	24.11.2018
	Dr. W. S. Dhillon ADG, Hort, ICAR	28.08.2018
	Dr. H. K. Pradhan Former Director National Institute of High Security Animal Diseases, Bhopal, Bhubaneswar, Odisha .	07.07.2018
	Dr. L. M. Garnayak Professor agronomy OUAT, Bhubeswar.	07.07.2018
	Shri Anant Upadhyay Chief Vigilance Officer HQ, NABARD, Bombay	11.12.2017
	Dr. Ch. Srinivasa Rao Director, ICAR-NAARM, Hyderabad	25.05.2017
	Dr. Sreenath Dixit Director ATATRI, Bangalore	17.5.2017
	Dr. H. S. Sen, Chairman, ZMC, NICRA and former Director, ICAR-CRIJAF, Barrackpore.	15.03.2016
	Dr. Prabhakar Nanda Principal Scientist ICAR-IIWM, Bhubaneshwar	15.03.2016
	Dr. A. K. Singh, Zonal Project Director	2012

G.6. Publications:

Bommayasamy, N., L. B. Singh and F. H. Rahman. 2020. Effect of planting methods and seedling age on growth, yield and nutrient uptake of rice under rainfall areas of Bay Islands. I*nternational Journal of Plant & Soil Science,32(6): 96-102.*

Bommayasamy, N., L. B. Singh and F. H. Rahman. 2020. Response of split application of nitrogen on yield and nitrogen use efficiency of rice under high rainfall area of Andaman & Nicobar Islands.

Choudhuri N C., Nagesh Ram, L.B. Singh, Z. George, B.K. Nanda, N.Bommayasamy, V.K. Pandey, H.Nayak and A Kundu. 2018. Backyard poultry production using disease resistant improved Nicobari fowl at NICRA adopted villages. In Abstract book of XXXV conference of Indian poultry science association and national symposium on rural poultry production challenges for sustainable entrepreneurship development. Pp: 8.

Choudhuri N C., Nagesh Ram, L.B. Singh, Z. George, B.K. Nanda, N.Bommayasamy, V.K. Pandey, H.Nayak and A Kundu. 2018. Amelioration of heat stress in poultry through improved shelter in NICRA adopted villages. In Abstract book of XXXV conference of Indian poultry science association and national symposium on rural poultry production challenges for sustainable entrepreneurship development.

Singh L. B., B. K. Nanda, N. Bommayasamy, V. K. Pandey, Harapriya Nayak and F. H. Rahman .2020. Land Based Integrated Farming System in Tsunami Affected Areas of Lal Pahad under TDC-NICRA Project - A Success Story. Biotica Journal

Singh L. B., Nagesh Ram, B. K. Nanda, N. Bommayasamy, V. K. Pandey, Harapriya Nayak, N. C. Choudhuri and F. H. Rahman. 2019. Technical bulletin on Successful Climate Resilient Technologies Practices in NICRA villages.

G.7. The details list of farm families of NICRA adopted villages have been mentioned in Table 58, 59, 60 &61 respectively.

Table 58 List of farm families at Port Mout Village – Drought Prone Area

Sl No	Name	Sl No	Name
1.	Shri Sreecharan	27.	Shri Surender
2.	Shri Pratap Singh	28.	Smt. Saraswati
3.	Smt. Pooja Devi	29.	Shri Martin Kerketta
4.	Shri Shivram	30.	Shri Sabdul Singh
5.	Shri Mohanjeet Singh	31.	Shri Markus Bhingra
6.	Shri Shwaran Singh	32.	Shri Jimri Minj
7.	Shri Kisan	33.	Shri Nisdor Minj
8.	Smt. Sabita Dei	34.	Shri Markus Kullu
9.	Shri Ram Nath	35.	Smt. Silvina Minj
10.	Shri Hargovind Pal Singh	36.	Shri Mintus Tirkey
11.	Shri Ramsukh Ram	37.	Shri Kumar Singh
12.	Shri Santh Ram	38.	Shri Ashok Kr. Sarkar
13.	Shri Ananth Ram	39.	Shri Oskar Kerketta
14.	Shri Paras Ram	40.	Shri Bandhu Minj
15.	Shri Devi Ram	41.	Shri Bimal Lakra
16.	Smt. Ratan Dei	42.	Smt. Malathi Sarkar
17.	Shri Ram Saha	43.	Shri Arun Bala Sarkar
18.	Shri Hilarius Bara	44.	Shri Sirajul
19.	Shri Zacharius Kawa	45.	Shri Basanti
20.	Shri Nicolus Tirkey	46.	Shri Sorama
21.	Late Shibu, C/o Ratan Dei	47.	Shri G. Apalswamy
22.	Shri D. Mohammed	48.	Smt. Mary Helena
23.	Shri Prem Kishen	49.	Shri Patrick Dung Dung
24.	Shri G. Karuppaiah	50.	Shri M.K. Thangapan
25.	Shri Nandlal	51.	Shri Emil Tirkey
26.	Shri Laxman Singh	52.	Shri parkas Xess

Table 59List of farm families at Badmash Pahad (Gopal Nagar) Village- Cyclone Prone Area

Sl No.	Name	Sl No.	Name	Sl No	Name
1.	Shri Kasinath Saha	26.	Shri Bage Toppo	51.	Shri Kamal Halder
2.	Shri Manoranjan Saha	27.	Shri Mahadevan Ural	52.	Shri Gopal Mondal
3.	Smt Kadambini Dutta	28.	Smti Basanta	53.	Shri Manu Biswas
4.	Shri Sukumar saha	29.	Shri Martin	54.	Shri Samphu Saha
5.	Shri Uttam Kumar	30.	Shri Parimal Mondal	55.	Smti Sheeja
6.	Smti Indirani Sajal	31.	Shri Nirmal Mondal	56.	Shri Mohan Sajal
7.	Shri Deepak Saojal	32.	Shri Raiappa Mirtry	57.	Shri B. Mondal
8.	Shri Champak Saojal	33.	Shri Ramakrishna	58.	Shri Sunil Ojha
9.	Shri Sholan Sajal	34.	Shri D.P.Mallik	59.	Shri K. Gharami
10.	Shri Oshi sajal	35.	Shri Abhijith Roy	60.	Shri K. Biswas
11.	Shri Rasik Joydhar	36.	Shri Shafali Mondal	61.	Shri Bibek Biswas
12.	Shri Harasit Joydhar	37.	Shri Madhabi Biswas	62.	Shri Dillp Biswas
13.	Smti Kholosa Biswas	38.	Shri Ramananda Patori	63.	Shri Shyam Gharami
14.	Shri Sushil Biswas	39.	Shri Narayan Halder	64.	Shri Suren Halder
15.	Shri Sisir Biswas	40.	Shri Sabal Basu	65.	Shri Kamala
16.	Shri Panchuram Joydhar	41.	Shri Kabiraj Guru	66.	Shri Kinachiya
17.	Shri Pradeep Joydhar	42.	Shri Sapan Mondal	67.	Shri Rajaram
18.	Shri Gouranga Sarkar	43.	Shri Dullal Halder	68.	Shri T. Alagan
19.	Shri Nithyananda Sarkar	44.	Shri Mohan Khujur	69.	Shri Barun Dhali
20.	Shri Bhadra Bhusan Sarkar	45.	Shri Ananda Mondal	70.	Shri Gopal Mondal
21.	Shri Ranjit Ray	46.	Shri Prem Mondal	71.	Shri Pulak Sarkar
22.	Shri Biswanath Mondal	47	Shri Hem Mondal	72.	Shri Sudeep Das
23.	Shri Gurinath Joydhar	48.	Shri Bimal Chakraborty	73.	Shri Dhalu Majundar
24.	Shri Mangal Guha	49.	Kiran Holder	74.	Shri Mithun Sajal
25.	Smti Kumudini Guha	50.	Shyamal Halder	75.	Shri Arun Sajal

Table 60: List of Farm Families at Creekabad Village – Water Submerged Area

Sl No	Name	Sl No	Name
1.	Shri. Achinto Biswas	17.	Shri. Hari Mohan Halder
2.	Shri. S.K. Dutta	18.	Shri. Durga Mohan Halder
3.	Shri Karun Mondal	19.	Shri. Akhil Biswas
4.	Shri. Tapan Mondal	20.	Shri. Sree Singh
5.	Shri. Jiban Biswas	21.	Smti. Abola Baidya
6.	Shri. Sunder Rao	22.	Shri. Narayan Mondal
7.	Shri. Anil Das	23.	Shri. Dulal Bain
8.	Shri. Ramesh Mistry	24.	Shri. Anup Mondal
9.	Shri. Niranjan Halder	25.	Smti. Banobashi Das
10.	Shri. D. N. Madhu	26.	Shri. Gourango Saha
11.	Shri. Mulluck Chand Baidya	27.	Shri. Nishi Halder
12.	Shri. Suren Gharami	28.	Shri babul Saha
13.	Shri. Rabi Dey	29.	Shri. Barun Saojal
14.	Shri. Jogen Mondal	30.	Shri. Samar Ghosh
15.	Shri. Motilall Mondal	31.	Shri. Ashok Ghosh
16.	Shri Mallick Biswas	32.	Shri. Gourango Guha

Table 61:List of Farm families at Lal-Pahad Village – Water Submerged Area

Sl No.	Name	Sl No	Name
1.	Smti. Lalita Das	15.	Shri. G. D. Mazumder
2.	Shri. Rajen Malakar	16.	Shri. Krishna Chandra Mazumder
3.	Shri. Santosh Dey	17.	Shri. Tarapada Mazumder
4.	Shri. Jagobandhu Joydhar	18.	Shri. Tukidasi Mazumder
5.	Shri. Sarat Mistry	19.	Shri. Khirodh Mondal
6.	Shri. D.N. Mistry	20.	Shri. Ganesh Mridha
7.	Shri. Biswanath Mazumder	21.	Shri. Gopal Banick
8.	Shri. Kalachand Mazumder	22.	Shri. Sunil Baroi

9.	Shri. Hari Mondal	23.	Shri. Nimai Bhattachary
10.	Shri. Ashim Baidya	24.	Shri. Bimal Mistry
11.	Shri. Kartick Mondal	25.	Smti. Bimal Mondal
12.	Shri. Gorango Banick	26.	Shri Dilip Mondal
13.	Shri. Payrilal Joydhar	27.	Shri. Bhakta Ranjan Mondal
14.	Smti. Budhi Joydhar	28.	Shri. Anil Halder
29.	Shri. Ananda Mridha	34.	Shri. Krishna Banick
30.	Shri Manindra Kirtania	35.	Shri. Priyolal Mistry
31.	Shri. Shanti Krishna	36.	Shri. Ramesh Mistry
32.	Shri. G. Chandra Babu	37.	Shr. Bishnu Halder
33.	Shri. G.Dalayan	38.	Shri. Swapan Mondal

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