

# **Establishing School Ponds for Fish Farming and Education to Improve Health and Nutrition of Women and Children in Rural Nepal**

Human Nutrition and Human Health Impacts of Aquaculture/Activity/13HHI04UM

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## **ABSTRACT**

Establishing school ponds and a curriculum for school-age children and women's groups should be an effective approach to educate rural communities about the nutritional value of fish and methods of aquaculture. Four ponds of 76–264 m<sup>2</sup> in size were established, one each in four public schools of Chitwan and Nawalparasi districts in Nepal. A school curriculum was also established to demonstrate methods of aquaculture and educate school-age children on nutritional value of fish. This technology was also disseminated to women's groups to expand understanding of the value of fish production and consumption for their families.

Carp and Nile tilapia seed were provided to each school from nearby government fish hatcheries and were stocked in each pond at 10,000 fish/ha (7,000 carps and 3,000 Nile tilapia/ha). The materials necessary to maintain ponds, including feed and fertilizer, were also provided to each school. Fish were cultured for one production cycle with the participation of high-school-age students. A course of study was developed for teacher and student education on fish culture. About 30 students of grade eight, nine, and ten and two teachers were selected from each school to receive training on fish culture. Training of teachers and students included fish pond development, managing pond depth, pond preparation, species choice, water color, fertilizing, feeding, grow-out, and harvesting of fish, as well as nutrition education, including fish preparation and eating. Five sets of training were conducted in all. In addition to training of students, informal education activities were also carried out for women's groups, which included forming two women's fish farming groups in the school community for each district. A training workshop was organized for each women's group. The topic was the role of household aquaculture in family nutrition and income. A linkage was developed so the women's fish farming groups could ultimately work with teachers and students in each school to ensure the long-term sustainability of the school ponds.

The establishment and maintenance and running of these ponds was a very exciting event for the school communities. Often, a number of adults showed up for events like stocking and harvesting, as well as visits during our training exercises. In fact, the ponds were so popular some neighboring farmers established ponds within a few months after our school ponds were completed, and the local people wanted advice and materials to develop a community pond on school property. Pre- and post-training evaluation showed a dramatic increase of awareness and fish consumption rate of participating students.

## **INTRODUCTION**

Women play an integral role in aquaculture and fisheries sectors all over the world. Even though women's roles and responsibilities are changing in some countries, there are constraints that limit female participation in aquaculture (Egna et. al. 2012). Some constraints women face in aquaculture and fisheries include time, land ownership, and access to water, credit, training, and labor. Lack of training opportunities can trap women in vulnerable and poorly paid positions with no prospects of advancement (FAO 1998).

Nepal has diverse agro-climatic and socio-economic characteristics, but suffers from limited communication and transportation networks. Rural poverty is a key factor affecting food security. Under-nutrition places children at an increased risk of morbidity and mortality and is also associated with impaired mental development. A report from the Nepal Demographic Health Survey (2011) found that 41% of Nepali children less than five are chronically malnourished (weight for age between two to three standard errors below the mean value), and 11% are wasted (weight for height or height for age two to three SE below the mean value). This has declined slightly from 49% stunted and 13% wasted in 2006. Similarly, underweight children less than the age of five decreased from 39% to 29% from 2006 to 2011 (CBS, 2011). Sadly, 85% of deaths among children less than five occur during the first year of life, and the overall infant mortality rate is 46 deaths per 1,000 live births. During infancy, the risk of neonatal and post-neonatal deaths is 33 and 13 deaths per 1,000 live births, respectively (MOHP et al. 2012). These deaths are mostly attributed to diarrheal diseases, which can be exacerbated by undernutrition.

There is a global concern that nutritious food must be supplied to women, as well as their children during the first 1,000 days of life. Fish provides valuable nutrients to the world's population, including high-quality proteins (about 6% of world protein supply in 2002); balanced amino acids; vitamins A, D, and B12; iodine and selenium; and long-chain omega-3 polyunsaturated fatty acids. Fish bones, when eaten, are also an excellent source of calcium, phosphorus, and fluorides. For optimum human health, about 33% of total protein consumed should come from animal sources, but only 10% is from this source for the average person in Nepal. At least a three-fold increase in animal protein supply is required for optimum health of many rural people. Nepal should promote small-scale aquaculture by setting immediate and long-term objectives. The immediate need is to increase awareness among rural communities of the potential for backyard fish farming, while in the long term, commercial aquaculture should be encouraged (Bhujel et al. 2008). Also, fish contribution to household food and nutrition security depends upon availability, access, and cultural and personal preferences (Beveridge et. al. 2013).

Fish has been considered “living cash” and a pond a “savings bank” because fish can usually be harvested throughout the year when needs arise (Bhujel et al. 2008, Shrestha et al. 2012). In a recent study conducted by Stepan (2013) on nutrition and fish consumption among household fish farmers in the Chitwan and Nawalparasi districts, fish consumption was seasonal (due to cultural practice and beliefs), and increased income was better correlated with improvements in nutrition rather than with fish consumption. Based on these results, educational efforts were focused on timing of fish harvests, post-harvest practices, and other income generating activities for household farmers.

### **OBJECTIVES**

The overall goal of this project was to use school ponds and education on the nutritional value and methods of aquaculture to help young people understand the value of fish production and consumption for their families. In addition to the education of children, the school ponds can be used to train a group of women in each community on the methods of aquaculture and the value of fish consumption to their families. Specific objectives were:

- To establish school ponds in villages for fish farming and education of school-age children on the value of household ponds; and
- To develop women's fish farming groups at each school village to teach them about fish farming and household health.

### **MATERIALS AND METHODS**

Four public schools were selected in Chitwan and Nawalparasi districts of Nepal. Ponds approximately 76–264 m<sup>2</sup> in area were established at each school. Carps and tilapia were provided for each school from nearby government fish hatcheries, and were stocked in each pond at normal densities. The carp species

included common carp (*Cyprinus carpio*), silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Aristichthys nobilis*), grass carp (*Ctenopharyngodon idella*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*), stocked at a combined density of 7,000 fish/ha. Tilapia (*Oreochromis niloticus*) were added to each pond at 3,000 fish/ha. The materials necessary to maintain ponds, including feed and fertilizer, were provided to each school. One cycle of fish culture was demonstrated with the participation of school teachers and students.

A course of study was developed to educate teachers and students about fish culture. About 30 students from grades eight, nine, and 10 and two teachers were selected from each school to receive regular training on fish culture. School students and teachers received regular training from the principal investigators and other experts about fish nutrition, pond measurement and farming activities, with similar lessons for both groups. Training of teachers and students included fish pond development, managing pond depth, pond preparation, species choice, water color, fertilizing, feeding, grow-out, and harvesting of fish. In addition, we included nutrition education, including fish preparation and eating, in the training. Five sets of training were conducted in all. Students and teachers were expected to be responsible for long-term maintenance, sales, and income generated from the school ponds.

We formed two women's fish farming groups in each school community for further training activities. A training workshop was organized by the project team at each school with a women's group. The topic was the role of household aquaculture in family nutrition and income. A linkage was developed so the women's fish farming groups could ultimately work with the teachers and students to ensure long-term sustainability of the school ponds.

Two surveys were designed to test the knowledge of students in fish pond production, as well as their knowledge about the benefits of fish nutrition. The surveys were administered before and after training was given in each school system.

## RESULTS AND DISCUSSION

Four public schools were selected for establishment of school ponds in Chitwan and Nawalparasi districts of Nepal (Table 1). Images of the pond in each school are provided in Figures 1–4. Ponds differed in design due to land available for a pond, location within the school, and soil permeability conditions.

**Table 1.** Details of the schools selected for school pond studies.

SN	School name	Address	Pond size	Pond type
1	Nepal Higher Secondary School	Tandi, Chitwan	13 m x 7 m	Earthen pond with plastic lining
2	Kathar Secondary School	Kathar, Chitwan	14.5 m x 8 m	Earthen pond with plastic lining
3	Prithivi Secondary School	Pragatinagar, Nawalparasi	19 m x 4 m	Concrete tank
4	Janta Higher Secondary School	Kawasoti, Nawalparasi	24 m x 11 m	Earthen pond with plastic lining



**Figure 1.** Fish pond constructed at Kathar Higher Secondary School, Kathar.



**Figure 2.** Fish pond constructed at Nepal Higher Secondary School, Tandi.



**Figure 3.** Fish pond constructed at Prithivi Secondary School, Pragatinagar.



**Figure 4.** Fish pond constructed at Janta Higher Secondary School, Kawasoti.

The establishment and operation of these ponds was a very exciting event for the school communities. Often, a number of adults showed up for events such as stocking and harvesting, as well as visits during our training exercises. In fact, the ponds were so popular that a neighboring farmer constructed several similar ponds in Kawasoti within a few months of our school pond development, and the local people wanted advice and materials to establish a community pond on school property. Some images of project events at different schools are shown in Figures 5–7.





**Figure 5.** Fish stocking at Nepal Higher Secondary School, Tandi.



**Figure 6.** Women's workshop at Kathar, Chitwan.



**Figure 7.** Women’s workshop at Kawasoti, Chitwan.

Training events were provided for teachers at each school and for children in all classes at each school. Details of the teachers involved in each training are provided in Table 2. The training included subjects such as economic and nutritional importance of fish, pond design and development, identification of cultivated fishes, pre-stocking management, liming, fertilization, seed transport and stocking, post-stocking management, water quality management (Color, DO, pH, Transparency, etc.), feed management, weed and pest management, harvesting, post-harvest management, integrated fish farming, introduction to fish diseases, and record keeping. A total of 121 students were trained during this program.

**Table 2.** Teachers involved in training at each school.

SN	School name	Name of teachers participated in training
1	Nepal Higher Secondary School, Tandi, Chitwan	1.Guru Prasad Adhikari 2.Ankur Paudel
2	Kathar Secondary School, Kathar, Chitwan	1.Rewati Prasad Pandey 2.Bishnu Hari Mainali
3	Prithivi Secondary School, Pragatinagar, Nawalparasi	1. Dhan Bahadur Saru 2. Shiva Hari Adhikari
4	Janta Higher Secondary School, Kawasoti, Nawalparasi	1. Ishwor Bahadur Aryal 2. Krishna Bahadur Basnet

In addition to training students, there were two training programs for each women’s group as part of the curriculum. A total of 44 women received training on the school pond project, the importance of fish for human nutrition and income, and fish farming techniques, problems and prospects.

Two surveys were designed, before and after training, to test the knowledge of students and teachers in fish pond production, as well as their knowledge about the benefits of fish to human nutrition. Students indicated a small and non-significant increase in access to fish ponds, as well as consumption of fish in the household. Of course, this study only occurred over a period of a few months so there was little time to change behavior. In comparison, there was a significant increase in knowledge of the students about aquaculture (chi-square test,  $p < 0.05$ ), with a median grade of <40% on the pre-test and of 61%–80% on the post-test. Initial knowledge about the nutritive value and production system of fish was very poor. By



the end of the training, the knowledge of students on fish production and nutritive value of fish was significantly increased.

**Table 3.** Household pond ownership and fish consumption of the participating students at different schools before and after training program.

School name	Number of students (n)	Having fish pond (% response of n)		Fish consumption (times/year)	
		Before training	After training	Before training	After training
Nepal	35	5.7	8.6	4.3±4.1	7.7±4.3
Kathar	31	12.9	25.8	22.4±30.3	27.1±41.1
Prithivi	28	7.1	7.1	2.9±3.1	7.3±4.5
Janta	23	17.4	17.4	3.0±3.7	7.7±5.6
<b>Total</b>	117	11.1	14.5	9.1±18.8	13.4±24.3

**Table 4.** Knowledge of students on fish production and nutritive value of fish at different schools before and after training program. Data indicates the mean percent response of the participant students (n) getting different range of scores.

School name	Number of students (n)	Score obtained (%)							
		Before training				After training			
		<40	40-60	61-80	>80	<40	40-60	61-80	>80
Nepal	35	80.0	17.1	2.9	0.0	0.0	23.0	57.0	20
Kathar	31	71.0	29.0	0.0	0.0	0.0	0.0	42.0	58.0
Prithivi	28	50.0	35.7	14.3	0.0	3.6	17.9	42.9	35.9
Janta	23	82.6	8.7	9.7	0.0	0.0	8.7	60.1	30.2
<b>Total</b>	117	69.2	26.5	4.3	0.0	1.0	13.7	53.0	32.3

### CONCLUSIONS

The development of school ponds and women's fish farming groups increased awareness of the value of nutrition and fish consumption in rural households by teaching school children, teachers, and adult women about aquaculture. We hope the schools will continue the fish ponds, and intend to continue some outreach over the next two years. Ponds will help generate income for schools, as well as act as teaching material for students. They also helped in capacity building of teachers who could spread the knowledge on the importance of fish in nutrition to parents during teacher-parent interactions. The development of curriculum will serve as the basis for future expansion of such programs to additional schools.

### QUANTIFIED ANTICIPATED BENEFITS

The development of school ponds and women's fish farming groups has significantly increased awareness of the value of nutrition and fish consumption in rural households by teaching school-age children and adult women about aquaculture. It helped generate income for schools from ponds. It has also helped in capacity building of teachers with knowledge on the importance of fish in nutrition and to parents during teacher-parent interactions. As anticipated four school ponds were established, 117 students were educated on the methods of fish farming, and 44 women received training in fish farming and its role in household health. There is also a large interest in other schools to initiate a similar program and spread this methodology to more locations.

### ACKNOWLEDGMENTS

The authors wish to acknowledge support from the Prithivi Secondary School, Pragatinagar, Nawalparasi, Janta Higher Secondary School, Kawasoti, Nawalparasi, Nepal Higher Secondary School, Tandhi, Chitwan and Kathar Higher Secondary School, Kathar, Chitwan for their help during this program.

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