

Different types of Paddy-Fish Farming System Adopted in Bishnupur district of Manipur.

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Abstract

This study is to identify the various Paddy-Fish farming system found in Bishnupur district. A total of 110 farmers were sampled. The study reveals that among the sampled 110 farmers it comprised of 76 Rotational, 24 Concurrent, 5 each of Paddy and Fish monoculture system farmers. In the study area, four different types of Paddy-Fish farming system were identified. There were basically the two main Paddy-Fish production systems, Concurrent culture – growing the fish together with the paddy in the same area and rotational culture – where the paddy and fish are grown at different times. And other two were Paddy and Fish monoculture system. The input-output ratio was highest on Rotational farming system which was 2.04 indicating the most economical system out of the four.

Keywords: *Rotational, Concurrent, input-output ratio*

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I. Introduction

Paddy-fish culture system consist a unique agro-landscape system all around the world with especial case in tropical and sub-tropical Asia. In the strictest sense rice-fish farming means the growing of rice and fish together in the same field at the same time also called concurrent culture. However, it is also taken to include the growing of rice and fish serially one after another within the same field (rotational culture) or the growing of rice and fish together side by side in separate column. This system is practised in many parts of the world. While each country has evolved its own unique approach and procedures, there are also some similarities, common problems and practices.

Rearing of fish together with paddy in India is an old practice. It is suggested that fish culture in paddy field was introduced into South-East Asia from India about 1500 years ago. It has largely been adopted in a traditional way. Fish rearing along with Paddy gives a satisfaction of producing food organically. Since it is Organic, the inputs cost is reduced for that cropping season, except for trench making during land preparation. In the areas where paddy grew with rain or irrigated water, wild fish is also found. Thus, according to researcher the production of fish from rice fields seems to be much lower than the actual production. Therefore, the figures have shown that in India the production of fish in paddy field is not upto mark.

Paddy-fish farming system exists both in hills and valley of Manipur. However, as per the suitability of farmers, they are practicing different systems in different sites. Among the North eastern States, Manipur is the most suitable site for paddy-fish farming system as the region has 79,360 hectares of water body. Out of the total paddy cultivated area of 3.39 million hectare only 0.03% is under paddy-fish cultivation. In the year 2017-18 total production of main paddy is 431.02 million tonne/hectare. In fiscal year 2017, the production of fish in the state amounted to about 32,000 metric tons, a significant increase from about 18.6 thousand metric tons in fiscal year 2008.

Kachadani (2016) studied fish culture in mountainous paddy fields with varieties of indigenous paddies in Ziro valley north eastern part of India. This paper attempt to analyse the fish culture with different varieties of paddy which are most suited to the fish growth in line with the maturity of crops. Apatanis practice the sedentary agriculture and adopted a system and eco- friendly systems of integrated rice with fish culture and millet on the bund. Allahyariet *et al.* (2014) studied on the Agro-economic factors determining on adoption of rice-fish farming: an application for artificial neural networks. They concluded that agro-economic factors influencing the adoption of integrated rice-fish farming were application of chemical fertilizers, application of herbicides, especially quantity using Diazinon, yearly income from agricultural activities, number animals and accessibility to agricultural organs. Singh *et al.* (2018) conducted a study on Rice-Fish Rotation in Valley

Districts of Manipur. The study was conducted for three years at twelve farmers field under refined SRI method (without ploughing, fertilizer or manure). After the harvest of fish in the month of February, rice nursery was raised and after the harvest of rice, fishes raised from the previous years in a separate nursery pond was stocked in the ratio of grass carp (500 no.), rohu (1000 no.), mrigal (1000 no.) and common carp (1000 no.). This practised enable the farmer to earn an average gross income of Rs348850/ha giving a B:C ratio of 2.56.

Bishnupur district has 21.86 thousand hectares area under paddy cultivation in 2018-19 (source: DOA, GoM, 2018-19) and a total paddy production of 44.64 MT and 7310 tonnes of total fish production. Peculiar feature of the district is that 50% of the area is covered by Loktak lake. This provides a greater scope for paddy-fish farming system in the district. But the adoption rate of the Paddy-Fish farming system in the district is still low even though it is the highest adoption rate in the state.

II. Methodology

In order to meet the stipulated objectives of the present study, a multi-stage sampling techniques was employed. The first stage of sampling plan was the selection of block (Stage I), second stage was the selection of villages from the selected blocks (Stage II) and finally, the last stage relates to selection of respondent farmers from the selected villages (Stage III).

Selection of block

Bishnupur district consists of three blocks viz., Bishnupur, Moirang and Nambol block. Out of these three blocks, Bishnupur and Nambol block was selected for the study using simple random sampling technique.

Selection of villages

A list of villages where Paddy-Fish farming system is adopted was prepared with the help of Block Development Officer. Leimpokpam, Sanjenbam and Wahengkhuman was selected from Nambol block while Laishoi, Hameiban and Chingmei were from Bishnupur block using simple random sampling technique. Altogether six villages were selected from the two selected blocks.

Selection of respondent farmers

In the final stage of sampling plan, a complete list of farmers adopting the Paddy-Fish farming system of each selected village was prepared with the help of respective village Pradhans' or Panchayat members. From the prepared list, using proportionate random sampling technique the respondent farmers were drawn for collection of relevant data and information with respect to Paddy-Fish farming system like different types of systems adopted in the region using pre-tested well-structured schedule. Thus, from the list, a total of 110 respondent farmers was selected as representative sample.

Data collection

To meet the objectives of the present study, both primary and secondary data will be collected for analysis and interpretation.

Primary data

The primary data was collected on pre-tested schedule by adopting personal interview method from the selected respondents.

Secondary data

The required secondary data for the present study was collected from various published and unpublished information sources of Directorate of Economics and Statistics, Government of Manipur, Basic Statistics of North East Region (NER), Department of Agriculture, Government of Manipur, Department of Fisheries, Government of Manipur and Directorate of Settlement and Land Revenue, Government of Manipur, etc.

Input-output ratio was found out by using the formulae

$$\text{Input-output} = \frac{\text{Gross income}}{\text{Total cost}}$$

III. Results & Discussion

The study revealed that (Table 1) on an average about 69.09 per cent adopted the Rotational Paddy-fish farming system followed by Concurrent (21.81%)

Paddy-Fish farming system, Fish monoculture and Paddy monoculture with coverage of 4.54 per cent each. The fingerlings species cultured are rohu, mrigal, common carp, grass carp, silver and catla.

Table1: Farmers distributions adopting different Paddy-Fish farming system

Particulars	Farming system				Total
	Rotational system	Concurrent system	Fish monoculture	Paddy monoculture	
No. of farmers	76(69.09)	24(21.81)	5(4.54)	5(4.54)	110(100)

Note: Figures in parenthesis are the percentage to the total

Different types of Paddy-fish farming system

The basic idea involved in integrated farming are the utilization of farm waste and the synergetic effects of integrated farming activities. Integration within the farm has been a practical necessity, where farmed fish have been economically and nutritionally most important. Paddy-Fish culture enhances both paddy and fish production, but production is high at low-medium intensities although the fish diversity is most in traditional and low intensity systems. Paddy-Fish farming is innovative and adopting to changes in rice farming. The two main Paddy-Fish production systems found in the study area were concurrent culture – growing the fish along with the paddy in the same area and rotational culture – where the paddy and fish are grown at different times. And two other monoculture systems – paddy and fish.

Rotational or Alternate Method

Under this method, fish was raised as a second crop after the harvesting of paddy. In the study area, paddy is generally sown as Rabi crop. Early maturing varieties RCM 9 and 807+ are mostly grown for this purpose. The seeds are sown during the first week of February and are later transplanted to the field after 28-30 days. During the early growth stages from the time of sowing irrigation is limited to 1 inch height where the field is kept dry until next irrigation. Similar procedure is done 3-4 times where eventually the irrigation increases to 2-3 inches according to the growth stage and further to 4-5 inches height. Fertilizers are applied 2-3 times per season at the ratio of 4:2:1, one before transplanting and once or twice during the early growth stage or the milking stage. Weedicide and pesticide are applied once per season. Paddy is harvested around 1st - 2nd week of June. And 2-3 days later the fingerlings are then released into the paddy field from the stock pond after fully flooding the paddy field. Any physical modification is not necessary as the paddy field is a pond area. Like a regular fish pond, the field can be managed and operated without paddy for three- six months.

Most of the farmers stocked the fingerlings in another pond or ponds besides the paddy field in a poly-culture manner during the paddy cultivation. The stocking density is in accordance with field size and sizes of the stocked fingerlings usually ranges from 5-8 cm long where the fingerlings turn around 100 gram or 1kilogram when it releases to the paddy field and this keep the soil surface loose by their activities.

When the paddy is harvested and threshed, the paddy field is turned into a pond by fully flooding with a drainpipe. The fingerlings are then harvested from the stocked pond using 2-3 meters long fish nets and released it to the paddy field directly. The released fingerlings fed on the paddy stubbles or cut off stock. Supplementary feeds are also given twice a day and mostly fed on grasses.

To harvest the fish, water is carefully drain out to the stocking pond using a temporary drainpipe leaving around 3-4 inches water level. The fish are then harvested during the month of November around 3rd week on the occasion of one of the biggest festivals of Manipur, NingolChakhoubha and Emoinu festival around 1st week of January. The harvested fish ranges from 1.5 kilogram to 3 kilogram per fish. The field is then cleaned and made free from paddy stubbles and let it dry for around 3-4 weeks and again is flooded with around 1-2 inches water level. The field is now ready for next paddy cultivation after ploughing once or twice usually twice.

Various fingerling species used in the cultured method are rohu (*Labeorohita*), catla (*Catlacatla*), mrigal carp (*Cirrhinus cirrhosus*), silver carp (*Hypophthalmichthys molitrix*), common carp (*Cyprinus carpio*) and grass carp (*Ctenopharyngodonidella*). Harvesting and releasing of fingerlings required 8-10 number of labour force.

Simultaneous or Concurrent Method

In this system fish is grown simultaneously with paddy and the growing period of the fish is limited to that of rice, which is usually 100 to 150 days. Used of early yielding variety leads to smaller fish size during harvesting time. But in the study area, growing of fish is not limited to that of rice as fish is not harvested at the time of harvesting the paddy and reared till the month of January. It was grown simultaneously for only 2-2.5 months. The stocking of fry or fingerlings is usually done in another stock pond beside the paddy field and the fingerlings are then release into the paddy field when the paddy attains vegetative stage or tillering stage.

Just like rotational system, paddy is cultivated as a Rabi crop. Early maturing varieties RCM 9 and 807+ are grown. Seeds are sown during first week of February and transplanted after 28-30 days like rotational system. In this system irrigation plays a crucial role, 1-2 inches level of irrigation is given during the early growth stage which is allowed to dry until next irrigation. The same procedure is repeated 2-3 times after which

the irrigation level is increased to 4-5 inches according to height of the paddy crop and eventually to 7-8 inches and then 9-10 inches where fingerlings of size 20-30 cm long are released.

An irrigation level upto 1 meter is given when fingerlings weighing around 50 grams are released into the field.

Fertilizers are given twice per season at the ratio 4:2:1. Compromises are made with respect to the application of fertilizer, which is done judiciously and no pesticides are used in the paddy field. Only hand weeding is also done without the use of any weedicide. The rearing of fish is not one period and it consists of two continuous rearing periods as the fingerlings are released batch-wise.

When the paddy attains early stem elongation stage (41-50 days after transplanting), the paddy stock becomes more strong and sturdy, the first batch of fingerlings are harvested from the stock pond and released into the paddy field. Only rohu, mrigal and common carp species of fingerlings of small size 20-30 cm long are released. Following the same pattern, the second batch of fingerlings are released after 15-20 days of first release when the paddy is in between flowering and milking stage. Here larger fish weighing around 80-100 gram are released as there is a limit in rearing larger fingerlings during the early stage since large fingerlings may be able to dislodge the rice seedlings. Grass carp of smaller size 40-50 cm long are also released during the second batch. This prevents them from feeding onto the paddy crop as the stock of the paddy becomes hard and sturdy and they only feed on the leaves growing downward. Even though the fish feed on naturally available resources, supplementary feeds are also given to further enhance their growth.

The water level is lowered a little bit at the time of harvesting the paddy. The paddy is harvested around first week – third week of June. And after which the field is fully flooded for continuing the rearing of fish. The fingerlings then feed on the rice stubbles and stalk. At the time of harvest the field is drained out leaving 2-4 inches height of water. The fish are then harvested using 3-4 fish net which is 2-3 meter long once during November, Ningol Chakhouba festival and Emoinu festival around first week of January.

Compared to concurrent Paddy- Fish farming system practices in other parts of region of the state or country, the Concurrent system practiced in the present study area has an advantage of harvesting fish larger in size which weighs around 2-3 kilogram per fish as it has longer rearing period.

The variety of fingerling species used in this system is similar to that of rotational system. The species includes: rohu (*Labeorohita*), catla (*Catla catla*), mrigal carp (*Cirrhinus cirrhosus*), silver carp (*Hypophthalmichthys molitrix*), common carp (*Cyprinus carpio*) and grass carp (*Ctenopharyngodon idella*). But in case of grass carp it was used in lesser amount.

Fish monoculture system

Besides from the two main Rotational and Concurrent Paddy-Fish farming system, fish monoculture is also practised in the study area. The culture of fish is nearly three months in one culture period. Fish monoculture is highly intensive as compared to the rearing of fish in both Rotational and Concurrent Paddy-Fish farming system. Some of the respondent farmers have separate stocked pond for rearing where it was further grown into fry and then to fingerlings. Most of them earned extra income by selling the fry to other farmers. Fish monoculture is also more capital intensive where most of expenses are incurred on different inputs like lime, vermicompost, vermivash, oil crude, supplementary feed, etc. as it directly relates to the yield. It was more of scientific way of culture. Further availability of sufficient amount of water is one of the most important factors in fish monoculture.

The fingerlings are released into the pond from the stocked pond and then it was cultured for around three months only which was then harvested. For those farmers who don't have stocked pond, they bought fingerling from other trader and was directly released into the pond. And after two-three weeks, another batch of fingerlings is then released.

Apart from rohu (*Labeorohita*), catla (*Catla catla*), mrigal carp (*Cirrhinus cirrhosus*), silver carp (*Hypophthalmichthys molitrix*), common carp (*Cyprinus carpio*) and grass carp (*Ctenopharyngodon idella*), additional species like climbing perch (*Anabas testudineus*), kandal (Notopterus notopterus), tilapia (*Oreochromis mossambicus*), scale carp (*Cyprinus carpio*), vacha (*Eutropiichthys vacha*), Indian carplet mola (*Amblypharyngodon mola*), etc. were cultured.

Paddy monoculture

Paddy monoculture system has a similar cultivation process with that of both Rotational and Concurrent Paddy-fish farming system. But in paddy monoculture, the respondent farmers cultivated paddy as both Rabi crop and Kharif season crop. Early maturity variety like 807+ and RCM 9 were used when it was planted as Rabi crop. Proper field preparation is necessary as the field was left uncultivated for mostly around six months as of Rabi crop and five months for Kharif crop. Two-three times ploughing is done before sowing paddy crop. And sowing of seed was done during first week of February and transplanted after 30 days around March first week. For Kharif season crop varieties like Leimaphou, drum, etc are sown during second to third week of June and transplanted around July second-third week. Irrigation was given in accordance with the

growth stages. During the early stages 1-2 inches level of irrigation was given and it increases to 4-5 inches and further to 6-7 inches of water level.

Fertilizer was given three times per season, once before transplanting, one around early tillering stage and lastly before milking stage. Weeding was done once or twice after the application of weedicide during mid tillering stage. Insecticide was also given to combat pest attack. For Rabi crop it was harvested mostly after three months, during second-third week of June. While that of Kharif crop was harvested after four month around last week of November.

Input-output ratio

The input – output ratio which is an indicator of economic efficiency in cropproduction for the crop was worked out. The input-output ratio was estimated to be 2.04 for Rotational system. This implies that for every rupee investment in this system, net income realized was Rs 2.04. Likewise, the input-output ratio of Concurrent, Fish and Paddy farming system was 1.96, 1.98 and 1.13 indicating a net return of Rs 1.96, Rs 1.98 and Rs 1.13 for every rupee investment in the respective Paddy-Fish farming system. It is evident from Table2 that Rotational system obtained the highest the input-output ratio and was the most economical system among the four systems adopted in the study area. And fish monoculture was more economical compared to the Rotational Paddy-Fish farming system. While the least economical system was the Paddy monoculture adopted in the study area.

Table2: Input -output ratio of the different Paddy-Fish farming system

Particular	Farming systems			
	Rotational	Concurrent	Fish	Paddy
Input-output ratio	2.04	1.96	1.98	1.13

IV. Conclusion

The study thus revealed that there are four Paddy-Fish farming system adopted in the study area namely Rotational system, Concurrent system, Fish monoculture and Paddy monoculture. Out of the four system, the two main farming system prevailing in the district were the Rotational and Concurrent farming system. An average about 69.09 per cent adopted the Rotational Paddy-fish farming system followed by Concurrent (21.81%) Paddy-Fish farming system, Fish monoculture and Paddy monoculture adopted coverage was 4.54 per cent each. Rotational farming system was found to be more profitable and economical. It is supported by the highest ratio of input-output (2.04) from among the four different systems. Fish monoculture (1.98) was more profitable as compared to Concurrent system (1.96). And Paddy monoculture (1.13) was the less profitable farming system in the study area which has the lowest benefit cost ratio.

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