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Feasibility study of the small-scale poultry-cum-fish farming in homestead ponds for empowerment of rural women: A case study in the new alluvial zone of west Bengal, India

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Abstract
The integrated fish farming is an eco-friendly lucrative venture which offers a higher farm income and also a cheap source of protein for the rural peasant families. For present study 20 economically backward women possessing homestead ponds were selected by a previously tested questionnaire from Berbari village of Nadia district under the New Alluvial Zone West Bengal to empower the rural women through participatory training on integrated poultry-cum-fish farming in their homestead ponds. Infrastructures for the integrated farming were developed for rearing 12 chicks and culturing Indian major carps (@ 7500 fingerlings/ha) in the homestead ponds for one year. Values of water quality parameters were within normal ranges for carp culture during the culture period. On an average net profit from poultry and fish farming was Rs. 14,460/- per beneficiary per year and benefit: cost ratio was 2.56:1. The activity is supportive to their self-employment and empowerment as well.

Keywords: Homestead pond, integrated farming, poultry-cum-fish culture, socio economic status, women empowerment

1. Introduction
In rural areas, particularly in weaker sections of the society, most of the women are illiterate and suppressed, the women empowerment should focus on slavery reduction, gender sensitization, scope building and advancement of micro-enterprises. Empowerment of women is a multifaceted and multi-dimensional concept. It is a process through which women gain greater access to resources and also gain control over decision-making of the family. It has been reported that money in the hands of the female member benefits children of the family [1]. The empowerment of women by linking up with Self Help Groups (SHGs) would not only beneficial for the individual woman, but also for her family which in turn will collectively cause development of the community [2]. There is enormous scope for improvement of socio-economic status of rural women through introduction of well-founded user-friendly technologies which is conducive to their self-employment and economic development. Integrated farming system offers resource-saving practices to provide acceptable profits and sustainable development by minimizing the negative effects of intensive farming with preserving the environment [3]. Small-scale integrated fish farming practices can be adopted as a useful technique to provide high quality animal protein [4] and other nutrients for nutritionally vulnerable groups. This farming system offers increasing food production and net farm income and also improves nutritional status, promotes natural resource and provides sustainable use of resources. Integration of poultry and fish farming might be an economically profitable and productive system as it reduces costs of fertilizers and feed in fish farming pond and maximizes benefits. Integrated fish farming is the practice of direct use of fresh livestock manure in fish farming ponds [5] and thus is an eco-friendly process to achieve economic and sustained production to fulfill diverse requirements of farm household with preserving the resource base and maintaining high environmental quality.
Ponds adjacent to the houses offer great opportunity for women to participate in fish culture, in contrast to other modes of aquaculture, from which rural women are often excluded because of cultural and social barriers or due to the long distance from the homestead [6].

Homestead ponds are either seasonal or perennial in nature but very common in the villages of New Alluvial Zone of West Bengal. Backyard poultry production is an age old practice in rural India which can be integrated with fish culture in homestead ponds. Poultry manure is a complete fertilizer, which possesses the characteristics of both organic as well as inorganic fertilizers. Digestive tract of poultry birds are very short and as a result 80% of chicken manure may present as undigested feed-stuff [7] which may contain about 20-30% total protein [8]. Therefore, the integrated fish farming approach for utilizing household resources is one of the best efforts to empower the rural women. Thus, the present work has been undertaken to validate poultry-cum-fish farming in small homestead ponds and to assess its feasibility for empowering rural women of the village.

2. Materials and Methods: Twenty economically backward women possessing homestead ponds were selected by a previously tested questionnaire from Berbari village of Nadia district under the New Alluvial Zone of West Bengal for participatory training on integrated poultry-cum-fish farming in their homestead ponds. Infrastructures for the integrated farming (*viz.* poultry house, pond renovation, fencing around the unit) were developed for rearing 12 chicks and for 3 species minimum-input composite culture of Indian major carps (@ 7500 fingerlings/ha) in the homestead ponds for one year.

2.1 Village Profile: The Berbari village (Latitude-23.0087768ºN, longitude-88.6373968ºE) is one of the remote villages of West Bengal. It is located in Deuli Gram Panchayat of Chakdah Block, Nadia district under the New Alluvial Zone of West Bengal. The area of the village is about 2.0 square kilometers. Total population of the village is about 2645 (618 families) as per Population Census 2011, of which 90.43% SC and 0.15% ST. The average size of the land holding is very small. They belong to either marginal farming community or daily-wage laborer community and live below or near the poverty line. There are about 70 ponds in the village Berbari and among them 40 are of homestead in nature.

2.2 Profile of beneficiaries: Twenty beneficiaries, belonging to economically backward community and each having one homestead pond were chosen from the village Berbari of Chakdah Block of Nadia district for the implementation of the thought on the basis of pre-scheduled questionnaires. The homestead ponds ranging between 100 m^2 to 667 m^2 of these beneficiaries were either un-utilized or underutilized which may be due to their lack of awareness, motivation and scientific knowledge on fish culture. The ponds of the selected beneficiaries were perennial and did not over flow during monsoon. Average depth of the water body during summer was about 3.2 ft and during monsoon was about 6.75ft. Among the beneficiaries 10% belonged to the age group of 21-30 years, 25% belonged to the age group of 31-40 years, 25% belonged to the age group of 41-50 years, and 40% were within 51-60 years. About 75% of them lived in kaccha house. Majority of the beneficiaries were semiliterate (50%), 35% were literate and 15% were illiterate. Annual income of these families was not good enough for supporting their families. Their average annual income of 40,000-60,000/-, 60,001-80,000/-, 80,001-1,00,000/- and 1,00,001-1,20,000/- and more than 1,20,000 was recorded for 40%, 30%, 10%, 15% and 5% families respectively.

2.3 Poultry breed selection and rearing: Among the improved poultry breeds "Vanaraja" (PDP, Hyderabad) and "Haringhata Black" were found to be acceptable and suitable for backyard poultry farming in the region. Due to the higher meat, egg production (150-200 eggs per laying year) potentiality and resemblance with *desi* poultry in plumage colour, Vanaraja breed and Haringhata Black as local improved breed (120-140 eggs per laying year) were selected for the study. Eight-day-old chicks were collected from reputed Govt. farms and were reared in a common place with sufficient brooding devices, drinkers and feeders where all the beneficiaries have got exposure to the process of brooding of chicks. After 5 weeks of brooding and rearing, chicks were distributed @ 20 chicks per beneficiary in May 2016 for rearing 10 healthy hens and 2 cocks in each unit for the study. Low-cost feed has been prepared with 38% cereals, 20% oil cakes, 40% rice/wheat bran and 2% vitamins and minerals supplements and provided them as input support. Deworming was done regularly before one week of vaccination and standard vaccination schedule has been followed all throughout [9]. Occurrence of diseases and chick mortality were recorded at regular intervals.

2.4 Fish species selection and rearing: Three species of Indian major carps, catla, rohu and mrigal were selected for culture for its suitability and high acceptability. Fish fingerlings (10$\pm$0.5 g) were procured from a reputed carp hatchery for stocking (@ 7500 fingelings/ha) with catla: rohu: mrigal at 3:3:4 ratio in each pond in May 2016. Standard methodology was followed for minimum-input composite culture of carps during the culture period [10]. Quick lime was applied at a dose of 200 kg/ha before stocking the fish fingerlings. Liming was followed all throughout to maintain the pH of water at a dose of 37.5 kg/ha at monthly intervals. In the present study a dose of 50 kg/ha/day of poultry litter was applied to the fish farming ponds in every morning after sunrise and the application of this is deferred on the days when algal bloom appears in the pond by following the standard methodology [11]. Netting or raking was done at monthly intervals to check out the fish growth.

2.5. Water quality analysis: Water samples from these ponds were collected in neutral plastic containers from 20 homestead ponds in the morning (6.00 a.m. to 8.00 a.m.) and brought to the laboratory for analysis. Physico-chemical parameters like, analysis of pH, alkalinity, free CO_2, NO_3-N, PO_4-P of water samples were monitored at regular intervals following standard methods [12]. Analysis of dissolved oxygen (DO) and of chemical oxygen demand (COD) of water samples were done following the standard methods [13] [14]. For microbial analysis water samples were collected in a sterilized container and pour plate method was followed to count the cfu [15].

3. Results and Discussion

Physico-chemical properties such as pH, free CO_2, alkalinity, DO, COD, organic carbon of water in any aquatic system are largely influenced by the existing meteorological condition, and are essential for determining the structural and functional status of natural water. Hydrological condition affects the aquaculture activities such as fish productivity and species diversity of aqua fauna, eutrophication and overall loss of

biodiversity that results in degradation of pond ecosystem. Physico-chemical parameters such as dissolved oxygen, alkalinity, pH and temperature are the most common water quality parameters which influence fish health and growth [16]. The study revealed remarkable variations in the physico-chemical parameters of water in different ponds investigated. The values of transparency from 15.7 to 45 cm, pH from 6.76 to 7.98 (Fig.1), free CO_2 from 29.66 to 47 mg/l, bicarbonate alkalinity from 172 to 248 mg/l, DO from 5.4 to 8.7 mg/l (Fig.2), COD from 57.5 to 87.2 mg/l, nitrite nitrogen from 0.17 to 0.65mg/l, ortho-phosphate from 0.010 to 0.036 mg/l (Fig.3) and CFU from 1.12×10^4 to 5.0×10^4 /ml (Fig. 4) of the selected homestead ponds were observed during the period of investigation. The values of pH [17], alkalinity [18], DO [17] of these ponds were supportive for biological productivity [17]. Concentrations of ortho-phosphate (0.010 to 0.036 mg/l) and nitrite nitrogen (0.17-0.65 mg/l) of these ponds varied greatly but within the ranges supportive to productivity for fish growth and survival [17]. Fish can take microbes as food and on the other hand microbes can directly influence the pond productivity, so coliform bacterial count per unit sample source (cfu) is a very important parameter in fish pond. In the present study bacterial count was similar with a previous study who has reported bacterial load of aquaculture pond within the range of 16×10^3-12.4×10^4 cfu/ml [19]. Heterotrophic bacterial population tends to increase after application of poultry litter [20], and similar observation (1.12×10^4-5.0×10^4 cfu/ml) was found in the present study. Values of different physico-chemical parameters of these ponds revealed that the values were within the range which implied that environmental conditions of the ponds were conducive to fish growth.

Table 1: Range and mean (±SD) values of different water quality parameters of the homestead ponds during the period of investigation.

parameter	Transparency (cm)	pH	Free CO_2 (mg/l)	Bicarbonate Alkalinity (mg/l)	DO (mg/l)	COD (mg/l)	Nitrite nitrogen (mg/l)	Ortho phosphate (mg/l)	Cfu/ml
Range	15.7-45	6.76-7.98	29.66-47.0	172-248	5.4-8.7	57.5-87.2	0.17-0.65	0.010-0.034	1.12×10^4-5×10^4
Mean+ SD	38±1.5	-	33.97±5.6	198±16.45	6.57±1.56	71.58±13.3	0.31±0.05	0.018±0.008	2.36×10^4±0.37×10^4

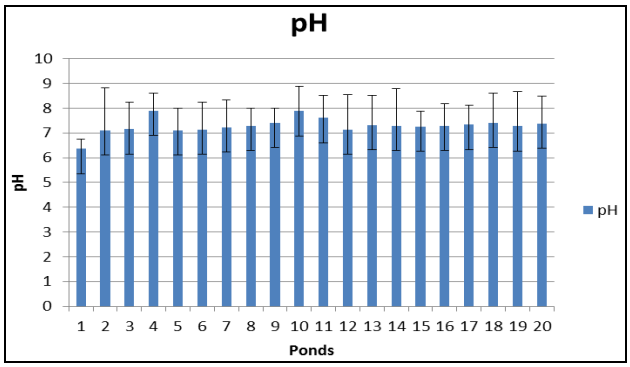

Fig 1: Variation of pH of the investigated ponds

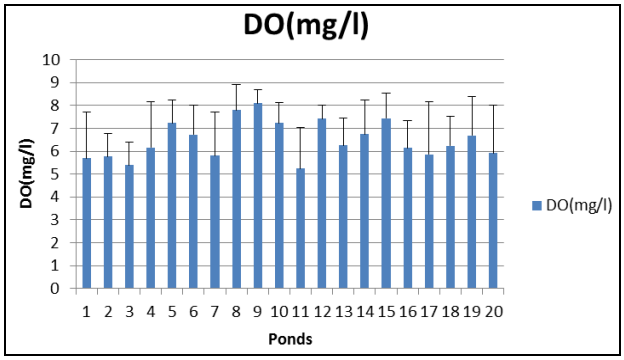

Fig 2: Conc. (mean + SD) of DO of the investigated ponds

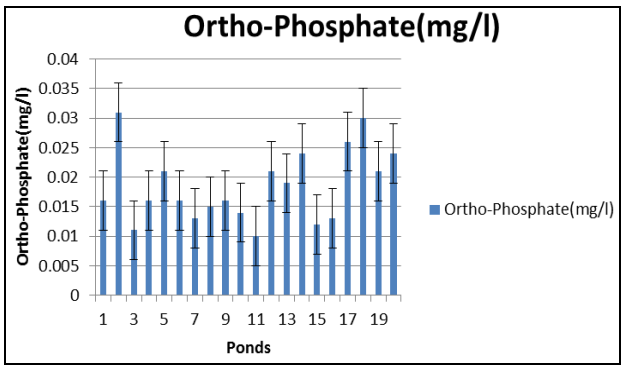

Fig 3: Conc. (mean + SD) of ortho-P of the Investigated ponds

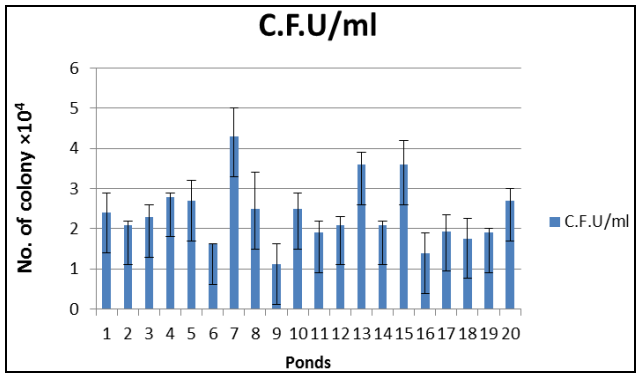

Fig 4: C.F. U/ml (mean + SD) of the investigated ponds

After attaining maturity at the age of 15 weeks, mortality of chicks was recorded as 7.5% in case of Vanaraja and 8% in case of Haringhata Black when cocks of Vanaraja attained the body weight of 1.5-1.9 kg and Haringhata Black attained 1.2-1.4 kg. Survivality of the poultry birds depended also on various other factors such as predator and similar problem was faced during early age of the poultry birds [21]. Some of the hens started egg laying at the age of 20-25 weeks when hens of Vanaraja attained the body weight of 1.8-2.2 kg and Haringhata Black attained 1.2-1.4 kg. Similar growth and egg laying performance of Vanaraja was reported with the egg production of 92-107 upto 72 weeks [22]. It was reported that Vanaraja breed is very much popular for better egg production and meat production with the taste of *desi* chicks, broodiness and adaptability to low input system [23]. Disease resistance potentiality of Harighata Black was more at the mature stage and has considered it as the highly resistant native breed in comparison to other highly adapted exotic breeds of backyard system [24]. In the present study egg laying potentiality of Vanaraja @ 12-13 /month/hen and Harighata Black @ 9-10/month/hen was obtained. Diseases like common cold, fever, diarrhoea and fowl pox etc. were occurred occasionally and these diseases are very common among the poultry birds [25].

Survival of different fish species was varied between 50-0%. Values of average weight gain of 450-600 g/yr, 300-400 g/yr and 250-350 g/yr were observed in catla, rohu and mrigal,

respectively, in these ponds investigated. Fish production ranging between 1200-3000 kg/ha/yr of these homestead ponds were obtained which was good enough as compared to inputs involved is the culture practice. But the production was far below than the semi-intensive carp culture [11]. More growth performance was obtained with application of artificial feed in composite fish culture ponds [26]. Yearly income from selling out produces like egg, meat and fish was varied by 10 folds depending upon their pond size, its positional advantage and follow up management practices for rearing chicks and fish. On an average, total income generation by selling out egg, chicken and fish was moderate and supportive to uplift the socio-economic status of the women (Table-2) which implied its feasibility.

Table 2: Economics of poultry-cum-fish culture in homestead pond (3.72 cottah) at Berbari Village

Item	Particulars	Amount (Rs.)
A. Capital Cost		
Expenditure for developing of the infrastructure	Poultry house (using locally available low-cost materials)	1800/-
	Pond preparation	400/-
	Sub-Total	2200/-
B. Operational Cost		
Rearing cost	Chicks (20)	300/-
	Poultry feed (165kg @ Rs.15/-per kg)(For 12 Chicks)	2475/-
	Vaccination and medicines	300/-
	Fish fingerling (3.7 kg) @ Rs. 140/-per kg	518/-
	Miscellaneous (liming, netting etc.)	700/-
	Sub-Total	4293/-
C. Expenditure		
Interest	Interest on Capital cost (@14%)	308/-
	Interest on operational cost (@14%)	601/-
Depreciation (@20%)	Infrastructure	440/-
	Operational cost	4293/-
Total expenditure		5642/-
D. Income		
Income from poultry farming	Avg. Egg production (890@ Rs 7/-per egg)	6230/-
	Chicken (42 kg @ Rs. 160/-per kg)	6720/-
Income from fish farming	44.7 kg @ Rs. 160/-per kg	7152/-
Total income		20102/-
Net profit (total income-total expenditure)		14460/-
Benefit/cost ratio (Net profit/Total expenditure)		2.56

The process of integrated fish farming is environment friendly and economically viable in the locality, so it will sustain for long time and in addition to that it became possible to empower the rural woman by making them financially independent [27]. Finally income generation from selling out eggs, chicks and fish was calculated and income generation ranging between 4,288/- and 42,000/- per beneficiary per year was obtained which in turn increased family income (Fig. 5) and increased the contribution of female members from 3.5 to 40.4% of total family income to their respective family income (Fig. 6) due to adoption of the integrated fish farming.

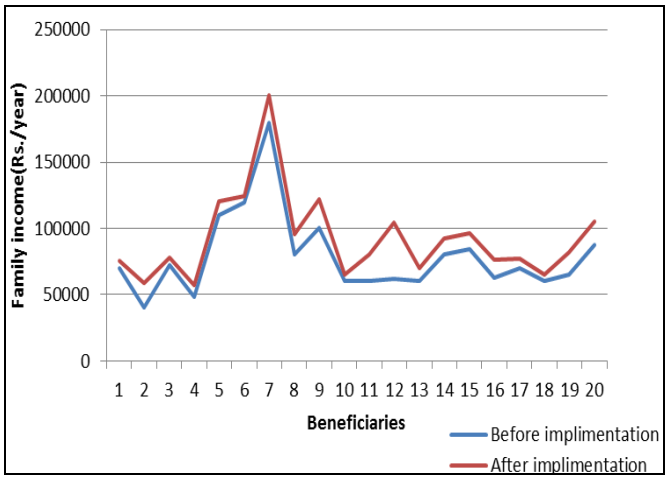

Fig 5: Increment of annual income of 20 beneficiaries after adoption of poultry-cum-fish farming in their homestead ponds.

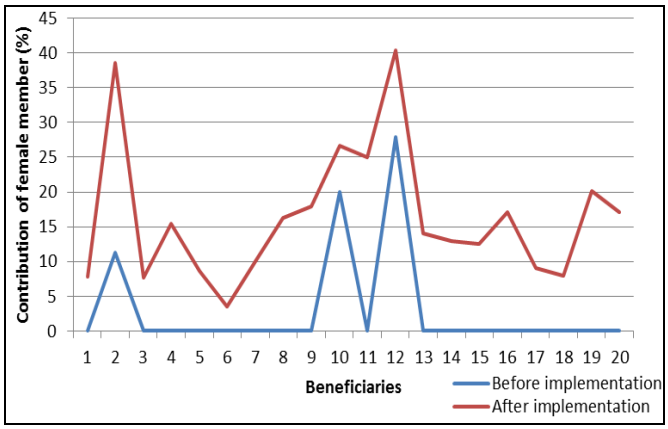

Fig 6: Increment of contribution of female members to their families after adoption of poultry-cum-fish farming in their homestead ponds

Contribution of woman to her family income is one of the issues for gender equality and supportive to her empowerment. The observation implied that the activity is supportive to their self-employment and empowerment as well.

4. Conclusion

The study concluded that the integrated poultry-cum-fish farming in homestead ponds is an economically viable (benefit/cost ratio=2.56:1) and feasible technology for adoption which could solve the issues of sustainability, women empowerment and livelihood security effectively. Adoption of integrated fish farming in homestead ponds with

improved poultry breeds would be supportive to empowering rural women. Future research and efforts are to be given to increase income and to adopt poultry-cum-fish farming in homestead ponds as one of the useful practices for women empowerment and livelihood security.

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