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Assessment of Livelihood Enhancement Through Integrated Duck Fish Farming Systems: A Case Study of Rural Purulia, West Bengal

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Abstract:
Integrated fish farming stands out as a highly viable, dependable, and profitable agricultural practice. It plays a significant role in economically empowering families, particularly in rural areas, by ensuring year-round productivity and optimal use of resources. Integrated fish farming is based on the concept that 'there is no waste', and waste is only a misplaced resource which can become a valuable material for another product. This farming system relies on the synergy among different agricultural activities and emphasizes the efficient use and recycling of farm by-products. The concept assumes mutual benefit among all components of the system, with fish often being the primary beneficiary through direct or indirect consumption of animal and plant waste. Because of its focus on recycling, integrated fish farming is also recognized as a cost-effective and environmentally friendly method of managing waste. The economic value of integrated fish farming is considerable due to its diverse and multifaceted nature. It not only ensures a consistent income stream from multiple farm outputs throughout the year but also strengthens food security and promotes self-sufficiency. For instance, in a duck-fish farming model, while fish take time to mature, farmers can generate income in the meantime by selling duck eggs and other associated crops or vegetables. This study, conducted from November to December 2023, collected primary data from 20 randomly selected farmers in four villages within the Purulia-I Block of Purulia district, West Bengal. The data were analyzed using statistical tools to measure productivity, gross and net returns, and the benefit-cost (B:C) ratio of the integrated duck-fish farming system. Findings indicate that this farming method is gaining popularity in the remote villages of Purulia, offering benefits such as improved household nutrition, economic empowerment of women, and enhanced livelihood security for under-resourced families. The research concludes that integrated duck-fish farming is a sustainable and effective model for addressing key development issues in rural communities.

Keywords: Integrated Farming, Duck cum Fish, Livelihood Enhancement, Nutritional Security, Rural Fishermen, Sustainability.

INTRODUCTION:

Integrated fish farming is a system that combines fish cultivation with livestock and/or crop farming to optimize the use of available resources. This method recycles waste from one component to benefit another, improving overall efficiency and maximizing productivity in limited spaces. With the rising

costs of protein-rich fish feed and chemical fertilizers, along with growing concerns about energy conservation, more attention is being given to utilizing rice fields and livestock waste for fish farming. In this system, livestock such as ducks, chickens, and pigs are raised alongside fish ponds. The animal waste, often deposited directly into the pond, acts as a natural fertilizer, promoting the growth of photosynthetic organisms that form the base of the fish food chain. These systems generally have minimal water exchange, and fish benefit from the nutrients released, often without the need for additional feed. In contrast, the livestock in these systems are typically raised intensively and may be given antimicrobial agents for growth and disease prevention. These substances, along with their residues and resistant bacteria, can enter fish ponds via animal waste or excess feed, posing risks of antimicrobial resistance. Duck-fish farming, in particular, is a well-matched example of integrated farming. Ducks feed on aquatic insects, tadpoles, mollusks, and weeds—organisms that are not typically consumed by fish. Their droppings serve as an excellent fertilizer, and their foraging behavior stirs up nutrients from the pond bed, enhancing pond productivity and boosting fish growth. Ducks also benefit by getting a clean living environment and access to natural, nutrient-rich food.

In India, this technique has been successfully demonstrated by the Operational Research Project in West Bengal. Farmers adopting this approach have achieved fish yields of 3,500–4,000 kg per hectare per year without additional feed. Ducks help reduce the cost of fish farming by 60% since their droppings fertilize the pond and eliminate the need for supplementary feed and fertilizers. Ducks derive 50–75% of their dietary needs from the pond environment. On average, a duck produces 125–150 grams of waste daily, which, at a stocking rate of 250–300 ducks per hectare, amounts to 10,000–15,000 kg of manure annually. The droppings not only fertilize the pond during the day as ducks roam freely but are also collected at night from duck houses and added to ponds the next morning. If excessive algal blooms appear, however, the addition of duck manure should be paused. The integration of duck and fish farming has the potential to enhance rural livelihoods and ensure food security, particularly in districts like Purulia in West Bengal. This study focuses on evaluating the economic viability of such systems and their role in promoting sustainable livelihoods in the region.

Research Methodology:

The present study is based on an intensive fieldwork conducted in Purulia-I Block of Purulia district, West Bengal during the months of November 2023 to December 2023 Before the commencement of fieldwork, a pilot study was conducted during the month of October 2023. Based on that pilot study, Purulia-I Block of Purulia district were selected for final study. Purposive sampling method was used while selecting the study area.

Physiographically, Purulia, the westernmost district of West Bengal, is well known as a drought prone district and falls within the semi-arid region of the state. Cultivation of this district is predominantly mono-cropped. Out of total geographical land 52.47 % are used for agriculture. 29.69 % are under forest coverage (including social forestry) and 10.15 % are identified as Wasteland. Soil erosion is the most prominent phenomenon of the district resulting huge deposition of fertile soil in the valley region. Vast areas of land remained uncultivable wasteland. Out of the total agricultural holding about 73 % belongs to small and marginal farmers having scattered and fragmented smallholding. About 90 % of the population lives in villages and about 44 % of the rural population is below poverty line.

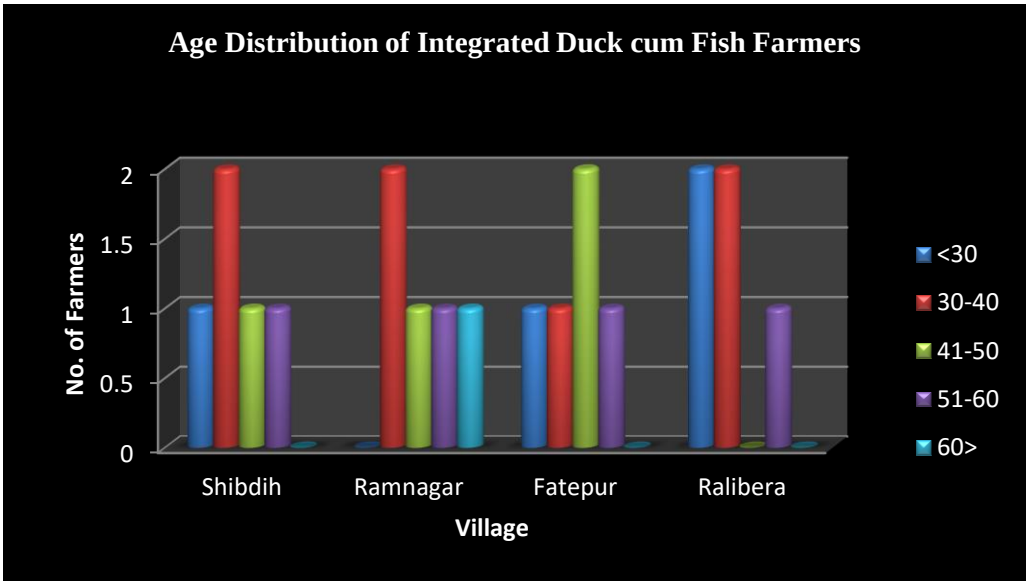
The three main advantages of sampling are that the cost is lower, data collection is faster, and since the data set is smaller it is possible to ensure homogeneity and to improve the accuracy and quality of the data. Sampling is concerned with the selection of a subset of individuals from within a population to

estimate characteristics of the whole population which is homogeneous in nature. Sampling is the process of selecting units likes people, organizations from a population of interest so that by studying the sample we may fairly generalize our results back to the population from which they were chosen. Using random sampling method around 20 Rural Integrated Duck cum Fish Farmer were selected for final study.

Result And Discussion:

Table-1: Age Distribution of the Integrated Duck cum Fish Farmers of Purulia-I block in Purulia District.

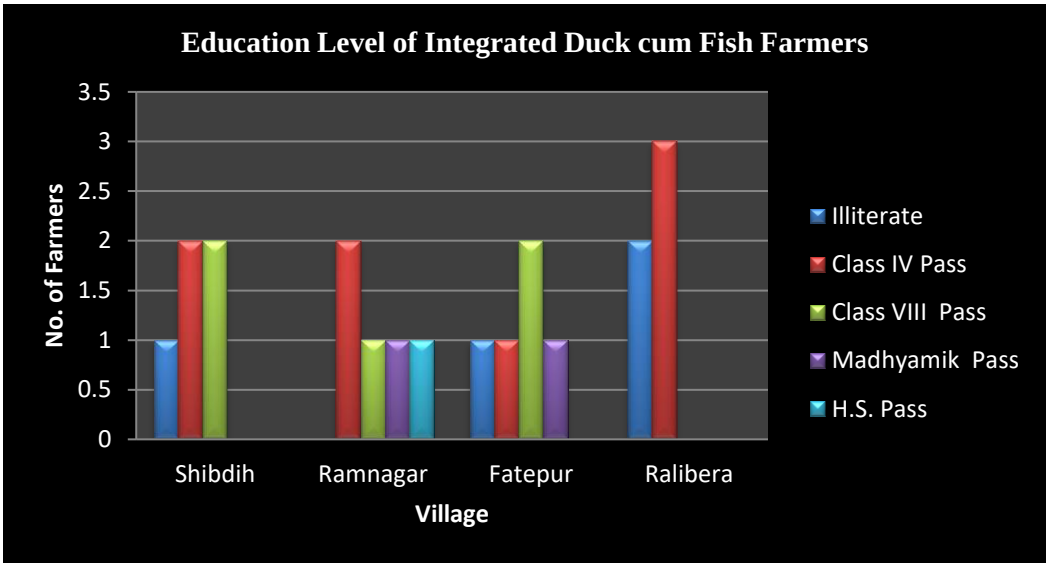
Age (Years) / Villages	<30	30-40	41-50	51-60	60>	Total
Shibdih	1	2	1	1	0	5
Ramnagar	0	2	1	1	1	5
Fatepur	1	1	2	1	0	5
Ralibera	2	2	0	1	0	5
Total with % Involved	4(20%)	7(35%)	4(20%)	4 (20%)	1 (5%)	20 (100%)



From (Table-1), it clearly indicates that the maximum percentage of Integrated Duck cum Fish Farmers in Purulia-I block were within medium age group (i.e. between the age group 30 to 40 years), while 20% Farmers age were below 30 years only, followed by 20% were 41-50 age group, 20% were 51-60 age group and only 5% Farmers were above 60 years age group. From the ensuing results it can therefore be concluded that the majority of the workforce participating in the study is fairly young.

Table-2: Distribution of the Education Qualification level of the Integrated Duck cum Fish Farmers of Purulia-I block in Purulia District.

Edu. Level / Villages	Illiterate	Class IV Pass	Class VIII Pass	Madhyamik Pass	H.S. Pass	Total
Shibdih	1	2	2	0	0	5
Ramnagar	0	2	1	1	1	5
Fatepur	1	1	2	1	0	5
Ralibera	2	3	0	0	0	5
Total with % Involved	4(20%)	8(40%)	5(25%)	2 (10%)	1 (5%)	20 (100%)

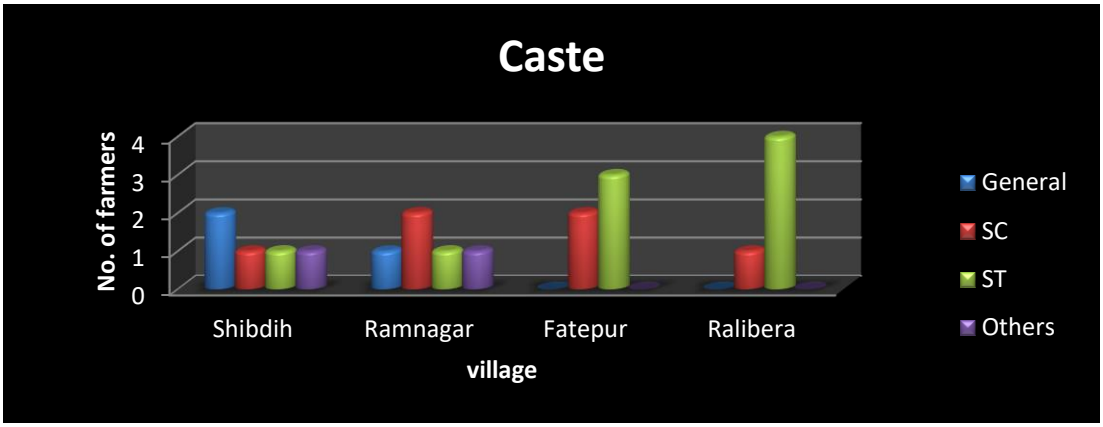


In the present study area it was evident that the literacy level of Integrated Farmers are very poor. From (table-2) it clearly indicates the major percentage (40%) farmers are educated upto primary level, while 20% farmers are Illiterate, followed by 25% are educated upto upper primary level. Whereas a considerable numbers of Integrated Farmers having education upto madhyamik (10%) and higher secondary level (5%). This clearly shows that the literacy rate of this area are really poor and miserable.

Table-3: Caste of the Integrated Duck cum Fish Farmers of Purulia-I block in Purulia District.

Caste / Villages	**General**	**SC**	**ST**	**Others**	**Total**
Shibdih	2	1	1	1	5
Ramnagar	1	2	1	1	5
Fatepur	0	2	3	0	5
Ralibera	0	1	4	0	5

Total with % Involved	3(15%)	6(30%)	9(45%)	2(10%)	20 (100%)



In the present study Caste category of the respondent shown in table 3, which depict the majority (50 percent) of Integrated duck cum fish farmers belonging to Schedule Tribe category , remaining 30 % famers belonging to Schedule Caste category whereas 15% farmers were General caste and only 10% were Other caste.

Table-4: Gender of the Integrated Duck cum Fish Farmers of Purulia-I block in Purulia District.

Gender / Villages	Male	Female	Total
Shibdih	5	0	5
Ramnagar	5	0	5
Fatepur	5	0	5
Ralibera	5	0	5
Total with % Involved	20 (100%)	00(00%)	20 (100%)

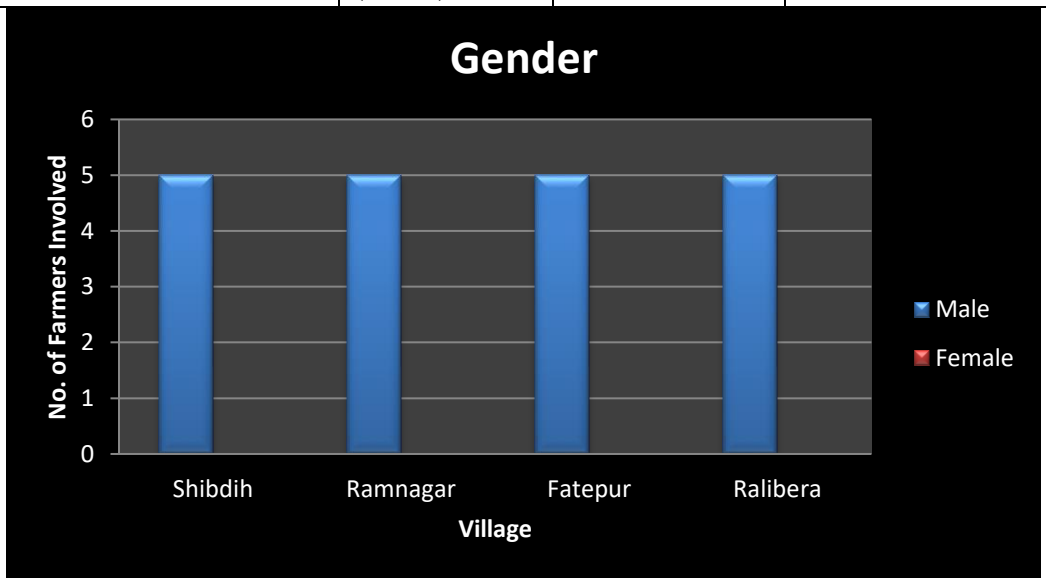


Table:- 4 present the percentage of gender distribution of the sample. The sample was representative of a larger number of male respondents to that of female respondents. Male respondents comprised of 100% compared to 00% female respondents. From the ensuing results it can therefore be concluded that the male responds are more interested in this job than female responds.

Table- 5: Marital Status of the Integrated Duck cum Fish Farmers of Purulia-I block in Purulia District.

Marital Status / Villages	Married	Unmarried	Total
Shibdih	4	1	5
Ramnagar	5	0	5
Fatepur	4	1	5
Ralibera	5	0	5
Total with % Involved	18 (90%)	2(10%)	20 (100%)

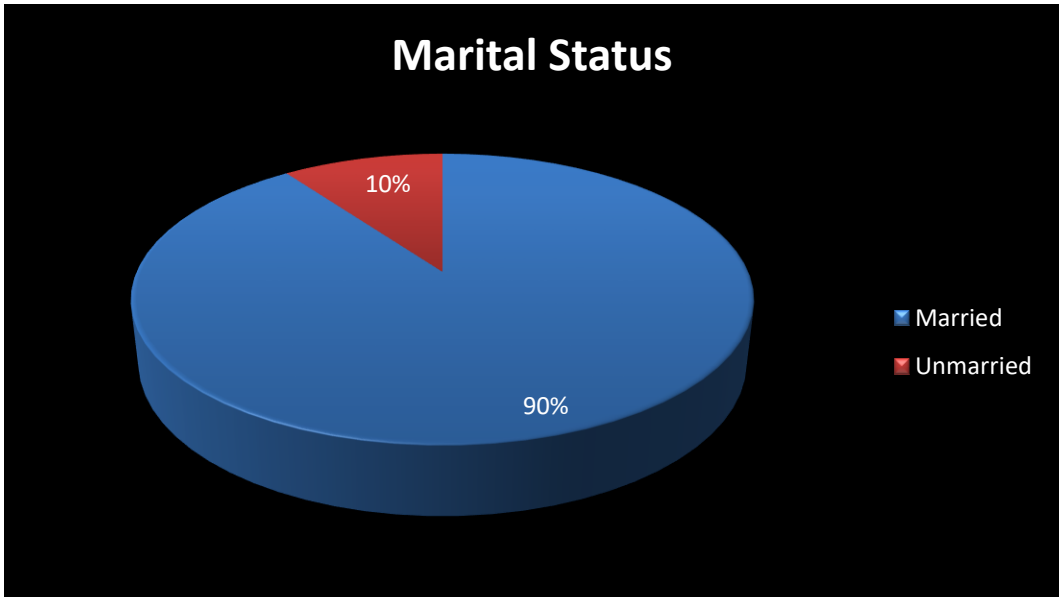
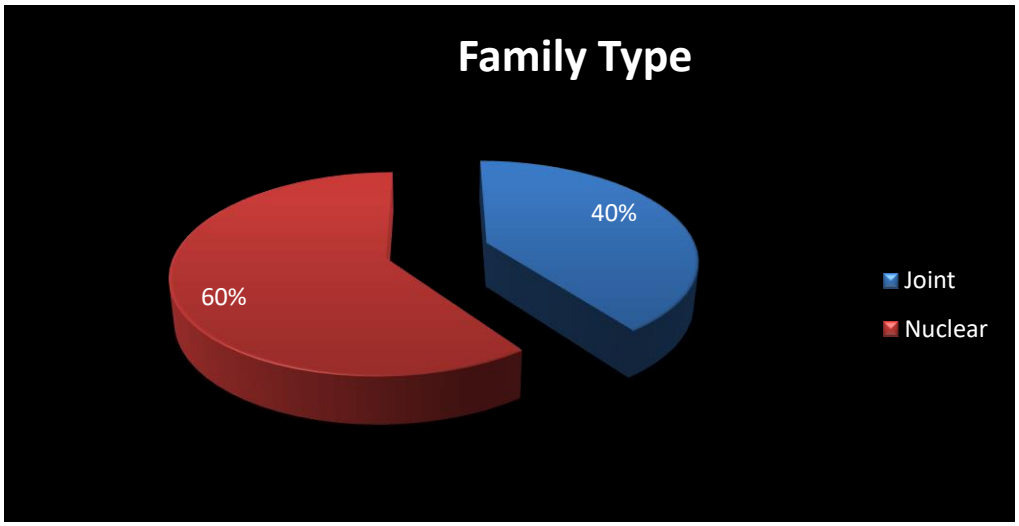


Table: 5 present the percentage of marital status of the respond. The sample was representative of a larger number of married respondents to that of unmarried respondents. Married respondents comprised of 90% compared to 10% unmarried respondents.

Table- 6: Distribution of Integrated Duck cum Fish Farmers according to family type of Purulia-I block in Purulia District.

Family Type / Villages	Joint	Nuclear	Total
Shibdih	2	3	5

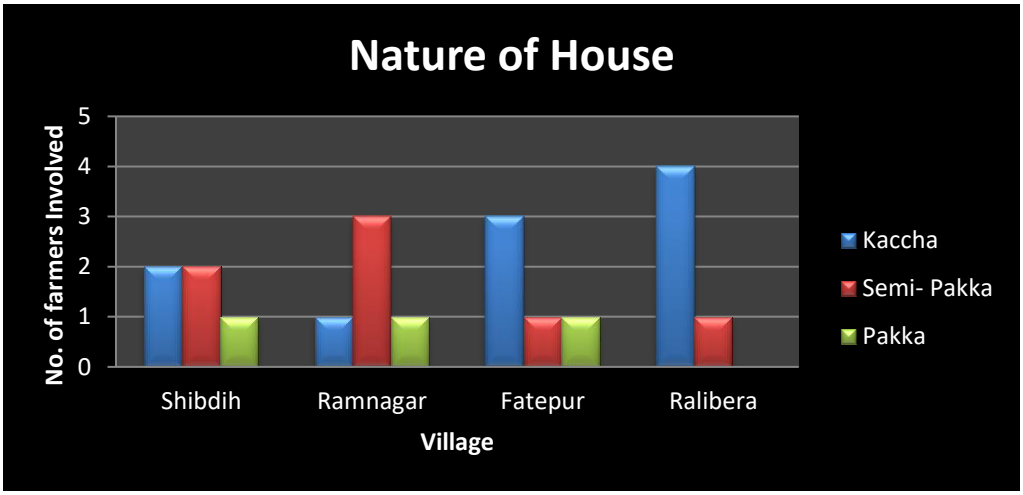
Ramnagar	0	5	5
Fatepur	2	3	5
Ralibera	4	1	5
Total with % Involved	8(40%)	12(60%)	20 (100%)



This study illustrates that the maximum percentage (60%) of Integrated Duck cum Fish Farmers in Purulia-I block having Nuclear family type whereas 40% Integrated Duck cum Fish Farmers having Joint family type.

Table- 7: Nature of House of the Integrated Duck cum Fish Farmers of Purulia-I block in Purulia District.

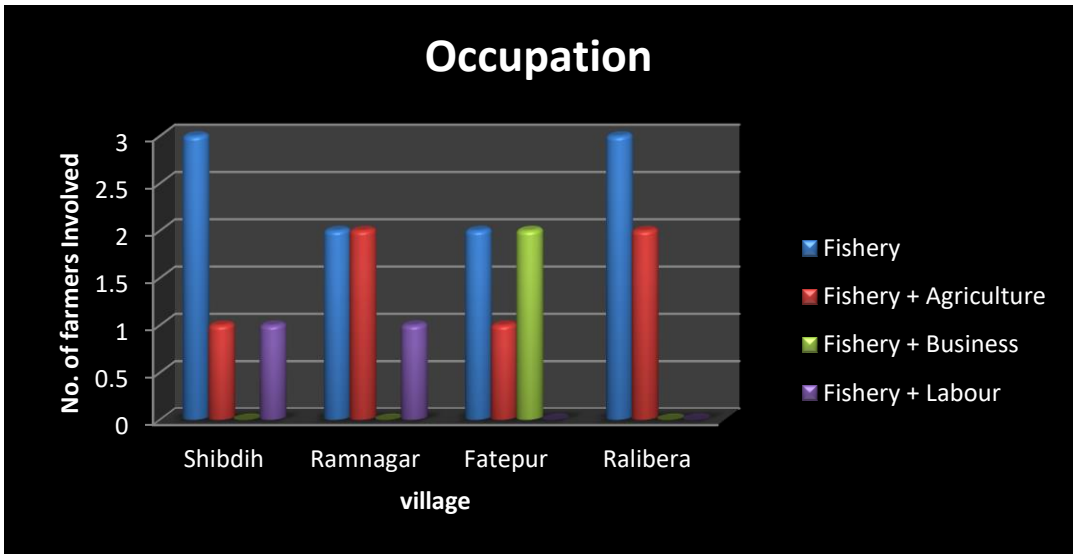
Nature of House / Villages	**Kaccha**	**Semi-Pakka**	**Pakka**	**Total**
Shibdih	2	2	1	5
Ramnagar	1	3	1	5
Fatepur	3	1	1	5
Ralibera	4	1	0	5
Total with % Involved	10(50%)	7(35%)	3(15%)	20 (100%)



From the above table it is very clear that 50% respondents have pure kaccha houses to dwell in, whereas 35% respondents do have semi-pakka houses, while only 15% respondents have pakka houses. Since they live in most of the villages have been situated in the remote, rural, and forest areas, so the people are forced to live in the kaccha houses. To construct a pakka house, there are plenty of problems.

Table-8: Distribution of Integrated Duck cum Fish Farmers according to different occupation of Purulia-I block in Purulia District.

Occupation / Villages	Fishery	Fishery + Agriculture	Fishery + Business	Fishery + Labour	Total
Shibdih	3	1	0	1	5
Ramnagar	2	2	0	1	5
Fatepur	2	1	2	0	5
Ralibera	3	2	0	0	5
Total with % Involved	10(50%)	6(30%)	2(10%)	2 (10%)	20 (100%)



All farmers are distributed in accordance with the subsidiary and a casual occupation since Pisciculture is main occupation. In every household, some of the members are involved full time in Pisciculture whereas others expense part time by practicing subsidiary and casual occupations as shown in the below table:

The data exhibited that majority of Integrated Duck cum Fish Farmers in Purulia-I block are engaged in Pisciculture activities (50 percent), followed by Pisciculture and Agriculture (30 percent), Pisciculture and Business (10 percent), Pisciculture and Labour (10 percent) as a subsidiary occupation.

Table- 9: Average Economics of all Traditional Culture and Integrated Duck cum Fish Farming at Purulia-I Block, Purulia: Schedule Depicted on Average Pond Size of 1 Bigha (1,333.33 m^2)

	Traditional Pisciculture			Integrated Duck cum Fish farming		
Farmers No.	**Investment (Approx) (Rs/Yr.)**	**Income (Approx) (Rs/Yr.)**	**Profit (Approx) (Rs/Yr.)**	**Investment (Approx) (Rs/Yr.)**	**Income (Approx) (Rs/Yr.)**	**Profit (Approx) (Rs/Yr.)**
Farmer 1	33500	52000	18500	53200	81500	28300
Farmer 2	35700	58000	22300	55000	85000	30000
Farmer 3	30000	51000	21000	53000	82000	29000
Farmer 4	32000	50000	18000	54000	88000	34000
Farmer 5	32500	52000	19500	51000	80000	29000
Farmer 6	37500	55000	17500	56000	82000	26000
Farmer 7	30000	51000	21000	54000	85000	31000
Farmer 8	36000	59000	23000	49000	80000	31000
Farmer 9	31500	53000	21500	60000	88000	28000
Farmer 10	35000	53500	18500	52000	80000	28000
Farmer 11	40000	60000	20000	55000	82000	27000
Farmer 12	38500	58000	19500	51000	81500	30500
Farmer 13	36000	57000	21000	57000	85000	28000
Farmer 14	31000	53000	22000	53000	82000	29000
Farmer 15	35000	54000	19000	52000	80000	28000
Farmer 16	37000	51000	14000	58000	85000	27000
Farmer 17	30000	56000	26000	51000	82000	29000
Farmer 18	35000	54000	19000	50000	86000	36000
Farmer 19	32000	49000	17000	52000	81000	29000

Farmer 20	38000	60000	22000	55000	83000	28000
Average value	**34310**	**54325**	**20015**	**53560**	**82950**	**29290**

Integrated farming is a sustainable and effective tool for improving rural economy due to its cumulative cost effectiveness, low investment and higher profitability. To achieve optimum production with cost effective low investment recycling of wastes and residues from one farming to other system with due environmental consideration is very much necessary. Sustainable integrated farming practice is a very good option. This is a viable option for augmenting overall farm productivity and better economic return of rural pond based farming community.

From table 9, it clearly indicate that in case of Traditional Pisciculture the average Investment, Income and Profit were Rupees 34210/-, Rupees 54325/- and Rupees 20015/- respectively. On the other hand in case of Integrated Duck cum Fish Farming the average Investment, Income and Profit were Rupees 53560/-, Rupees 82950/- and Rupees 29290/- respectively.

Conclusion:

The economic benefit of integrated fish farming cannot be over-emphasized since the integration is varied and diversified in nature. It is one of the most viable, reliable and profitable of any farming enterprise. It contributes immensely to the economic empowerment of many families especially in the rural communities. It enables the farmer to be productive all the year round and fully maximize its production. Its contribution in the enhancement of food security and self sufficiency is highlighted in this study. Integrated fish farming provides the farmer with a steady source of income all year round; this comes from various farm products. In duck-cum fish farming before the harvesting of the fish, which may take some months, the farmer can sell the eggs which will generate money for some time. Apart from this, money can also be generated from the vegetables or the crops that may be combined in the integrated fish farming.

Integrated fish farming is the blending of various compatible agricultural enterprises into a functional or unified farming system for the purpose of sustainability and it varies from one area to another in terms of production combination, rates and sizes. Women/youth being the most vibrant group of people are involves in this system. It plays very important role in many aspects of women/youth development and empowerment and more profitable than unitary system of farming as it ensures a spread of financial risk for its varied diversified nature in rearing fish, animals and crops; it has a capacity of making more food available thus enhancing food security. Besides, it provide employment, thus alleviating poverty and enhancing the economic status of the rural populace in India and reduce to the barest minimum the level of violence from disenchanted youth that is characteristic of the country in recent times. From the research work carried in the block of Purulia-I, it clearly shows a positive impact upon the culture and subsequently to the farmers. To be more specific the following schemes are mainly emphasized viz, economic upliftment of rural people through operation of integrated pisciculture development, socio-economic upliftment of fishefolk through operation of pisciculture development scheme etc. are in operation. Study also reveals that, fisheries represent a vital sector in the thrust Programme of West Bengal Government for rural development through production of fish and other ancillary activities thereby generating rural employment and improvement of socio-economic status of the fishers who are the prime contributors of fisheries production. Fisheries sector embraces a large population of scheduled

castes and scheduled tribes. Rehabilitation of scheduled castes and scheduled tribes families through fishery activities has become a major boon for upliftment of their economic status above poverty line.

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