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# Location Specific Fish Based Farming System in Dhalai District of Tripura for Proper Utilization of Agri-Resources

**Dilip Nath[1] Ratan K. Saha[2]**

[1]Department of Zoology, Holy Cross College Agartala

[2]Department of Fish Health and Environment, College of Fisheries, Central Agricultural University, Lembucherra, Tripura (W)

***Abstract – Fish based farming system is allocation specific farming system which is appropriate for the north eastern region. The sub project has been introduced by the College of fisheries, CAU, Tripura under National Agricultural Innovation Project (NAIP) Comp III. The various integrated fish farming technology developed by CIFRI and CIFA have been identified suitable for northeastern states particularly for Tripura. Some modifications of such technologies have been done by College of Fisheries under NAIP. Total 52 farmers were involved to develop A[3] (Agriculture + Aquaculture + Animal Husbandry) model of farming system with in the area of 10.19 ha (Land= 6.94 ha; Water area= 3.25 ha) under the direct supervision of College of Fisheries, CAU. The integrated farming systems which were introduced in the two clusters (Balaram and Maracherra) of Dhalai includes - (i) Composite fish farming, (ii) Fish- cum-vegetable farming, (iii) Fish-cum-fruit farming, (iv) Fish-cum-pig farming, (v) Fish-vegetable-pig farming, (vi) Fish-fruit-pig farming, (vii) Fish-fruit-vegetable-pig farming, (viii) Fish spawn rearing–vegetable farming, (ix) Fish-medicinal plant farming and (x) Fish-rice-vegetable-fruit farming. Out of such technologies four (4) of them were recorded as most suitable for this region. These are (i) Fish Spawn rearing cum vegetable farming, (ii) Fish-Rice-Vegetable-Fruits farming, (iii) Fish-fruit-vegetable-pig farming and (iv) Fish-fruit-vegetable farming. The productivity of fish, animal and plant components are found in growing trend and the farmers are getting better economic benefit from such practices.***

***Key words: NAIP, Dhalai, Tripura, College of Fisheries, Technology, Fish Based Farming System, Location Specific.***

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## INTRODUCTION

Northeastern Region of India consists of eight States, *viz.,* Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim. The northeastern states are located between geographical ordinates, 21° to 29°30' N and 89°46' to 97°30' E. The region, surrounded almost on all sides by Bhutan, China, Myanmar and Bangladesh, which can be broadly divided into two characteristic zones *viz*., Mountainous and Plain. Although distinguished in the altitude differences, both the mountain and plain are closely interrelated in terms of natural resource sharing and economic flow. According to the physiographic characters this region is divided into five physiographic units, the Assam Himalayas, the Brahmaputra valley, the Shillong plateau, the Barak valley and the Southeastern hill region. Except the Brahmaputra and Barak valleys in Assam and the Imphal valley in Manipur, the terrain is hilly and mountainous, only making 65% of the northeast an undulating land with elevations ranging from 200 to 900 m above MSL. This region which collectively account for about 8 per cent (262,190 sq km,) of the country's geographical area and roughly 4 per cent of its population. Geographically, apart from Brahmaputra, Barak (Assam) and Imphal (Manipur) valleys and some flat lands in between the hills of Meghalaya and Tripura, two-thirds of the area of the region consists of hilly terrain. Most of this hilly portion is either owned, controlled or managed by tribes, clans or village communities. The most populous part is the Brahmaputra Valley, which constitutes about 22 per cent of the region (Munilkumar and Nandeesha, 2007).

This region has been ranked 6$^{th}$ among the top 25 biodiversity spots in the world. It has varied physiographic features ranging from river valleys to snowcapped mountains making it a favourable habitat for variety of ecthyofauna (Gurumayum and Choudhury, 2009). An estimated 43.5 million people

in the world are directly involved, either full or part time, in fisheries and aquaculture.

Fish is one of the major sources of protein in the northeast region of India and plays an important role not only to combat malnutrition but also in livelihood security especially in Tripura. Most of the area in this region is covered by rugged and inaccessible terrain, step hills, high mountain ranges, undulating topography (Saha and Nath, 2012a). However, owing to some unique problems of demographic pattern, age old techniques of production, land tenure system and comparative isolation, there has not been much breakthrough in farming system concept (Saha and Nath, 2010).

The present work was carried out under National Agricultural Innovation Project (NAIP) of Component III deals with the transfer of location specific technologies of Fish based farming system.. Finally the outcome of the transfer of these technologies in terms of productivity and income were discussed.

## OBJECTIVES

1. *Evaluation and validation of indigenous and improved farming system models for enhancing production in fish based farming system for sustainability, profitability and competitiveness.*

2. *Addressing the constraints of deliverables to facilitate the community/people to harness optimum benefit from fisheries and related agriculture sector.*

3. *Capacity building, skill upgradation, information access and promotion of activity specific SHGs.*

4. *Employment generation through agro-processing and value addition including storage, packaging, transportation and marketing of the produce.*

## PROGRAMME IMPLEMENTATION

The implementation of the programme is involved the following four phases.

**Phase I:**

- Base line characterization for bio physical and socio economic variables.
- Evaluation and validation of indigenous and improved farming system models on fish based technology
- for upscaling. Identification of crop/animal/ fish of strength
- Formulation of site specific action plan involving all stakeholders.

**Phase II:**

- Entry point activities

**Phase III:**

- Actual implementation of the action plan at each site.

**Phase IV:**

- Addressing issues of post project sustainability and hand holding. Creating new linkages, strategies for up-scaling, policy implications, etc.

The program has been blended with some innovative features, as briefed below, so as to make it successful.

- Consortium approach in place of fragmented or compartmentalized approach shall be followed for delivery of economically viable, environment friendly and agri-business oriented technology to the people living in un-reached areas.
- Focus on bio-prospecting in the clusters besides introducing the concept of protected cultivation of high value crops involving the masses.
- Focus on organic agriculture-*in situ* production and management of inputs.
- Support mechanism like processing units envisaged to be put in place in the selected project districts.
- Mass production of cluster strength specific crops/animals so as to get the district recognized after that crop/animal to ensure post project continuation of the activities
- Diversification approach attempted to be explored for better economic return and market tapping.
- Dove tailing of programmes like weather monitoring (for fore-warning and disaster management), rural knowledge centres (ICT based) and rain water harvesting models.
- Empowerment of rural poor, community with focus on women with desired level of skill and information to face the implication of globalization.

## TECHNOLOGY OF FISH BASED FARMING SYSTEM

Aquaculture, if integrated with agriculture and animal husbandry has been found to be a productive and economical venture as compared to the conventional farming practices. It provides efficient means of recycling agriculture and domestic wastes in the ponds as such as maintaining the energy flow and the environmental equilibrium. Out of the various integrated fish farming technology developed by CIFRI and CIFA, the following technologies have been identified suitable for northeastern states particularly for Tripura.

1. **Composite fish culture:** The fish culture in the village pond is analogous to agricultural practices. Six fish having different feeding habits and habitats are used for composite fish culture. These comprises three indigenous species like Rohu, Mrigal, Catla and three exotic varieties like Grass Carp, Silver Carp and Common Carp.

2. **Fish- cum-vegetable farming:** Fish culture practices are same as CFC (1). In addition, usually a land space of about200$m^2$ is needed for kitchen gardening and embankments of a fish pond provide more area than this. In a year two crops of vegetables can be grown. Pond embankments can also be used for growing crops of pulses and oil seeds. This integration can add to the income of fish farmers by 25 to 35%, if not more (Saha and Nath, 2012a).

3. **Fish-cum-fruit farming:** In this system fruit farming is mainly practiced at the adjoining sloppy or upland near the pond embankment. Six fish having different feeding habits and habitats are used for fish culture. The fruit culture produce would not only provide the additional income to the fish farmers but also improves the environment. Generally, to meet the daily needs of fruits for a family of 4 – 5 members a land space of about 200$m^2$ is needed. Among fruit crops, banana, papaya and coconut are the best. In case of upland or hilly areas, the main cultivable fruits include papaya, pineapple, banana etc. Some tuber crops like ginger, turmeric etc. may be cultivated at the space between the fruit plants. The fish would get benefit by way of shades from plants, free direct heat of sunlight to promote the extensive algal growth (Saha and Nath, 2012a).

4. **Fish-cum-pig farming:** Rising of pigs can be fruitfully blended with fish culture by setting animal housing units on the pond embankment in such a way that the waste and washings of house are drained into the fish pond. About 60% of the fish production cost generally incurred for feed and fertilizer and by utilization of pig manure which acts as both feed and fertilizer, the cost of fish production can be considerably reduced. A stocking density of 7,500 fish fingerlings per hectare water area comprising of 40% of surface feeders, 20% column feeders, 30% bottom feeders and 10% of fishes feeding on macro-vegetations is ideal in such farming practice. During a period of one year, two crops of pigs (6 months each) can be raised. The pigs are fed three times a day with balanced pig diet as per their requirements and generally fed @ 1.4 kg/pig/day. Grasses and green cattle fodder can also be provided to the pigs to reduce the feed coast. The green fodder can be incorporated to the extent of 15 to 30% in the feeding ration. Harvesting of fish can be done after 12 months of culture and a fish production of 3000 - 3500 kg/ha can be achieved along with 4,200 to 4,500 kg of pig meat (live weight) (Saha and Nath, 2012a).

5. **Fish-vegetable-pig farming:** Usually a land space of about 200$m^2$ is needed for kitchen gardening and embankments of a fish pond provide more area than this. In a year two crops of vegetables can be grown. Humus acts as a rich source of fertilizers for crops. The pig rearing practices are same as stated earlier. This integration can add to the income of fish farmers by 25 to 35%, if not more (Saha and Nath, 2012a).

6. **Fish-fruit-pig farming:** Fish culture can also be done along with the fruits, vegetable and flowers. These horticulture produce would not only provide the additional income to the fish farmers but also improves the environment. In one hectare pond area 0.3 hectare land is available in shape of dykes on which any citrus plant having low root system or papaya can be cultivated. Among fruit crops, banana, papaya and coconut are the best. Lemon and guava are also good fruits for growing on pond embankment. Flowers and vegetable can be grown also in remaining space. The fish would get benefit by way of shades from plants, free direct heat of sunlight to promote the extensive algal growth. The fruit, vegetable and flowers would get the rich pond bottom soil which can be used as a good fertilizer for the plantation. The singhara/ pani phal (*Trapa* sp.) culture can also be done in 2/3 portion of the pond. The rest portion of pond is left open for aeration and light preparation. The pig rearing

practices are same as stated earlier (Saha and Nath, 2012a).

7. **Fish-fruit-vegetable-pig Farming:** It is a very important technology to integrate the fish culture activity along with different plant (fruit and vegetable) and animal (pig).The farmers would get benefit from the programme in different ways by producing fish along with fruits and vegetables according to the specific area and location. There is a good demand of fish, vegetable, fruit and meat in local market. So, it is very important to integrate the fish culture activity along with the different plant and animal according to specific area, location and topography (Saha and Nath, 2011).

8. **Fish spawn rearing–vegetable farming:** It is a profitable practice through which the fallow small ditches can be utilized for scientific system of spawn rearing. The system ensures maximum benefit for the farmers within a short period by the utilization of minimum investment. The practice can be performed in a small ditches/ water bodies of 0.02 to 0.10 ha area with depth of 0.75 to 1.0 m. The spawn can be stocked @ 5- 10 million of single or combination of two to three species. After harvesting the advance fry or fingerlings, the same fallow land can be used for the low land adapted vegetable. Arum (*Arum* sp.), amaranthus (*Amaranthu* sp.), dhane (*Coriandrum sativum*) can be cultivated and the farmers can also be earned around Rs.12,000- 15,000/- as additional money from one ha area(Saha and Nath, 2012a).

9. **Fish-medicinal plant farming:** Another input are that as identified is fish culture along with the different medicinal plants. This provides the additional income to the fish farmers and improves the environment. In these practice different medicinal and ornamental plants like sandal (*Santalum album*), aloes (*Aloe vera*), agar (*Aquilaria crassna*), arjun (*Terminalia arjuna*), Cinchona (*Cinchona Rubra*), haememelis (*Hamamelis virginiana*), turmeric (*Curcuma longa*), pudina (*Mentha asiatica*), amla (*Emblica officinalis* Gaertn) etc. can be incorporated. It is not only for economic benefit, it can strengthen local and national medicine company and ethnic groups (Saha and Nath, 2012a).

10. **Fish-rice-vegetable-fruit farming:** Places where paddy fields retain water for 3-8 months in a year, such type of farming system can be adopted. The plot can be renovated by excavating canals, pools or trenches to retain water which provides shelter to fish during summer months. The stored water also is used for the irrigating crop of paddy. A production of fish to the tune of 300 to 350 kg/ha can be achieved during the period depending on the climatic conditions and natural productivity status of the soil and water. The dyke of the pond and channel can be used for the plantation of fruit crops like papaya, banana etc. Among vegetable crops, brinjal, cucumber, pumpkin, bottle gourd, bean etc. can be cultivated after the harvesting of rice in the same field. The dyke and the field adjoining the pond can be used for bottle gourd and pumpkin cultivation. The platform for bottle gourd and pumpkin can be made above the pond water and channel which provides shed for the fishes and the bamboo twig and pole under the water have facilitate the growth of periphyton/ biofilm and minimize the cost of fish feed(Saha and Nath, 2012a).

## OUTCOME OF THE TECHNOLOGY

Some of the above mentioned technologies were found suitable and recommended as most effective for the NEH region particularly for Tripura. In the present intervention, various location specific scientific inputs of fish farming and other agricultural practices are provided by College of Fisheries (CAU), Tripura under the "Livelihood Improvement and Empowerment of Rural Poor through sustainable Farming Systems in North Eastern Region" of National Agricultural Innovation Project (NAIP, Component 3) in disadvantageous areas of Dhalai District of Tripura under which two clusters viz., Balaram and Maracherra have been covered. The subproject of the technology is defined as "*Fish based Farming System".*

The required farm inputs like, quality fish seed, lime, fish feed, organic manure, and the planting materials according to the specific land availability and pattern also provided to the farmers by the College. Total 52 farmers were involved to develop $A^3$ (Agriculture + Aquaculture + Animal Husbandry) model of farming system with in the area of 10.19 ha (Land= 6.94 ha; Water area= 3.25 ha) under the direct supervision of College of Fisheries, CAU.

**1. Fish Spawn rearing cum vegetable farming:**

To enrich the rural economy through fish spawn rearing initially 5 (five) farmers and has been selected from Balaram (3) and Maracherra (2) clusters of Dhalai District during the year 2010-11. From Balaram cluster 1 (one) SHG group has also been selected for spawn rearing practices. Such practice under aquaculture is a new technology for this area. Out of the five farmers total four belongs to SC and one is under ST community. Under the programme initially a total 20.7 lakh spawn of *Labeo rohita*, *Cirrhinus mrigala* and *Catla catla* has been provided to the farmers. The spawn rearing practice has started in the small ditches where there is the water

retention problem. The new ponds also used for this purposes for short term income. Low cost spawn feed has been prepared by the farmers with the available local natural resources. The farmers have started to sale the fingerlings to our beneficiaries or other farmers from which they have earned Rs. 11,925/- by selling 20300 nos. of fingerlings. The survivality was recorded as 15-20%. The rest of the fingerlings were kept by the farmers for culture in their own ponds (Saha and Nath, 2011).

During the year 2011-12 total 10 lakh lakh spawn of *Labeo rohita*, *Cirrhinus mrigala* and *Catla catla* has been provided among three farmers (one of Balaram and two of Maracherra). The farmers have earned 21,000/- by selling 40,600 nos. of fingerlings. The survivality was recorded as 18-22%. The rest of the fingerlings were kept by the farmers for culture in their own ponds. It has proven as a cost-effective practice for marginal and poor farmers of this district. The farmers could produce seed with better return after the adoption of scientific knowledge of spawn rearing (Fig. 1).

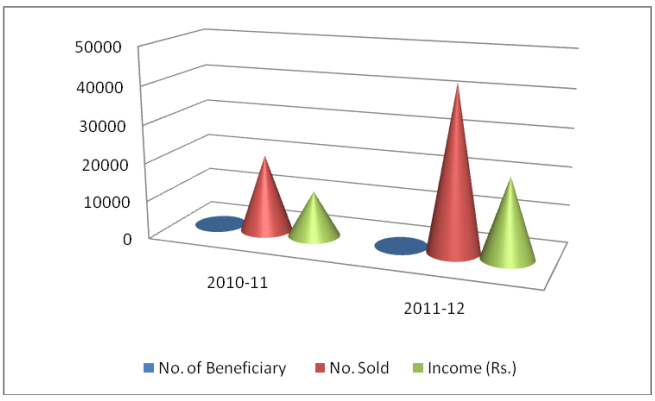


**Fig.1. Status of Spawn rearing during the year 2010-11 and 2011-12**

## 2. Fish-Rice-Vegetable-Fruits farming:

Fish-rice-vegetable-fruit farming was found an effective system as compared to others in the plain low land of Maracherra. The production of fishes per ha was found to the tune of 1.25 tons after intervention from the field of Suryasen Satnami of Maracherra. The income of rice, vegetable and fruit is also showing growing trend from fish based farming system.

Since aquaculture requires resources such as pond, land, water and other inputs, poor farmers cannot afford these. If we really target to the rural poor of NE region to develop their livelihood through integrated fish farming one option is utilization of common water resources available in their rice-fields. So, fish-rice-vegetable-fruit farming is the most appropriate technology for this area. Such approach may pave the way for enhanced farming system production and aquatic productivity from the natural waters (Saha and Nath, 2011d).

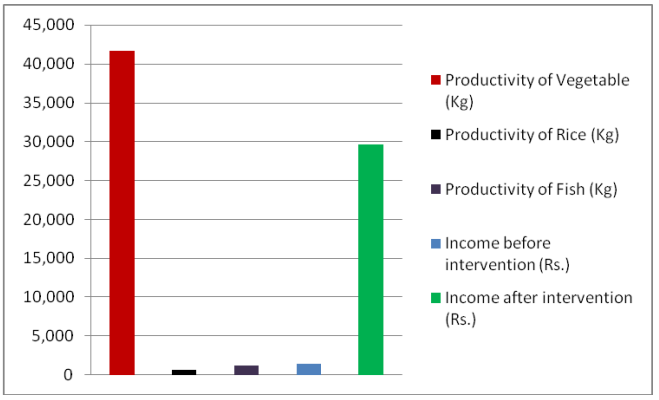


**Fig. 2. Economics of Fish-Rice-Vegetable-Fruit Farming**

## 3. Fish-fruit-vegetable-pig farming:

From this technology the average income per farmer ranged from 25,572 to 83800 compared to 9500 per farmer before intervention. The significant findings/results of the technology demonstration are furnished in table 1. The farmer's economic status improved substantially by adopting the fish based farming system. The BCR before intervention was recorded at 1.57, whereas it was raised up to 2.71 during the year 2010-2011 after intervention (Fig. 3). From the pig rearing practices the farmers received Rs. 10,000/ to Rs. 14,000 during the year 2010-2011 (Table 1). One farmer deposited an amount of Rs. 20,000/- in LIC annually from the income of fish based farming system. They are able to maintain their farm by themselves without any financial help from the 2nd year.

Out of nine interventions Fish-fruit-vegetable-pig farming was found as more effective as compared to others. The productivity of fish per ha increased to 2.7 to 3.1t/ha after intervention as compared to the initial status of 0.3 to 0.6t/ha. The people have learned about the scientific integration of fish, vegetable, fruits and pigs for better economic development. They have learnt about the integrated farming system and management in proper ways. The other farmers are now motivated very much leading to generation of interested to follow fish based farming system after realizing the potential economic benefit of fish based farming system (Saha and Nath, 2012c). This practice can give economic return from a single through production of fish, meat, vegetable and fruit. The natural resources, namely, soil, water and forest contemplated to be conserved in the project site areas shall facilitate the needed shift towards multiple cropping using the scarce resource- the conserved water besides checking soil erosion, thereby facilitating the spread of the

technology as well as creating multiple livelihood options to the farmers for employment and economic gain (Saha and Nath, 2011c).

**Table 1. Economics of Fish + fruit + vegetable + pig farming system in farmer's field**

| | Before Intervention | | After Intervention (2008-09) | | After Intervention (2009-10) | | After Intervention (2010-11) | |
|---|---|---|---|---|---|---|---|---|
| | Exp. (Rs.) | Return (Rs.) | Exp. (Rs.) | Return (Rs.) | Exp. (Rs.) | Return (Rs.) | Exp. (Rs.) | Return (Rs.) |
| Total (Rs.) | 16500 | 26000 | 22528 | 48100 | 36175 | 94350 | 48950 | 132750 |
| Net return (Rs) | 9500 | | 25572 | | 58175 | | 83800 | |
| **B: C ratio** | **1.57** | | **2.13** | | **2.60** | | **2.71** | |

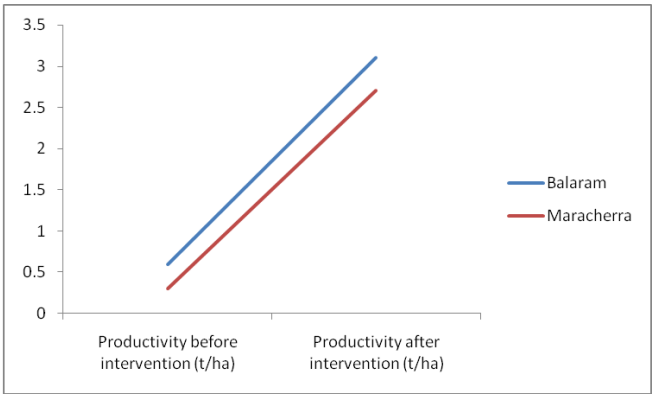


**Fig. 3. Productivity of fishes before and after intervention**

## 4. Fish-fruit-vegetable farming:

The fish-vegetable-fruit farming intervention is a location specific scientific modification of traditional fish culture which gives low fish production to the farmers. Hence, technology for proper utilization of land as well as water in an integrated with fish-vegetable-fruit farming was introduced. A scientific layout of the available land has been planned in such a way that farmer can grow fish, vegetable and fruits simultaneously. The farm pond was renovated which can retain water throughout the year for fish culture and also utilize for fruit or vegetable farming on the adjacent land and pond dyke to minimize soil erosion.

To perform such activities various training programme was organized on location specific fish based farming system modules and also provided different input such as quality fish seed, balanced fish feed, lime, vegetable seeds and different planting materials etc. The stocking ratio of fish species was maintained as 6 species @ catla (2.5): silver carp (1): rohu (3): grass carp (0.5): mrigal (1.5): common/ amur carp (1.5). Initial stocking density was @ 12,000 nos. /ha and periodical stocking @ 8,000 nos./ha. The vegetable (bottle guard, pumpkin, brinjal, local bean) cultivation was done on pond embankment as well as adjacent plain land and dyke whereas the fruit crops like banana, papaya and amropalli were planted on pond embankment.

The monitoring and maintenance of fish pond, fruit field, vegetable field, pest management, soil and water quality were followed regularly for better production. Present intervention was undertaken by Santineer SHG, Balaram in an land area of 0.16 ha + Water area of 0.32 ha (total 0.48 ha)

This technology was also found as an effective. The production of fishes per ha was increased to the tune of 2.6 tons after intervention from 0.6 tons. The income of vegetable and fruits are also in growing trend (Fig. 4).

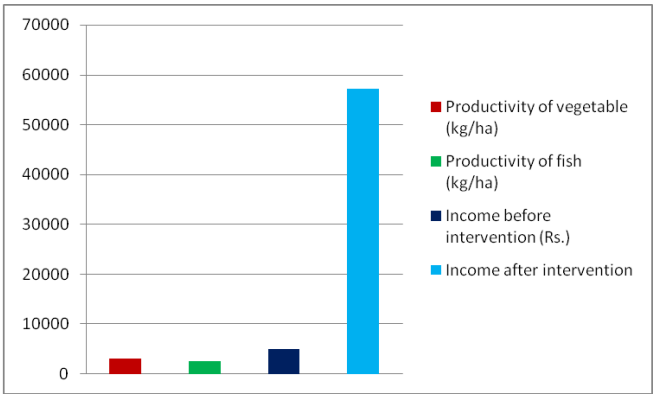


**Fig. 4. Economics of fish-fruit-vegetable farming**


**Fig.5. Fish based farming system at Dhalai of Tripura**

## CONCLUSION

There is lots of opportunity for the development of hill farming system. The major problem that faces the credibility of in-situ harnessing of runoff water is very much linked with certain weakness, which are to be assessed simultaneously. Some of these weaknesses are highlighted as hereunder for consideration of the planer and policy makers.

The North Eastern Hill Region, due to its rugged terrain has limited land resource; however, the region is blessed with enormous water source in the form of rivers, streams, ponds, beels, mini barrages, etc. There exists a tremendous potential for fish farming in various forms as mentioned in the above. However, an integrated approach of fish farming by associating different components of paddy and livestock including poultry, piggery and duckery are found more meaningful to utilize the available farm space of a farmer so as to boost up the farm income and subsequently fish production of the state as witnessed from the production and income of the farmers after intervention.

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