Final Report: AwF- Nepal Project

Tribhuvan University
Department of Aquaculture
Institute of Agriculture and Animal Science (IAAS)

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AwF – Nepal: Empowering women through Small-scale aquaculture

Final Report

By

Ram C. Bhujel[1], Madhav Shrestha[2] and Hare Ram Devkota[2]

[1]Aquaculture and Aquatic Resources Management
Asian Institute of Technology, Bangkok, Thailand

[2]Institute of Agriculture and Animal Science (IAAS), Rampur, Chitwan, Nepal

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Executive Summary

This report covers major activities of small-scale aquaculture project implemented with the objectives of improving nutrition and income of rural communities through empowering women aimed at achieving the goal of food security and poverty reduction. The two-year project (Jan 2008-Dec 2009) was funded by Aquaculture without Frontiers (AwF) launched in "Rainas Tar" within the Dhamilikuwa Village Development Committee, of Lamjung, a mid-hill district of Nepal in collaboration with the Institute of Agriculture and Animal Science (IAAS), Rampur, Chitwan, Nepal and a local NGO.

Initially, an awareness/interaction program was organized in the village to explain the objectives, describe activities and inform them that the Project Team would cover only 50% of the pond construction. A total of 52 women showed interests in digging ponds in their lands which was almost double the Project Team had planned to support. A demonstration field visit was organized for all of them to observe the similar previously implemented project in Chitwan and interact with the women. The women were trained on general fish farming on the following day and requested to dig ponds. Forty families, organized in two groups, dug a pond each within three months while others waited for the second year. Nine of those family ponds were used for M.Sc. student research. Polyculture of Common carp, Grass carp, Silver carp and Bighead carp were recommended. The average size of ponds was 44 m^2 (range 12 – 169 m^2). Average support for pond digging was NRs 2,429 (US$33). After growing fish for about 8 months (May - Dec 2008), average production was achieved 4 kg (maximum 33 kg) per family with the total production of 191 kg. Over 2/3rd of the fish produced was consumed by families and their relatives harvested partially on different occasions. In the second year, five of these women did not continue because of frequent problem of leakage and shortage of water. The remaining farmers continued fish farming without the financial support of the project. They chose Common carp and Grass carp which grew best in the first year. In addition, Nile tilapia was included in polyculture. As a result production and fish consumption increased by two-folds with the highest production of 55kg by a family.

In the second year, despite the interests of many, only 27 new women were selected to support by the project. This new group constructed 30 fish ponds including three for a primary school. The mean size of their ponds was 43 m^2 (range of 12 – 200 m^2) which were constructed with the same type of support. The newly joined women produced 158 kg of fish (average 6 kg/family, maximum 24 kg) in the growing period of about 8 months.

In summary, the two-year project was successful in establishing three groups of women, training them and motivating them to dig 70 new ponds and culture fish. This clearly shows that small-scale aquaculture intervention in mid-hills of Nepal empowering women is possible and has tremendous scope. AwF project should serve as a model for the expansion of small-scale aquaculture in Nepal.

AwF – Nepal Project:
Empowering Women through Small-Scale Aquaculture

I. Background

This report describes the approaches and activities of the project funded by Aquaculture without Frontiers – Nepal (AwF-Nepal) during January 2008 – December 2009 (two-year) in Rainas Tar of Lamjung District in mid-hills of Nepal. The small-scale aquaculture project was launched jointly by the Aquaculture and Aquatic Resources Management (AARM) program of the Asian Institute of Technology (AIT), Thailand and the Institute of Agriculture and Animal Science (IAAS), Nepal in cooperation with a local NGO and women's groups.

1.1 Project site

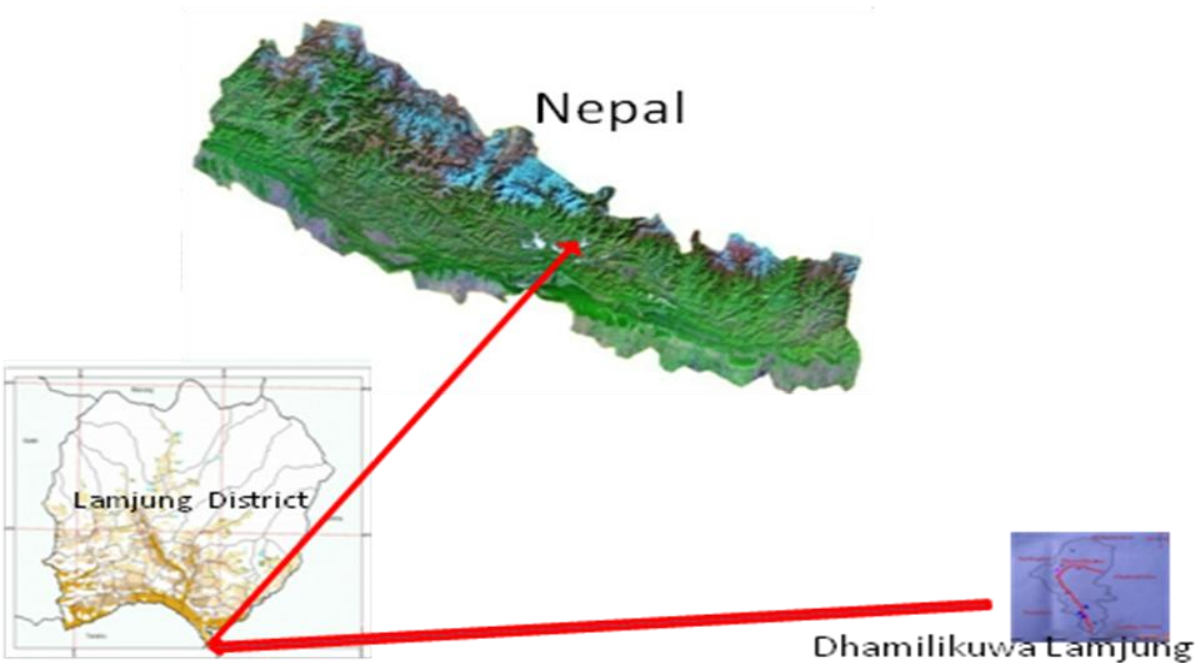

Fig. 1 Map of Nepal showing the location of project site.

The project site is located in mid-hills of Nepal, approximately 150 km west of Kathmandu at the elevation between 1,400-2,000 feet, 28'4" N latitude and 84'28 E longitude (Fig 1). and The site has been recently connected by a muddy/seasonal road. During summer only big-wheelers can reach. During rainy season, we have to walk to reach the site for an hour across the Marsyandi River from Baisjangar, a small town on along a paved road that connects the district headquarters of Lamjung i.e. Beshi Shahar with the Kathmandu - Pokhara highway. Lamjung district covers an area of about 1,700 km² and has a population of about 0.2 million. The project site is in the eastern side of the district adjacent to west part of Gorkha district. The site is popularly known as Rainas Tar ('Tar'

meaning plain area at the foot of mountains and the 'Rainas' is the name of a mountain peak which is about 5,400 ft high. The major parts of Rainas Tar is in the Dhamilikuwa Village Development Committee (VDC). At the time of the 1991 Nepal census, the VDC had a population of 3,831 and 791 individual households. But now corresponding figures have gone up considerably. The site is sandwiched between two rivers named Marsyandi and Chepe. The land in the village is irrigated with the water diverted from Chepe River which originates from a glacier lake also called Dudhpokhari (Milky-white Water Lake) under Rainastar Irrigation Project. The diversion canal is operating since 1984 covering an area of over 580 hectare of land. The canal is the main source of water for newly built family fish ponds. The main occupation of people in the district is agriculture and livestock husbandry. Among the crops, rice is the main. Before irrigation canal was built peanuts and black grams were the major cash crops as they do not need so much water. Irrigation has changed the cropping pattern of the village. Peanuts and black grams are no longer cultivated. Farmers are seeking opportunities of having water based crops and occupations.

1.2 Problems addressed

Almost all of the people of this village rely on subsistence agriculture. Due to limited employment opportunities and income generating activities, majority men migrate to cities in or outside the country in search of employment and income. Majority women stay at home struggling to feed their kids and other family members get enough food. They grow mainly rice, some vegetables and also raise some animals. Due to decline in pasture land, raising animals has become difficult as it consumes considerable time for collection of fodder and feeding/pasturing). Meat is becoming more scarce and expensive. Cereals and root crops are the main food items of regular diet. Most children are suffering from moderate to severe stunting; one or more forms of malnutrition.

People of Rainas Tar used to catch fish from Chepe and Marsyangdi rivers. Catching fish using hooks and lines is common among few ethnic groups from both the rivers. River diversion (Duwali Thunne), poisoning (Bish Halne) and dynamiting (Bam Hanne) especially in Chepe River is very common during winter. These activities can often be organized as community work involving all the ethnic and non-ethnic groups including women and children. These have seriously affected the wild fish stock. They also used to catch fish from rice fields especially during monsoon season. However, drastic decline in fish catch has been realized though people do not understand the underlying reasons which are their own mal-practices or illegal activities. In addition to these, two dams in Marsyandi hydropower (Fig 2); one downstream and the other recently completed upstream side of Rainas Tar, constructed for hydropower generation have been the main causes. These dams have completely blocked the fish migration. The demand for fish consumption is increasing because of increased population and also the more awareness about the health benefits of fish as a source of protein.

This village was also one of the most affected parts of the "decade-long internal conflict". In fact, the root causes of the conflict were rural poverty, lack of food security, discrimination against women and dalits, and their exclusion from the development process and social/political activities.

In summary, this project was an initial attempt to address problems of discrimination against women and dalits (untouchables and disadvantaged), shortage of animal protein and human health, unemployment and low income, pressure on wild fish stock.

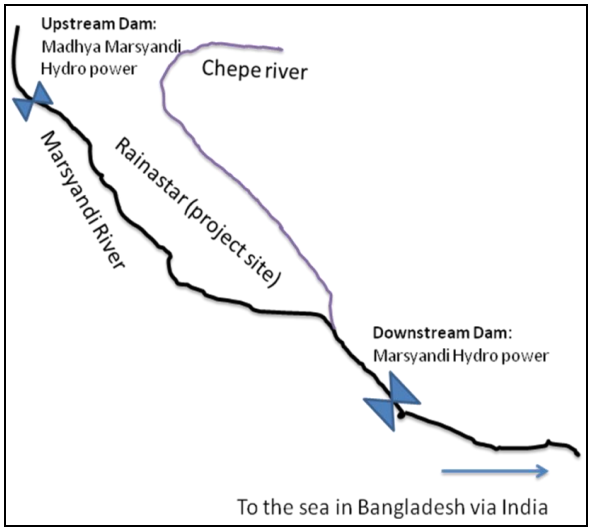

Fig 2 Schematic diagram (not to scale) showing project site, two rivers and dams for hydropower generation

II. Goals and objectives

2.1 Goal

The goal of the project is to improve of livelihoods of people through small-scale aquaculture.

2.2 Main Objective

The main objective of the project is to test whether aquaculture is feasible in mid-hills of Nepal technically and economically with the objectives of supplying animal protein and generative supplementary income. As nearly two-third of Nepal is covered by hills, outcome of this project could help policy makers whether small-scale fish farming should be promoted in mid-hills. The project was an expansion of a women-in-aquaculture project launched in a lower plain area (Chitwan) of Nepal by AIT, Thailand in collaboration with IAAS, Nepal.

2.3 Specific objectives

The specific objectives of the proposed project are to:

- establish an "AwF - Model Village" and women's fish farming groups
- assign and train student intern to manage the project with the purpose of developing career and gaining hands-on field experience
- train household women in small-scale pond fish culture
- assist in constructing fish ponds
- provide a promising alternative source of animal protein, minerals and vitamins for the rural communities
- assist women to earn supplemental income while working at home
- increase women's participation in social activities
- introduce an idea of nutrient re-cycling avoiding external inputs in which fish are fed with kitchen wastes and farm by-products, and pond-water is fertilized using animal manure or urine to grow natural food which can also be used to irrigate vegetable garden
- develop a practical model / evidence and disseminate it to mid-hills that cover over two-third of the country

III. Major activities

3.1 Year I

3.1.1 Awareness program

In order to initiate the process, an awareness program was organized gathering a group of women in mid-March 2008 using a classroom and computer of a higher secondary school in the village. A program in CD produced based on the "Women in Aquaculture Project" in Chitwan was shown followed by questions and answers. Organizers reported that many women showed their interest during that time (Fig. 3).

Fig.3 Interaction with women (left) for the group formation and project poster hanged above the office of the local NGO which depicts the project concept.

3.1.2 Feasibility study visit

During April 14-17, 2008, the project team comprising Dr. Ram C. Bhujel (Asian Institute of Technology), Dr. Madhav K, Shrestha (Institute of Agriculture and Animal Sciences, Rampur, Chitwan), Mr. Jiyan Chaudhary (Rural Integrated Development Society, Chitwan) and Mr. Hareram Devkota (IAAS, Student) along with representatives of the local organization visited the sites of almost all of the applicant families (Fig. 4), observed their lands set aside for digging ponds and also provided some suggestions on where and how to dig/manage fish ponds. A meeting with RDC committee was organized at the end of the visit. During the meeting, in addition to guidance/suggestions, plans for demonstration trip, training, pond digging, transportation and stocking of fingerlings were discussed thoroughly and tentative schedules for these activities prepared.

Fig. 4 Project Team observing the potential land and source of water for fish culture (left) and meeting with potential women who were planning to participate (right).

3.1.3 Demonstration trip

A one-day demonstration trip to Kathar, Chitwan was organized on 26 April 2008 to make familiar with the activities and show the systems and understand functioning of a cooperative of women fish farmers in an ethnic Tharu community managed by women themselves. All of the 50 women (plus 2 single men and RDC committee members) were included in the trip. Kathar is one of the most successful Women-in-Aquaculture project site initiated by AIT and IAAS where women's group has been upgraded as "Women's Fish Farming Cooperative" which is the first fish farming cooperative of the country. It is successfully running itself. Locals borrow money at the rate of 12% interest rate. The cooperative group offered to have a lunch (picnic) together at a nominal rate as is the case for any visitors. This provides them an opportunity to save some amount of money for the cooperative and provide more time for interaction among them and help build good cooperation.

3.1.4 Formation of women's group

The local NGO made a public announcement about the project and requested interested women to apply with an application fee of NRs. 35 (~US$0.5). Altogether 52 families applied and showed interests in culturing fish in their lands which is almost double compared to the number the project team had expected. Full technical (training, field visit and fry supply) and partial financial supports were extended to all of them dividing them into four categories based on which the level of support was provided. Table 1 shows the type of farmers in the first year and supports. The complete list of all the women farmers are given in Appendix 1&2.

Table 1. Categories of women farmers supported by the project in Rainas Tar Village

Group	No. of farmers	Financial support	Technical support	Remarks
Poor group	31	50%	Full	Main target group
Middle class group	2	40%	Full	Very few
Higher middle class	6	30%	Full	Few
Existing farms	3	-	Full	Who began a year ago only

Finally, 43 fish farmers were selected organized in two Women's Fish Farmer groups named Champhabati (historical name of nearby river 'Chepe') Women Fish Farmer's Group (CWFFG) and Maharudra Women Fish Farmer (MWFFG) groups. They were grouped based on their area of location.

3.1.5 Training of women's group

The group was trained by Dr Madhav Shrestha, technical expert, on the following day (27 April 2008) of the demonstration trip. They were explained in detail on how to dig and prepare a pond, and stock fry, feed and take care afterwards (Fig. 5).

Fig. 5 Madhav Shrestha giving training in a classroom organized using a primary school (left) and also describing of how to construct a pond construction as well as outside (right).

3.1.6 Digging ponds and stocking fry/fingerlings

After receiving a simple training, the selected farmers completed digging their ponds of various sizes depending upon their availability of land and their willingness. As an incentive in taking risk or to attract the attention of people, a minimum fund was made available to the project farmers and give as the basis of size of the pond they constructed. The rate was fixed i.e. NRs 55/m2 (=US$0.75 m2) which is based on the estimated cost of digging at the local area. They utilized their own family labour for digging ponds (Fig. 6). Altogether 40 families dug new ponds and stocked fry into their ponds in the first year of the project. In addition, other three families who had small ponds were also included in the group for technical support.

Bighead carp fry were procured from Fisheries Research Center (FRC), Pokhara and fry of other species such as Common carp, Grass carp and Silver carp were from a government run farm named Bhandara Commercial Fish Farm, Chitwan. Stocking of fingerlings was done after nursing in small hapas (Fig. 7) for over a month. After stocking regular visit and monitoring was carried out by Mr. Hareram Devkota who is an M. Sc. Aquaculture student at IAAS, Rampur, Chitwan, who has been working with the women's group as an Aqua Intern supported by EU Asia Link project of AIT. Fry stocking was done on various dates depending upon the completion of pond construction. It started from the beginning of June continued through July until mid-August 2008. A total of 2,213 fish fry/fingerlings were provided to the farmers. The average number was 65 fry/fingerlings per family. Stocking was done at the rate of about 1.4 fish / m2 using common carp as the main species, followed

by silver carp and then bighead and grass carp at the ratio as shown in Table 2.

Fig. 6 Husband and wife digging a pond (left)

Table 2 Ratio of fish species stocked in the pond.

Fish species	**Average stocking ratio**	**Remarks**
Common carp	47%	Main species
Silver carp	26%	Filter feeding
Bighead carp	16%	Zooplankton
Grass carp	11%	Plant feeder
Total	100%	

Fig. 7 Fish fry transportation where there is no access to road (left) and fry nursing in hapas before stocking into the grow-out ponds (right).

3.1.7 Fish harvest

The grow-out period was of about 7-8 months. Some of the farmers partially or completely harvested fish a few months earlier because of shortage of water while others later depending upon the family needs. Farmers were allowed to harvest fish whenever they needed for consumption or cash for their family purposes. But they were asked to keep record the amount for the project purpose. Some of the families have started eating fish when fish were still small (<100g) and others wait little bit longer. As the weather in Nepal is cold (Fig 8), all the farmers had to harvest fish before December. Although morning dissolved oxygen level increases during the winter (Fig 9).

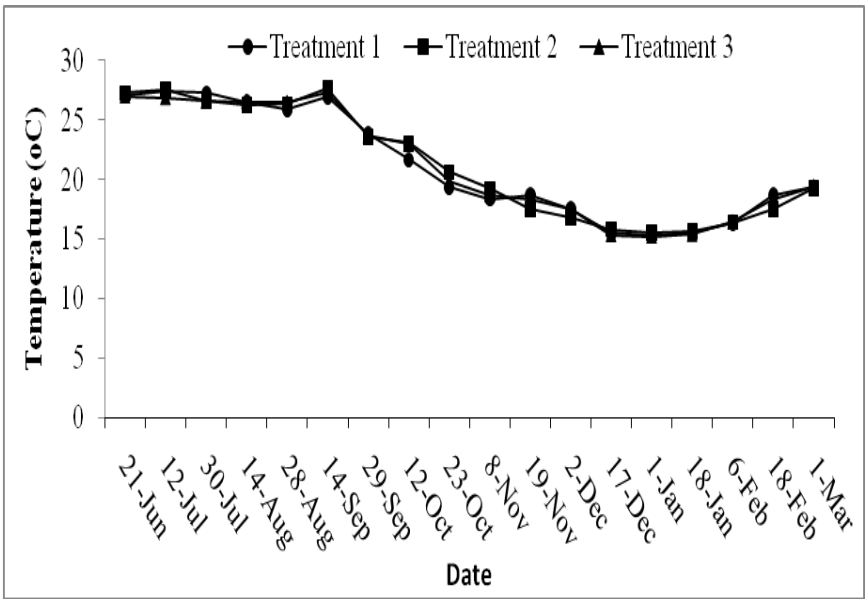

Fig 8 Mean morning temperatures (°C) of pond water during experimental period (21 June 2008 – 1 March 2009).

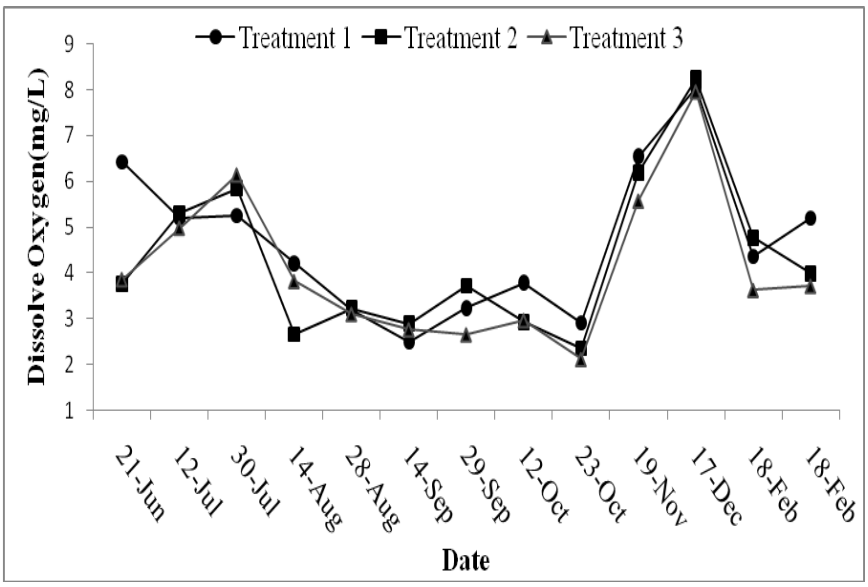

Fig 9 Fortnightly dissolved oxygen (mg/L) of pond water measured between 7 am-9 am in experimental / representative ponds during 21 June 2008 -18 February 2009.

3.2 Year II

3.2.1 Group formation and training

In addition to the two women's fish farming group formed during the first year, one more group of 27 women fish farmers in the second year named, "Karmada" (historical name of Marsyangdi River) on February 27, 2009. Among the first year's 43 women, five of them could not continue due to inadequate water. Therefore, the women's groups were re-organized to make more or less equal number of farmers per group. Each member of these groups saves NRs 10 (US$1= ~NRs73) each month to give loan to other for fish culture activities. They also organize monthly meeting and discuss in groups about the performance of their fish and culture techniques. This has built confidence and created an environment of helping each other especially to new entrants by the women farmers who joined in the first year.

For the new 27 women farmers, one-day training was organized on May 23rd, 2009. They were trained showing slides as well as doing field work. Five experts from the Institute of Agriculture and Animal Sciences, Rampur, Chitwan (Fig 10) and District Agriculture Development Office were involved. A training manual of complete fish farming with data sheet for input record was distributed to the participant women farmers. During the training, a radio journalist also attended to cover the news (Fig 11).

Fig 10 Subject matter specialist of IAAS involve in women fish farmer training

Fig 11 Discussion among the members and a radio journalist during farmers training

3.2.2 Pond construction and preparation

In the second year 30 fish ponds were constructed (Figs 12-14). A lower secondary school (Sharada Ni Ma Bi, grades 1-8) run by the local community was supported for construction of three ponds (Fig. 15, total area of 169 m^2). Pond was constructed by students and the school used the fund to purchase equipment and other materials for kids. Digging of all the new ponds started in January and almost all of them were completed within two months. They completed construction by mid-May 15, 2009. As in the first year, the project supported 50% cost of pond construction. After completing pond construction they applied 5kg of lime/100m^2 and after 15 days, another dose of 2,000kg /ha cow dung was added. Ponds were filled with water from irrigation canal of the Chepe River. Ponds were fertilized with DAP and Urea at the rates of 0.4 g N/m^2/day and 0.2g P/m^2/day as basal dose and continue pond fertilized from cow urine on a weekly basis as a splitting doze.

Fig 12 Pond construction on sloppy land

Fig 13 Measuring the ponds.

Fig 14 Expansion of pond in Year II

Fig 15 Contour pond construction

3.2.3 Fish seed rearing and stocking

Realizing the problem of fish seed transportation and need of nursing of fry to fingerlings before stocking, women fish farmers group formed a committee to take the responsibility of fish transportation, nursing and distribution. They obtained and transported fish seed from Fishery Research Center (FRC), Pokhara (about 80 km away) on the first of April 2009 (Fig 16). Three farmers were selected for fry nursing in hapas-installed in ponds (Fig 17) with the technical and financial supports by the project. After doing this, Farmers know how and where to get seed, how to transport and nurse fry to fingerlings by themselves. Based on the experience of the first year farmers choose Common carp and Grass carp. Additionally, tilapia was provided to all the farmers in order to test as a new species. Fingerlings of Nile tilapia were procured from Sundar Bazar of the same district where few farmers are trying to grow on their own. They were stocked in old ponds belonging to the groups from the first year on March 12, 2009. Grass and Common carps were added on May 29 at the stocking density of 2 fish/m^2.

Fig 16. Fry transport

Fig 17. Fry stocking in hapa

3.2.4 Fish grow-out and harvest

Fish were grown feeding locally available agricultural by-products e.g. rice bran, oil cakes etc. Farmers were taught to use feeding trays made locally from bamboos (Fig 18). Many farmers are using cow/buffalo urine to fertilize the ponds. They also grew some legume grasses on the dikes to control dike erosion and also to feed the grass carp (Fig 22). Fish were harvested partially if they have tilapia using a net sharing among them. Those farmers who have carps, they harvest at the end during November – December just before the beginning of cold season. All the families consume more than half of the fish by themselves either during festivals or other days while less than half was sold for cash. Selling fish is not a problem. Local people gather and buy fish when fish harvest is announced. Several farmers are now having tilapia recruits in their ponds. Some of them are giving free while others are now selling at (2 NRs/piece) fry to other farmers as per the suggestion by the project team.

Fig 18. Locally made bamboo tray used for fish feeding (left) and Common carp harvested from one of the farmers' ponds in the village (right).

IV. Results

4.1 Year I

4.1.1 Experimental ponds

A 250 day-experiment using nine ponds conducted by the intern under EU Asia Link program at AIT/IAAS program showed that Common carp grew biggest ($P<0.01$) amongst all the species (Table 3) with the mean weight of 601g (SD 103g) and survival 77% (±21 SD). Some of the farmers were able to harvest up to a kilo in 8 months from about 50-60 g. Similarly, final mean weight of Grass carp was significantly higher ($P<0.01$) than the other carps reaching above 200 up to 425 g. The daily weight gain of Common carp (2.0±0.4) and Grass carp (1.0±0.2) were comparable to the values achieved in most sub-tropical climate. But the corresponding values for Silver carp and Bighead carp was 0.3±0.2 which is poorer compared to values obtained from most of the studies. These are the reasons of why the two species were therefore preferred and selected by the farmers in the second year.

Table 3. Mean weights of experimental fish.

Farmers	Grass carp	silver Carp	Bighead carp	Common carp
Shanta Maya Thapa	290.6	65.3	61.7	492.4
Indra Kumari Nepali	221.4	65.3	61.7	492.4
Krishna Kumari Bk	220.9	73.2	61.7	479.2
Rin Maya Nepali	425.7	105.3	60.3	658.3
Krishna Maya Nepali	302.1	112.6	58.4	687.5
Yam Kumari Kadariya	312.3	108.5	56.6	638.6
Dhan Maya Thapa	311.8	102.3	100.5	742.8
Ramdevi Bhujel	260.1	98.2	98.8	692.9
Dhan Maya Bk	291.7	124.0	80.0	523.9
Total	2,637	855	639	5,408
Mean weights	293	95	71	601
SD	61	22	18	103
Mean Daily Weight gain (g/day)	1.0	0.3	0.3	2.0
(±SD)	0.2	0.1	0.1	0.4
Mean Survival (%)	60%	67%	56%	77%
(±SD)	12%	38%	18%	21%

4.1.2 Overall

Forty three (43) ponds of about 1,900 m^2 total water surface area were constructed with the support of AwF in the first year. The mean size of the fish pond was 44 m^2 with the range from 12 to 169 m^2 (Appendix 2). Altogether 43 families were supported including three families with existing ponds. A total of 2,213 fish fry/fingerlings were obtained from Fisheries Research Center (FRC), Pokhara and

Fisheries Development Center (FDC), Bhandar, Chitwan, and provided to the farmers in an average of 65 fry/fingerlings per family to stock into their pond.

Data (Appendix 2) show that three families completely lost (0% Survival) their fish; however, average survival remained at 73±25% as some of the farmers had very high survival up to 97%. The average size of the fish consumed was 124±77 g where as average size of fish sold was 136±49 g. Altogether 146 kg (3.4 kg/family) of fish was consumed by the families whereas only 45 kg (1 kg/family) was sold to the local people. Based on the total consumption and total production data, 76% of the total fish produced was consumed by the farmer's families or relatives (Table 4). Very interestingly, individual family data show that two third (67%) of the families consumed all the fish (100%) they had grown (Appendix 2). Data showed that fish sold were bigger than the fish consumed. This indicates that most families started consuming fish earlier rather than waiting for fish to grow and also those who sold fish knew that to get good price they have to grow for longer and bigger. Only two families sold less than half they produced. This indicates that the project has contributed considerably in family nutrition in the community. Table 4 shows that the value of fish produced per farmer is US$12 with the maximum of US$90.

Table 4 Summary of fish production, consumption and sale in Year I.

	Pond	**No. of Fish**	**Consumed**	**Sold**	**Cons+**	**Total value of fish**	
	(sq. m)	Stocked	(kg)	(kg)	Sold (kg)	NRs.	US$
Total	1,899	2,535	146	45	191	38,274	524
Mean	44	59	3.4	1.3	4.5	890	12
SD	30	44	1.9	4.3	5	996	14
Min	12	17	0	0	0	0	0
Max	169	241	9	25	33	6,600	90

4.2 Year II

4.2.1 First Year Farmers (old group)

Among the 43 farmers who started in the first year 5 had to stop fish farming because of shortage of water. Based on the results of the first year, the remaining farmers stocked only two carps which grew fastest i.e. common carp and grass carp at 1:1 ratio. But in addition to these, Project Team also asked to add tilapia about one-fourth of carp. A total of 3,635 fish were stocked out of that 1,598 were Grass carp and Common carp each and 439 fry were tilapia with the mean of 107 fish/family (Appendix 3).

Among the farmers who continue in the second year i.e. the remaining 38 farmers, interesting figures have been noted (Table 5, Appendix 3&4). Although total pond surface area decreased (because of 5 farmers could not continue), Table 6 showed 161% increment in the total fish production (i.e. consumed + sold = 309 kg) compared with the same figure in the first year (191 kg). Similarly, total consumption and sales increased almost at the same rate. More interestingly, in the second year average (i.e. per family) value of fish consumption i.e. (7.0 vs 3.4 kg) increased by more than two folds (207%). This indicates clearly that farmers are improving in techniques, getting better experience and improving the productivity of their ponds and also consuming more realizing the value of fish in terms of nutrition and health.

Similarly, results (Table 6, Appendix 4) show that value of fish produced per family increased by nearly two-fold. Although average value per family still remained at US$21, highest value has reached to US$151 in the second year it was only US$90. In an average, these farmers received only US$33 (range US$9-127) as financial support (50%) for pond construction. One of the interesting points here is that women were happy to dig ponds in their lands with the subsidy of US$10 or even less.

Table 5 Summary of fish production, consumption and sale in Year II by the farmers joined in Year I.

	Consumed (kg)	Sold (kg)	Total (kg)	Consumed (%)	Sold%	Income (NRs)	Income US$
Total	239	72	309	-	-	60,800	833
Mean	7.0	2.0	7.9	74.4	4.3	1,559	21
Min	0	0	0	0	0	-	0
Max	19	40	55	100	73	11,000	151

Table 6 Improvement among the farmers who joined and started fish farming in Year I or percentage changes in fish production, consumption and sale in Year II as compared to Year I.

	Pond area	Total fish production	Consumption	Sale	Value of produce
Total	-11%	+61%	+63%	+60%	+59%
Average value	-2%	+78%	+107%	+65%	+175%

4.2.2 Second Year Farmers (New Group)

As mentioned earlier 27 women joined the fish farming group in the second year. A total of 30 ponds constructed with the water surface area of 1,213 ranging from 12 sq. m size pond up to 200 sq. m. (Table 7, Appendix 5&6). They stocked about 3,099 (average 111/family) fish fry and produced 158 kg of fish (6 kg per family), out of which over 80% was consumed by the family. Total value of produce ranged from US$12 up to US$66 in the mean of US$15 which is very similar to the level which was obtained by the farmers in the first year when they started. Hopefully, they will improve productivity and the income in the coming years to come after having experience.

Table 7 Fish production and consumption data from among the new women farmers in Year II.

	Pond Area (m^2)	Consumed (kg)	Sold (kg)	Total (Kg)	Yield t/ha	Value of produce (fish) NRs	US$
Total	1,213	131	27	158		31,600	433
Mean	43	5	1	6	2	1,129	15
SD	43	2	3	4	1	893	12
Min	12	-	-	-	-	-	-
Max	200	8	16	24	5	4,800	66

V. Major outcomes and lessons learned

5.1 Fish production and income

In two year's time with less than US$10,000 fund, AwF-Nepal project has been successful in digging 70 (40+30) ponds with the total of 3,112 m^2 in Rainaster village of Lamjung, a representative mid-hill district of Nepal (Table 8). Direct beneficiaries include family members of the women fish farmers i.e. 300 (193+107) and a primary school with about 500 children. This activity has produced more than 658 kg of fish, 80% of fish have been consumed by the families. Although total value of fish produced is still less than US$2,000, the Project Team expects, the production will increase over time and also more farmers will grow fish and generate more than US$10,000 invested by the project within another 2-3 years. Time saving while growing fish compared to other farming system component is tremendous. Average time spent in fish farming was estimated only 10-15 minute per day for 8 month which is a couple of days only. Most women group members see no additional time is necessary for fish farming. More interestingly, one of the women who has recently expanded fish pond from 36 m^2 to 200 m^2 says, "one rupee gives you 100 rupees; no other agriculture component gives you so much profit at such a low investment". Most important is the value of health benefits of home grown fish consumption, empowerment of women and its benefits to the community easily outweigh the investment of AwF and the efforts of the Project Team.

Table 8 Overall outcomes of the AwF-Nepal project.

Particulars	**Figures**
No. of ponds	70
Area of ponds (m^2)	3,112
No. of women supported (=families)	70
Direct beneficiaries	300
School (primary)	1
Total fish production (kg)	658
Consumption	516
Sale	142
Total value (NRs)	131,674
Total value (US$)	1,804

5.2 Women empowerment

The AwF Nepal project has established three women's fish farming groups involving 70 women in a village of less than 5,000 residents. The Project Team has trained them in fish farming and facilitated them to organize regular meetings to discuss problems and share experiences (Fig. 19). Men counterparts are also helping in various ways including pond construction, fish transport, organizing meetings and also facilitating discussions. Before the initiation of the project, aquaculture activity was almost none in the whole district. This project has created awareness throughout Lamjung about fish farming by women organized in groups. Local FM radio has broadcast the highlights of the project several times. Various groups have visited the project site. The Project Team with the support from District Agriculture Development Office (DADO) has also been successful in forming a District Fish Farming Association (DFFA) and network connecting the fish farmers of Lamjung (Fig 20). The major responsibilities of the committee are to disseminate the idea of small-scale fish farming in other

parts of the district, coordination among concerned organizations and facilitate in implementation of such programs. Women's groups have been successful to convince the district government and get supports from district administration partial supports for the sustainability of the fish farming. There is an indication that this is likely to serve as a model for small-scale fish farming program for mid-hills of Nepal that occupies about two-third of the country. Several neighboring villages have requested for technical assistance.

Fig 19. Group discussion in Maharudra Fish Farmer Group about Common carp breeding

Fig 20. Members of District Fish Farmer's Association (DFFA), Lamjung with Agriculture Extension Afficer.

5.3 Diversification in existing farming system

Fish ponds are used for different agriculture purposes in addition to farming fish showing Integrated Agriculture and Aquaculture System (IAAS) is highly relevant. It has been more visible around the ponds of the first year farmers of the project (Fig 21). The second year farmers are also following the same path learning from the former. Locally available inputs such as agriculture by-products e.g. rice bran, mustard oilcake etc. as fish feed, legumes grown on the dyke (Fig 22) to feed fish and control soil erosion and animal manure or urine as pond fertilizers (Fig 23) have been utilized following the principle of resource utilization, energy saving and waste recycling for fish culture. Farmers apply partial harvest especially who have stocked with tilapia. The farmer who did not stock tilapia they had complete harvest from November to January. Now farmer start to share and sell the Tilapia recruit to other farmer hence farmer can eat fish always when they need.

Fig 21: Trench constructed at the edge of rice plot for fish culture

Fig 22: Growing peanuts on the dike for grass carp and to control erosion


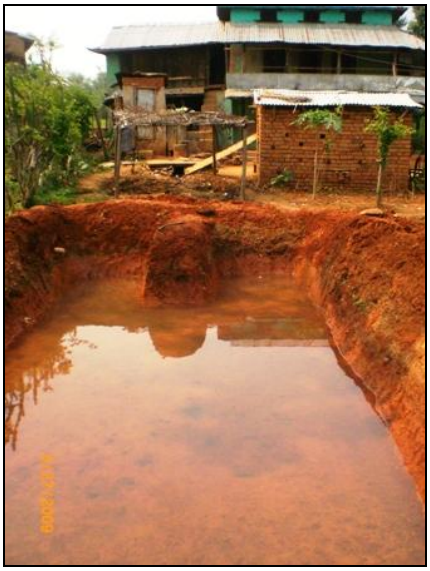

Fig 23: Cow urine collection to fertilize pond (left) and pig rearing next to the pond (right)

5.4 Test of fish species for mid-hills

In first year, project introduces silver carp, common carp, grass carp and big head carp. But Silver carp and Bighead carp showed poor growth; therefore these species were rejected in the second year. Nile tilapia was included to replace them procuring from one of the farmers of Lamjung District with the assistance of newly formed District Fish Farming Association (DFFA). Inclusion of tilapia showed very positive impression on farmers as it has given them a solution of fish seed supply instead of carrying fry and walking from far away distant. Some of them are selling tilapia fry. Ponds are never empty. It has improved production and consumption than in the first year. This project has at clearly indicated that Common carp, Grass carp and Tilapia are *the best* species for mid-hills of Nepal which occupies about 2/3rd of the country. However, more research is needed to determine the best species ratio to achieve higher production. At the same time some indigenous species such as Mahaseer (*Tor* sp.), Asala (*Shizothoraz* sp.), Bhitte (*Puntius* sp), Faketa (*Barillius* sp), Buduna (*Garra* sp.), Bhoti (*Channa* sp.) etc. in combination of these species can be the subject of further research.

5.5 Technology dissemination and adoption

Although most ponds are quite small in size, there are indications that they will either add new ponds (Fig 24) or expand the same pond. As all the farmers are new entrants of aquaculture, some of the farmers are achieving national level productivity. Within a year's time, they have already shown improvement by 100%. It has been regarded as a great success; therefore, it is being disseminated rapidly to other neighboring districts as well as other parts of Nepal. A radio journalist was invited during the occasion of farmers training and field visit to disseminate the technology from local FM radio. When this news was broadcast from local FM radio from the district headquarters of Lamjung (Fig 25), women farmers (Mahila Milan Fodder Production Group, Chiti Tilar, Fig 26) from high hills came to visit the project site to observe fish farming methods in Rainas Tar and wanted to test fish culture in high hills. More importantly, a group of 40 students from the Institute of Agriculture and Animal Sciences (IAAS), Lamjung campus, satellite campus of IAAS, Rampur Chitwan, visited the

project site for their practical field experience. It also attracted the attention of various other organizations/individuals including the Chief District Agriculture Officer of Lamjung. Similarly, WorldVision which works in the district has shown interest to work together in expanding small-scale aquaculture. One of the farmers of the Rainas Tar had taken 14 days on the job training on Common carp breeding from government farm and prepared to start breeding from the following year.

Fig 24. A pond constructed in Year I and another pond under construction. By adding a new pond, the woman has increased the area to 200m^2 from 36 m^2.

Fig 25 Dr Madhav Shrestha giving interview to local FM radio for fish farming technology dissemination in mid hills.

Fig 26 Women farmers from Chiti visited to the AwF supported fish ponds in Rainas Tar.

5.6 Lessons learned and feedback

- After implementing the project for a year, farmers and the Project Team realized that small fry have low survival. Therefore, large size fingerlings are suitable. Therefore, hapa nursing of fry for about 2 months before stocking into the ponds was done in the second year. As there is demand for fingerling from other villages, if fingerlings could be produced locally or procured from Chitwan or other places to make available to them any time they want would tremendously help promote small-scale aquaculture in rural areas.
- Local farmers are very much receptive of fish farming if they can see a successful program (Seeing is Believing) and also success of early adaptors. More people are interested to join the group if limited pond digging cost, training and fingerlings are provided.
- Farmers would need supports for equipment (water lifting pump) and harvesting nets which can be shared among the group members. This makes them feel the value of working in group.
- Field visit and training of women on fish farming provides an opportunity for their empowerment
- Farmers have learned that lack of basic needs such as adequate water, seed or fry (hatchery) supply either on-site or distant but transportation facilities, and appropriate feeds and ingredients, technical know-how, initial capital investment especially for digging ponds and their dedication in managing constrains the development of aquaculture.
- During rainy season there is high risk of flooding and land slide which can be avoided by selecting the better land while digging ponds.
- Tilapia has been one of the best choices for farmers as farmers do not need to worry about fry supply and transportation from distant place. It also has improved the production and increased the frequency of harvest thus increased the total production. They like the test of tilapia flesh.
- Farmers understand / perceive gradually the benefits of fish in terms of family nutrition as they consume fish more frequently.
- Fish has been a main item to offer for to the guests or own family members working in the cities or abroad who may visit home during feasts and festivals. Women feel proud of offering to them which is produced by their own efforts at home.
- It is difficult to make farmers perfect in any technology. Among them, they have differences in skill and performance. Many of them need more training. While some of the farmers ignore the guidelines and objectives of the program as they are concerned with their family needs rather than the purpose of the project. Therefore, farmers need to be oriented and convinced adequately, especially if participatory research is done.
- While working with local organizations, there is always groupism and politics. Some of them might try to take advantage of the activities, may try to distort and even create hurdles for their benefits or not to allow others take credits. As they may consider their career more than the project purpose. In some cases, they may think more on their financial benefits and may try to misuse the funds for other purposes than for the project activities. Regular monitoring by the Project Team has to be done or some other arrangement for check and balance has to be put in place so that funds will not be used for other purposes.
- Developmental project can be implemented through involvement of student(s) as manager(s) who can carry out research using farmers' field facilities, learn how to work with local communities and get very useful experience. More importantly, findings from such farmer's field trial have direct implications to the farmers.

5.7 Problems encountered and solutions applied

Most local people in the village have expressed that fish farming program has been successful and has made people enthusiastic with good social benefits though low in economic terms. They see it as a new idea which can flourish if the following problems can be avoided or handles appropriately;

5.7.1 Managerial/technical

Managing groups of farmers is a difficult task. Any Local Organizations have to have managerial as well as technical persons/skills to initiate and implement any successful projects like this. It is difficult to have these expertise and capabilities with local organization. During the first year, The Project Team encountered some difficulties. However, during the second year, the Project Team made the farmer to be more active to handle the group activities by themselves. They learnt in first year about the management practice of project. As a result, in the second year women farmers themselves were able to formulate plan based on which the local NGO and the Project Team facilitated the activities.

5.7.2 Water supply

As almost all the fish farmers were dependent on irrigation canal which is primarily for rice and other crops. It was often interrupted due to erosion and flooding resulting in early harvest of fish and even death. Adequate attention need to be given on the fish pond, and also if alternate source of water supply can be made that would solve the problem in such situation.

5.7.3 Predators

Farmers are facing the problem of snake. It seems fish ponds provide shelter as well as prey for them. Various ways have to be applied to control them especially when fish are small so that farmers can save their fish. Some of the farmers kill the snakes by sticks whenever they see. Some others used kerosene or petrol on the dyke area to repulse them but during summer rain washes away very quickly. Project Team has suggested use of snake traps or fencing the pond with some nets or plastics wherever possible. Although not a major but some farmers are pointing out that some birds e.g. king fisher, cranes etc. have eaten some fish. For this farmers have used scare crows and more attention give to the pond. They have also given a suggestion of use of long film of old cassettes or simple ropes across the pond with plastic pieces hung on to it. Another case of predatory problem encountered by several farmers is diving beettle (*Cybister limbatus*) which attacks the fish many times and eventually kill the fish. It has been difficult to find the solution for this. Farmers see frogs might be problems but the Project Team has mentioned it they are not predatory and are not problems.

5.7.4 Dike erosion

Many farmers encountered dike erosion as a problem. It has been a problem because many of the farmers are not making adequate slope because they see it as a loss in terms of area. Some of the group members are growing legume crops that can keep the dike intact. At the same time, legume leaves have been the sources of feed to fish. Because of the dike erosion and run off water, problem of clay siltation is quite common especially during rainy season. Farmers have been advised to divert away excessive run-off water.

5.7.5 Fry supply and transportation

In some cases, there was mortality of fry during transport due to long distance transportation and rough handling. Therefore, if the fry can be produced locally it would not be a problem. Surprisingly, farmers have got tilapia now which is giving fry in their ponds. Hopefully this will solve this problem for those who want to grow tilapia. However for other species growers, one of the innovative and early adopter farmers have been trained who has a plan to breed in his farm. Large fingerlings are difficult to get from hatcheries and also difficult to transport. Therefore, farmers have already done nursing of fry in hapas before they stock into the ponds. Hapas are additional cost to farmers. Hopefully, nursery farmers can afford them if larger fingerlings are sold at premium prices.

5.7.6 Technical support

One of the most important problems of fish farming in mid-hills of Nepal, especially in rural areas, is lack of human resource. It is difficult to get someone to work for the project and also it is difficult to arrange to continue technical supports during and after the end of the project. Fortunately, for this project purpose, an M. Sc. aquaculture student was hired as an intern to serve as manager who served as medium to pass on the technical know-how and also the guided directly. It may not be possible in other cases. More importantly, most of the District Agriculture Offices of Nepal, there is no aquaculture officer. They are mostly general agriculture graduates who do not have adequate knowledge and skill to guide farmers. This is a national problem and will be critical when aquaculture programs are planned to launch as a campaign. The Project Team is trying its best to make this voice heard by the concerned authorities and also trying to produce more graduates and trained manpower from IAAS and other institutions.

VI. Conclusions and recommendations

Women of the Rainas Tar showed exceptional enthusiasm when the project was initiated as evident from the fact that 40 fish ponds were constructed within 3-4 months after demonstration trip followed by one-day training. Although ponds constructed are quite small and total production of fish is not a big volume, large proportion of family consumption (80%) indicates that it has played significant role in family nutrition. The Project Team is very optimistic and express that this is just an entry to fish farming. There will be substantial productivity improvement as seen in the second year among the farmers who started a year ago. Continuation of fish farming with improvement in the second year without project support indicates that they see the benefits and are committed to carry it on. However, the Project Team plans to register the group as Cooperative so that they can move further in the long-run. A small amount of seed fund in addition to membership fee should be provided so that the group can provide loan to the interested person and collect reasonable interest.

Interest of many other farmers in the Year II (though only 27 were added amongst them) clearly shows the scope of fish farming by women in this village and same can be expected throughout mid-hills of Nepal, if the program can launched in a well-planned manner. This intervention has been considered very successful which will serve as a model for the whole mid-hills of the country. District Agriculture Development Office (DADO) has taken the idea as innovative and committed to support the groups as well as other groups. Similarly, other organizations have also shown interest to collaborate for its expansion in Lamjung and nearby other districts. If more training and technical supports are provided to cope with the problems faced by the farmers, for examples, seed shortages, water interruption, predator control etc, there is possibility that many of the low land swamps and rice fields will change to fish ponds moving towards commercial scales which could increase production and income considerably. However, they still need to get convinced that fish farming is easier and profitable than other components of existing farming system. As the people of rural Nepal are very much biased with the rice, as staple food, they would not be willing to sacrifice their lands for digging ponds. It may take some time to understand the principle of market economy. Once they understand that income from fish is about 10 times higher than the rice and if they feel they can buy rice easily from others, they will increase size of ponds to move to commercial fish farming. At the same time, a pilot scale-rice fish farming program might be useful so that farmers could directly see and compare the benefits. One of the supporting factors for commercial fish farming in this village has been the inclusion of tilapia. It is hoped that many more farmers will have seeds to stock throughout the year. However, a hatchery that supplies other fish species such as Common carp and Grass carp would tremendously help farmers. In addition, more research on using indigenous species together with the three species (Grass Carp, Common carp and Tilapia) would add more local flavour in exotic idea. Another, conducive factor for commercial fish farming, newly constructed mud/gravel road which connects with Kathmandu and other cities. Marketing for fish if produced in a large volume will not be a problem as it takes only about 5-6 hours to reach the capital and other cities such as Pokhara and Bharatpur.

It is very important at this stage, the findings or outcomes of this project should be highlighted and promoted nationwide. Scaling up activities, possibly few more district as demonstration sites would help tremendously. More importantly, roles of mass media should be exploited for example FM radios, television, publications. A stakeholders meeting involving government extension office, research institutions, NGOs and others would also help promote the idea.

VII. Plan for expansion

In the coming years, attempts will be made to register the groups as Women's Cooperative and encourage them to move forward towards integrated development approach. Attempts will be made to provide them a revolving fund so that they can make provisions for the members so that women interested in fish farming and other small businesses can take loan. They will also technically be assisted to start and run small enterprises.

Integration of fish farming with other component of agriculture will be further strengthened, for an example, growing fish in rice fields to utilize space and water. So far, only 0.3 areas have been used for fish culture. Rainas Tar (plain land) has 850 ha of irrigated lands. Fish culture can be introduced in most of these lands. Similarly, suggestions will be provided for the integration of vegetable gardening and livestock farming e.g. pig, goat and chicken adjacent to or above the fish ponds.

A planning is also under way together with local government body to develop the site as a "Model Village" under which RDC, local NGO plans to establish/arrange a small local market where women, and also men, can sell their products organizing regular fairs in the morning or evening or during weekends. In addition to agricultural products, they will be encouraged to produce any items based on their skills and available local resources such as handicrafts from wood, clays, stones, clothes etc. Arrangements will be made for the better quality products to transport to nearby cities. The idea of One Tambon One Product (OTOP) in Thailand will be used giving slightly different name "One Village Many Products or "OVMP".

The Project Team is also attempting to expand fish farming to other parts of the district such as Chakratirtha and Bhorletar VDCs. At the same time, feasibility study is on-going in other districts such Gorkha, Tanahun and Kavre.

VIII. Acknowledgements

The project Team would like to thank Aquaculture-without-Frontiers (AwF) / WAS officials; especially Dr M.C. Nandeesha, Michael New, Kevin Fitzsimons, Geoff Alan, anonymous proposal reviewers and others for their supports and encouragement. The Team is highly indebted to the local people of Rainas Tar who have selflessly assisted in making the initiative a success. More importantly, the women and their families, who are showing so much enthusiasm besides living with hardships, are appreciated.

IX. Financial report

To be submitted later separately.

X. Appendices

Appendix 1: Name of farmers and no. of fish stocked.

Appendix 2: Fish harvest record, consumption and sales records.

Appendix 3: Inputs in the second year used by the farmers joined in Year I.

Appendix 4: Fish production, consumption and sale records in Year II of the farmers who joined in the first year.

Appendix 5: Inputs used by the farmers who joined in the Year II.

Appendix 6: Fish production, consumption and sale records of the farmers who joined in the Year II.

Appendix 1: Name of farmers and no. of fish stocked.

SN	Names of the participating women	Family size (no.)	Pond size (m^2)	Fish species stocked				
				Common 47%	Bighead 16%	Grass 11%	Silver 26%	Total
1	Bhagawati Pandey	5	150	101	34	23	56	214
2	Bhunti Shrestha	3	12	8	3	2	5	17
3	Bimala Chiluwal	5	41	28	9	6	15	58
4	Devi Dumrakoti	3	20	14	5	3	8	29
5	Durga Devi Chiluwal	4	50	34	11	8	19	71
6	Goma Hatuwal	6	20	14	5	3	8	29
7	Indira Kumari Shrestha	3	54	36	12	8	20	77
8	Indra K. Shrestha	7	169	114	38	25	63	241
9	Juna Kumari Chiluwal	6	26	18	6	4	10	37
10	Kubija Kumari Kadariya	4	23	16	5	3	9	33
11	Mina Thapa	6	58	39	13	9	22	83
12	Mithi Bhatta	5	27	18	6	4	10	38
13	Naba Kumari Chiluwal	5	40	27	9	6	15	57
14	Nanu Maya Laudari	5	27	18	6	4	10	38
15	Niranjana Parajuli	4	29	20	7	4	11	41
16	Parbati Nepali	4	40	27	9	6	15	57
17	Rama Naral	5	18	12	4	3	7	26
18	Rama Laudari	4	57	38	13	9	21	81
19	Ramdevi Laudari	4	80	54	18	12	30	114
20	Santa Maya Nepali	4	36	24	8	5	14	51
21	Santa Maya Tamang	5	50	34	11	8	19	71
22	Santa Nepali	4	36	24	8	5	14	51
23	Saraswoti Chiluwal	6	42	28	9	6	16	60
24	Saraswoti Chiuwal	4	56	38	13	8	21	80
25	Sita Laudari	4	33	22	7	5	12	47
26	Sita Pandey	3	27	18	6	4	10	38
27	Sobita Nepali	4	36	24	8	5	14	51
28	Sochana Laudari	3	24	16	5	4	9	34
29	Suk Maya Nepali	2	57	38	13	9	21	81
30	Tib Kumari Nakhola	4	53	36	12	8	20	76
31	Tirtha Kumari Hatuwal	5	18	12	4	3	7	26
32	Uma Hatuwal	4	61	41	14	9	23	87
33	Yaklaxmi Bhujel	6	36	24	8	5	14	51
34	Sarmila Bhujel	8	47	32	11	7	18	67
35	Shanta Maya Thapa	4	41	12	15	18	15	60
36	Indra Kumari Nepali	6	40	12	15	18	15	60
37	Krishna Kumari Bk	5	38	11	14	17	14	56
38	Rin Maya Nepali	6	34	8	15	18	10	51
39	Krishna Maya Nepali	2	34	8	15	18	10	51

40	Yam Kumari Kadariya	5	36	8	16	19	11	54
41	Dhan Maya Thapa	3	66	10	20	40	30	100
42	Ramdevi Bhujel	4	31	5	9	19	14	47
43	Dhan Maya Bk	4	26	4	8	16	12	40
	Total	193	1899	1,125	477	416	717	2,731
	Mean	4.5	44.2	26.2	11.1	9.7	16.7	63.5
	SD	1.3	29.6	21.6	6.9	7.8	11.2	42.2
	Min	**2**	**12**	**4**	**3**	**2**	**5**	**17**
	Max	**8**	**169**	**114**	**38**	**40**	**63**	**241**

Appendix 2: Fish harvest record, consumption and sales records.

SN	Names	Pond size m^2)	Total fish stock	Fish harvest data									Total prod^n (kg)	% Consumption	Value of fish		Project Support	
				Home consumption			Sold to others			Dead No.	In pond	Surv. (%)			NRs	US$	NRs	US$
				Wt (kg)	no.	Mwt (g)	Wt. (kg)	no.	Mwt (g)									
1	Bhagawati Pandey	150	214	2	55	36	0	0		159	0	26	2.0	100%	400	5.5	8,250	113
2	Bhunti Shrestha	12	17	0	0		0	0		17	0	0	0.0		-	0.0	660	9
3	Bimala Chiluwal	41	58	3.5	32	109	0	0		3	23	95	3.5	100%	700	9.6	2,255	31
4	Devi Dumrakoti	20	29	2	25	80	0	0		4	0	88	2.0	100%	400	5.5	1,100	15
5	Durga Chiluwal	50	71	6	43	140	0	0		8	20	89	6.0	100%	1,200	16.4	2,750	38
6	Goma Hatuwal	20	29	3	24	125	0	0		5	0	84	3.0	100%	600	8.2	1,100	15
7	Indira K. Shrestha	54	77	4	22	182	1	6	167	4	45	95	5.0	80%	1,000	13.7	2,970	41
8	Indra K. Shrestha	169	241	8	46	174	25	134	187	14	47	94	33.0	24%	6,600	90.4	9,295	127
9	Juna K. Chiluwal	26	37	2	36	56	0	0		1	0	97	2.0	100%	400	5.5	1,430	20
10	Kubija K. Kadariya	23	33	2	9	222	4	21	190	3	0	92	6.0	33%	1,200	16.4	1,265	17
11	Mina Thapa	58	83	5	44	114	1	12	83	10	17	88	6.0	83%	1,200	16.4	3,190	44
12	Mithi Bhatta	27	38	1	8	125	0	0		30	0	21	1.0	100%	200	2.7	1,485	20
13	Naba K. Chiluwal	40	57	2	46	43	0	0		11	0	81	2.0	100%	400	5.5	2,200	30
14	Nanumaya Laudari	27	38	4	32	125	0	0		6	0	83	4.0	100%	800	11.0	1,485	20
15	Niranjana Parajuli	29	41	3	14	214	3	16	188	11	0	73	6.0	50%	1,200	16.4	1,595	22
16	Parbati Nepali	40	57	2	18	111	1	12	83	3	24	95	3.0	67%	600	8.2	2,200	30
17	Rama Naral	18	26	1	20	50	0	0		6	0	78	1.0	100%	200	2.7	990	14
18	Rama Laudari	57	81	2	32	63	1	16	63	12	21	85	3.0	67%	600	8.2	3,135	43
19	Ramdevi Laudari	80	114	1	43	23	0	0		71	0	38	1.0	100%	200	2.7	4,400	60
20	Santa Nepali	36	51	3	21	143	1	7	143	6	17	88	4.0	75%	800	11.0	1,980	27
21	Santamaya Nepali	36	51	4	35	114	0	0		16	0	68	4.0	100%	800	11.0	1,980	27
22	Santmaya Tamang	50	71	0	0		0	0		71	0	0	0.0		-	0.0	2,750	38
23	Saraswoti Chiluwal	42	60	4	21	190	0	0		7	32	88	4.0	100%	800	11.0	2,310	32
24	Saraswoti Chiuwal	56	80	6	54	111	2	16	125	10	0	88	8.0	75%	1,600	21.9	3,080	42
25	Sarmila Bhujel	47	67	5	52	96	0	0		3	12	96	5.0	100%	1,000	13.7	2,585	35
26	Sita Laudari	33	47	3.5	43	81	0	0		4	0	91	3.5	100%	700	9.6	1,815	25
27	Sita Pandey	27	38	2	23	87	0	0		15	0	60	2.0	100%	400	5.5	1,485	20
28	Sobita Nepali	36	51	2.5	19	132	1	9	111	7	16	86	3.5	71%	700	9.6	1,980	27
29	Sochana Laudari	24	34	9	21	429	2	10	200	3	0	91	11.0	82%	2,200	30.1	1,320	18
30	Suk Maya Nepali	57	81	6	36	167	3	32	94	13	0	84	9.0	67%	1,800	24.7	3,135	43

31	Tib K. Nakhola	53	76	6	46	130	0	0		9	21	88	6.0	100%	1,200	16.4	2,915	40
32	Tirtha k. Hatuwal	18	26	4	20	200	0	0		6	0	78	4.0	100%	800	11.0	990	14
33	Uma Hatuwal	61	87	3	77	39	0	0		10	0	89	3.0	100%	600	8.2	3,355	46
34	Yaklaxmi Bhujel	36	51	4	28	143	0	0		4	19	92	4.0	100%	800	11.0	1,980	27
35	Shanta Maya Thapa	41	27	3.5	27	276						45	3.5	100%	697	9.6	2,255	31
36	Indra Kumari Nepali	40	30	2.4	30	221						50	2.4	100%	487	6.7	2,200	30
37	Krishna Kumari Bk	38	37	2.4	37	190						66	2.4	100%	486	6.7	2,090	29
38	Ril Maya Nepali	34	35	5.5	35	340						69	5.5	100%	1,107	15.2	1,870	26
39	Krishna Maya Nepali	34	40	2.7	40	274						78	2.7	100%	544	7.4	1,870	26
40	Yam K. Kadariya	36	39	3.7	39	225						72	3.7	100%	750	10.3	1,980	27
41	Dhan Maya Thapa	66	66	4.7	66	208						66	4.7	100%	935	12.8	3,630	50
42	Ramdevi Bhujel	31	23	2.3	23	291						49	2.3	100%	468	6.4	1,705	23
43	Dhan Maya Bk	26	26	3.5	26	241						65	3.5	100%	700	9.6	1,430	20
	Total	1899	2535	146	1368		45	291	1634	562	314		191	37	38,274	524	104,445	1,431
	Mean	44	59	3.40	32	154	1.3	9	136	17	9	73	4.5	1	890	12	2,429	33
	SD	30	44	1.92	16	88	4.3	24	49	30	14	25	5	0	996	14	1,630	22
	Min	12	17	0.00	0	23	0.0	0	63	1	0	0	0	0	-	-	660	9
	Max	169	241	9.00	77	429	25.0	134	200	159	47	97	33	1	6,600	90	9,295	127

Appendix 3. Inputs in the second year used by the farmers joined in Year I.

SN	Name Of Farmer	Inputs						Total
			Urea g/15		Fish Seed			
		DAP g	Days	Lime (Kg)	Grass Carp(no)	Common Carp (no)	Tilapia(no)	
1	Bhagawati Pandey	630	315	7.5	150	150	0	300
2	Bhunti shrestha	Stopped because of water problem						
3	Bimala Chiluwal	Involved in group from the first year but farming started in second year						
4	Devi Dumrakoti	84	42	1	20	20	6	46
5	Dhan Maya Bk	109	55	1.3	26	26	8	60
6	Dhan Maya Thapa	277	139	3.3	66	66	20	152
7	Durga Devi Chiluwal	210	105	2.5	50	50	15	115
8	Goma Hatuwal	109	55	1.3	26	26	8	60
9	Indira Kumari Shrestha	227	113	2.7	54	54	16	124
10	Indra Kumari Nepali	168	84	2	40	40	12	92
11	Indra Kumari Shrestha	710	355	8.5	170	170	51	391
12	Juna kumari chiluwal	Stopped because of water problem						
13	Krishna Kumari Bk	160	80	1.9	38	38	11	87
14	Krishna Maya Nepali	143	71	1.7	34	34	10	78
15	kubija kadariya	0	0	0	0	0	0	
16	Mina Thapa	244	122	2.9	58	58	17	133
17	Mithi Bhatta	113	57	1.4	28	28	8	64
18	Naba Kumari Chiluwal	168	84	2	40	40	12	92
19	Nanu Maya Laudari	113	57	1.4	28	28	8	64
20	Niranjana Parajuli	122	61	1.5	30	30	9	69
21	Parbati Nepali	N/A for the first year - data are available for second year						

22	Rama Naral	Stopped and replaced by Yam Kumari Sedain in the second year						
23	Rama Laudari	239	120	2.9	58	58	17	133
24	Ramdevi Bhujel	130	65	1.6	32	32	9	73
25	Ramdevi Laudari	336	168	4	80	80	24	184
26	Rin Maya Nepali	143	71	1.7	34	34	10	78
27	Sabita Nepali	Stopped because of water problem						
28	Santa Maya Nepali(D)	151	76	1.8	36	36	11	83
29	Santa Maya Nepali(G)	151	76	1.8	36	36	11	83
30	Santa Maya Tamang	Stopped because of water problem						
31	Saraswoti Chiuwal(D)	235	118	2.8	56	56	17	129
32	Saraswoti Chiuwal(G)	172	86	2.1	42	42	0	84
33	Sharmila Bhujel	197	99	2.4	48	48	14	110
34	Shanta Maya Thapa	172	86	2.1	42	42	12	96
35	Sita Laudari	139	69	1.7	34	34	10	78
36	Sita Pandey	113	57	1.4	28	28	8	64
37	Sochana Laudari	101	50	1.2	24	24	7	55
38	Suk Maya Nepali	233	109	2	56	56	22	134
39	Tib Kumari Nakhola	223	111	2.7	0	0	16	16
40	Uma Hatuwal	256	128	3.1	62	62	18	142
41	Tirtha Kumari Hatuwal	Had a small pond but discontinued						
42	Yaklaxmi Bhujel	151	76	1.8	36	36	11	83
43	Yam Kumari Kadariya	151	76	1.8	36	36	11	83
	Total	6,880	3,436	82	1,598	1,598	439	3,635
	Mean	174.9	87.6	2.1	40.6	40.6	11.0	107
	SE	23.1	11.6	0.3	5.6	5.6	1.5	1
	Min	0.0	0.0	0.0	0.0	0.0	0.0	0
	Max	710.0	355.0	8.5	170.0	170.0	51.0	51

SN	Name of farmers	Pond no	Family	Pond area	Consum-ption (kg)	Sale (kg)	Total Prod	Remain	Cons (kg)	Prodvt ton/ha	Cons%	sale%	Income NRs	Income US$
1	Bhagawati Pandey	2	2	150	15	40	55	0	7.5	3.7	27	72.7	11,000	151
2	Bhunti shrestha	1		0			0		0.0		0	0	-	-
3	*Bimala Chiluwal*													
4	*Devi Dumrakoti*													
5	Dhan Maya Bk	1	4	20	5	0	5		1.3	2.5	100	0	1,000	14
6	Dhan Maya Thapa	1	3	26	9	0	9		3.0	3.5	100	0	1,800	25
7	Durga Devi Chiluwal	1	3	66	7	0	7		2.3	1.1	100	0	1,400	19
8	Goma Hatuwal	1	6	20	4		0		0.0		0	0	-	-
9	Indira K. Shrestha	1	6	20	9	0	9		1.5	4.5	100	0	1,800	25
10	Indra Kumari Nepali	1	6	54	6	0	6		1.0	1.1	100	0	1,200	16
11	Indra K. Shrestha	1	7	169	19	25	44		2.7	2.6	43	56.8	8,800	121
12	Juna kumari chiluwal	1		26			0		0.0		0	0	-	-
13	Krishna Kumari Bk	1	5	40	4	0	4		0.8	1.0	100	0	800	11
14	Krishna Maya Nepali	1	2	38	2	0	2		1.0	0.5	100	0	400	5
15	kubija kadariya	1		23			0		0.0		0	0	-	-
16	Mina Thapa	1	6	34	9	0	9		1.5	2.6	100	0	1,800	25
17	Mithi Bhatta	1	7	58	1	0	1	0	0.1	0.2	100	0	200	3
18	Naba K. Chiluwal	1	5	39	6	0	6		1.2	1.5	100	0	1,200	16
19	Nanu Maya Laudari	1	6	27	5	0	5		0.8	1.9	100	0	1,000	14
20	Niranjana Parajuli	1	7	40	4	0	4		0.6	1.0	100	0	800	11
21	*Parbati Nepali*	place in first year they involve formally in second year												
22	*Rama Naral*	replaced by yam kumari sedai												
23	Rama Laudari	1	4	29	9	0	9		2.3	3.1	100	0	1,800	25
24	Ramdevi Bhujel	1	4	26	5	0	5		1.3	1.9	100	0	1,000	14
25	Ramdevi Laudari	1	4	57	7	0	7		1.8	1.2	100	0	1,400	19

26	Rin Maya Nepali	1	6	31	3	0	3	0	0.5	1.0	100	0	600	8
27	sabita Nepali	1		34			0		0.0		0	0	-	-
28	Santa M Nepali(D)	1	4	36	4	0	6		1.0	1.7	67	0	1,200	16
29	Santa K Pandey	1	4	34	14	0	14		3.5	4.1	100	0	2,800	38
30	Santa M. Nepali(G)	1	4	36	4	0	4		1.0	1.1	100	0	800	11
31	Santa Maya Tamang	1	0	50			0		0.0		0	0	-	-
32	Sarswoti Chiluwal(G)	1	5	36	19	0	19		3.8	5.3	100	0	3,800	52
33	Sarswoti ChiLuwal(D)	1	4	56	8	0	8	0	2.0	1.4	100	0	1,600	22
34	Sharmila Bhujel	1	7	47	1	0	1		0.1	0.2	100	0	200	3
35	Shanta Maya Thapa	1	4	41	12	0	12		3.0	2.9	100	0	2,400	33
36	Sita Laudari	1	3	33	3	0	3		1.0	0.9	100	0	600	8
37	Sita Pandey	1	2	27	3	0	3		1.5	1.1	100	0	600	8
38	Sochana Laudari	1	3	24	8	0	8		2.7	3.3	100	0	1,600	22
39	Suk Maya Nepali	1	3	57	12	7	19		4.0	3.3	63	37	3,800	52
40	Tib Kumari Nakhola	1	4	53	13	0	13		2.0	1.5	100%	0	1,600	22
41	Uma Hatuwal	1	6	61	0	0	0		0.0	0.0	0	0	-	-
42	Yaklaxmi Bhujel	1	4	36	3	0	3		0.8	0.8	100	0	600	8
43	Yam K Kadariya	1	5	36	6	0	6		1.2	1.7	100	0	1,200	16
	Total	40	155	1690	239	72	309	0	59	64			60,800	833
	Mean	1.0	4.4	43.3	7.0	2.2	7.9	0.0	1.5	1.9	74.4	4.3	1,559	21
	SD	0.2	1.7	30.7	4.8	8.1	11.0	0.0	1.5	1.3	41.4	15.5	2,195	30
	Min	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
	Max	2.0	7.0	169.0	19.0	40.0	55.0	0.0	7.5	5.3	100.0	72.7	11,000	151

Appendix 5. Inputs used by the farmers who joined in the Year II.

SN	Name of Farmer	Family No	Pond area (m^2)	**Inputs**						
							Fish Seed			
				DAP g	Urea g/15 days	Lime (Kg)	Grass Carp(no)	Common Carp (no.)	Tilapia (no.)	Total no of fry
1	Basundhara Giri	6.0	14.0	58	29	0.7	14	14	4	32
2	Bhuba Laxmi Chiluwal	4.0	36.0	151	76	1.8	36	36	11	83
3	Bijaya Devi Parajuli	7.0	50.0	210	105	2.5	50	50	15	115
4	Bimala Chiluwal	4.0	41.0	172	86	2.1	42	42	12	96
5	Bimala Magar	5.0	40.0	168	84	2	40	40	12	92
6	Devi Dumrakoti	4.0	20.0	84	42	1	20	20	6	46
7	Dil Kumari Pandey	5.0	30.0	126	63	1.5	30	30	9	69
8	Durga Chiluwal	4.0	20.0	84	42	1	20	20	6	46
9	Goma Chiluwal	4.0	56.0	235	118	2.8	56	56	17	129
10	Gyanu Maya Nepali	4.0	21.0	88	44	1.1	22	22	6	50
11	Harimaya Pariyar	5.0	40.0	168	84	2	40	40	12	92
12	Hom Kumari Parajuli	2.0	200.0	840	420	8	400	400	50	850
13	Kali Maya Tamang	5.0	21.0	88	44	1.1	22	22	6	50
14	Mira Mishra	5.0	36.0	164	82	2	40	40	12	92
15	Musi Maya Nepali	2.0	40.0	151	76	1.8	36	36	11	83
16	Parbati Nepali	4.0	27.0	109	55	1.3	26	26	8	60
17	Phul Maya Nepali	5.0	50.0	168	84	2	40	40	12	92
18	Radha Bisural	5.0	25.0	210	105	2.5	50	50	15	115
19	Rita B.K.	3.0	74.0	105	53	1.3	26	26	8	60

20	Sabitri Pandey	5.0	33.0	311	155	3.7	74	74	22	170
21	Santa Kumari Pandey	4.0	48.0	139	69	1.7	34	34	10	78
22	Santosh Kumari Pandey	3.0	20.0	202	101	2.4	48	48	14	110
23	Sarita Sedain	3.0	20.0	84	42	1	20	20	6	46
24	Sharada Ni Ma Bi	0.0	169.0	709	355	8.5	0	0	254	254
25	Sita Khaniya	1.0	14.0	59	29	0.7	14	14	4	32
26	Sita Sedain	3.0	32.0	134	67	1.6	32	32	10	74
27	Suk Maya B.K.	2.0	24.0	101	50	1.2	24	24	7	55
28	Yam Kumari Sedain	3.0	12.0	50	25	0.6	12	12	4	28
	Total	107.0	1,213	5,168	2,585	60	1,268	1,268	563	3,099
	Mean	1.5	43	184.6	92.3	2.1	45.3	45.3	20.1	111
	SE	0.3	8	34.2	17.1	0.4	13.7	13.7	9.0	
	Min	0	12	50	25	1	0	0	4	28
	Max	7	200	840	420	9	400	400	254	850

Appendix 6: Fish production, consumption and sale records of the farmers who joined in the Year II.

SN	Name of farmers	no of fish pond	Family no.	Pond area (m2)	Consum-ption (kg)	Sale (kg)	Produ ction (kg)	Cons/ fam(kg)	Prodvt ton/ha	Consum-ption%	Sale%	Total income	
												NPRs.	US$
1	Basundhara Giri	1.0	6.0	14.0	5.0	-	5	0.8	3.6	100	0.0	1,000	14
2	Bhuba L. Chiluwal	1.0	4.0	36.0	4.0	-	4	1.0	1.1	100	0.0	800	11
3	Bijaya Parajuli	1.0	7.0	50.0	5.0	-	5	0.7	1.0	100	0.0	1,000	14
4	Bimala Chiluwal	1.0	4.0	41.0	6.0	-	6	1.5	1.5	100	0.0	1,200	16
5	Bimala Magar	1.0	5.0	40.0	3.0	-	3	0.6	0.8	100	0.0	600	8
6	Devi Dumrakoti	1.0	4.0	20.0	6.0	-	6	1.5	1.5	100	0.0	1,200	16
7	Dil K Pandey	1.0	5.0	30.0	3.0	4	7	0.6	2.3	43	57.1	1,400	19
8	Durga Chiluwal	1.0	4.0	20.0	5.0	-	5	1.3	2.5	100	0.0	1,000	14
9	Goma Chiluwal	1.0	4.0	56.0	3.0	-	3	0.8	0.5	100	0.0	600	8
10	Gyanu M Nepali	1.0	4.0	21.0	8.0	-	8	2.0	3.8	100	0.0	1,600	22
11	Harimaya Pariyar	1.0	5.0	40.0	3.0	-	3	0.6	0.8	100	0.0	600	8
12	Hom K. Parajuli	1.0	2.0	200.0	0.0	-	-	0.0	0.0	0	0.0	-	0
13	Kali M Tamang	1.0	5.0	21.0	6.0	-	6	1.2	2.9	100	0.0	1,200	16
14	Mira Mishra	1.0	5.0	36.0	5.0	-	5	1.0	1.3	100	0.0	1,000	14
15	Musi M Nepali	1.0	2.0	40.0	2.0	-	2	1.0	0.6	100.0	0.0	400	5
16	Parbati Nepali	1.0	4.0	27.0	8.0	4	12	2.0	4.6	66.7	33.3	2,400	33
17	Phul Maya Nepali	1.0	5.0	50.0	4.0	-	4	0.8	1.0	100	0.0	800	11
18	Radha Bisural	1.0	5.0	25.0	6.0	3	9	1.2	1.8	67	33.3	1,800	25
19	Rita B.K.	1.0	3.0	74.0	8.0	-	8	2.7	3.2	100	0.0	1,600	22
20	Sabitri Pandey	1.0	5.0	33.0	8.0	16	24	1.6	3.2	33	66.7	4,800	66
21	santa K pandey	1.0	4.0	48.0	6.0	-	6	1.5	1.0	100	0.0	1,200	16
22	Santosh K Pandey	1.0	3.0	20.0	8.0	-	8	2.7	1.7	100	0.0	1,600	22
23	Sarita Sedain	1.0	3.0	20.0	3.0	-	3	1.0	1.5	100	0.0	600	8
24	Sharada Ni Ma Bi	3.0	0.0	169.0	0.0	-	-	0.0	0.0	0	0.0	-	0
25	Sita Khaniya	1.0	1.0	14.0	6.0	-	6	6.0	4.3	100	0.0	1,200	16

26	Sita Sedain	1.0	3.0	32.0	4.0	-	4	1.3	1.3	100	0.0	800	11
27	Suk Maya B.K.	1.0	2.0	24.0	4.0	-	4	2.0	1.7	100	0.0	800	11
28	Yam K Sedain	1.0	3.0	12.0	2.0	-	2	0.7	1.7	100	0.0	400	5
	Total	30	107	1,213	131	27	158	38	51	2,410	190	31,600	433
	Mean	1.1	3.8	43.3	4.7	1.0	6	1.4	1.8	86.1	6.8	1,129	15.5
	SD	0	2	43	2	3	4	1	1	30	18	893	12
	Min	1	-	12	-	-	-	-	-	-	-	-	-
	Max	3	7	200	8	16	24	6	5	100	67	4,800	66