



Integrated Rice Fish Farming System in Arunachal Pradesh: An Overview

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ARTICLE INFO

Article history:

Received 2016

Revision Received 2016

Accepted 2016

Key words:

integrated rice fish farming system, economics, arunachal pradesh.

ABSTRACT

Rice-fish culture (RFC) is a type of farming system in which rice is the main enterprise and fish are taken as additional means for nutritional security and extra income. This system may open a new horizon to improve farmer's socio-economic conditions enhancing land use efficiency at low inputs and by waste recycling. Integrated Rice Fish Farming System under either capture systems or culture systems is a low-cost sustainable practice to obtain high value protein food and minerals. A total of 04 villages of East Siang district and 04 village of Ziro area of Lower Subansiri district of Arunachal Pradesh were surveyed during *Kharif* and *Rabi* seasons of 2015 and 2016 cropping season to evaluate the economic viability and acceptability of Integrated Rice Fish Farming System. Evaluating the multilocational report on Integrated Rice Fish Farming System it has been observed that 90% of the farmers release fish seed in the ranged from 3.0 cm to 5.0 cm size in their rice field during the month of April and July in Lower Subansiri and East Siang districts, respectively. It was also found that survival rate of advanced fry was between 42 % and 47 % with an average weight of 0.075 kg to 0.110 kg at harvesting for both of the districts. The average net income in RFC was Rs. 45,876 and Rs. 43,713 in Lower Subansiri and East Siang district respectively, while in sole cropping of rice it was Rs. 29,694 and Rs. 32,904, respectively. The additional income of Rs. 16,182 and Rs.10,809 were gained by adopting the RFC system as compared to sole cropping of rice.

1. Introduction

The North Eastern Hill States of India and Arunachal Pradesh in particular receives ample rain fall during the *kharif* season and the major farming activity in this season is cultivation of rice. Moreover, livelihood of majority of the rural communities depends on rice farming. The tribal people of the North Eastern Hill region traditionally practices shifting and terrace rice cultivation in hills and wet rice cultivation in the valleys. The core diet of the inhabitants of the region is rice, maize, millets, pulses and

a wide variety of local semi domesticated wild plants and meats as well as fishes are integral part of their diet. In this region fishes fetches higher price than many other non vegetable items and it is highly revered for its nutritious flesh. Fisheries sector in the north eastern region is mostly based on capture from natural resources, even though the fish is an integral part of their diet still the aquaculture activities in the region is in primitive stage. However, the culture of through advanced aquaculture techniques is not vibrant due to inadequate availability of stocking material and proper feed. The major constraint for development of ponds and tanks for aquaculture in north eastern hill states is hill topography.

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Hence, there is a pressure on foothills for agriculture mostly rice cultivation and other agricultural allied activities. Under these situations, there is a need of the hour to switch over from traditional method of farming to technically sound integrated farming systems. Rice-fish culture is a type of farming system in which rice is the main enterprise and fish are taken as additional means for nutritional security and extra income. Potential rice-fish area of Arunachal Pradesh is 2650 ha, out of which only 150 ha is under this system with an average productivity of 125 kg/ha/year (Das 2002). Rice-fish system is practiced traditionally by the farmers of Apatani Plateau in Arunachal Pradesh since time immortal with production of fish ranging between 150–250 kg/ha within 3 months in addition to rice production. A unique integrated paddy fish finger millets agriculture practices by Apatani tribes are unequivocally appreciated not only from the corners of Arunachal Pradesh but also from outside state and foreign country (Tayo et al. 2017). The ecology of rice fields of the districts can be divided into upland terrace cultivation and lowland/foothill rice ecosystems (*pani kheti*). Catching fish from rice fields is a common traditional practice among the villagers of both the districts taken for study. Keeping in view of the potentialities of the culture system, an efforts has been made to study the economics and feasibility of the system in East Siang and Lower Subanshiri districts of Arunachal Pradesh.

2. Material and Method

2.1 Study area

In the present study a total of 08 villages viz. Niglok, Mirem, Aholi and Yagrung of East Siang and Hari, Hong, Siiro and Sibey of Zero area of Lower Subansiri district of Arunachal Pradesh were surveyed during *Kharif* and *Rabi* seasons of 2015 and 2016 cropping season to evaluate the economic viability and social acceptability of Integrated Rice Fish Farming System. The East Siang district is located between 27.30^o to 29.42^o North latitude and 94.42^o to 95.35^o East longitude with an altitude of 133 m in Ruskin to Sipo 500 m and Lower Subansiri district is lying between 92.40^o to 94.21^o East Longitude and 26.55^o to 28.21^o North Latitudes. The altitude of Lower Subansiri district headquarters is 1500 meters above sea level (msl).

2.2 Study approach

The study combined interviews with individuals with focus group discussions, transect walks, informal interactions and participant observations. All together 18 field surveys involving 72 persons (54 male and 18 females) in age group

Table 1. Area under channels and trance for Fish culture, Average Survival of Fish, Average Size of fish at harvest, gross harvest of rice and fish observed at various locations during 2015 and 2016 cropping season.

District	Villages	Area under channels and trance for Fish culture (%)	Average rate of survival of fishes (%)	Average Size of fish at harvest (kg)	Rice harvest (kg/ha) (RFC)	Rice harvest (kg/ha) WRC (control)	Fish harvest per plot (kg)
Year-2015							
East Siang	Niglok	4-5	-	0.050	5200	5100	0.065
	Mirem	2-3	-	0.060	4850	4950	0.050
	Aholi	4-5	-	0.070	5100	5000	0.090
	Yagrung	3-5	-	0.060	5000	5000	0.085
Lower Subansiri	Hari	7-9	42	0.090	5100	5200	0.167
	Hong	11-13	45	0.100	4500	4700	0.237
	Siiro	8-10	47	0.105	5000	4900	0.198
	Sibey	10-12	47	0.110	4600	4700	0.248
Year-2016							
East Siang	Niglok	4	-	0.040	5150	5200	0.060
	Mirem	2	-	0.065	4925	4750	0.085
	Aholi	4	-	0.050	5080	4800	0.070
	Yagrung	3	-	0.070	4800	4900	0.080
Lower Subansiri	Hari	7	44	0.110	4990	5130	0.200
	Hong	13	47	0.095	4680	4700	0.230
	Siiro	8	45	0.100	5170	5100	0.178
	Sibey	10	46	0.100	4700	4880	0.238

between 35-65 years were conducted. Open ended questions were asked for understanding the farming process and data collection. Pooled data of 2015 to 2016 were utilized for comparative study of the experimental findings.

3. Results and Discussion

It has been observed that farmers of Lower Subansiri district utilized around 7-13% of the total area for making the trenches and ditches for providing shelter to fishes during the dry spell and for easy harvesting of fishes while rest of the area was under rice cultivation and movement of fishes during the cropping season (Table 1). However, highest amount of area under different trenches and ditches were recorded in the village Hong of Lower Subansiri and lowest area in the village Mirem of East Siang district. Land preparation for rice cultivation was done by adopting traditional practice of the farmers in both the districts. The farmers of East Siang district generally transplanted one month old seedlings of local rice variety *Deku* in the 2nd and 3rd week of July, in all the years at the spacing of 20-25 X 10-15 cm whereas in Lower Subansiri district transplantation of one month old seedlings of local rice variety *Mipya* and *Emoh* starts from the month of April onwards with a spacing 20– 30 X 10-20 cm. In Ziro areas, after 15 days of transplanting when paddy roots holds the earth, advance fry of common carp (*Cyprinus carpio*), rohu (*Labeo rohita*) and mrigala (*Cirrhinus mrigala*) were released in the rice field @ 10,000 no.s/ha whereas in East Siang district farmers depends on natural stocking from the water feeding channel only.

The farmers of East Siang district does not preferred to spend money on fish seed stocking due to uncontrolled water flow and lack of awareness on scientific method of rice cum fish farming system. Moreover, the bottleneck of adopting the scientific method of the farming system was due to unavailability of fish seed in the district as there was no any functional fish seed hatchery in the district. In the Ziro areas, farmers produces common carp seeds by using hapa breeding technology, hence there was no scarcity of seed for stocking. The farmers of Ziro areas fixed bamboo made nets in the inlet and outlet of water channel to check escape of the stocked fishes. Integrating aquaculture with agriculture assures higher productivity and year round employment opportunities for farmers of Ziro areas. The farmers of the Ziro areas constructed strong bund (Agher) in order to prevent leakage and to retain water upto a desired depth as well as to avoid the risk of escape of fishes during rain and floods. The bunds were further supported by bamboo mating. Cultivation of millets in the bunds is a common practice in Apatani plateau of Ziro areas. It was observed that no fertilizer and other agrochemicals were used in the rice fields of Ziro area.

- Sale price of fish per kg was Rs.150 and Rs. 180; rice per kg was Rs.11 and Rs.12 and rice straw per kg was Rs.0.20 and Rs. 0.25 in the year 2015 and 2016 respectively.
- Total cost of production includes cost of labour for pond preparation and management, fertilization application, liming, netting *etc.* and material cost like fish fingerlings, feed, fertilizer, lime *etc.*

Table 2. Economics of Rice-Fish Culture and Sole cropping of rice during 2015 and 2016 cropping season.

Parameters (Average of different location)	RFC		Sole cropping of rice					
	East Siang (Avg. of selected Villages)		Lower Subansiri (Avg. of selected Villages)		East Siang (Avg. of selected Villages)		Lower Subansiri (Avg. of selected Villages)	
	2015	2016	2015	2016	2015	2016	2015	2016
Total Cost of production (Rs. ha ⁻¹)	27,000	28,500	44,000	49,000	25,000	26,700	27,000	30,000
Yield of fishes (t ha ⁻¹)	0.073	0.074	0.213	0.212	-	-	-	-
Rice yield (t ha ⁻¹)	5.038	4.989	4.800	4.885	5.013	4.913	4.875	4.953
Straw yield (t ha ⁻¹)	7.439	7.523	7.127	7.180	7.437	7.682	7.410	7.380
Income from fish (Rs.ha ⁻¹)	10,950	13,320	31,950	38,160	-	-	-	-
Income from rice grain (Rs.ha ⁻¹)	55,418	59,868	52,800	58,620	55,143	58,956	53,625	59,436
Income from rice straw (Rs.ha ⁻¹)	1,488	1,881	1,425	1,796	1,487	1,921	1,482	1,845
Gross income (Rs.ha ⁻¹)	67,856	75,069	86,175	98,576	56,630	60,877	55,107	61,281
Net returns (Rs. ha ⁻¹)	40,856	46,569	42,175	49,576	31,630	34,177	28,107	31,281
Benefit Cost ratio	2.51	2.63	1.96	2.01	2.27	2.28	2.04	2.04

Rice-fish integration reduces the use of fertilizers as opined by Yong et al. (2006), pesticides and herbicides by Kathiresan (2007) in the field. Harvesting of rice and fish was generally done in the first fortnight of November in different years in East Siang district and during October last in Ziro areas of Lower Subansiri district. In all the locations under study, survival rate of advanced fry was recorded between 42% and 47% with an average size of 0.075 kg to 0.110 kg at harvest (Table 1). A good harvest of rice ranging from 4.85 t ha⁻¹ to 5.20 t ha⁻¹ in East Siang district and from 4.50 t ha⁻¹ to 5.10 t ha⁻¹ was recorded in Lower Subansiri district in all the surveyed fields. Fish harvest to the tune of 0.167 t ha⁻¹ to 0.248 t ha⁻¹ and 0.05 t ha⁻¹ to 0.09 t ha⁻¹ was recorded as an additional source of income and nutrition for the farmers in Lower Subansiri and East Siang district respectively (Table 1). Total average cost of cultivation of RFC and sole cropping of rice was recorded to be Rs 46,500 and Rs. 28,500 respectively per ha in Ziro areas of Lower Subansiri district where as in East Siang district the difference between cultivation cost of RFC and sole cropping was only Rs. 1,900 per ha (Table 3). Average fish productivity from the RFC recorded was 0.208 t ha⁻¹ and 0.07 t ha⁻¹ in Lower Subansiri and East Siang district, respectively. Average gross income in RFC was Rs. 92,376 and Rs. 71,463 in Lower Subansiri and East Siang district respectively, while in sole cropping of rice it was Rs. 58,195 and Rs. 58,754 respectively (Table 3). It was also observed that the average net income in RFC was Rs. 45,876 and Rs. 43,713 in Lower Subansiri and East Siang district respectively, while in sole cropping of rice it was Rs. 29,694 and Rs. 32,904 respectively (Table 3). Integration of fish with rice culture increased the net profit of the system. This corroborates with the findings of Saikia and Das 2008.

Conclusions

The advantage of RFC is efficient utilization of land and water as well as securing extra income and nutritional

security from fish without additional labour (Sen et al. 2012). This integrated system could be a profitable venture for optimum utilization of land and water resources especially for hilly terrain of Arunachal Pradesh. Moreover, it has the benefit of supplying rice as a source of carbohydrates and fish as a source of high quality protein. This aspect may be particularly relevant for the optimum resource utilization and providing nutrition security to tribal community of region. Adoption of this technique will open new avenues for self-employment, supplement the income of the farmers and enhance fish production in the region.

Reference

- Das DN (2002). Fish farming in rice environments of North eastern India. *Aquaculture Asia* VII (2): 43-47
- Kathiresan RM (2007). Integration of elements of a farming system for sustainable weed and pest management in the tropics. *Crop Protection* 26: 424-429
- Saikia SK, Das DN (2008). Rice-fish culture and its potential in rural development: A lesson from Apatani farmers, Arunachal Pradesh. *Ind J Agri Rural Develop* 6(1&2): 125-131
- Yong Y, Hong-cheng Z, Xiao-jun H, Qi-gen D, Yang-jiang Z (2006). Characteristics of growth and yield formation of rice in rice-fish farming system. *Agricultural Science China*. 5(2): 103-110
- Sen Debashi, Hussain SM, Pathak M (2012). Rice-fish-farming- a potential venture for livelihood security for the tribal community of East Siang district of Arunachal Pradesh. *Oryza* 49(1): 53-56
- Tayo T, Safi V, Meena T, Heli T, Tabyo T, Longjam M (2017). integrated paddy, fish and finger millets cultivation by Apatani tribes in the Eastern Himalayan region - Arunachal Pradesh. *Ind J Hill Farming* 30(1): 63-69

Table 3. Average of Cost return analysis of RFC and sole cropping of rice during 2015 and 2016 cropping season.

Parameter	RFC (Rs. ha ⁻¹)		Sole cropping of rice (Rs. ha ⁻¹)	
	East Siang	Lower Subansiri	East Siang	Lower Subansiri
Income from Paddy	57,643	55,710	57,050	56,531
Income from Paddy straw	1,685	1,611	1,704	1,664
Income from fish	12,135	35,055	-	-
Gross Income	71,463	92,376	58,754	58,195
Cost of Production	27,750	46,500	25,850	28,500
Net Income	43,713	45,876	32,904	29,694
Benefit-Cost Ratio	2.58	1.99	2.27	2.04



Figure 1. *Burning of straw & preparation of bunds in Ziro.*



Figure 2. *Azolla culture in rice fields.*



Figure 3. *Aerial view of rice fields in Ziro.*



Figure 4. *Indigenous fish trap used by farmers of East Siang district.*



Figure 5. *Trances for fish shelter at Niglok, East Siang.*



Figure 6. *Harvesting of fishes at Mirem, East Siang.*