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Prioritization Strategies for the Resources of Traditional Paddy-Cum-Fish Culture in Lower Subansiri District of Arunachal Pradesh, India

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A B S T R A C T

The present study was conducted on resource-use-efficiency of traditional paddy-cum-fish in Lower Subansiri district of Arunachal Pradesh during the agricultural year 2014-15; a total of 70 numbers of paddy-cum-fish respondents were selected by following a multi-stage simple random sampling technique. Study reveals that the majority of the farmers were dependent upon agriculture and traditional paddy-cum-fish culture, the total cost of production of traditional paddy-cum-fish per hectare was Rs. 28,7782.70/-; with an average per hectare yield of traditional paddy-cum-fish was 2.76 q. The constraints faced by the traditional paddy-cum-fish farmers during production and marketing of traditional paddy-cum-fish culture *viz.,* poor marketing channel, price fluctuation and exploitation of farmers by intermediaries thereby farmer receives less profit, lack of knowledge about plant protection, low productivity and training activities.

Introduction

Arunachal Pradesh 'the land of dawn lit mountains' stretches an area of 83,743 sq km characterized by lofty mountainous terrains, crisscrossed by number of turbulent rivers and rivulets situated in the extreme north-eastern tip of India in the Trans-Himalayan regions (Singh and Gupta, 2002). In India, 42 million ha area is under paddy cultivation out of which 0.23 million ha is under rice-cum-fish culture (Anon. 2007). As per census 2013-14,the total area for paddy-cum-fish culture in state like Arunachal Pradesh is 2800 ha with production of 200-400 kg/ha/season (Ghosh *et al.*, 1984; Kacha, 2014). At present there are 19 districts of the state, among them Lower-Subansiri is the district where cultivation of paddy is done abundantly (Olapade *et al.*, 2015). The practice of Rice-cum-Fish is extensively practice by Apatani tribe living in the count our plateau of Lower Subansiri District having its headquarter (Ziro), popularly known as "Rice Bowl of Arunachal Pradesh', Ziro, a scenic valley is the home of the Apatani tribe whose unique land use pattern, resource management and culture of conservation have made them a focal point of attraction" (Ramakrishnan, 1990; Moyoung *et al.*, 2012). They mainly depend upon wet-rice-cultivation. According to local mythology literally, the word Apatani comprised of two words 'Apa' display of affection and 'Tani' human race (Goswami *et al.*, 2004). The

tranquil valley originally consists of the seven villages viz. Hong, Bulla, Lempya, Mudangage, Bamin-Michi, Sululya and Hari. There are three Blocks namely, Ziro I, Ziro II and Ziro III (Anon. 2014a). In order to sustain maximum production in protein-rich fish as well as, the general concern for energy conservation, Integrated farming of Paddy along with Fish offers a unique and Lucrative venture providing higher source of farm income, supply of feeds for the Livestock and increase productivity on small land-holdings and multi-enterprise development (Salehi and Momennia, 2006). The Rice growing Belt of the world like China, Bangladesh, Malaysia, Korea, Indonesia, Philippines, India, Thailand etc. also practice the Rice-Fish culture (Mitra and Nath, 2012). This system fetches additional means of income out of farming (Anon. 2016).

It is believed that Paddy-cum-fish culture was first introduced from South-East Asia since 1500 years ago. The terrace wet rice cultivation begun with Abotani, the earliest Ancestor of Apatanis. At present, in respect to Arunachal Pradesh it started in the year 1964 under the dynamic leadership of officers of Fishery Department of Apatani Plateau. Since, then Paddy-cum-fish culture became the Part and Parcel of Apatani Agricultural system. Organic inputs are used in the plots utilized for rice cum fish culture (Anon. 2014b). Some of the inputs used are poultry dropping (Paropai), pig excreta (Alyiekha), cow dung (Siiekha) and wastes of plants such as rice husks (Piina), ashes from household stoves (Mubu) and remains of burnt straws (Muyu) and decomposed straw (Liisi), weeds (Tamih) and stalks (ankho). Production of fish in rice fields is almost as old as the practice of rice or paddy culture itself combined culture of rice and fish is also known as Paddy-cum-fish culture. The practice of culturing fish in rice fields is a long tradition in many parts of Asia. It has largely been practiced in a traditional way in the Indian coastal states of Kerala and West Bengal (Shingara *et al.,* 2000). Fish farming in rice fields has become an additional source of income and important economic avenue among the Apatani farm families of the state (Ravi, 2005). Local farmers have modified the system in such way that it has become an excellent example of rice fish-farming system in hill tracks and it has also become intimately related with the agrarian life of Apatani people in North-eastern states of India (Flex *et al.,* 1992). The states of Arunachal Pradesh, Mizoram, Meghalaya, Nagaland and Tripura have a type of huge rice field where farmers intentionally allow various fish species to grow along with their rice crop. The production rate from such plots could be raised up to 200kg/ha/season (Anon. 2012).

In Apatani valley, about 48.38 per cent land is under paddy cultivation followed by 16.41per cent of bamboo forest, 2.75 per cent home-gardens. Integrating aquaculture with agriculture assures higher productivity and year round employment opportunities for farmers (Kumar, 2015). The yield of fish from such indigenous practice ranges from 45-280 kg/ha/season (Rahman *et al.,* 2012). The terrace type of plots are stocked with common carp at a density of 6,000/ha and fed either with 1: 1 mustard oil cakes and rice bran at 1 kg/ ha or simply provided with domestic kitchen waste, giving an average production of 186 kg/ha in two months where the rate of production ranges around 200-300 kg/ha/season (Anon. 2014). The paddy field of Ziro valley includes both irrigated and rain-fed cropping which provides ample scope for enhancement and production through concerted efforts integration of paddy-cum-fish, have popularly become boon for entire state ushering "Blue Revolution". The Apatani plateau possesses a very fertile and terraced type, with estimated area of nearly 2779 ha (Anon. 2016) under wetland paddy field. Their

dedications in Paddy-cum-fish culture have made a lucrative opportunity for enhancing tourist activities and development rural economy. The indigenous practice of Azi (Rice field) using a combination of paddy and fish together with millet on the bunds is belief to be the most productive and efficient agricultural system of the region. The whole paddy is kept under shallow submergence 5 to 10 cm on the submerged area of terrace field, where fish gets nutrition through manuring of paddy field (Sakia and Das, 2004).

Fish varieties like common carp; tali-ngiyi (Channa Sp.) and papi-ngiyi (Puntiussp), catla, rohu, grass carp are the preferred fish species stocked in the rice field, which is reared in the month of April to September when the paddy grows in the field and can be taken up simultaneously from the month of November to February after harvesting and before transplantation of paddy crop until next season begins (Sakia and Das, 2008).

The channels (Siikho/Parkho/hehte) in the paddy field are used for water management. They are constructed at the middle of the paddy fields in such a way that they divide the paddy field vertically and horizontally. The parkho provides the rearing space for fishes. It also serves as the shelter for fishes during the sunny day. The paddy fields generally have two outlets (hubur) and one inlet. One outlet is used for over flow of water and the other is meant for draining of the water during harvest of paddy and fish. Indigenous trap prepared from bamboo is placed on the outlet to catch fish, while the remaining is caught by nets or bamboo baskets. Such natural occurrence of fish in paddy field led the Government of Arunachal Pradesh to start Paddy cum fish culture in Apatani valley on experimental basis (Mitra and Nath, 2014). Repairing of embankments and levelling is done periodically by shifting soil from one area to another on large flat wooden trays. To support the bunds (Yapyo), bamboo mating is done at the base. Cultivation of millets (sarse) on the bunds or strong dykes to prevent leakage of water is a common practice in Apatani plateau. Bunds can also be utilised for cultivation of several vegetables, like cauliflower, cabbage, tomatoes, radish, pumpkin, cucumber, beans etc. Therefore, no portion of paddy plot remains unutilised. Weeding of millet (*Eleusine coracana*) is done twice with minimal external inputs, low cost of cultivation and purely organic based Agriculture. India is one of the 2nd largest producers in production of rice crop in the world. Arunachal Pradesh 'the land of Rising sun' mainly practices Paddy-cum-fish cultivation, one of the predominant factors for getting additional income out of farming (Nimachou *et al.*, 2010). The present study was conducted in Lower Subansiri district of Arunachal Pradesh. Lower Subansiri district was purposively selected as the researcher is a native of the area where paddy-cum-fish culture is quite prevalent (Yani, 2015).

Materials and Methods

For the present study a total of 70 numbers of paddy-cum-fish respondents were selected by following a multi-stage simple random sampling technique. In the first stage, one RD Block from Lower Subansiri district *viz.*, Ziro-I block, out of 3 blocks were selected purposively. In the second stage, seven villages namely; Hong, Bulla, Sululya, Mudang-Tage, Bamin-Michi, Hari, Lempya, were selected randomly for the present study from Ziro-I block were selected by simple random sampling method. At final stage, a list of farmers of the selected villages will be prepared separately based on their experience and ITK knowledge, and then selected farmers were stratified into four groups based on their total land holding. A list of the paddy-cum-fish growers was acquired through various Government Offices and VDBs taking the households as the ultimate unit as under:

The production-function analysis was carried out to measure the efficiency of input variables on the output and also to access the impact of input s. The Cobb-Douglas form of production function was fitted by the method of least squares. The equation of Cobb-Douglas production function is as follows:

Whereas:

y = Return of fish-cum-paddy cultivation in Rs. / ha,
x_1 = Land cost in ha.
x_2 = Human labour cost in Rs.
x_3 = Irrigation water cost in Rs.
x_4 = Farm yard manure cost in Rs.
x_5 = Seed / fingerling cost incurred in Rs.
x_6 = Miscellaneous expenditure cost incurred in Rs.
x_7 = Marketing cost in Rs / q.
x_8 = Chemical fertilizer cost in Rs.
x_9 = Plant protection measures cost in Rs.
a = Constant.

b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, and b_9 = Regression coefficients of respective independent variables over dependent variable (y) (Table 1).

Results and Discussion

Table 2(a-e), reveals the values of coefficients of multiple determination (R^2) function fitted explained with maximum and large variation of 98.61 per cent with positive significant at 1 per cent level of probability on large farm size group, which was followed by 91.37 per cent variation with positive significant at 1 per cent on medium farm size, it was found 54.99 per cent positive at 1 per cent level of probability on small farm size and which was found to be least 26.51 per cent with positive significant at 1 per cent on marginal farm size group, while on overall variation was accounted to be 19.29 per cent of the total output has been explained by the variables fitted in the function of the model.

The constant (a) was found to be significant at 1 per cent level on marginal, small, medium, large and overall farm size groups, which indicates the good fit of the model. As among the different independent variables the regression coefficient of land (x_1) was found to be significant at 5 per cent level on marginal, medium and overall farm size groups; while the human labour (x_2) was also found to be significant at 5 per cent level on marginal, medium, large and overall farm size groups. While the irrigation water (x_3), was found significant at 5 per cent level on small and medium farm size groups, whereas the farm yard manure (x_4) was found non-significant, which shows that none of the farm size groups has used the recommended doses in the paddy-cum-fish culture, respectively.

The seed / fingerlings (x_5) was found significant at 5 per cent level on overall farm size groups, while miscellaneous item cost (x_6) was found significant at 5 per cent level on medium and large farm size groups, whereas the market cost (x_7) was found non-significant; which indicate that none of the farm size groups has utilized the variable in rational manner in the paddy-cum-fish culture, respectively. While the machinery used (x_8) was found significant at 5 and 1 per cent level on marginal and large farm size groups, respectively.

While the disease and protection measure cost (x_9) was found non-significant; which indicate that none of the farm size groups has utilized the variable in rational manner in the paddy-cum-fish culture, respectively.

Resource use efficiency in fish-cum-paddy cultivation

Table 3 (a-e) reveals that the Marginal value of product (MVP) of an input is compared with its respective factor cost to evaluate how efficiently the farmers are using their

resources in the study areas; the large MVP of output is worked out at 5.983 indicating that addition of one unit of output would increase gross income by Rs. 5.983. Among the different size groups, it ranges from 1.009 to 5.983 on marginal to large farm size group, respectively.

The marginal value product of x_1 (land) was worked out at 2.859, indicating that addition of one unit of land unit cost would increase gross income by Rs. 2.859. Among the different farm size groups, it ranged from 1.069 to 2.859 on marginal to medium farm size groups, respectively. Also, the marginal value product of x_2 (human labour) was worked out at 1.095, indicating that addition of one unit of human labour unit cost would increase gross income by Rs. 1.095. Among the different farm size groups, it ranged from 1.009 to 1.095 on marginal to overall farm size groups, respectively.

The marginal value product of x_3 (irrigation water land) was worked out at 1.143, indicating that addition of one unit of land unit cost would increase gross income by Rs. 1.143. Among the different farm size groups, it ranged from 1.118 to 1.143 on small to medium farm size groups, respectively. The marginal value product of x_4 (farm yard manure) was worked out at 1.299, indicating that addition of one unit of land unit cost would increase gross income by Rs. 1.299.

The marginal value product of x_8 (machinery and implement charges) was worked out at 1.868, indicating that addition of one unit of land unit cost would increase gross income by Rs. 1.868. Among the different farm size groups, it ranged from 1.12 to 1.868 on small to large farm size groups, respectively.

While x_5 (seed or fingerlings cost), x_6 (miscellaneous charges), x_7 (marketing cost) and x_9 (disease and plant protection measures cost) were found to be non-significant, which indicate less contribution towards the gross income, therefore it is an urgent needs to re-allocate the resources to the potential area or resources even the negative values on inputs further indicate loss in the returns after investment of single unit, therefore the investment on these inputs may be diverted towards the (x_1) land, (x_2) human labour, (x_3) irrigation water charges, (x_4) farm yard manure area and (x_8) machinery and implement cost on different farm size groups were having more potential and to utilize the inputs in a better way and having maximum return from the same investment.

Constraints faced by the respondents during the production and marketing of traditional Paddy-cum-fish culture in the selected areas

Table 4 reveals the constraints faced by the paddy-cum-fish farmers during production can be known. Some of the major constraints faced by the farmers were lack of knowledge about plant protection, low productivity, and lack of training on how to cultivate ginger for more production, lack of technical assistance from extension workers, lack of knowledge about fertilizers, fund and capital and also high cost of labour. Out of all the constraints the problems with highest frequency was lack of knowledge about plant protection with a percentage of 86.33 per cent followed by low productivity with a percentage of 81.67 per cent which was mainly due to lack of cultural practices. Problems like lack of technical assistance by extension workers, lack of knowledge of fertilizers and high labour cost accounted with a percentage of 70.00 per cent, 65.00 per cent, and 48.33 per cent. The constraints faced by the farmers in the production of paddy-cum-fish cultivation were high in percentage which justifies the reason why the farmers go for small scale farming in the study area.

Table.1 Selection of respondents on different far size groups

S. N.	Farm size groups	Land Holdings (ha)	No. of selected respondents
1.	Marginal	< 2.00	27 (38.57)
2.	Small	2.01 - 4.00	17 24.28)
3.	Medium	4.01 - 5.00	13 (18.57)
4.	Large	5.01 and above	13 (18.57)
Total			70 (100.00)

(The figure in the parentheses indicates percentage to the total)

Table.2 (a) Coefficient, SE, t value and remark of marginal farm group

SN	Particulars	Coefficient	Standard Error	t value	Remarks
1.	R^2	0.265101	-	-	NS
2.	Observation	27	-	-	
3.	F value	0.681381	-	-	NS
4.	Standard Error	0.154451	-	-	NS
5.	Intercept	3.830916	1.416608	2.704288	***
6.	X Variable 1	0.158682	0.138283	1.14751	*
7.	X Variable 2	0.237057	0.241359	0.982176	*
8.	X Variable 3	0.005683	0.115725	0.049104	NS
9.	X Variable 4	-0.05034	0.069326	-0.7262	NS
10.	X Variable 5	0.017904	0.036241	0.494014	NS
11.	X Variable 6	-0.00731	0.053927	-0.13561	NS
12.	X Variable 7	-0.02505	0.342118	-0.07321	NS
13.	X Variable 8	-0.07947	0.188922	-0.42063	NS
14.	X Variable 9	-0.17119	0.16034	-1.06764	NS

Table.2 (b) Coefficient, SE, t value and remark of small farm group

SN	Particulars	Coefficient	Standard Error	t value	Remarks
1.	R^2	0.549938	-	-	NS
2.	Observation	17	-	-	
3.	F value	0.950381	-	-	NS
4.	Standard Error	0.141083	-	-	NS
5.	Intercept	4.099186	1.635009	2.507133	***
6.	X Variable 1	-1.14508	0.643491	-1.77949	NS
7.	X Variable 2	0.028966	0.298644	0.09699	NS
8.	X Variable 3	0.121794	0.133851	0.909923	*
9.	X Variable 4	-0.05086	0.133086	-0.38216	NS
10.	X Variable 5	0.001186	0.074459	0.015934	NS
11.	X Variable 6	-0.0484	0.086383	-0.56032	NS
12.	X Variable 7	0.091455	0.276108	0.331229	NS
13.	X Variable 8	0.185725	0.215039	0.863683	*
14.	X Variable 9	0.155848	0.270965	0.57516	NS

Table.2 (c) Coefficient, SE, t value and remark of medium farm group

SN	Particulars	Coefficient	Standard Error	t value	Remarks
1.	R^2	0.913743	-	-	
2.	Observation	13	-	-	
3.	F value	3.531078	-	-	***
4.	Standard Error	0.083471	-	-	
5.	Intercept	3.839219	0.946319	4.057004	***
6.	X Variable 1	2.386599	1.03557	2.304624	*
7.	X Variable 2	0.251241	0.148543	1.691364	*
8.	X Variable 3	0.198933	0.096746	2.056243	*
9.	X Variable 4	-0.20732	0.12801	-1.61955	NS
10.	X Variable 5	0.102946	0.041682	2.469789	*
11.	X Variable 6	-0.05974	0.054577	-1.09458	NS
12.	X Variable 7	-0.41444	0.229548	-1.80547	NS
13.	X Variable 8	-0.4264	0.153299	-2.78151	NS
14.	X Variable 9	-0.31099	0.224803	-1.38337	NS

Table.2 (d) Coefficient, SE, t value and remark of large farm group

SN	Particulars	Coefficient	Standard Error	t value	Remarks
1.	R^2	0.986073	-	-	*
2.	Observation	13	-	-	
3.	F value	23.60168	-	-	***
4.	Standard Error	0.02695	-	-	
5.	Intercept	6.105458	0.691093	8.834495	***
6.	X Variable 1	-1.74829	0.181243	-9.64614	NS
7.	X Variable 2	0.131828	0.082687	1.594295	*
8.	X Variable 3	-0.22572	0.054481	-4.14303	NS
9.	X Variable 4	0.160135	0.029936	5.34919	NS
10.	X Variable 5	0.024969	0.020413	1.223216	*
11.	X Variable 6	-0.0545	0.023555	-2.31361	NS
12.	X Variable 7	-0.23499	0.118186	-1.98832	NS
13.	X Variable 8	0.60043	0.067638	8.877118	***
14.	X Variable 9	-0.26231	0.066179	-3.96358	NS

Table.2 (e) Coefficient, SE, t value and remark of overall farm group

SN	Particulars	Coefficient	Standard Error	t value	Remarks
1.	R^2	0.192947	-	-	***
2.	Observation	70	-	-	
3.	F value	1.59384	-	-	***
4.	Standard Error	0.147862	-	-	
5.	Intercept	3.929324	0.575911	6.822796	***
6.	X Variable 1	0.110683	0.080504	1.374879	*
7.	X Variable 2	0.181386	0.115396	1.571853	*
8.	X Variable 3	0.038988	0.055954	0.696785	NS
9.	X Variable 4	-0.02079	0.04754	-0.4374	NS
10.	X Variable 5	0.022482	0.021722	1.034965	*
11.	X Variable 6	-0.00685	0.02839	-0.24136	NS
12.	X Variable 7	-0.06025	0.134524	-0.44788	NS
13.	X Variable 8	-0.07762	0.090464	-0.85804	NS
14.	X Variable 9	-0.03272	0.098104	-0.33357	NS

Table.3 (a) Allocation of resources on marginal farm group

SN	Marginal	MPP	MFC	MVP	Efficiency	Remark
1.	Land size cost	1.069302	580	620.19514	1.069302	Underutilized
2.	Human labour cost	1.0092002	28	28.257606	1.0092002	Underutilized
3.	Irrigation water cost	0.0074393	80	0.5951469	0.0074393	Over utilized
4.	FYM cost	-0.0512569	805	-41.261799	-0.0512569	Over utilized
5.	Seed cost	0.0241005	998	24.052263	0.0241005	Over utilized
6.	Miscellaneous cost	-0.0077779	485	-3.7722645	-0.0077779	Over utilized
7.	Marketing cost incurred Rs / q	-0.0270945	79	-2.140464	-0.0270945	Over utilized
8.	Machinery and Implement cost	-0.0804841	179	-14.40666	-0.0804841	Over utilized
9.	Medicine and Plant Protection measure cost	-0.2014962	80	-16.119696	-0.2014962	Over utilized
Total		3.7056496	10000	37056.496	3.7056496	Underutilized

Table.3 (b) Allocation of resources on small farm group

SN	Small	MPP	MFC	MVP	Efficiency	Remark
1.	Land size cost	1.1833496	6650	7869.2751	1.1833496	Underutilized
2.	Human labour cost	0.0308897	170	5.2512488	0.0308897	Over utilized
3.	Irrigation water cost	1.1182223	85	95.048895	1.1182223	Underutilized
4.	FYM cost	-0.0517817	705	-36.506084	-0.0517817	Over utilized
5.	Seed cost	0.0012249	680	0.8329659	0.0012249	Over utilized
6.	Miscellaneous cost	-0.0514777	485	-24.966708	-0.0514777	Over utilized
7.	Marketing cost incurred Rs / q	0.0958888	69	6.6163305	0.0958888	Over utilized
8.	Machinery and Implement cost	1.1283645	25	28.209111	1.1283645	Underutilized
9.	Medicine and Plant Protection measure cost	0.1834427	80	14.675417	0.1834427	Over utilized
Total		3.9651469	10000	39651.469	3.9651469	Underutilized

Table.3 (c) Allocation of resources on medium farm group

SN	Medium	MPP	MFC	MVP	Efficiency	Remark
1.	Land size cost	2.8598666	6500	18589.133	2.8598666	Underutilized
2.	Human labour cost	1.0345213	86	88.968831	1.0345213	Underutilized
3.	Irrigation water cost	1.142804	80	91.424321	1.142804	Underutilized
4.	FYM cost	-0.2016933	725	-146.22763	-0.2016933	Over utilized
5.	Seed cost	0.104644	704	73.669362	0.104644	Over utilized
6.	Miscellaneous cost	-0.0631741	445	-28.112461	-0.0631741	Over utilized
7.	Marketing cost incurred Rs / q	-0.4397422	71	-31.221694	-0.4397422	Over utilized
8.	Machinery and Implement cost	-0.4344423	171	-74.289641	-0.4344423	Over utilized
9.	Medicine and Plant Protection measure cost	-0.3196325	69	-22.054643	-0.3196325	Over utilized
Total		3.7622014	9000	33859.812	3.7622014	Underutilized

Table.3 (d) Allocation of resources on large farm group

SN	Large	MPP	MFC	MVP	Efficiency	Remark
1.	Land size cost	1.763402	6150	10844.922	1.763402	Underutilized
2.	Human labour cost	0.1426031	182	25.953764	0.1426031	Over utilized
3.	Irrigation water cost	-0.2421311	89	-21.549671	-0.2421311	Over utilized
4.	FYM cost	1.2999183	45	58.496322	1.2999183	Underutilized
5.	Seed cost	0.0249952	670	16.746772	0.0249952	Over utilized
6.	Miscellaneous cost	-0.0575548	445	-25.61188	-0.0575548	Over utilized
7.	Marketing cost incurred Rs / q	-0.2452763	73	-17.905167	-0.2452763	Over utilized
8.	Machinery and Implement cost	1.8680072	234	437.11368	1.8680072	Underutilized
9.	Medicine and Plant Protection measure cost	-0.2695997	69	-18.602376	-0.2695997	Over utilized
Total		5.982978	9000	53846.802	5.982978	Underutilized

Table.3 (e) Allocation of resources on overall farm group

SN	Overall	MPP	MFC	MVP	Efficiency	Remark
1	Land size cost	1.2188977	650	792.2835	1.2188977	Underutilized
2	Human labour cost	1.0958738	48	52.601944	1.0958738	Underutilized
3	Irrigation water cost	0.0510408	80	4.0832672	0.0510408	Over utilized
4	FYM cost	-0.0202297	725	-14.666543	-0.0202297	Over utilized
5	Seed cost	0.0228529	704	16.088439	0.0228529	Over utilized
6	Miscellaneous cost	-0.007246	445	-3.2244798	-0.007246	Over utilized
7	Marketing cost incurred Rs / q	-0.0639288	71	-4.5389442	-0.0639288	Over utilized
8	Chemical fertilizer cost	-0.0790845	171	-13.523452	-0.0790845	Over utilized
9	Medicine and Plant protection measures cost	-0.0336341	69	-2.3207546	-0.0336341	Over utilized
Total		3.8504985	9000	34654.486	3.8504985	Underutilized

Table.4 Production constraints perceived by the paddy-cum-fish cultivators

S N	Problems faced by farmers	Frequency	%	Rank
1.	Lack of Training Programmes	63	90.00	I
2.	Damages due to active predators like birds, wild cats and Rodents	62	88.57	II
3.	Fish Run Off during wet rainy season	58	82.86	III
4.	Poor Bund formation	57	81.43	IV
5.	Non Availability of Vehicle	57	81.43	IV
6.	Shortage of Labour	55	78.57	V
7.	Risk to natural or artificial calamities	50	71.43	VI
8.	Involvement of activities by Theft or robbers	49	70.00	VII
9.	Insufficient water during dry season	46	65.71	VIII
10.	Damages due to use of excessive pesticides	34	48.57	IX

Table.5 Marketing constraints perceived by the paddy-cum-fish growers

SN	Constraints	Frequency	Percentage	Rank
1.	High Price Fluctuation	70	100.00	I
2.	Problem of credit Facilities	70	100.00	I
3.	Exploitation of price by middle men	70	100.00	I
4.	Lack of market Information	70	100.00	I
5.	Lack of packing and Grading materials	70	100.00	I
6.	Lack of Storage facilities	57	81.43	II
7.	Lack of modern Technology	57	81.43	II
8.	Poor plant protection measures	56	80.00	III
9.	Poor Marketing Facilities	52	74.29	IV
10.	Negligible govt. support	42	60.00	V
11.	Lack of cooperative society	42	60.00	V
12.	Poor Transportation	40	57.14	VI
13.	Lack of availability of Funds	34	48.57	VII

Table.6 Prioritization strategies and suggestion of respondent for the improvement of traditional paddy-cum-fish culture

SN	Strategies and Suggestion adopted	Frequency	Percentage	Rank
1.	Application of Poultry Droppings, Local Beer and Rice Bran, pig excreta, household burnt, decomposed weeds and stalks for growth of paddy and fish development.	70	100.00	I
2.	Use of Best and healthy Fingerlings *viz.*, Common carps etc.	58	82.80	II
3.	Hardening of Soil to avoid insect infestation and roots damages.	57	81.43	III
4.	Higher and bigger bunds or dykes to prevent fish runoff during wet-rainy season.	54	77.14	IV
5.	Deeper Channels of about 40-50 cm for good fish shelter during scorching hot summer.	51	72.86	V
6.	Use of Cultural practices or indigenous methods should be followed, beside chemical pesticides should be avoided as it may hamper fish health.	49	70.00	VI
7.	Adequate Culture of Fish Fingerlings is required for ensuring good yields of paddy and to prevent fish from damaging of young paddy leafs.	49	70.00	VI
8.	Intercropping practices should be maintained to ensure rigidity of dykes or bund as it can prevent leaping of fish.	44	62.86	VII
9.	Formulation of Strict Laws and Regulation must be imposed by the village committee members for preventing robberies or theft.	31	44.29	VIII
10.	Active participation of Govt., NGOs, FBOs and other concern departments for further development of paddy-cum-fish cultivation.	29	41.43	IX
11.	Making own Fish Ponds to reduce cost of Purchasing.	22	31.43	X
12.	Use of Modern Farm machines like water pump or Drip irrigation can help crop growth during dry season.	14	20.00	XI

Table 5 revealed the problems faced by the paddy-cum-fish farmers during marketing of both paddy and fish cultivation was list out. Marketing channel where producers sell their produce directly to the final consumers was weak; hence the producers have to sell their produce to the paddy-cum-fish retailers at a lower price such type of problems estimated around 88.33 per cent out of the total respondents. Price fluctuation, exploitation of

price by intermediates, lack of storage facilities, lack of government support and lack of market information were also some of the major problems faced by the farmers.

Policy/strategies to overcome the problems faced by the paddy-cum-fish cultivators

As the north-east India considered as one among the highest producer and productivity area in the world and is emerging as India's organic hub for paddy as well as fresh water inland or cultured fishes. Most of the tribal farmers from north-east follow traditional ways of cultivation which are generally eco-friendly, less expensive and utilize local resources, knowledge and labours (Table 6). Some of the suggestions to overcome the problems faced by the farmers during production and marketing of paddy-cum-fish cultivation are:

Training farmers for effective control of pest and diseases

Knowledge about the pest and diseases of paddy-cum-fish culture and measures to prevent it should be imparted to the farmers for more production. Importance of selecting of healthy fingerlings, good seeds, feeds for fish during sowing, land preparation, mulching should be made available to the farmers.

Establishing regulated block market

Regulated market should be established to help reduce in price fluctuation. Due to price fluctuation the farmers face immense problems and exploitation of price by the intermediaries usually happens.

Application of price policy

Price policy is an important factor for commercial cultivation of both paddy and fish. Improving market linkage for selling and export of the farmer produce should be given proper importance.

Proper storage facilities

Proper storage infrastructures are required for storing the surplus of yield out of paddy field and quantity of fish harvested by reducing the vulnerability of market functionaries to risk like thief and fire.

Farmers disposed tones of ginger due to poor storage structure and also due to poor marketing channels and hence cultivation of paddy in larger scale becomes impossible in the study area.

Proper transportation system

Proper transportation is required to make the farmer easily accessible to the nearby towns and markets with less damages and losses in the process of transportation.

Institutional credit facilities

Credit at normal rate should be made available to the farmer to take up commercial large scale production of paddy and fish.

Effective farmer organization

A strong farmer organization is required to get benefits of different schemes and projects from the government which includes involvement of FBOs, NGOs, and cooperative society's.

Application of organic compost

Application of Poultry Droppings, Local Beer and Rice Bran, pig excreta, household burnt, decomposed weeds and stalks can help in growth and development of both paddy and fish.

Higher and bigger bunds or dykes

Bunds should be maintained in order to prevent fish runoff during wet-rainy season.

Use of cultural practices

Indigenous methods should be followed, beside chemical pesticides should be avoided as it may hamper fish health.

Formulation of strict laws and regulation

Laws and regulation must be imposed by the village committee members for preventing robberies or theft.

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