

# Aquaculture options for alternative livelihoods: Experience from the Agriculture and Nutrition Extension Project in Bangladesh and Nepal



This project is funded by  
the European Union

**ANEP**  
Agriculture and Nutrition  
Extension Project



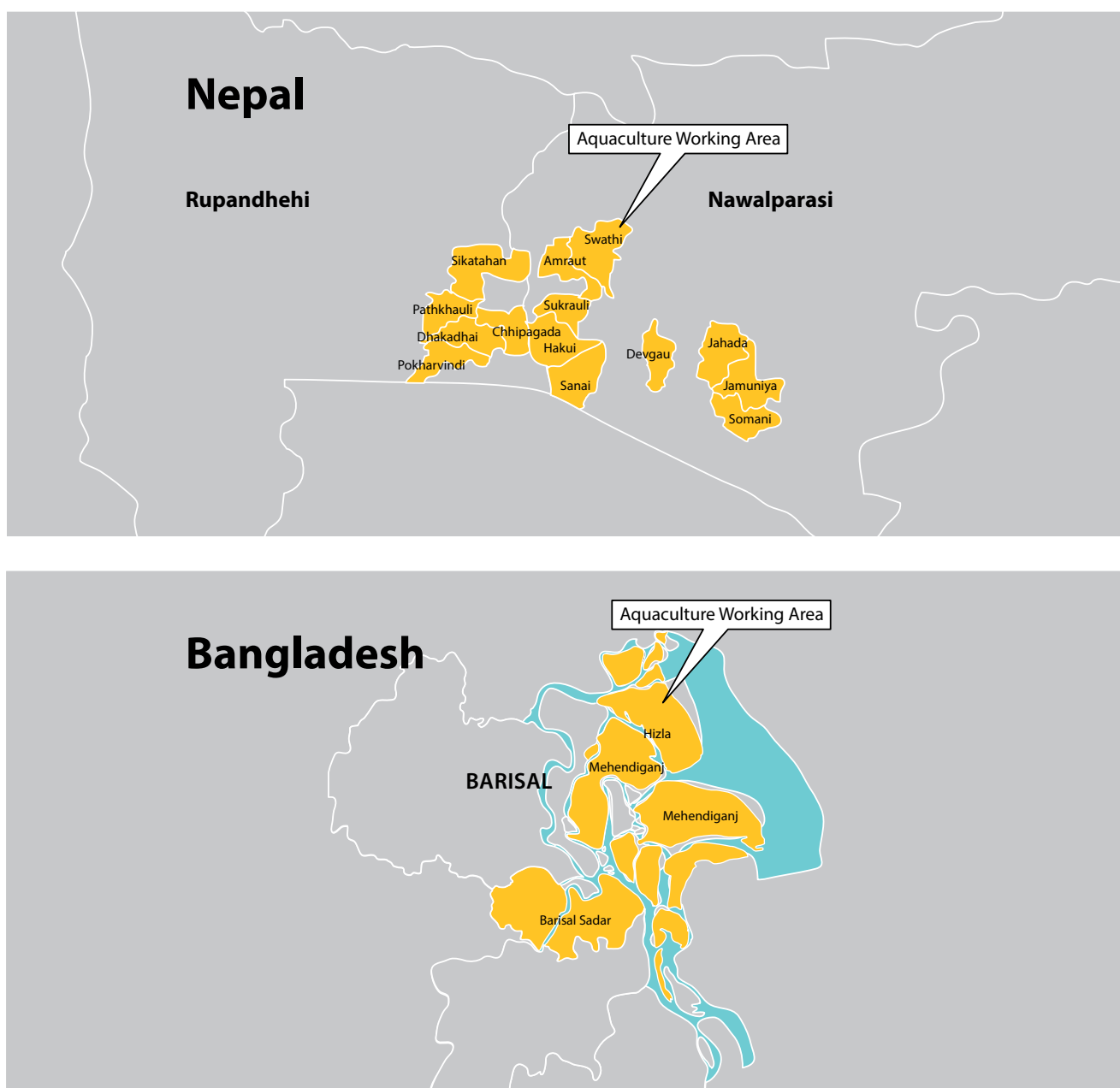
# HIGHLIGHTS

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- Following two decades of work on aquaculture technologies for smallholder farmers, WorldFish is leading the aquaculture component of the Agriculture and Nutrition Extension Project (ANEP), targeting poor farmers in Bangladesh and Nepal.
- A total of 1909 poor households in Bangladesh and 603 in Nepal were direct beneficiaries of the project. The project started its work on 17 December 2011 and was completed on 16 December 2014.
- ANEP increased the average income of participating households in Bangladesh from a baseline of € 1,313 (US\$ 1,660) to € 1,843 (US\$ 2,330) after the intervention and from € 1,748 (US\$ 2,210) to € 2,327 (US\$ 2,943) in Nepal against a approximate project investment (both direct and indirect costs) of € 299 (US\$ 379) per household. Increased income from fish contributed 29% and 20% of the total income increase for the project farmers in Bangladesh and Nepal, respectively.
- Annual fish consumption from pond production increased from 42 kg per household to 60 kg per household after intervention in Bangladesh and from 34 kg to 54 kg per household after intervention in Nepal.
- Partnership between farmers, action researchers and project staff led to scaled-up adoption of micronutrient-rich small, indigenous fish species (SIS) and orange sweet potato (OSP) technologies in Nepal.
- It is estimated that adoption of good management practices of ponds contributed to increased production of an additional 348 tons of fish worth € 0.54 million (US\$ 0.68 million) in Bangladesh and an additional 86 tons of fish worth € 0.16 million (US\$ 0.20 million) in Nepal annually.
- ANEP capacity development initiatives motivated project-supported private sector actors to invest in hatchery, nursery and feed segments of the value chain. A total of € 34,599 (US\$ 43,753) and € 129,878 (US\$ 164,242) capital investment were recorded in Bangladesh and Nepal, respectively. These helped many new farmers to adopt optimal practices for aquaculture.

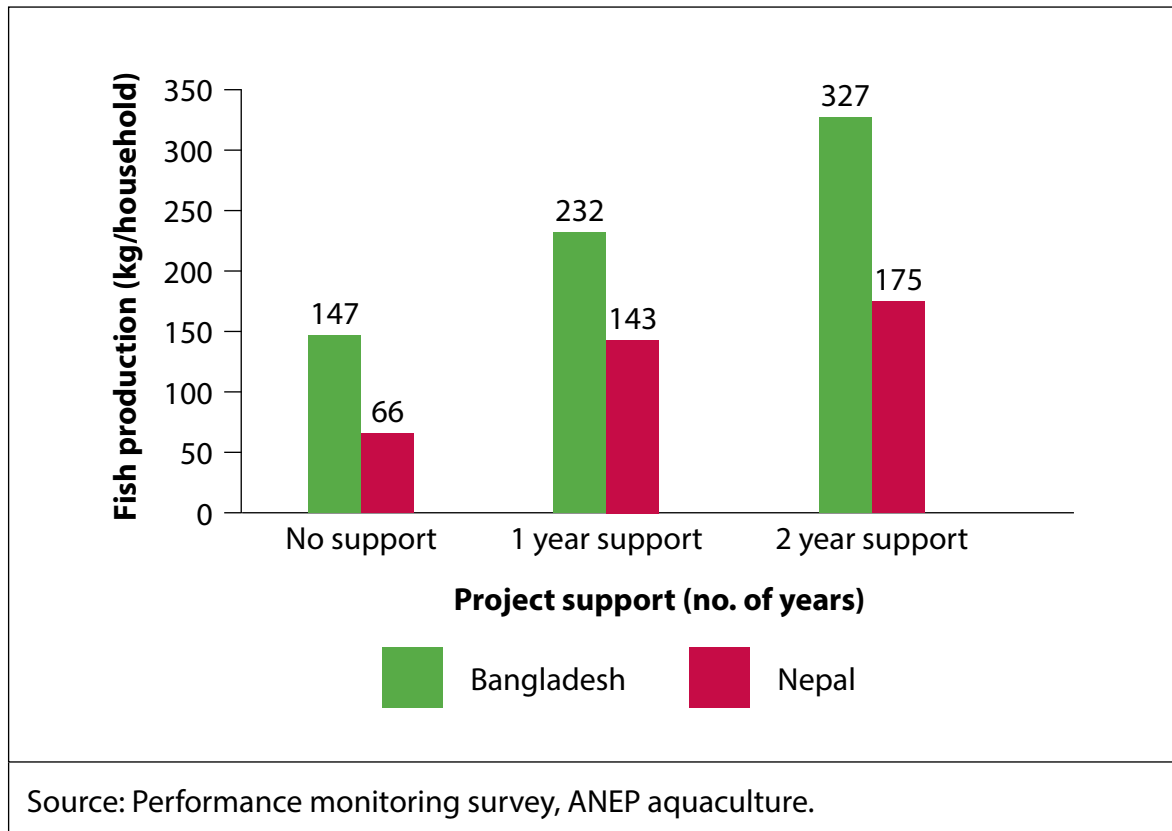
# INTRODUCTION

The EU-supported ANEP worked in the three *upazilas* (sub-districts) of Barisal district in Bangladesh (Barisal Sadar, Hizla and Mehendiganj), two districts of the Terai region (Nawalparasi and Rupandehi) and two hill districts (Rukum and Surkhet) in Nepal. International Development Enterprises (IDE) led overall project management and vegetable subsector activities. The international centers International Maize and Wheat Improvement Center (CIMMYT), International Rice Research Institute (IRRI) and WorldFish led the transfer of cereal/legume crops and fish technologies and activities. Save the Children Nepal and Save the Children Bangladesh led the selection and social mobilization of food-insecure rural and urban target households and provided them with health and nutrition training. National partners including the Community Development Center (CODEC), the Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED), and the Backwardness Eradication Society (BES), implemented the project in collaboration with the respective international partners. The project started on 17 December 2011 and was completed on 16 December 2014. The objective of ANEP was to improve the food security and nutrition of the poorest and most vulnerable households by facilitating the adoption of productive and environmentally sustainable agricultural technologies that improve livelihoods both in Bangladesh and Nepal.



**Figure 1.** Aquaculture working area of ANEP (Data source: CEAPRED and WorldFish GIS unit; Note: Among four districts of ANEP, aquaculture component worked in Nawalparasi and Rupandehi districts in Nepal).

WorldFish led the aquaculture component of ANEP and provided technical support to its implementing partners (CODEC in Bangladesh and CEAPRED in Nepal) for the dissemination of aquaculture technologies to smallholder fish-farming households. The main goal of ANEP aquaculture component was to increase fish production, household nutrition, incomes and alternative employment opportunities for smallholders by facilitating the adoption of productive and environmentally sustainable agricultural technologies. The project disseminated two pond based aquaculture technologies – integrated aquaculture-agriculture based carp polyculture and integrated aquaculture-agriculture based carp – with nutrient dense small indigenous fish species (SIS). A total of 1909 poor households in Bangladesh and 603 poor households in Nepal were direct beneficiaries of the project.



**Figure 2.** Impact of 2 years of continuous training support on fish production of the project beneficiaries in Bangladesh and Nepal.



## ANEP INTERVENTIONS AND THEIR OUTCOMES

A number of interventions/activities were undertaken to promote small-scale aquaculture technologies to poor farmers in Bangladesh and Nepal. These included:

**Pond development.** The project was designed to improve the production of unused and underused seasonal ponds using methods that were feasible, affordable and acceptable to poor households. A total of 1909 ponds were selected for the program in Bangladesh against a target of 1800. However, selection of ponds was a challenge in Nepal, with only 238 ponds or ditches identified within the project area. Therefore, grant support (25% of the total pond construction costs) was provided to interested households to help them to develop the assets required for aquaculture. A total of 365 ponds were newly constructed and 202 ponds were re-excavated to meet the target of 600 pond households for fish culture. The total area operated under fish culture by ANEP beneficiaries in Bangladesh increased from 149 ha in 2011 to 164 ha in 2014. In the same period, the pond area operated by project farmers in Nepal increased from 9 ha to 30 ha.

**Farmer groups and training.** ANEP formed 99 farmer groups in Bangladesh and 41 farmer groups in Nepal for the effective dissemination of knowledge on aquaculture technologies. A total of 117 lead farmers (LFs) were selected in Bangladesh and 45 in Nepal to facilitate the training sessions. The LFs were trained by WorldFish and partner staff in: group operation, leadership development and monitoring of pond performance using fish farmer record books. The enhanced knowledge base among the lead project farmers was expected to help to continue the support for community fish farmers, even after the end of the project. In 2014, out of 198 farmers' training sessions in Bangladesh and 82 sessions in Nepal, about 80% of these sessions were conducted by the lead farmer compared to none during the first year of the project.



Photo Credit: Chandan Kanti Das/ICRAF

Pond construction in Nepal.





Farmer-led group session in Bangladesh and Nepal.

ANEP provided two years of continuous training support to participating farmers to enhance their knowledge of aquaculture. Farmers attended an average of seven, 3-hour long training sessions during the project period. Formal training was complemented by regular, informal sessions such as pondside group meetings. The training focused on simple, low-cost, proven pond management practices that have a scientific basis. These included: control of predatory fishes; staggered harvesting and stocking regimes; stocking large-sized quality fingerlings; organic and inorganic pond fertilization to increase primary production; aquatic weed control; better water management; increased regularity and consistency of supplementary feeding; and regular observation of water color, turbidity, fish behavior and the presence of natural feed items. Figure 2 shows how these measures and two years of continuous training had significant and positive impacts on production for participating farmers in Bangladesh and Nepal. Based on the project monitoring, it is estimated that adoption of good practices contributed to an additional 348 tons of fish in Bangladesh (worth US\$ 0.68 million) and an additional 86 tons of fish (worth US\$ 0.20 million) in Nepal in 2013. The amount of fish produced by these farmers before project intervention in 2011 was 250 tons (worth US\$ 0.49 million) in Bangladesh and 21 tons (worth US\$ 0.05 million) in Nepal.

**Increasing women’s participation in aquaculture.** The project implemented a family-based approach to increasing women’s participation in project activities. It improved the capacity of women to address technical and nutritional issues. The project worked to ensure that women’s skill and knowledge development would increase their ability to be important contributors to the local economy while providing them a greater role in household decision-making in the long-term. This approach increased women’s involvement in aquaculture from about 15 hours per household before project intervention in Bangladesh to 49 hours per household afterwards in the production cycle. In Nepal, women’s involvement in aquaculture increased from 32 hours to 88 hours per household after the intervention in the production cycle. Although in group discussions women members mentioned the positive impacts of aquaculture in terms of less physical labor and more profits, the increase in labor time and its implications for women’s overall work burden needs to be further investigated.



**Building the capacity of private sector entrepreneurs to support farmers.** The project was noteworthy for following an innovative participatory market chain approach (PMCA) in order to disseminate the technologies and to improve market access for the resource-poor. PMCA aims to foster market access for small-scale farmers by generating fruitful collaboration among different value chain actors. Nine 'fish thematic groups' that included fish farmers and fish value chain actors were established in Bangladesh and three were established in Nepal to strengthen linkages between these actors.

The project worked to increase the capacity of market actors through skills development training, exchange visits in and out of the country, and developing links to researchers and scientists at home and abroad. Skilled market actors were found to increase the competitiveness not only in the market chain but also among communities and producers, who were empowered by improved access to markets. The immediate results of these private sector capacity development efforts were:

two electric feed machines were established in Bangladesh and three in Nepal with 40% grant support from the project, and 60% entrepreneur investment, totaling about US\$ 750 in each case. A further three feed making machines were subsequently established in the ANEP project area in Bangladesh by farmers who had received training from ANEP, but without any financial support. In Nepal, US\$ 164,242 of private investment occurred in the hatchery, nursery, and input sector among value chain actors who had receiving training from Bangladesh. These investments will improve access to quality inputs among poor producers.



Feed machine under operation in Bangladesh and Patel's new hatchery complex under construction in Nepal.





Information and communication technology was used for expert consultation between Bangladesh and Nepal. Farmers are equipped with modern equipment (lead farmer from Nepal using a dissolved oxygen (DO) meter).



Photo Credit: Hagar Ali / WorldFish and Khondker Rounaqul Karim / WorldFish

**Linking farmers and market actors to key information and science.** The project worked to establish close linkages between farmers, market actors, government agencies, research organizations and financial institutions. Linkages were forged through participation in awareness-raising and planning events. The researchers from universities and research institutes and extension agency staff were asked to take part in relevant training sessions and training material development as resource persons. The aim was to create opportunities for farmers and market actors to easily access information. The thematic group members' mobile numbers were distributed to farmers based upon the agreement of thematic group members; this created opportunities for farmers to access up-to-date market information. The project also created opportunities for farmers and market actors to receive support from international experts through exchange visits and use of information technology. Fish thematic groups were given equipment such as pH and dissolved oxygen (DO) meters to enable them to deliver services to community members at minimal cost.

**Creating partnerships that supported technological innovation.** Participatory action research was designed to innovate or fine-tune technologies to suit the contextual setting of fish-farming communities in Bangladesh and Nepal. A partnership among action researchers, project staff and farmers was developed to help identify and jointly solve research issues. Two pieces of action research were designed under the project. In southern Bangladesh, most of the ponds were surrounded by trees. As trees are valuable, farmers were reluctant to trim their branches. Fish production in these ponds is unproductive due to inadequate exposure to sunlight, which is essential for the fish to grow. The action research in Bangladesh attempted to investigate this issue. In Nepal, research explored the feasibility of producing micronutrient-rich SIS and orange sweet potato.



In Bangladesh, an integrated floating cage aqua-geonics system (IFCAS) was found to be a suitable way of producing fish and vegetables together in shaded ponds. As the IFCAS cage system is mobile, farmers were able to place it in a sunlight-exposed area of the shaded pond. Within the experimental 4-month production cycle of the IFCAS from July to October 2013, the average production of vegetables was about 20–30 kg of cucumber and snake gourd, and the total amount of fish harvested was 25–35 kg (mainly tilapia), all from an investment of US\$ 78. The IFCAS technology was used in Nepal due to the interest shown by Nepalese farmers who observed it during an exchange visit. A total of seven IFCAS were established experimentally in Nepal in 2014, mainly for fingerling production, as farmers there need to travel long distances for fingerling collection. To help future dissemination of the technology, two workshop owners in the project area in Bangladesh and two in Nepal were trained in the production of an IFCAS cage.

In Nepal, carp-SIS polyculture integrated with agriculture around the pond was found to be an effective option for poor, small-scale farmers, which resulted in enhanced household nutrition and provided supplemental income. Research results showed that SIS contributed about 9–12% of total production. The research also examined the feasibility of growing orange sweet potato in Nepal. Seven superior lines of OSP were tested for productivity and based on the results CIP440021 was recommended for cultivation on fishpond dikes by the Potato Research Division of the National Agricultural Research Council (NARC) of Nepal.



IFCAS model developed in ANEP to address the shaded pond problem. Highly nutritious OSP is introduced in the pond dike system in Nepal.



**Awareness creation that helped wider dissemination of technologies.** Project farmers received nutritional education training from Save the Children that helped to create awareness about nutritious food; this was also highlighted in aquaculture training sessions. Several other awareness programs were organized by the project such as a nutrition fair, nutrition education program in the primary school and madrasa (religious school) to educate parents on the nutritional value of fish, particularly small indigenous species, for children and mothers. Field days and technology demonstration events were organized to raise awareness about modern fish culture techniques among fish-farming communities.

This approach fostered the adoption of innovative technologies and new nutritious species in aquaculture. The pond dike cropping technology has been adopted by most of the farmers in Bangladesh and Nepal. Micro-nutrient rich SIS production technologies were adopted by 1720 farmers in Bangladesh after the intervention, up from only 148 farmers

before the intervention. In addition, 1566 farmers now farm orange sweet potato, up from none before the project intervention. In Nepal, SIS and OSP technologies were disseminated to 300 and 493 households, respectively, none of which cultivated these prior to the project intervention. Results of the monitoring survey show that the average production of SIS and OSP per household was about 13 kg and 20 kg, respectively in Bangladesh, and 7 kg and 10 kg, respectively in Nepal. Most SIS and OSP were consumed by producer households, thereby improving family nutrition in these households.



School nutrition program in Bangladesh and field day in Nepal.



## ANEP INTERVENTION IMPROVES FARMER LIVELIHOODS

Increases in fish production per household result in a larger proportion of fish being sold, with the quantity disposed in the market increasing by 83% and 133% for project pond households in Bangladesh and Nepal, respectively (Table 1). However, although fish consumption decreased as a proportion of total household fish production, larger absolute volumes of fish were consumed, with consumption increasing from 42 kg per household to 60 kg per household after intervention in Bangladesh and from 34 kg to 54 kg per household after intervention in Nepal. Results show that the total production (i.e. sales, consumption and gift) of self-produced fish among project households grew at a higher rate compared to control households in both the countries. Distribution of fish among neighbors and relatives, particularly during festivals, is a cultural tradition in both Bengali and Nepali communities. Evidence showed that the gifting of fish to neighbors and relatives increased marginally among project farmers after intervention but gifted amount is much higher compared to control farmers in both countries. This indicates that increases in fish productivity may also help to strengthen social capital to some extent.

During the project period, the total income of project households in Bangladesh grew at an average rate of 40% per year, from US\$ 1,660 in 2012 to US\$ 2,330 in 2013. During the same period, total income grew at an average rate of 33%, from US\$ 2,210 in 2012 to US\$ 2,943 in 2013 among project households in Nepal. Results show that income grew at a higher rate among project farmers compared to the control farmers in both countries. Prior to the project intervention, income derived from fish culture contributed only 29% and 9% to the total farm income and total household income respectively in Bangladesh and 9% and 4% respectively in Nepal. The contribution of fish to farm income and total income grew substantially after project intervention. The contributions of fish culture to farm income and total income amounted to 42% and 15%, respectively for project farmers in Bangladesh after intervention. The aquaculture contribution to total farm income and household income after intervention increased to 20% and 8%, respectively in Nepal.



Fish harvesting picture in Nepal (small indigenous fish species) and Bangladesh (carp fish).

Fish-use patterns	Bangladesh						Nepal					
	Project farmer (n=249)		Control farmer (n=98)		Growth rate (%)		Project farmer (n=113)		Control farmer (n=30)		Growth rate (%)	
	2012	2013	2012	2013	Project farmer	Control farmer	2012	2013	2012	2013	Project farmer	Control farmer
<b>Produced</b>	154 (100.0)	259 (100.0)	48 (100.0)	52 (100.0)	68	8	78 (100.0)	150 (100.0)	75 (100.0)	85 (100.0)	92	13
<b>Sold</b>	105 (68.1)	191 (74.1)	14 (29.7)	21 (40.2)	82	47	39 (49.5)	91 (60.7)	23 (31.1)	35 (40.6)	135	45
<b>Consumed</b>	42 (27.6)	60 (23.3)	32 (68.0)	30 (57.1)	42	-9	34 (44.0)	54 (35.8)	43 (57.5)	48 (56.3)	56	11
<b>Gifted</b>	6.5 (4.3)	7.4 (2.6)	1.3 (2.3)	1.4 (2.6)	13	6	5.1 (6.5)	5.3 (3.5)	8.6 (11.4)	3.1 (3.1)	4	-64

Source: Performance monitoring survey, ANEP aquaculture (2013 registered farmer)  
 Note: Growth rate between 2012 and 2013 is calculated following the straight-line method; Year 2012 and 2013 is considered as before intervention and after intervention period respectively for the project farmers; Parentheses indicate the percentage of total fish production in the specific year

**Table 1.** Production and use patterns of fish harvested (kg per household) from ponds among project and control farmers.

Income sources	Bangladesh						Nepal					
	Project farmer (n=249)		Control farmer (n=98)		Growth rate (%)		Project farmer (n=113)		Control farmer (n=30)		Growth rate (%)	
	2012	2013	2012	2013	Project farmer	Control farmer	2012	2013	2012	2013	Project farmer	Control farmer
<b>Farm-without fish</b>	371	487	214	300	31	40	866	958	1003	872	11	-13
<b>Fish</b>	153	346	39	42	126	8	88	232	91	136	164	49
<b>Non-farm</b>	986	1243	1033	1023	26	-1	725	859	537	647	18	21
<b>Off-farm</b>	57	95	127	85	66	-33	24	14	25	9	-43	-65
<b>Remittances</b>	92	159	348	331	72	-5	561	881	425	751	57	77
<b>Total income</b>	1,660	2,330	1,760	1,782	40	1	2,210	2,943	2,082	2,415	33	16
<b>% contribution of fish to total income</b>	9	15	2	2	-	-	4	8	4	6	-	-
<b>% contribution of fish to farm income</b>	29	42	15	12	-	-	9	20	8	13	-	-

Source: Performance monitoring survey, ANEP aquaculture (2013 registered farmer)  
 Note: Growth rate between 2012 and 2013 is calculated following the straight-line method; Year 2012 and 2013 is considered as before intervention and after intervention period respectively for the project farmers

**Table 2.** Household income (US\$ per household) of project and control farmers by sources.



# CONCLUSION

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ANEP improved small-scale pond farming households' livelihoods in both Bangladesh and Nepal. The participants adopted nutrient-rich SIS and OSP in their pond systems. Monitoring survey results demonstrate that the type of nutrition-sensitive aquaculture systems promoted in ANEP is profitable. As farmers were able to substantially improve their livelihoods within the first year of the introduction of the intervention, it is anticipated that they will sustain and further build upon these improvements as their experience grows.



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WorldFish is an international, nonprofit research organization that harnesses the potential of fisheries and aquaculture to reduce hunger and poverty. In the developing world, more than one billion poor people obtain most of their animal protein from fish and 250 million depend on fishing and aquaculture for their livelihoods. WorldFish is a member of CGIAR, a global research partnership for a food-secure future.

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