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Socio-economic impacts of the Women in Aquaculture (WiA) project in Nepal

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Abstract

Subsistence crops and livestock are mainstay livelihood components in rural communities in Nepal. However, aquaculture is becoming a popular tool to combat household malnutrition and low economic opportunities. A household survey was conducted during January–April 2017 interviewing 71 women in Kathar village, Chitwan, Nepal to investigate the status and impacts of the Women in Aquaculture (WiA) project after a decade since project completion. The results showed that over 50 percent of the farmers interviewed had started their fish-ponds in 2000 with the support of the WiA project. The average size of ponds surveyed recently was 437 m^2 and the average fish production per family was 123 kg/yr for all fish farms. Farmers supported by the WiA project had 18 percent higher average fish production per family than farmers with no project support. Farmers who had received project support produced 35 percent more fish per unit pond area (0.35 kg/m^2/yr) than farmers who did not receive support (0.26 kg/m^2/yr). The average fish consumption of a fish farming household (80 kg/yr) was approximately 2.5 times that of non-fish farmers (30 kg/yr). Fish farmers generated an additional average USD 265 in net profit annually by selling their fish. Fish farming women involved in the cooperative expressed a feeling of increased happiness and self-confidence and an increase in their education and skill set. Even after support from the WiA project had ceased, aquaculture practice continued to spread throughout the village. Non-project fish farmers started their farms by copying their neighbors and their farms became just as successful. Overall, the WiA project is deemed a success due to its long-lasting socio-economic impacts and further expansion; it should undoubtedly serve as a role model for further development efforts in Nepal and elsewhere.

Introduction

In Nepal, agriculture provides a livelihood for almost 60 percent of the population and accounts for about one-third of the national gross domestic product (GDP). Men commonly migrate to urban areas or abroad in search of work. Nepal is heavily dependent on their remittances (29% of GDP) (World Bank, 2016). In 2016, Nepal ranked 110 out of 144 countries in terms of having parity among men and women (World Economic Forum, 2016). The proportion of households reporting women as economically inactive is much higher than for men 21.8 percent versus 8.3 percent (Inter Cluster Gender Working Group, 2016). Furthermore,

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only 53.1 percent of women are literate compared to 76.4 percent of men (Index Mundi, 2016).

A pilot project popularly known as "Women in Aquaculture (WiA)" was initiated in 2000 jointly by the Asian Institute of Technology (AIT), Thailand and the Institute of Agriculture and Animal Sciences (IAAS)/Agriculture and Forestry University (AFU), Chitwan, Nepal. The project began in Kathar village, Chitwan, Nepal and was funded by the German NGO "Women's World Day of Prayer" (WDP) to improve rural food security, generate supplemental income, and empower ethnic women through small-scale aquaculture (Bhujel, Shrestha, Pant, & Buranrom, 2008). It was initiated by constructing 26 new ponds and providing training and some inputs. Due to good progress in achieving its objectives, WDP funded a second phase during which another 53 ponds were constructed. As per their policy, the WDP ceased funding in 2004 after two phases. Then from 2005 to 2006, the Canadian Cooperation Office (CCO) in Kathmandu supported the project's further expansion by establishing women's cooperatives and revolving funds. By 2007, 30 additional ponds had been constructed. At the end of 2007, the CCO's support also ended, and the women of Kathar were left to manage their ponds on their own through their local cooperatives. Despite the lack of outside assistance, small-scale aquaculture spread throughout the village. In 2011, there were 121 fishponds belonging to 106 households in Kathar village alone. Since then, fish farming has also been observed in neighboring villages without any external support. Therefore, in order to gauge the impacts, benefits, and sustainability of the WiA project on household aquaculture, an updated assessment of the socioeconomic impacts of household aquaculture on women's livelihoods and identification of problems they are encountering were needed in order to recommend an appropriate plan of actions for further expansion.

Literature Review

Subsistence crop and livestock farming have traditionally provided food for the rural communities in Nepal. However many families in rural Nepal face food shortages. The effects of global climate change have further decreased the productivity of traditional agriculture (Bhujel et al., 2008). The most common forms of malnutrition in Nepal are mainly due to short supply of protein, iodine, iron and vitamin A (Rai, Thilsted, Shrestha, Wahab, & Gupta, 2014). According to UNICEF, about 18 percent people are undernourished in Nepal and about 28 percent of households have limited food consumption, that is, food insecurity (Gurung, 2016). The national average protein consumption is only about 10 percent, which is considerably lower than the 33 percent recommended for proper nutrition (Asian Institute of Technology, 1994, chap. 1.2, p. 98; Bhujel et al., 2008). The effects of malnutrition and food insecurity are especially evident amongst Nepali women and children. Over 37 percent (approximately 1 million) children under the age of 5 years are stunted or severely stunted, whilst 36 percent of women aged 15–49 are anemic (World Bank, 2016). Therefore, Nepal needs effective and sustainable local solutions to these problems. Fish is the best source of animal protein and can be caught in rivers, rice fields, lakes, and swamps but they are also declining. The per capita consumption of fish is about 2 kg/year, which is 10 times lower than the world average (Bhujel, 2014; Gurung, 2016).

Aquaculture involves the farming of aquatic animals and plants in water. In Southeast Asian countries culture of crustaceans, mollusks, and seaweed is well advanced and commercially important. Some ethnic communities catch crabs, snails, and prawns along with fish from lakes, rivers, rice fields, and swamps. However, farming is limited to finfish species and they are mainly Indian Major carps and Chinese carps (Bhujel et al., 2008). Recently, Nile tilapia and Pangasius have become popular because they grow fast and their meat has no small bones. As only finfish are cultured in Nepal, by aquaculture there, most people understand it to mean finfish culture. Fish farming is limited to pond culture on the plains. Rainbow trout was introduced to utilize the cold water of mountainous areas (Rai, Bhujel, Basnet, & Lamsal, 2005) but it is still in its infant stage.

The government of Nepal is trying to promote aquaculture as it has been recognized as a popular tool to combat household malnutrition and low economic opportunity (Shrestha, Pant, & Bhujel, 2012). Aquaculture is growing at 8.4 percent annually, producing about 50,000 t and is expanding rapidly even into the mid-hills (Bhujel, Shrestha, Devkota, & Nepal, 2014; Rai et al., 2005). Current women's roles in combating malnutrition in Nepal, and contributions of the development projects to empower the women are expected.

Methods

This assessment took place during January–April 2017 surveying 71 households in Kathar village, Chitwan, Nepal to investigate the present status and impacts of the WiA project. Assessment was done a decade after completion of the project in terms of fish production, consumption, and income generated, and of the overall changes in socioeconomic status. It was hypothesized that there were differences between project-supported and non-project-supported fish farmers in terms of pond size, fish production, yield efficiency, family fish consumption, fish sales, and net income. Another hypothesis was that there was also a difference between the project-supported fish farmers and non-fish farmers in terms of fish consumption as an indicator of food and nutrition security. In order to test these hypotheses, a semi-structured questionnaire was used to survey 71 households interviewing women in each household. We had earlier records of the total fish farmers in that area being 215 (26 + 53+30 + 106), and with some increment after adoption by non-project farmers, we expected the total number of fish farmers in that area to be 250. Assuming a 10 percent error margin or the 90 percent confidence level, we calculated a sample size of 54 using a standard formula by Yamane (1967). Due to time limitations, we had to stop after collecting data from 42 fish farmers (1 was discarded as an outlier), and we re-checked the error margin (1-ß) again—it was 12 percent—which we thought was still acceptable level because in some survey research it has been considered acceptable even up to 20 percent. Compilation of the data indicated 30 project-

supported and 11 non-project-supported fish farmers. By that time we also had completed interviews with 30 non-fish farmers. Therefore, we decided to compare these results simply using descriptive statistics. All the data related to pond area, fish production, consumption, sales, costs, and incomes were compiled in The Microsoft Excel software package. Family income from fish sales was initially collected in local currency (Nepali rupees, NPR) then converted into US dollars using an average exchange rate (USD 1 = NPR 104) applicable for the data collection period. Descriptive statistics and percentage data were used to compare the results.

Results

On average all fish farmers had just one pond. At least 54 percent of farmers interviewed started their fishponds in 2000, while the remaining ponds were constructed throughout 2001–2015. The average size of ponds surveyed was 437 m^2, with the size of ponds ranging from 120 to 2,664 m^2. On average, fish farmers who did not receive project support had larger ponds (mean = 477 ± 143 m^2) than those supported by the project (mean = 423 ± 110 m^2) as shown in Table 1.

Farmers grew between one and seven fish species, with most farmers (93%) cultivating more than three species together in one polyculture system (Figure 1). Species included mrigal (*Cirrhina mrigala*), rohu (*Labeo rohita*), grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophtalmichys molitrix*), bighead carp (*Hypopthalmichys nobilis*) common carp (*Cyprinus carpio*), catfish (*Clarias* sp.), and tilapia (*Oreochromis niloticus*). Most farmers with no project support cultured five species, while most project-supported farmers cultured four. The most commonly cultured species amongst all fish farmers were mrigal and rohu (81% each, Figure 2). In cases where only one species was kept, the species was either tilapia or catfish. The most common feed ingredients used by all farmers were mustard oil cake (95%) and rice bran (90%), followed by rice (29%) and banana leaves (26%) as shown in Figure 3. The number of feeds per day ranged from one to three, with an average of 1.6 (±0.5 SD). There was no considerable difference in the feeding practices between project-supported and non-project-supported farmers. All farmers acquired seed stock from the Bhandara Government Farm, Chitwan apart from one tilapia farmer who was producing his own seed stock initiated from the Institute of Agriculture and Animal Science (IAAS). At least 24 percent of all fish farmers interviewed said that the transportation and accessibility of seed stock was the main problem. Fish production per family ranged from 15 to 1,200 kg/yr for all fish farmers.

The average fish production per family was 123 kg/yr for all fish farms (Table 1). Farmers supported by the project had 18 percent higher average fish production per family (129 kg/yr) than farmers with no project support (109 kg/yr). Farmers who received project support produced 35 percent more fish per unit pond area (0.35 kg/m^2/yr) than farmers who did not receive support (0.26 kg/m^2/yr). The average fish consumption of a farming household (80 kg/yr) was approximately 2.5 times that of non-fish farmers (30 kg/yr), or 50 kg more. Project-supported farm households consumed 12 percent more fish per year than non-project-supported households (Table 1). At least 29 percent of all fish farming households consumed more fish than they produced per year. All the fish farmers reported seeing health benefits from consuming fish. The average amount of fish sold per fish farming household was 80 kg/yr (Table 1). The price of fish was species dependent, ranging from NPR 200–300 (USD 1.9–2.9)/kg. Only 7 percent of all fish farmers sold more fish than their household consumed per year. At least 77 percent of fish farmers reported selling their fish to neighbors or to the market. About 22 percent of fish farmers reported that they did not sell any fish as it was for household consumption only. Families which kept fish exclusively for household consumption saved NPR 15,000 (USD 144)/year.

Table 1
Key findings from interviews with fish farmers and non-fish farmers

Parameter/Indicator		Project-supported fish farmers	Non-Project-supported fish farmers	All fish farmers	Non-fish farmers
Female farmers interviewed	(n)	30	11	42	30
Cooperative members	(n)	30	9	39	–
Total no. of ponds	(n)	32	15	47	–
Ponds per family	Mean	1.07	1.00	1.05	–
	SE	0.05	0.00	0.03	–
Pond size (m^2)	Mean	423	477	437	–
	SE	110	143	14	–
Fish production (kg/yr)	Mean	129	109	123	–
	SE	38	81	28	–
Yield efficiency (kg/m^2/yr)	Mean	0.35	0.26	0.33	–
	SE	0.01	0.01	0.00	–
Fish consumption (kg/yr)	Mean	78	70	76	30
	SE	6	8	5	6
Fish sales (kg/yr)	Mean	82	74	80	–
	SE	37	25	28	–
Net profits (NPR/yr)	Mean	29,954	21,113	27,581	–
	SE	8,366	4,652	6,165	–
Net profits (USD/yr)	Mean	288	203	265	–
	SE	81	45	59	–

Note: Net profits were calculated by deducting labor and feed costs from revenue generated
Exchange rate: USD 1 = NPR 104

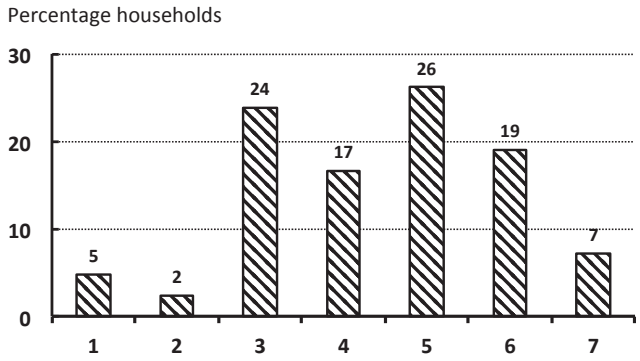

Figure 1 Percentage of households culturing 1–7 fish species per household

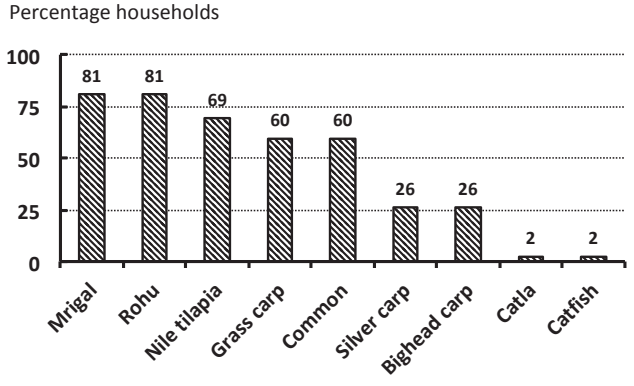

Figure 2 Species of fish cultured by farmers in project site

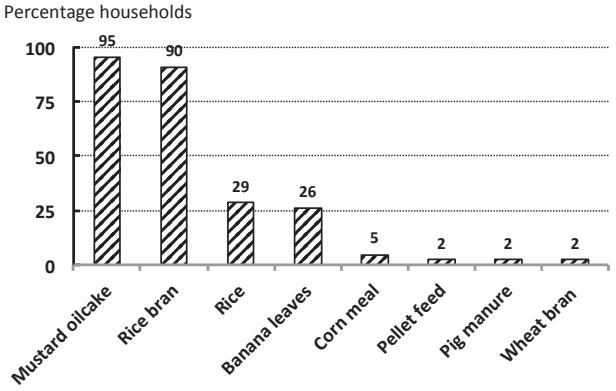

Figure 3 Percentage of household using various locally available feed ingredients

The average cost to start a household fish farm was NPR 9,524 (±5,666 SD, or USD 92). About 70 percent of farmers interviewed were originally supported by the project. The average amount of financial startup support provided by the project to supported households was NPR 2,747 (±658 SD, or USD 26). Only one surveyed farmer was not an agricultural cooperative member. At least 42 percent of fish farmers had taken a loan from the agricultural cooperative, with the average amount being NPR 28,667 (±19,452 SD, or USD 276). The average cost for monthly maintenance was NPR 3,017 (USD 29). On average, fish farmers spent less than 1 hr working on the fish farm each day (mean = 52 min ± 26.4 SD). Nearly, 90 percent of participants spent 1 hr or less working on their fishpond per day. Non-fish farmers typically spent 4–12 hr working on agricultural activities per day. In addition to working on their fish farms, 80 percent of participants reported working on household activities and 73 percent also engaged in other forms of agricultural work. Agriculture was the primary source of income amongst all fish farmers, apart from three individuals who had other businesses or employment. Over 90 percent of fish farmers explicitly reported

that fish farming had helped them economically. On average, each fish farming household earned NPR 27,581 (USD 265) in net profit per year. Farmers spent this supplemental income mainly on children's education (33%) and to buy agricultural inputs (33%).

About 65 percent of the participants interviewed were from the Tharu ethnic minority followed by 23 percent from the Newari and 12 percent others. All women indicated receiving help from family members and felt happy owning a fish farm. Over 92 percent of fish farmers were part of the local cooperative, which they said encouraged a sense of community, built self-confidence, and gave woman access to training workshops and the opportunity to develop skills. At least 40 percent of fish farmers interviewed indicated that they would like to enlarge their existing pond(s) or add more ponds. However, many of these respondents (50%) did not have land available. About two-thirds (66%) of non-fish farmers indicated that lack of land was the principal reason they had not tried fish farming, while 10 percent said it was due to a lack of knowledge. At least 37 percent of non-fish farmers indicated that they would like to learn more about fish farming and the support given to fish farmers. Water scarcity was the most commonly mentioned problem (86%) fish farmers faced, followed by fingerling transportation (26%), predation (21%), and market competition (21%). Access to quality fish feed, theft, and fish diseases were also mentioned as obstacles.

Discussion

The vast majority (80%) of the non-fish farming households did not know about fish farming and their common sources of protein were traditional sources such as lentils, milk, curd, eggs, and meat. Only 20 percent consumed fish regularly. This indicated that dissemination of proven aquaculture technology is still weak even within the district. Nevertheless, among fish-consuming families, 83 percent confirmed that they had noticed the health benefits from eating fish, which underpinned the WiA project team's mission of expanding fish farming. One of the goals of the project was to empower the community and to help produce fish as a high quality diet to fight against malnutrition. It is very encouraging to see project farmers are producing a significant amount of fish at home (129 kg of fish per family annually), the majority of which (60% or 78 kg) is consumed by the family. This is almost 16 kg per capita per annum assuming an average family size of five members and is close to the world average of 20 kg, which is more than two-fold the apparent seafood consumption in low-income, food-deficit countries (LIFDC), and nearly eight times the national average of Nepal (FAO, 2016; Gurung, 2016). This serves as an important source of protein for the community that otherwise relies mainly on traditional sources. Small amounts of other animal meats are consumed, but still the average consumption of animal protein in Nepal is far below the recommended level (AIT, 1994). Fish farming, not only for fish farmers' families, but also for non-fish farming community members provides a ready supply of fish for purchase in the vicinity. Most fish farming households typically sell their fish from their pond sites or homes to neighbors in the community at a cheaper than market prices. Therefore, small-scale, household aquaculture has certainly improved the food and nutrition security of fish farming households.

The impact of the WiA project has been highly successful and commendable in terms of economic viability as was indicated by overwhelming percent (95%) of female fish farmers surveyed who said that their households had economically benefitted from fish farming. It is remarkable that project farmers earned an average net profit of NPR 27,581 (USD 265) per family per year from the average pond size of 423 m^2. It is likely that by doubling the size of pond to approximately 850 m^2, a female farmer may earn a net profit sufficient to break out of poverty benchmark set by the World Bank of USD 1.25/day or USD 456.25/year (World Bank, 2016). If there are five members in the family (the average for this survey), then about 4,500 m^2 of pond would be required, so that a fishpond of less than half a hectare could easily eliminate rural poverty where there are conditions suitable for fish farming. While not all fish farmers sold fish, those who did obtained NPR 200–300 (USD 1.9–2.9) per kilogram, which was generally spent on children's education. Even households which kept all the fish they produced for consumption, on average directly saved approximately NPR 15,000 (USD 144) in fish purchases which freed up funds for alternative essentials such as child education. Furthermore, aquaculture requires relatively low levels of management, investment, and inputs, with farmers only working on their ponds for about an hour per day on average. This allows farmers to still undertake other agricultural and household activities.

The Women in Aquaculture project endeavored to empower women in the project by equipping them with essential skills. Initial training and workshops educated woman in fish production techniques, and all women reported strong feelings of happiness from owning a fishpond. Almost all the fish farmers (97%) surveyed were part of a cooperative, which increased their self-confidence and enhanced their sense of community. The fish farmer cooperative also gave women access to further training, workshops, and more opportunities for additional skill development. It is apparent that the implementation and support of household aquaculture in Kathar was a success and it continues to show potential for growth. The average pond size of the project-supported fish farmers (423 m^2) in this study clearly showed that they have at least doubled the size of their fishponds over the period compared to the average size (175 m^2) reported or recommended (200 m^2) earlier (Bhujel et al., 2008). The success is also evident in the number of households (11 interviewed), which subsequently initiated their own fish farms without support from the WiA project. Households, which did not receive support from the project emulated the farming practices of the project-supported farmers, culturing the same species and using similar feed items. Non-project farmers, on average, had relatively (13%) larger ponds than project-supported farmers. This suggests that the financially better off members of the community adopted the economically viable and technically successful aquacultural practices initiated by the project. More importantly, they attempted to take advantage of economies of scale. However, the average annual fish production and yield per unit area of ponds of

non-project farmers were lower than those of the WiA project-supported farmers. This suggests that project farmers are more adept at this type of fish farming as they had proper, planned training and workshops provided during the project implementation period, which might have made them more effective fish farmers, and they have likely been improving and developing their fish farming practices for a longer period than the unsupported farmers. While non-project fish farmers indicated that they similarly benefited from their fish farms, there appears to be more room for culture practice improvement to maximize their income such as by providing technical inputs, organizing well-planned training, and workshops. Furthermore, the productivity of both project-supported and unsupported farmers was found to be quite low as they depended on farm byproducts and household inputs for fish feeding. Improved management of feeding and water quality in addition to preventing predation could result in a higher productivity.

Despite aquaculture being a good alternative to rural communities, only 37 percent of non-fish farming households said that they would like know more about it and the support given to fish farmers. This is likely due to the fact that most non-fish farmers indicated that they did not have extra land or human resources available and therefore could not pursue aquaculture naturally and more widely. Furthermore, most non-fish farming households indicated alternative supplemental income sources were employment or business interests. Despite this, 40 percent of non-fish farming households said they felt financially and nutritionally insecure about their future.

Small-scale, household fish farmers such as those in Kathar, Chitwan, are also encountering various problems. The principal problem faced by fish farmers is water scarcity. They rely on rainfall to fill their ponds. Evaporation is the main cause of water loss in ponds, followed by seepage, which is likely worse in poorly constructed ponds. With growing concern about the uneven distribution of monsoonal rain due to climate change, fish farmers might be unable to readily replace the water losses in their ponds. This is particularly problematic in the absence of consistent water sources such as boreholes, nearby streams, and equipment for lifting and moving large volumes of water, such as pumps and water bowsers. A cheap, sensible solution to this problem is required so that existing fish farmers could readily expand the size and depth of their ponds.

Other problems commonly mentioned by fish farmers were the limited availability and access to fingerlings, costly transportation, and fish losses due to bird predation and diseases. These problems are commonly encountered by rural fish-farmers. The major obstacles such as lack of land, water scarcity, predation, and fingerling transportation have no simple solutions. Aquaculture expansion requires land availability, but flat land is limited in Nepal.

Conclusion and Recommendation

Small-scale fish farmers are able to produce a considerable amount of fish using a small pond and family labor, thereby generating a significant amount of supplemental income annually. The limited financial and full technical support provided by the project increased fish productivity. It has also doubled fish consumption in the fish farming households. If they could increase the size and number of fishponds to a commercial level, it would be possible for them even to surpass the poverty benchmark. However, they need loans at reasonable interest rates. Cooperative activities increased the women's happiness, self-confidence, and skill. Farmers residing nearby could emulate their farming activities after seeing their neighbors and become just as successful. This way, fish farming could spread. This clearly shows that aquaculture is an easily integrated practice that women are keen to undertake as fish farming promotes positive feelings. Fish farming practices have been shown to spread readily throughout communities in Chitwan and neighboring districts.

This does not mean that aquaculture in Nepal has no problems. Limited availability and access to fingerlings, costly transportation, and fish losses due to bird predation and diseases are the major ones. Not only is it costly, but also the transportation of fingerlings is a major concern as the poor road infrastructure leads to major shock and eventual mortality for fingerlings. Loss of seed stock during transport must be mitigated if fish farmers are to make effective use of their ponds. In order to solve these problems, the government of Nepal should encourage and provide support to the private sector to establish more hatcheries in certain pocket areas so that fingerlings do not need to be transported long distances. Proper conditioning of the fry before packing them in polythene bags (by keeping them in clear water at least 12 hr or overnight without feeding) could solve the problem of mortality during transportation. Selecting mixed-sex tilapia or small indigenous fish that could breed themselves (Rai et al., 2014) in the culture system may also avoid the need for seed transport or reliance on fingerling delivery.

Most people thought there was a shortage of suitable land for aquaculture expansion. However, if only 1 percent of underused and unproductive rice fields or swamps could be converted into fish farms, fish production would double. Similarly, to solve the water scarcity issue, an action plan is recommended for the storage of monsoonal rainfall such as by constructing dams in the seasonal streams and making ponds deeper to avoid the impact of water losses through seepage and leaks. Adequate compaction of the soil bottom layer and incorporation of plastic sheeting should be the focus of future pond constructions. The provision of large water tanks or reservoir ponds to store water from periodic rainfall could also serve as an emergency water supply to the ponds. Predation of fry and fingerlings by birds is major problem for many rural forms of pond fish farming, and in the case of small ponds, the effects of one or two large herons or cormorants can be devastating for a household. Efforts to exclude and deter bird predators can be undertaken by covering the pond with coarse-meshed bird netting or creating a lattice of cheap polyethylene ropes across the pond. This will serve to either completely exclude or at least deter large bird predators from ponds. Furthermore, young fry (below 5 g) are the most vulnerable to predation, so efforts can be made to focus bird deterrence measures or exclusion structures around the “hapas” and pens used for fingerling development.

Despite several obstacles, rural aquaculture has great potential to improve the nutritional and economic security of ethnic women and their families in rural agricultural communities of Nepal. The diversification of agricultural and on-farm food supplies is essential for rural household resilience in the face of changing social, economic, and climatic conditions (Shrestha et al., 2012). Furthermore, the WiA project has demonstrated that the self-confidence, independence, and capacity of women can be greatly improved by supporting them to start their own fish farms. It is clear that a little effort spent on planning and initiating similar projects nationwide could have tremendous impacts on the enhancement of food and financial security in rural communities. Additional support for extension and the skills development of existing farmers could help in maximizing their productivity and economic benefits.

Overall, the WiA project is deemed to have been successful due to its long-lasting socio-economic impacts and the further independent expansion after its formal completion. It should undoubtedly serve as a model for further development efforts in Nepal and other countries especially for food and nutrition security.

Conflict of Interest

There is no conflict of interest.

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