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Traditional Rice-Fish Farming of Mao Indigenous Community, Manipur, India

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ABSTRACT
The present investigation was carried out in terrace rice field of Mao Sub-division of Senapati district, Manipur, north-east India. The native indigenous community, Mao Naga, mainly practiced two types of agricultural practices viz., shifting cultivation and terrace cultivation. The physico-chemical parameters of the rice field are: average atmospheric temperature 21°C; water temperature 18.5°C; pH 7.9; conductivity 143.79 µmho/cm; dissolved oxygen 8.22 mg/l; FCO_2 11.5 mg/l; alkalinity 123.07 mg/l; phosphate 0.362 mg/l and nitrate 0.07 mg/l. Indigenous carps such as *Labeo rohita*, *L. bata*, *L. catla* and fish such as *Channa punctata* and *C. striatus* were cultured in both perennial and seasonal rice fields with the local rice varieties such as Phurel, Phicharo, Muzharo, Mikhriro, Chusoro, Rodziiro, Romonoro and Disha. The rice variety Mikhriro is the costliest and famous for its flavour and stickiness. One ha of rice-fish culture field produced 3,500 kg of paddy (Rs. 52,500/-) and 200 kg of fish (Rs. 30,000/-) in one year. The net profit for perennial rice-fish field was Rs. 54,200/ha (against expenditure Rs. 28,300/ha) and Rs. 43,700/ha for the seasonal field (against expenditure Rs. 38,800/ha).

Key words: Terrace rice, Fish farming, Carps, Mao, Manipur

INTRODUCTION

The rice cum fish culture has always played an important role in socio-economic condition of the agricultural communities in many parts of the world. It has been reported that rice grows better in fields with fish culture with yield increase up to 10%. The system also provides the farmers with an important source of protein and extra income. The other advantages of rice-fish culture may be the control of insects and pest which would otherwise cause diseases to the crop (Halwart 1994). The continued flooding of the paddy and rooting activity of fish help to control weeds. In Indonesia modern rice-fish culture started in mid nineteenth century (Khoo and Tan 1980). While in China such a culture can be dated back to the middle of the Han Dynasty (Li 1988), it might had been introduced 1,500 years ago in Bangladesh, Cambodia, Egypt, Indonesia, Republic of Korea, Madagascar, Thailand and Vietnam (Halwart 1998). The fish culture in rice fields is being practiced in different states of India viz., West Bengal, Bihar, Andhra Pradesh, Tamil Nadu, Kerala and Orissa other than the North-eastern states (Lipton 1983, Das et al. 2000, Sinhababu and Das 2007).

The ethnic communities of the north-eastern states of India practiced their traditional cultivation practices of diverse crop suitable in different ecosystems solely on organic conditions without any external input to the system with the system of sustainability for future generations. They cultivate rice as their staple food crop. In many of these areas, irrigation–fed rice fields have also been in practice locally by the farmers to include fish farming (Das 2002). There has been an extensive study on the practice of rice fish culture and its potential importance in rural development in Assam and Arunachal Pradesh (Bayan et al. 1996, Das 2002, Saikia and Das 2008). In Arunachal Pradesh, Manipur, Nagaland, Sikkim etc. the rice is cultivated on carefully designed wet terraces. In this system of rice cultivation, there is no control on the movement of nutrients with water (Kannan et al. 1999).

Mao Naga tribe is the sub tribe of Shepoumaramth Nagas viz., Mao, Maram, Poumai and Thangal, mostly inhabited in the Mao area (northern hills) of

Senapati district, Manipur. Traditional cultivation practice is based on their traditional knowledge system closely linked with their socio-economic, socio-cultural and geo-physical factors of the area. Congenial edapho-climatic condition and topographical features of the areas favours the cultivation of variety of crops (Pfoze et al. 2010). Among different agricultural practices, integrated farming system commonly called rice fish cultivation is mainly derived through hypothetic deductive trial and error method based on societal experience and perception accrued by traditional societies during the process of their interaction with nature and natural resources. It is so deeply rooted to the agrarian Mao society that it cannot be separated out from the marginal farmers as it has strong bondage with the cultural ethos and social fabric of the Mao Naga.

In Manipur, the Mao Naga tribe follow two types of agricultural practices viz., shifting cultivation and wet-rice terrace cultivation performed in hill slopes and foot hills (Chanu et al. 2010). Almost all necessary arrangements for the fish rice farming performed in these remote areas are being managed and arranged by the farmers themselves (Anonymous 2010-2011). In view of the above, the study attempts to explore the unique traditional terrace rice-fish farming existing in the area followed by the ethnic Mao tribe by integrating their traditional ecological knowledge with the traditional knowledge of terrace cultivation.

MATERIALS AND METHODS

The present study was conducted in the terrace rice fields of Punanamei, Mao, (25°30'21.46" N 90°10'05.65" E & 1592 msl), Manipur during February, 2011 to end of October 2012 (Fig. 1a, b). The analysis of physico-chemical parameters of terrace rice field were carried out as per the standard methods of APHA (Anonymous 1998). The package of practices existing among the ethnic community for rice-fish culture was recorded through interactions with the group of indigenous farmers, selected using simple random sampling technique, interviewed with the help of pre-designed questionnaires.

RESULTS AND DISCUSSION

Preparation and design of rice field

The preparation of the rice fields begins from the last week of February when *Buhinia purpurea*, L. starts flowering an indigenous way of determining plantation season, (Mao and Hynniewta 2011). There is limited report(s) of using modern technology while preparing the paddy fields. The local farmers usually dig the fields either using spades or ploughed using buffaloes. There are no reports of farmers using the chemical fertilizers, pesticides and insecticides at all. They usually prefer the indigenous practice where in the domestic waste, cow-dung, pig-dung and other decomposed plant waste products are added at the time field preparation to make the field nutrient rich. The water coming from the upstream and highlands is allowed to flow through from one terrace field to the other in a regulated manner through indigenously managed irrigation channels. To enable retaining of water level at about 20-30 cm during the fish culture period, field margins are erected to stand about 40-60 cm high. A small depression (Fig. 2a) with 0.80 -

Figure 1. (a) A view of terrace rice field of Mao, (b) Mature paddy plant (harvesting)

Figure 2. (a) Small fish refugee centre, (b) Spitted bamboo prevents the fishes

1.5 m deep, 3.0 m wide and 7.5 m long was prepared in the middle of the field to act as refuge centre either during dry season or when the ambient temperature becomes high. The size of refuge centre may vary according to the size of the field. The water outlets connecting one field with the others are guarded to prevent the fishes from escaping with either spitted bamboo or bamboo made screens (Fig. 2b). When the field is properly prepared, the transplantation of the rice seedlings is carried out starting from the early part of May till June. When the plantation is over and about 10 days later or latest by the last week of June, the fish fingerlings are stocked at the rate of 2000-3000 per ha field. There is no report of any supplementary feed during the fish culture period.

Physico-chemical characteristics of farm fields

Mean values of the selected physico-chemical parameters of the terrace rice field water were given in Table 1. The atmospheric temperature ranged from 14 to 28°C and water temperature from 11 to 26°C. The average water temperature of rice filed was 18.5°C; pH 7.9; conductivity 143.79 µmho/cm; dissolved oxygen 8.22mg/l; FCO_2 11.5mg/l; alkalinity 123.07 mg/l; phosphate 0.362 mg/l and nitrate 00.07 mg/l. The temperature values were found to be low in comparison to those reported by Meijen (1940) who found the maximum temperature to be 40°C in rice fields at higher altitude. The method of culture of the fish in rice fields too differs depending on the availability of the water as in some paddy fields there is the water throughout the whole year where as in some the water availability is restricted to only for a season of the year. Thus, the fields are grouped into perennial and seasonal fields,

Table 1. Physico-chemical parameters of terrace rice field water

Parameters	Average values
Atmospheric temperature (°C)	21
Water temperature (°C)	18.5
pH	7.9
DO (mg/l)	8.22
FCO_2 (mg/l)	11.5
Conductivity (µmho/cm)	143.79
Alkalinity (mg/l)	123.07
Phosphate (mg/l)	0.362
Nitrate (mg/l)	0.070

respectively.

The fishes cultured in both perennial and seasonal fields include indigenous carps such as *Labeo rohita, L. bata, L. catla* and live fish such as *Channa punctata* and *C. striatus.* The local farmers usually cultured such fish species in the fields where the local rice varieties such as Phurel, Phicharo, Muzharo, Mikhriro, Chusoro, Rodziiro, Romonoro, Disha etc. are grown. Among these rice varieties, Mikhriro is the costliest and is famous for its flavour and stickiness. This rice is also often used for making the costliest rice beer in the region. As far as the fish culture in perennial paddy fields are concerned, suitable plots are sorted out where in the water level was maintained at about 20-30 cm. This water level was sufficient for fish culture as reported by Piepho (1993) and Rothius (1998) in Northeast Thailand.

As far as harvesting of the fish is concerned, the fishing was done in two different times depending on the availability of water. In the case of seasonal,

Figure 3. (a): Certain carps *Labeo rohita* and *L. catla* caught, (b) fisingh from the rice field

Figure 4. (a) A view of water logged in the fields post harvesting of paddy, (b, c) Common water hyacinth and duck weed in the fields, (d) A view of refugee centre with water hyacinth post harvesting (for stocking)

once the rearing process ends with the harvesting of the rice. Thus, the harvesting of fish is performed right after the harvesting of the paddy which usually starts from late September and continued till late October (Fig. 3a, b). When the paddy is harvested and other fields are drained to dry, rice-fish fields are still kept water logged (Fig. 4a). During weeding in the fields some of the aquatic plants like common Duckweed (*Lemna minor*, *Azolla pinnata*) and common water hyacinth (*Eichornia crassipes*) and water lettuce (*Pistia stratiotes*) are not removed as they can supplement nutrients in the fields (Fig. 4b,

c). Harvesting of the fishes from the perennial fields is performed when the atmospheric as well as water temperature decreases (i.e., 1st and 2nd week of December). Few mature male and female fishes are selected out from the harvested fishes and released to the perennial fields or refuge centers for the fish seed production for the next season (Fig. 4c, d). Thus, fish farming along with the paddy culture in the area year after year is performed in an indigenously sustainable way without any aid or input from anywhere.

Economics of rice-fish culture

The rice fish farms of 1 ha produced 3,500 kg/ha of paddy (Rs. 52,500/-) and 200kg/ha of fish (Rs. 30,000/-) in one year. The total return from the paddy and fish sale was Rs. 82,500/ha. The total expenditure for perennial field was Rs. 28,300/ha and for seasonal field was Rs. 38,800/ha. The net profit for perennial field was Rs. 54,200/ha while for seasonal field was Rs. 43,700/ha (Table 2).

Table 2. Average cost of production of rice and fish

Head of expenditure	Qty/No.	Approximate cost (Rs/ha)
Earth work (dyke, refuge etc.)		10,000/-
Preparation (ploughing)		2,500/-
Bamboo screens		450/-
Rice seed		900/-
Fish seed		
Perennial field	6 pairs	750/-
Seasonal field	2500 fingerlings	10,500/-
Cowdung	30 bags	3,000/-
Weeding	3 times	5,700/-
Miscellneous expenditure		5,000/-
Total expenditure		
Perennial field		28,300/-
Seasonal field		38,800/-
Return		
Paddy 3,500 kg/ha (@ Rs. 15/kg)		52,500/-
Fish 200 kg/ha (@ Rs.150/kg)		30,000/-
Total return		82,500/-
Net profit		
Perennial field = Rs.(82,500-28,300) =		54,200/-
Seasonal field = Rs. (82,500-38,800) =		43,700/-

Future outlook

There are many potential advantages of rice-fish culture i.e., additional protein rich food and increased income provided by fish production and such a culture also enhances the rice production resulting due to the easy controlling of harmful insects to the rice as insects being the fish food. The rice yield is also often enhanced due to the rooting activity enabling to control weeds and extra supply of nutrients which comes in the form of nitrogen rich fish excreta. Thus, rice fish culture has many advantages and can be considered as a low-cost, low-risk option for poor indigenous rice farmer in the rice farming areas. Moreover, rearing of fish in the paddy fields can enable the recycling of nutrients by the fish through feeding and depositing nitrogen rich faeces in the soil. Besides this, there is also an overall decrease in insect pests such as leaf hopper, stem borers and aphids and also the weeds which the fishes eat which results in an increase in rice yields. Such a culture also provides a reliable source of protein in the form of fish for the poor farmers and their families. Thus, it is a win-win situation where in farmers are given an opportunity to increase their income from the production of both rice and fish.

The success of such farming practice also depends on the availability of good quality water, especially uncontaminated by pesticides and chemicals. Availability of fish fingerlings of the right size and at appropriate time is also critical to the success of the system. This means that the practice will be successful in the areas where fish hatcheries are there. Thus, the first and foremost important requirements of the terrace rice-fish culture in Mao area of Manipur is the intervention from the Government as well as Social Organizations to make the hatcheries, rain water harvesting and storage tanks available in the area. Thrust on research to enable improving the early maturing and improved varieties of rice suitable to the area as well as development of fast-growing fish species suitable to be cultured in the paddy field of the area are also the important prerequisites. In addition to the age-old indigenous practices performed by the community, introduction, integration of modern agricultural tools and techniques are also of immense importance to bring about improvement in both quality and quantity of the products whereby the natural resources are also conserved.

CONCLUSION

It is important to create awareness among the indigenous farmers of modern scientific knowledge

and proven eco-friendly environment created by rice-fish culture as fishes play an important role as bio-control agents, help in nutrient cycling and thereby maintaining good soil health. Thus, to increase fish production, proper and judicious utilization of all the aquatic resources deserves proper attention. This will help in enhancing fish production and uplift the socio-economic conditions by generating self-employment opportunities and fight malnutrition problem particularly the farmers of the Mao area and the state at large.

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