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Improving household fish and vegetable availability through participation of rural women: A case study

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Abstract

Homestead integrated aquaculture has immense potential towards alleviating poverty and undernourishment. In order to have sustainable and equitable impacts through small holder aquaculture innovations, a focus on gender being included at the very start of the design and dissemination is required. The present case study showcases the impact of gender inclusive interventions in improving the participation of women in homestead aquaculture, thereby improving the household fish and vegetable availability and income. Conservation of the diminishing stock of small indigenous fishes by deliberately farming them along with the Indian major carps (IMCs) was also a focus of the study. A gender inclusive approach was adopted in the capacity building of women on scientific aquaculture management practices. Twenty four homestead ponds having areas ranging from 0.17-0.22 ha in Puri District, Odisha covering a total area of 4 ha from four villages were selected to undertake participatory action research. The ponds were stocked with IMCs @10000 ha^{-1} and small indigenous fishes like *Amblyphanrynogon mola* and *Puntius* spp. @25000 ha^{-1}. Several women friendly interventions like gillnets (mesh size 12 mm) a passive fishing gear and trellis system around pond bund for growing climber vegetables were introduced in the villages with an aim to improve the participation of women in homestead integrated aquaculture. As a result of the interventions, the fish production increased from 0.75 t ha^{-1} yr^{-1} to 2.48 t ha^{-1} yr^{-1}. The involvement of women in harvesting of small fish using passive gear like gillnets and traps resulted in regular fortnightly availability of around 750 g of small micronutrient rich fish to rural families. The utilisation of pond bund for growing vegetables following the cropping calendar resulted in production around 790 kg vegetables per hectare of pond area. The study showed that women can immensely contribute to increasing and stabilising family income and in improving family nutrition by participating in homestead integrated aquaculture. The research also proved that polyculture of IMCs with small indigenous fishes by following the scientific management practices will result in better yield, improved fish availability to the house and better management of the household resources.

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Introduction

Fisheries is an important sector of food production which besides providing nutritious food to millions, also serve as a livelihood option for many. In India, a total of around 28 million people are involved in fisheries activities (both marine and Inland) of which 44% are women (DoF, 2020). When the sector is taken as a whole, 28% of women are involved in full time fisheries activities and 19% are involved in part time activities. Aquaculture can contribute to food and nutrition security of the entire household, as well as provide the much needed micronutrients for women and children. Aquaculture can also help in reducing vulnerability of the rural families by ensuring availability of fish as a source of income and food in the lean season.

Women have a leading role in the rapid growth of aquaculture around the world with their participation along the aquaculture value chains, although their contribution remains unnoticed in most circumstances. Active participation of women in aquaculture is important from the point of view of their empowerment by facilitating their decision-making on the consumption and provision of nutritious food to their families. The integration of gender inclusive strategies with technical

capacity development will help in overcoming the barriers to enable women to better engage in aquaculture and to provide a sustainable economic and nutritional security to their family. Women and their societies, through their own agency and with expert help from research institutes, NGOs and development agencies, can fulfill important subsistence roles and satisfy multiple security needs, especially food security and nutrition even from the small-scale household aquaculture (Gopal *et al.,* 2017).

Fish farming is mostly an annual activity in which the fish, mostly Indian major carps (IMCs) are harvested once in a year. But the possibilities of polyculture of IMCs with small indigenous fishes in ensuring regular availability of fish to rural families is yet to be explored fully in rural areas of India. The small indigenous freshwater fishes of India (SIFFS) are rich in micronutrients. For eg: *Amblypharyngodon mola*, locally called as Mahurali has a Vitamin A content of more than 2000 µg Retinol activity equivalent $100g^{-1}$ (Anderson *et al.,* 2016) which is fifteen times higher than that in rohu. Many studies have highlighted on the needs of promoting the culture of SIFFS in rural backyard ponds as a source of nutrition and income for the rural women (Thilsted, 2012; Bogard *et al.*, 2015). Odisha is rich in freshwater resources with around 10 lakh ha of inland water bodies. Homestead ponds of less than 0.1 ha which is quite common in the coastal districts of Odisha is an easily accessible resource by women which could be utilised for integrated homestead aquaculture (Sultana and Thompson, 2008). The present study elaborates on the participatory research on gender inclusive homestead aquaculture and its impact on improving the household availability and consumption of fish thereby making rural women a partner in improving the availability of quality protein and micronutrients to their family.

Methodology

A SWOT analysis of the integrated homestead aquaculture was done in the coastal district of Puri, Odisha to study the potential use of homestead ponds in improving women's participation in aquaculture thereby enhancing family nutrition and income. The participation of women in homestead aquaculture activities was studied using semi-structured interview schedules. Data on participation was collected from both men and women of the households (n=48). Knowledge level of both men (n=24) and women farmers (n=24) on scientific aquaculture management practices was also assessed to identify the scientific practices in which their skill and knowledge need to be enhanced. Pre and post-intervention data was collected on the consumption pattern of households to assess the availability and consumption of fish and vegetables. Purposive sampling was done for the selection of block and villages to undertake the participatory action research. The selection was based on the availability of homestead pond, proximity to input services, Krishi Vigyan Kendras (KVKs) and State Fisheries Department. Twenty four homestead ponds were selected randomly from four villages in the Satyabadi Block of Puri District, Odisha covering a total water area of 4 ha with size ranging from 017-0.22 ha. The focus of the study was to ensure the involvement of both the spouses in the aquaculture activities. One of the major constraints faced by women to participate in aquaculture activities is the lack of knowledge and skill. The training topics were selected sequentially to make them understand about the scientific management practices for integrated homestead aquaculture in a participatory manner. Hands-on training was given to them on various aquaculture management practices like pre- and post-stocking management, feed preparation and feeding and preparation of organic manure from fish waste. Women were made comfortable with ice breaking sessions which involved games focusing on building trust and communication. They were also made aware of the importance of active listening and communication during training programmes. The importance of fish especially micronutrient rich small indigenous fishes in the diet of women and children were emphasised through awareness sessions. Several women friendly interventions like gillnets (mesh size 12 mm) a passive fishing gear and trellis system around pond bund for growing climber vegetables were introduced in the villages with an aim to improve the participation of women in homestead aquaculture.

Participatory research started with stocking of the homestead ponds with fingerlings of IMCs at the rate of 10000 ha^{-1} in the month of September 2017. Small indigenous freshwater fishes (SIFFS) collected from the wild (rivers and canals) were stocked in the ponds @ 25000 ha^{-1}. Reservoir pond of SIFFS (*Amblypharyngodon mola, Puntius sophore* and *Etroplus* sp.), was maintained in the villages for periodic replenishment of small indigenous fishes in the homestead ponds. Critical inputs like lime (for maintaining water quality), ground nut oil cake and mustard oil cake (for supplementary feeding of stocked fishes) and urea (for fertilisation of pond water) were also provided to the homestead pond owners in the first year. Periodic monitoring through sampling of fish was conducted to assess the effect of introduction of small indigenous fishes on the growth of IMCs. The women farmers were provided with seeds of high yielding vegetable varieties to grow them in the trellis system that was built around the pond bunds. A crop calendar was introduced and the women were advised to follow the cropping calendar for the cultivation of vegetables. They were also provided with several garden implements and tools to facilitate them in vegetable cultivation. The interventions introduced in the study are given in Table 1. Data on homestead production of Indian major carps and SIFFS was collected from the farm records for yield and income gap analysis.

Results and discussion

The SWOT analysis (Table 2) revealed that strengths like presence of large number of perennial backyard ponds, active women SHG groups, proximity to KVK, State Fishery department and hatcheries could be exploited for better utilisation of homestead resources for improving family nutrition and income. Weakness like lack of awareness and skill in scientific aquaculture management practices could be converted to strength through capacity building and training. The high market demand for micronutrient rich small indigenous fishes is an opportunity for popularisation of polyculture of these fishes with the IMCs.

Majority of the aquaculture activities were observed to be carried out by men in the present study. Women's participation was highest in post-harvest processing of the produce (100%) (Fig. 1). They were also taking part in feed preparation (91.66%) and feeding (54.17%). Globally women are the major workforce in post-harvest and product transformation activities (FAO, 2017). Meetei *et al.* (2016) have reported a similar participation profile of women in Manipur. Only 8% of women participated in the harvesting of fish as final harvesting of fish by using drag nets is a cumbersome and drudgery prone activity. The percentage

Table 1. Interventions introduced in homestead integrated aquaculture

Practices	Before the project	Interventions made
Stocking density of IMC fingerlings	25000-30000 ha^{-1} Do not keep record of fingerlings stocked	Stocking density - 10000 ha^{-1} Total 24 nos. of ponds stocked (4 ha area)
Quality seed	Bought from local sellers – low quality, high mortality	Linkage with State Fisheries Department and private hatcheries for seed procurement
Water quality management	Not practiced	Training given on testing water quality, liming and periodic fertilisation. Critical inputs supplied for maintenance of water quality
Supplementary feeding	Occasional feeding with cow dung and rice polish	Supplementary feeding with rice bran and GNOC by calculating the biomass
Feeding method	Broadcasting - leading to wastage of feed	Tied in plastic gunny bags with holes
Monitoring for growth and health of fishes	No periodic sampling	Periodic sampling done (Average weight 400-450 g in 5 months)
Incorporation of small indigenous freshwater fishes (SIFFS) for polyculture with IMC	SIFFS are removed by netting before stocking of IMC in ponds	Stocked along with IMC @25000 ha^{-1} and harvested in biweekly intervals
Availability of seed of SIFFS	SIFFS are harvested from open water (rivers, canals) during rainy season	Reservoir ponds maintained in villages for continuous replenishment of homestead ponds
Harvesting of SIFFS	Harvested only by men as fishing gear suitable for women not available	Popularisation of passive fishing gears like gill nets and traps to enable women to harvest SIFFS periodically to ensure continuous availability of fish to their households
Utilisation of pond bund for growing vegetables	No cropping calendar followed and vertical space utilisation was not done	Cropping calendar for cultivationg vegetables for the pre-kharif, kharif and rabi seasons were introduced and trellis farming of climber vegetables popularised

Table 2. SWOT analysis of Integrated Homestead Aquaculture

Strengths	➢ Availability of large number of backyard ponds (25-30 ponds per village) in coastal villages with the size of pond ranging from 300 m^2 to 2000 m^2 ➢ Most ponds are perennial with presence of water for 8-9 months a year ➢ Supportive local people and presence of active women SHG groups ➢ Proximity to KVK, State Fisheries Department and ICAR institutes and other input supply services for sustainability of the project ➢ Proximity to river aids in collection of small indigenous fishes for stocking in backyard ponds ➢ The farmers and farmwomen are aware of the health benefits of eating small fish especially its positive effect on the health of eyes ➢ Men consume fish all the days of a week and women consume 4 days a week if the availability of fish exists
Weaknesses	➢ Farmers /farmwomen not aware of the scientific aquaculture management practices and higher stocking density practiced ➢ No fertilisation schedules practiced ➢ No testing of water quality done ➢ No proper supplementary feeding done ➢ No training received till now on scientific aquaculture management practices ➢ The women resort to traditional unhygienic sun drying of small fishes either on the terrace of their houses or on open roads ➢ Decreasing availability of small indigenous fishes affecting the consumption and thus the nutrition
Opportunities	➢ Existence of large number of backyard ponds for taking up aquaculture activities ➢ Farmers and farmwomen highly interested in learning the scientific aquaculture management practices ➢ Conservation of small indigenous fishes by rearing them along with Indian major carps ➢ High market demand of small indigenous fishes ➢ Promotion of homestead aquaculture through capacity building of farmers/farmwomen in scientific fish farming practices ➢ Improving the participation of women in aquaculture management practices
Threats	➢ Natural disasters like cyclones and floods resulting in flooding of ponds and loss of fish ➢ Leaching of pesticides resulting in reduced species diversity of small indigenous fishes

of women in aquaculture was quite low as compared to other countries, *e.g.* 33% in the rural aquaculture workforce in China, 42% in Indonesia and 80% in Viet Nam (Raney *et al.,* 2011), 31% in Japan and 10% in Malaysia (Brugere and Williams, 2017). Benson *et al.* (2017) recommended that challenges facing gender participation in fishing activities need to be tackled to serve as a tool for sustainability. The participation of women in aquaculture activities mostly depends upon socio-cultural traditions of a region. They were also not participating in the pond fertilisation, liming and stocking as they were unaware of the scientific practices.

The knowledge gap level studied revealed that men were better aware of the scientific management practices in aquaculture (Table 3). This was mainly because of their participation in training programmes and exposure to experiences of successful fish farmers. But less than 50% of men had knowledge on the pond productivity and water quality management practices like liming and fertilisation. Although both men and women were involved in feed preparation and feeding, they did not resort to the preparation of feed using scientific feed formulation method. Although all the women participated in drying of fishes (100%), they were not aware of the scientific and hygienic practices. The study pointed to the necessity of capacity building of both men and women in the scientific aquaculture management practices and post-harvest processing.

Gender inclusive interventions resulted in better adoption of scientific aquaculture practices by the women. The capacity building of women farmers resulted in better involvement of them in activities like water quality testing and management, feed preparation, harvesting and hygienic drying of fish. Increased awareness and better capacity building initiatives are reported to be important in increasing women's participation

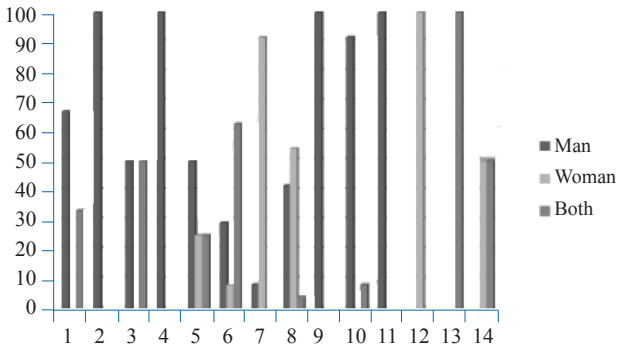

Fig. 1. Gender-wise participation in homestead aquaculture (N=48)

1. Pond preparation 2. Purchase of fish feed, fertiliser, line, cow dung. 3. Manual weeding around and inside the pond. 4. Application of insecticdes and pesticides. 5. Pond fertilisation and liming. 6. Stocking of fish fingerlings. 7. Feed preparation. 8. Feeding. 9. Sampling. 10. Fish harvesting/netting. 11. Fish transport to market. 12. Processing and value addition 13. Watch and ward. 14. Accounting/record keeping

in the aquaculture activities (Gopal *et al.,* 2017). Interventions raised the productivity of homestead aquaculture from 750 to 2.29 t ha^{-1} in the first year (2017-18). The farmers could yield a gross income of ₹251900 ha^{-1} with a B:C ratio of 1.73. In the year 2019, the farmers experienced huge loss of stock due to the cyclone Fani which struck Odisha Coast. In the year 2019-20, the mean annual IMC production increased to 2.48 t ha^{-1} with an increase in B:C ratio to 1.84 (Table 4). The adoption of passive fishing gears like gillnets reduced the dependence of women on men for harvesting of SIFFS. The women harvested on an average 750 g of SIFFS on a bi-weekly basis which ensured the regular supply of micronutrient rich small indigenous fishes to the rural families instead of the annual catch of these fishes along with the IMCs. Since the gill net is a passive net, the drudgery associated with the use of harvesting nets was considerably reduced. Parvin (2003) has reported increased fish production and empowerment status of rural women in Bangladesh by their involvement in aquaculture. Nandeesha (1994) found that in Cambodia the ponds where women carried out at least half of the tasks associated with aquaculture had higher yields than other ponds.

In many developing countries, polyculture of carps with small indigenous fishes is being promoted as a strategy to improve production, income and nutritional security (Rai *et al.,* 2012). Yengkokpam *et al.* (2022) reported that the polyculture of carp with small indigenous fishes in pens proved to be an effective climate-resilient system which could enhance income and livelihood of the fishers besides providing nutritional security. As the two types of species do not interfere with each other, carp production can generate income, while the SIS production will add to the micronutrient availability of rural families (Rai *et al.,* 2014; Karim *et al.*, 2017). Enhanced access to nutrient-rich foods like SIFFS for pregnant and lactating women and infants and young children is crucial to promote optimal growth, development and cognition. Reports suggest that homestead aquaculture contributes to positive outcomes in terms of participation of women in decision-making around consumption and provision of nutritious food to self and family; more equitable power relations within households; improvement in women's access and control of resource use and incomes as well as increased awareness of

Table 3. Knowledge assessment of farmers on the scientific aquaculture management practices (N=48) before the interventions

Sl. No.	Scientific practices	Men (N=24) (%)	Women (N=24) (%)
1	Scientific method of removal of unwanted fish and weeds from ponds	50	8.3
2	Scientific method of eradication of insects	62.5	4.2
3	Liming schedule, dosage, and pH measurement	41.66	0
4	Manuring and fertilisation schedule and dosage	20.83	0
5	Assessing plankton productivity	20.83	0
6	Viability of fish seed	75	41.66
7	Stocking density	50	8.33
8	Acclimatisation and stocking of fish seed	91.66	20.83
9	Post-stocking fertilisation schedule and dosage	20.83	0
10	Scientific formulation and preparation of fish feed	41.66	0
11	Feeding of fish	95.83	75
12	Identification of diseases and remedial measures to be taken	20.83	8.33
13	Sampling	50	8.33
14	Harvesting	100	12.5
15	Scientific protocol for drying of fish	0	0
16	Scientific protocol for preparation of value added products	0	0
17	Utilisation of bund for kitchen garden/preparing the land for vegetable gardening	100	100
18	Calendar of crops that could be grown on the bund	41.66	33.33
19	Disease identification and management of crops	62.5	33.33

Table 4. Economics of IMC culture in homestead ponds

Details	Year 2017-18	B:C Ratio	Year 2018-19	B:C ratio	Year 2019-20	B:C ratio
Production (t ha^{-1})	2.29	1.73	0.45	0.32*	2.48	1.84
Gross income (₹ ha^{-1})	251900		51750		322400	
Gross cost (₹ ha^{-1})	145000		159500		174900	

*Year of Cyclone FANI

women about their rights. (Victoria *et al.,* 2008; Dewey and Vitta, 2013; Parrao *et al.,* 2021).

Women could benefit both in terms of increased income and improved vegetable availability by taking up trellis farming of vegetables around homestead ponds and by using the bunds for growing the vegetables according to the cropping calendar introduced (Table 5). The nutrient rich pond water was used for watering the vegetables. A crop calendar was given to them so that they could plan the cultivation to ensure year-round availability of vegetables. On an average, 790 kg of vegetables per ha of pond area were harvested from both vertical trellis system and horizontal gardening around pond bunds during the Kharif (July-October) period. Prior to the interventions the vegetables were grown on the ground which resulted in damage to the crops. The trellis system also facilitated easy harvest of vegetables by women without postural discomfort caused by bending to harvest the vegetables.

Table 5. Cropping calendar for growing vegetables around pond bunds

Season	Crop
Rabi (October-March)	Leafy Veg (Palak, Fenugreek)
	Solanaceous Veg (Tomato, Brinjal, Chilli, Capsicum)
	Cruciferous Veg (Cauliflower, Broccoli, Cabbage)
	Legume Veg (French bean, Dolichos bean)
	Root Veg (Carrot, Radish)
	Pineapple
Pre-kharif (March-June)	Leafy Veg (Basella/Indian spinach, Amaranthus)
	Cucurbitaceous Veg (Pumpkin, Bitter Gourd, Ridge gourd, Cucumber)
	Okra, EFY
Kharif (July-October)	Drumstick, Papaya, Banana
	Okra
	Leafy Veg (Water Spinach, Basella/Indian spinach)
	Sweet Potato (Biofortified), Taro
	Cucurbitaceous Veg (Pumpkin, Bitter Gourd, Ridge gourd, Bottle Gourd)

Information on women's participation in aquaculture value chains is necessary but not sufficient. Assimilation of sex-disaggregated data in aquaculture needs to be done in many countries to throw light on how many women are employed, the variety of work carried out by them and work transformation over time. This will help in gender inclusive aquaculture policy planning and development to attain the goal of gender equality in aquaculture. When given a choice, women will always choose to grow nutrient dense diverse crops. Hence it is important to strengthen their agency through capacity building, technological backstopping and credit so that they can decide on the choice of food to be grown for their family. The study revealed that purposive involvement of women in homestead integrated aquaculture activities will result not only in their improved skill and participation in integrated aquaculture but also in improved food availability to the family. The model can be replicated in other similar ecosystems like coastal states and north-east India where homestead ponds are a common feature in almost every rural household.

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