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PADDY CUM FISH FARMING - A SUSTAINABLE WAY OF AGRICULTURE, PRACTICED IN JORHAT DISTRICT OF ASSAM, WITH SPECIAL REFERENCE TO HATIGARH VILLAGE

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Abstract: Production of fish in rice fields is almost as old as the practice of rice or paddy culture itself. Rice- fish duo culture is a type of farming system in which rice is the main enterprise and fishes are taken as additional means to secure extra income. Rice- fish culture is practiced in many rice-growing belt of the world including China, Bangladesh, Malaysia, Korea, Indonesia, Philippines, Thailand and India. Rearing of fish along with paddy is an old practice in India It has largely been practiced in a traditional way in the Indian coastal states of Kerala and West Bengal. However, though it has not much popularity in Assam, yet, it is practiced in certain areas of the state. Depending upon the availability and suitability for culture under local conditions, fingerlings of *Labeo rohita, Catla catla, Cirrhinus mrigala, Hypophthalamichthys molitrix, Cyprinus carpio, Labeo gonius, L. calbasu, L. bata* and Puntius sp., were mainly stocked by the farmers in the paddy field. Rice is the main cultivated crop in Assam. Fish culture in the rice fields occupies about 27,000 ha area out of a potential 45,000 ha. Fish is one of the most preferred foods in Assam. Thus, rice-fish farming has a great potential to help improve the economy of the state. Very few studies on cost and returns as well as production function analysis have been reported for rice-fish culture farming system. This paper attempts to assess the economic viability of rice-fish farming in Jorhat district of Assam. This paper is an effort to identify the ideas and practices that constitute our concept of sustainable agriculture. The study was conducted in Hatigarh village of Jorhat district. A structured and pretested interview schedule was used to collect the data from 50 randomly selected sample farmers from the village. Based on data collected, costs and returns and maximum profitability of the farming system were worked out. An emerging trend was observed among the farmers to adopt rice-cum-fish culture in a transition phase between traditional and scientific farming, where, farmers practiced both simultaneous and rotational systems of culture depending on the prevailing conditions. The present study has clearly indicated that rice-fish culture is a viable, environment friendly, low-cost, low-risk additional economic activity with multiple benefits including, increased incomes and greater availability of fish to rural farming community. Extension and development agencies should pay due attention to bring the benefits of the technology to village farmers. On the other hand the government should make provisions for financial assistance to encourage the poor farmers to adopt rice-fish culture.

Key words: Rice-fish duo culture, Sustainable, Economy, Profit, Village.

INTRODUCTION

Farming is a stochastic dynamic, biological and open system with human and social involvement. It specifically refers to crop-combination or enterprise -mix in which the products and/or the by-products of one enterprise serve as the input for the production of other enterprise (Maji, 1991). The farmers in Assam follow both settled and shifting types of farm practices. Every farm household follows an integrated mixed farming system where they grown crops, rear livestock and fish and in addition to homestead gardening and farm forestry.

Production of fish in rice fields is almost as old as the practice of rice or paddy culture itself. Rice- fish duo culture is a type of farming system in which rice is the main enterprise and fishes are taken as additional means to secure extra income. Rearing of fish along with paddy is an old practice in India (Alikunhi, 1955). It is suggested that fish culture in rice fields was introduced into South-East Asia from India about 1500 years ago. Rice- fish culture is practiced in many rice-growing belt of the world including China, Bangladesh, Malaysia, Korea, Indonesia, Philippines, Thailand and India.

It has largely been practiced in a traditional way in the Indian coastal states of Kerala and West Bengal.

The farmers of the Northeastern part of India in all the seven states viz. Assam, Arunachal Pradesh, Nagaland, Meghalaya, Mizoram, Manipur and Tripura cultivate rice as their staple food. In this region of the country, a fish crop is traditionally raised only from the paddies of rain fed lowlands (both shallow and deepwater). Traditional rice-fish production systems have an important socioeconomic part in the life of the farmers and fishers in the region. The indigenous rice-fish farming practices prevailing among the farmers in the northeastern India can be categorized as:

(a) Rice field capture fishery systems

(b) Wild aquatic cropping systems

(c) Mountain valley rice fish farming system and

(d) Running water terrace rice-fish farming systems.

However, though it has not much popularity in Assam, yet, it is practiced in certain areas of the state. In the unmanageable vast waterlogged rice environments, perennial waterlogged wet rice lands, oxbow type rice fields or flooded river basin rice fields, naturally occurring fishes and prawns enter the field during the monsoon and grow together with the rice crop. The gravid females and young fingerlings enter the field during the wet season when field water overflows and connects neighboring watercourses to form a vast sheet of water under the rice canopy. The floodwater carries huge and diversified community of fish, prawn, crabs and other aquatic organisms into the rice paddies. This situation is very common in the flood plain rice fields of whole of the Brahmaputra and Barak Valleys of Assam. The fishing activities there start just after arrival of the floods from late June and continue until the water recedes in November-December. In a true sense, these areas become temporary fishing grounds. The farmers and fishers use those fields as common property resources for about 5-6 months of the year using gill nets, cast nets, and various indigenous traps, either operating them in the rice-free spots or fixing the traps at appropriate water entry and exit points in the fields. In such fisheries, the average capture rate is typically around 3 kg/ha/yr. Such practices are highly prevalent in the districts of North Lakhimpur, Dhemaji, Barpeta, Nalbari, Bongaigaon, Dhubri, Kachhar and Jorhat district of Assam. As Assam lie in a heavy rainfall zone and therefore, a longer aquatic phase is possible in these areas than in rain-fed low lying rice fields. Harvesting of the rice starts in November- December after the recession of floodwater at the end of wet season. All the low-lying ditches, marginal swamp and natural depressions inside the field area are also harvested at the same time. This is done either by pumping out the water or by using traditional nets or traps. In addition to direct capture during the wet season, the farmers also rear wild seed until the water level drops down below the level of the fields. During this phase wandering fish accumulate in the trap ponds or natural ditches in and around field contour. These fishes are harvested after dewatering the ditches and canals. The rate of production is ranges around 200-300kg/ha/season. The fish fauna from such flooded fields are very diverse. Depending upon the availability and suitability for culture under local conditions, fingerlings of *Labeo rohita, Catla catla, Cirrhinus mrigala, Hypophthalamichthys molitrix, Cyprinus carpio, Labeo gonius, L. calbasu, L. bata* and Puntius sp., are mainly stocked by the farmers in the paddy field. Rice is the main cultivated crop in Assam. Fish culture in the rice fields occupies about 27,000 ha area out of a potential 45,000 ha. Fish is one of the most preferred foods in Assam. Thus, rice-fish farming has a great potential to help improve the economy of the state. Very few studies on cost and returns as well as production function analysis have been reported for rice-fish culture farming system. This paper attempts to assess the economic viability of rice-fish farming in Jorhat district of Assam. This paper is an effort to identify the ideas and practices that constitute our concept of sustainable agriculture.

The survey was done at Hatigarh Village, which is situated in the south- eastern part of Jorhat District, Assam. The total distance from Jorhat town to Hatigar Village is approximarely 15 Kms. The area is basically a plain area in the Southern

part of the river Brahmaputra and besides a small tributary *Bhogdoi* (Fig. 1)

The objectives of this paper are:

1) Study the integrated farming system for better fish and rice production.
2) Work out the economic efficiency of the paddy-cum-fish culture system practiced by farmers.

Rice-fish fanning systems have received a great deal of attention in the recent past because of Government's focus on sustainable rural development, food security, and poverty alleviation. Several reviews on historical, socio-economic, and ecological aspects of rice-fish fanning have been published in the past decade with either a global or a national focus (Li, 1988; Fernando, 1993; Halwart, 1994; MacKay, 1995; Choudhury, 1995; Little *et al*., 1996)

Rice- fish culture is a small-scale aquaculture in rice based fanning systems. This system may be classified according to management intensity, growing period, field design, cultured species and stage in the production cycle. Rice-fish culture practice has had a long tradition in many of the South and South-East Asian countries for thousands of years (Ghosh *et al*., 1985).

Multiple cropping further improved the returns from agricultural land thus shifting the emphasis from such integrated farming. So rice-fish farming in India is considered particularly suitable for the less productive rain fed areas (Halwart, 1994).

Rice-cum-fish culture could play a prominent role in Niger State with the production of grain and animal protein (fish) on the same piece of land and at the same time. it might be considered as an almost ideal method of economic land use (Coche, 1967).

In many countries, rice-cum-fish culture is captural in nature whereby various species of wild fish enter into the flooded rice field. These fishes are trapped in the rice fields and grow along with the rice and are captured at the time of harvest (Mukherjee, 1995). The situation has however been depleted due to reduced stocks of water resources. In recent years, these circumstances have shifted attention to research in the natural

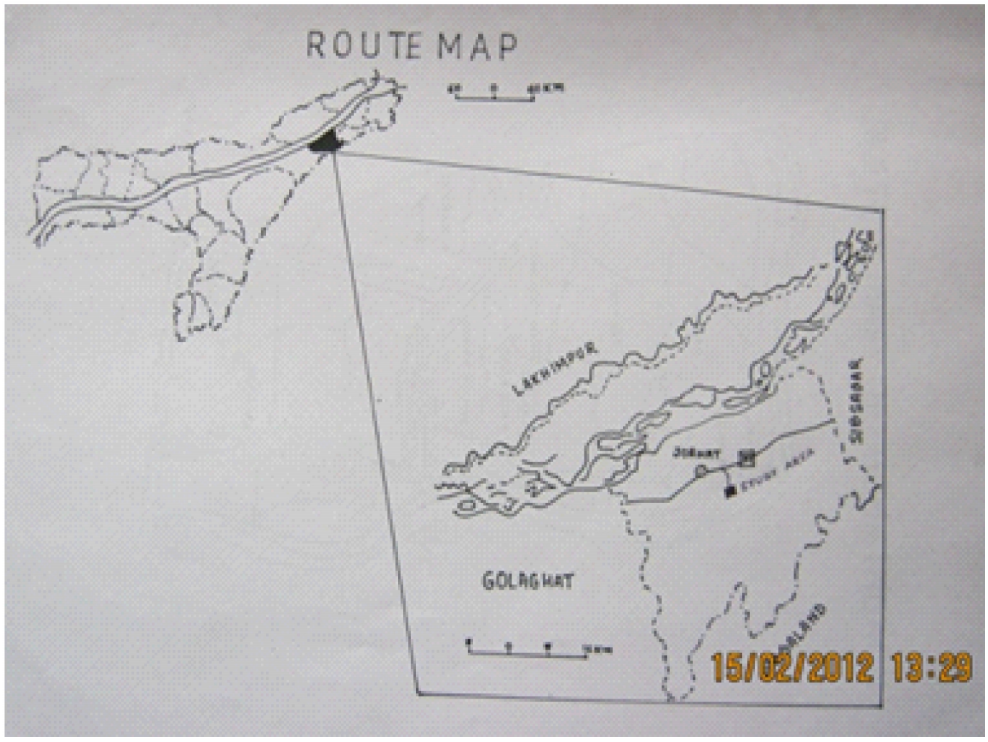

Fig. 1. Survey area and Route map

association between rice and fish, with much success and impact (Devendra, 1995).

On average, a fishpond area of 0.29 ha and rice field area of 1.25 ha yielded a net profit of Rs 25,123 and a 53.60 per cent rate of return. The study conducted on rice-fish fanning in Mekong Delta in Vietnam revealed that total farm cash return from rice introduced fish, rice indigenous fish, rice-monoculture were Rs.3, 243.00, Rs. 3, 180.00 and Rs. 3, 914.00 ha^{-1} respectively (Nhan *et al*., 1997).

Shingare and Shirgur (2000) reported that rice-fish culture at a village of Raigad district of Maharashtra, India, in summer yielded an average of 140 kg of fish per ha over 80 to 90 days of culture. The yield of paddy was higher by 38 per cent in the plot with fish culture compared to the plot with rice alone. An appraisal of the economics of the trial operation indicated a net profit of around Rs. 3103.00 largely from the sale of common carp.

Current efforts at promoting conservation and sustainable use not withstanding, there is a need to further augment the natural resource base and integrate sustainable use concept in all relevant economic sectors (such as agriculture, animal husbandry, fisheries, forestry and industry) so as to ensure intra- and inter-generational equity (NBAP, 2007).

MATERIALS AND METHODS

As stated earlier the study was conducted in Hatigarh village in Jorhat district of Assam. A structured and pretested interview schedule was used to collect the data from 50 randomly selected sample farmers from the village. Based on data collected, costs and returns and maximum profitability of the farming system were worked out.

RESULTS AND DISCUSSION

Farming System

An emerging trend was observed among the farmers to adopt rice-cum-fish culture in a transition phase between traditional and scientific farming, where, farmers practiced both simultaneous and rotational systems of culture depending on the prevailing conditions. In this paper, economic analysis is made only on simultaneous system in which fish and rice are cultured in the same field, with rice as the main crop. In the traditional farming, the rice is planted during April-May by direct seeding and after getting first shower of rain the seeds are germinated. Then the tall seedlings are transplanted after accumulation of rainwater during June-July (Fig. 2). The fields connect with neighbouring water courses during the monsoon when they overflow, allowing seeds of various wild fish and prawns into the field. Sometimes farmers dig trap ponds inside the field intentionally to give the animals refuge and facilitate their entry in the field. In addition to direct capture during the wet season, the farmers also rear wild seed until the water level drops down below the level of the fields. During this phase wandering fish accumulate in the trap ponds or natural ditches in and around field contour. These fishes are harvested after dewatering the ditches and canals (Fig. 3).

Fig. 2. Transplanted seedlings during monsoon

Fig. 3. Fish harvest from ditches

In the scientific method of rice-fish culture, proper fish pond preparation, selective stocking of different species of fish, addition of inputs like feed, fertilizer along with other post stocking managements and harvesting of marketable size of fish after gathering paddy crop are undertaken. As the water level increases with the onset of monsoon during June-July, the farmers release fingerlings at a very high density of about 20,000-25,000/ha. Fish stay in the paddy field up to December and start migrating to the actual fish pond as the water level goes down in the paddy field (Fig. 4). Paddy is harvested during November-December followed by harvest of fish in January-February. Farmers use organic and inorganic fertilizers during paddy field preparation. They apply lime, to correct the acidity of water as the surface waters of Assam are a little bit acidic. Feed in the form of rice bran and Mahua oil cake in small quantity is given.

Cost and Returns

It was observed that only 16% respondents of the study area follow the scientific method of rice-fish culture. Farmers adopted the technology in 0.1 ha pond size with an adjoining 1ha paddy area. The remaining 74% farmers adopted rice- monoculture only. To compare the productions of integrated and monoculture of rice, 0.12 ha of rice- monoculture area was selected. The average weight of fish in gram (gm) at harvest for a period of 150-180 days was as follows:

The cost and returns of paddy-cum-fish culture and rice monoculture is given in Table 2. From the table it can be seen that net profit from rice cum fish culture is Rs. 55940/ha and the production of rice increases by 10% (404 kg/ ha), when rice and fish are cultivated together and it gives the farmers an extra income of Rs. 4040/ ha. Again on an average, if each farmer has a pond of size 0.1 ha in a one hectare rice plantation plot, it gives an approximate profit of Rs. 2000 per cropping. Thus an extra profit of Rs. 6040/ha will be generated per crop when fish farming is introduced with a traditional rice culture.

If we also consider the wild variety of captured fishes other than the cultivated one, Rs. 1000-1500 may be added to the extra profit, which we

Table 1. The average weight of fish in 150-180 days

Name of the Fish	Weight in gms.
Labeo rohita	300
Catla catla	250
Cirrhinus mrigala	250
Hypophthalamichthys molitrix	450
Cyprinus carpio	450
Labeo gonius	200
L. calbasu	200
L. bata	150
Puntius gonionatus	100

Fig. 4. Stocking pond during winter

Fig. 5. Wild fish harvesting

Fig. 6. Some captured fishes

Table 2. Cost and returns of paddy- cum- fish culture and rice monoculture

Sl. No.	Category	*Cost/ Return in Rupees
A	a) Paddy cultivation	
	1. Rice seed	1000
	2. cow dung	1220
	3. Urea	525
	4. Other fertilizers	2600
	b) Labour cost	
	1. During plot preparation, seeding & maintaining	6000
	2. During harvest	1600
	Total	12945
B	Fish Farming	
	a) Operational Cost:	
	1. Fish seed	3565
	2. Lime	1800
	3. Cow dung	300
	4. Rice bran	1100
	5. Oil cake	1400
	b) Labour cost:	
	1. During culture	2850
	2. During harvest	900
	Total	11915
C	Total cost of rice- cum- fish culture (12945+11915)	24860
D	Rice production:	
	i) From rice cum fish culture: 4480kg	
	Income from rice cum fish culture	44800
	ii) From rice monoculture: 4076kg	
	Income from rice monoculture	40760
E	Fish production: 400kg	
	Income from fish farming	36000
F	Total income from rice- cum fish culture (44800+ 36000)	80800
F	Net Profit:	
	i) From rice- cum- fish culture	
	(80800- 24860)	55940
	ii) From rice mono culture	
	(40760-12945)	27815
G	Increase in rice production:	
	(4480-4076)kg= 404Kg	
	Extra profit from rice	4040

are not considering at the moment (Plate- 5&6). But some varieties of cat fishes like *Clarious batracus* have very high market value. Some times its price goes up to Rs. 500-600/ kg and becomes very much profitable for the farmers.

On the basis of findings of the present study, the following policy recommendation may be highlighted:

1 The Government should make a policy to embark on rice-cum- fish- culture.

2 Provision of proper training of the farmers should be made by the government and non- government organizations.

3 The financial institutions should pay attention for institutional credit, should be easy terms and condition to farmers.

CONCLUSIONS

Integrated farming activity has opened new horizons of increasing production per unit area at low inputs through an increased interest in utilization of animal manures as a substitute of high cost of major inputs fish feed and inorganic fertilizer, involved in aquaculture. It is a multi-commodity farming system with the waste recycling as the key feature and fish culture as the major activity. Almost in all the states of Northeastern India have plenty of areas under flooded paddy fields This would definitely increase yields, enhancing socio-economic development in rural areas.

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