

# Association of Anaemia with Parasitic Infection in Pregnant Women Attending Antenatal Clinic at Koshi Zonal Hospital

Manju Chaudhary and Mahendra Maharjan

Central Department of Zoology, Tribhuvan University, Kirtipur, Kathmandu, Nepal

For correspondence: mmaharjan@cdztu.edu.np

## Abstract

Intestinal parasitic infections associated with anaemia during pregnancy have direct negative impact on the health of expected mother and developing baby. In order to assess the association between anaemia and parasitic infection during pregnancy, a total of 200 stool samples from pregnant women on their first consultation to antenatal service in Koshi Zonal Hospital were collected from April to August 2012. The stool samples were examined for intestinal parasites by direct smear technique, while haemoglobin level of pregnant women were collected from laboratory record of the hospital. Out of 110 anaemic pregnant women 40(36.3%) had parasitic infection, while from 90 non-anaemic pregnant women; only 18(20%) of them were infected with intestinal parasites. The association of anaemia with intestinal parasite was statistically significant ( $p < 0.008$ ). The prevalence of Hookworm (76.9%) was most prevalent infection followed by *Ascaris lumbricoides* (73.3%) in anaemic pregnant women. The mean Haemoglobin (Hb) level of pregnant women with single parasite and with multiple infection was  $10.4 \pm 1.80$  gm/dl (mild anaemia) and  $9.81 \pm 0.84$  gm/dl (moderate anaemia) respectively. However, the overall prevalence of the parasitic infection among pregnant women was 58(29%). *A. lumbricoides* (32.3%) was the most predominant followed by Hookworm (26.1%), *Giardia lamblia* (21.5%), *Entamoeba histolytica* (10.7%), *Trichuris trichiura* (6.15%), *Strongyloides stercoralis* (1.5%) and *Hymenolepis nana* (1.5%). An integrated programme for the control of this parasitic infection should be regarded as an issue of public health priority in order to reduce the degree of anaemia during pregnancy.

**Key words:** *Ascaris*, Haemoglobin, Hookworm, Prevalence, Trimester

## Introduction

Intestinal parasitic infection (IPI's) caused by pathogenic helminthes and protozoan species are endemic throughout the World. Intestinal parasitic infections (IPI) constitute a global health burden causing clinical morbidity in 450 million people, many of these are women of reproductive age and children in developing countries (Quihui et al. 2006). The major IPI's of global public health concern are the protozoan species *Entamoeba histolytica* and *Giardia intestinalis* and the soil transmitted helminthes *A. lumbricoides*, *T. trichiura*, and Hookworm (WHO 1999, WHO 2000). Amoebiasis, Ascariasis, Hookworm infection and Trichuriasis are among the ten most common infections in the world (WHO 1987). The incidence and prevalence of these parasitic pathogens varies both between and within countries (Mata 1982, Montresor et al. 1998). Gastrointestinal helminth infections rank fourth in the top ten infectious diseases in Nepal (Magar et al. 2011). An epidemiological study by Brooker et al. (2008) estimated one-third of all pregnant women in developing countries were infected with Hookworm. Hookworm infection is a recognized major contributor to gastrointestinal blood loss; causing malnutrition and anaemia (Crompton 2000, Dreyfuss et al. 2000 and Stephenson et al. 2000). Hookworm infestation was significantly related with anaemia (Shah and Baig 2005), and were

considered as stronger predictors of anaemia in pregnant women (Navilsky et al. 1998, Bondevik et al. 2000, Dreyfuss et al. 2000 and Brooker et al. 2008).

Prevalence of anaemia among pregnant women in developing countries averages 56% with a range of 35%-100% among various regions of the world (WHO 1992). Studies from South-Asian countries (Bondevik et al. 2000 and Dreyfuss et al. 2000) have estimated 75% prevalence of anaemia among pregnant women, the highest in the world (WHO 1998). Dreyfuss et al. (2000) showed the prevalence of anaemia to be 73% in the plains of Nepal and Shah and Baig (2005) reported prevalence of anaemia to be 66% in eastern Nepal, while according to the Demographic Health Survey in 2006 of Nepal, prevalence of anemia in pregnant women is 42%.

### Materials and Methods

The study was done in Koshi Zonal Hospital (KZH), Biratnagar, it was designed to include the all the pregnant women coming for their antenatal care except those pregnant women, who were already on iron supplement, or who had been dewormed by anti – helminthic drug. Altogether 200 stool samples from pregnant women from April to August 2012 were collected. The entire stool sample was examined in the laboratory of KZH by direct smear method; both stained and unstained preparations were used for detection of intestinal parasites. Both the Macroscopic and microscopic examinations were conducted for laboratory diagnosis of helminth parasites. The Haemoglobin report of respective pregnant women was recorded from record file of haematology department of KZH.

### Results

Out of the 200 stool samples examined, 58(29%) were positive with one or more intestinal parasites. The prevalence of specific intestinal parasitic infection found showed that *A. lumbricoides* was the most predominant 21(32.3%), followed by Hookworm 17(26.1%), *Giardia lamblia* 14(21.5%), *Entamoeba histolytica* 7(10.7%), *T. trichiura* 4(6.15%), *Strongyloides stercoralis* 1(1.5%) and *Hymenolepis nana* 1(1.5%).

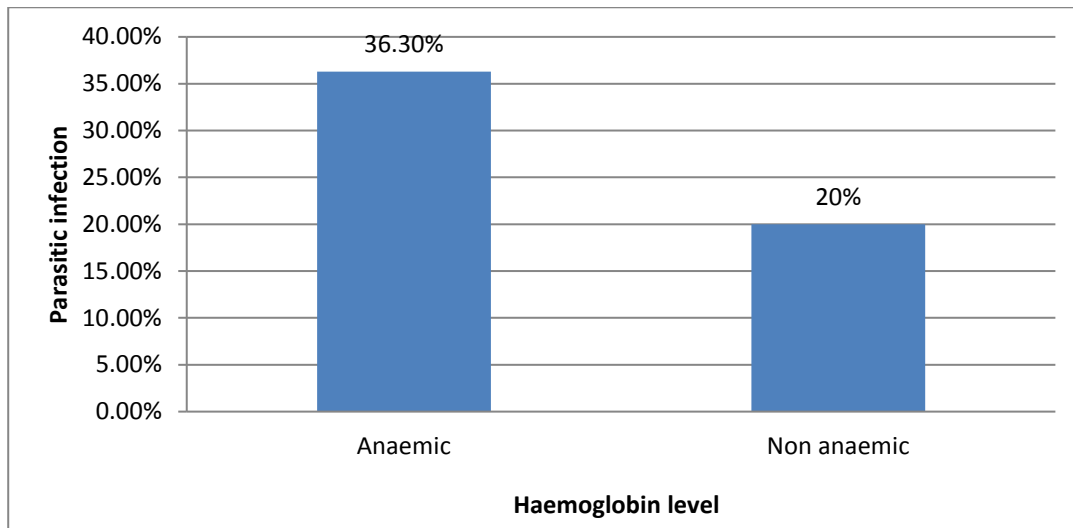
Among 58 positive cases, 51(88%) included infection with single parasite, and 7(12%) were infected by two species of parasites. The occurrence co-infection of *Ascaris* and Hookworm infection was more prevalent i.e. 4(57.1%) than infection of *A. lumbricoides* and *T. trichiura*, *A. lumbricoides* and *H. nana*, and *E. histolytica* and *G. lamblia* in which one case was observed in each (14.3%). Among infected samples, almost two-third of the parasites belonged to helminthes parasites 44(67.7%) whereas protozoan in one-third of parasite 21(32.3%) (Table 1).

**Table 1.** Prevalence of specific intestinal parasitic infection in pregnant women (N=58).

Parasites	Frequency	Percentage
<b>Protozoan parasites</b>		
<i>Giardia lamblia</i>	14	21.5%
<i>Entamoeba histolytica</i>	7	10.7%
<b>Nematodes</b>		
<i>A. lumbricoides</i>	21	32.3%
Hookworm	17	26.1%
<i>T. trichiura</i>	4	6.15%
<i>Strongyloides stercoralis</i>	1	1.5%
<b>Cestodes</b>		
<i>Hymenolepis nana</i>	1	1.5%

There was a significant association of anaemia with intestinal parasitic infection ( $p < 0.008$ ). The haemoglobin level of 110(55%) of the study population were anaemic. Among these anaemic pregnant women, 40(36.3%) of them had parasitic infection. Similarly the haemoglobin level of

remaining 90(45%) cases were within normal range, and only 18(20%) of them were infected with intestinal parasites (Figure 1).



**Figure 1.** Prevalence of parasitic infection in anaemic and non anaemic pregnant women

However, the mean Hb level of pregnant women without any parasites was  $11.1 \pm 1.5$  gm/dl whereas with multiple infections recorded the lowest mean Hb levels of  $9.81 \pm 0.84$  gm/dl (moderate anaemia). The mean Hb levels of pregnant women who were with single parasitic infection were  $10.4 \pm 1.80$  gm/dl (mild anaemia). Using the one-way ANOVA test, there was a significant difference within the groups ( $p < 0.008$ ).

**Table 2.** Prevalence of anaemia within different specific species of intestinal parasites

Species	Haemoglobin level	
	Anaemia	Non-anaemia
<i>Giardia lamblia</i>	9(69.2 %)	4 (30.8%)
<i>Entamoeba histolytica</i>	1(16.7%)	5 (83.3%)
<i>A. lumbricoides</i>	11(73.3%)	4 (26.7%)
Hookworm	10(76.9%)	3 (23.1%)
<i>T. trichiura</i>	2 (66.7%)	1 (33.3%)
<i>Strongyloides stercoralis</i>	1 (100%)	-
Multiple-infection	6(85.7%)	1 (14.3%)

Table 2 shows the prevalence of anaemia within the different specific species of Intestinal Parasites. Among those infected with Hookworm 10(76.9%) of them were anaemic. Similarly, in case of pregnant women who were infected with *A. lumbricoides* 11(73.3%), *Giardia lamblia* 9(69.2%), *T. trichiura* 2(66.7%) and *Strongyloides stercoralis* 1(100%) of them were anaemic. Additionally, 6(85.7%) of dual infection was affected with anaemia. In contrast to those, infected with *Entamoeba histolytica*, only 1(16.7%) were anaemic case.

## Discussion and Conclusion

Intestinal parasites are worldwide in distribution. Poverty, illiteracy and different aspects of culture may play leading role in increasing rate of prevalence of parasites. Among 200 stool samples collected from the pregnant women, 58(29%) were infected by at least one type of intestinal parasites. This high rate of prevalence among pregnant women may be associated with unsanitary living style, poor socio-economic condition, usual contact with soil and consumption of vegetables, fruit and water contaminated with infected faeces, walking bare foot in faecal contaminated open area which was not considered in this study.

Overall prevalence rate of IPI among pregnant women showed comparatively less than several studies which showed higher rate (Nauvilsky et al. 1998, Dreyfuss et al. 2000, Rodriguez-Morales et al. 2005 and Shah and Baig 2005). Comparable prevalence of IPI was, however reported in some other studies (Vaidya and Acharya 1998, Ozumba et al. 2005, Fuseini et al. 2010 and Sehgal et al. 2010). This might be due to the difference in geographical location and economic status. Rai et al. (1994) concluded that the annual rate of positivity for STH ranged from 18.0-36.6%. The factors influencing soil transmitted helminth infection includes natural factors such as temperature and humidity and socio-ecological factors, structure of dwelling, life style, and habits of food consumption.

In this study seven different types of specific intestinal parasites were found which were *A. lumbricoides* (32.3%), Hookworm (26.1%), *Giardia lamblia* (21.5%), *Entamoeba histolytica* (10.7%), *T. trichiura* (6.15%), *Strongyloides stercoralis* (1.5%) and *H. nana* (1.51). *Ascaris lumbricoides* was the leading parasite followed by Hookworm. All these parasites had also been reported from Terai area Sarlahi District (Nauvilsky et al. 1998), in hilly area i.e. Dhankuta District (Shah and Baig 2005), in Venezuela (Rodriguez-Morales et al. 2005). The occurrence of helminthic infection at high rates among pregnant women is an indicative of faecal pollution of soil, domestic water supply around homes due to poor sanitation, ignorance of the mode of transmission of these worms and improper utilization of latrine and poor personal hygiene among the study population.

The present study had shown *A. lumbricoides* (32.3%) as the most prevalent intestinal helminth parasite followed by Hookworm (26.1%). This result is in agreement with that reported previously (Abebe et al. 2008, Van Eijik et al. 2009 and Rai et al. 1994) which also showed *A. lumbricoides* as the most prevalent helminth followed by Hookworm.

The result of this study was in favour with Navilsky et al. (1998) and Dreyfuss et al. (2000) that Hookworms were the stronger predictors of anaemia in pregnant women and Hookworm as the most prevalent helminth parasite in anaemic pregnant women (Nauvilsky et al. 1998, Shah and Baig 2005). General specific prevalence of Hookworm (26.1%) was relatively the second most common parasite species identified in this study. This prevalence rate is low when compared with the value from other studies in various parts of the country both now and in the past. Navilsky et al. (1998) reported infection rate of 78.8% in rural plain of Nepal, Dreyfuss et al. (2000) reported 74.2% in the plain of Nepal, and Kunwar et al. (2006) reported 53% in Himalayan region of Nepal. Comparable prevalence of Hookworm was reported in Vidya and Acharya (1998) study only 15.7% in Maternity Hospital, Kathmandu. Poor sanitary disposal of human faeces and indiscriminate defecation are the principal factors in the etiology of Hookworm infection (Mordi and Ngwodo 2007). However, the high prevalence of intestinal nematode recorded in this study indicates high level of unhygienic practices which enhanced transmission in the community.

This study had shown 110(55%) pregnant women attending antenatal care at KZH were anaemic patient, among those anaemic pregnant women 40(36.3%) had parasitic infection, while 90(45%) pregnant women were non-anaemic with 18(20%) among them with parasitic infection. The prevalence rate shows the association of anaemia with intestinal parasite was statistically significant ( $p=0.008$ ). Pregnant women having multiple infections showed the lowest mean Hb levels of  $9.81 \pm$

0.84 gm/dl (moderate anemia) while the mean Hb levels of pregnant women infected with single parasite was  $10.4 \pm 1.80$  gm/dl (mild anaemia).

There are many studies on anaemia, both hospitals based and community based in pregnancy in Nepal, which are comparable to the result of this study. In hospital based study done by Bonevik et al. (2000) showed prevalence of anemia 62.2% in Kathmandu, while Adak and Nazri in 2006 showed 54.6% in another study conducted in young girls and pregnant women of Birgunj, and study conducted by Marahatta in 2009 showed 42.6% in NMCTH. Similarly high prevalence (50% - 60%) (Ulstein et al. 1988) of anaemia were noted in various community based studies particularly important studied carried out by Shah and Gupta (2002) showed that prevalence of anaemia in adolescent girls in Dharan, a town in eastern region of the country was 68.8%. The probable reason for low proportion of women with anemia in our study may be due to the fact that this study is hospital based study which is located in the city. The women who come for antenatal care to the hospital are slightly better informed with good health awareness. Although we cannot generalize the results of this study to the overall prevalence of anemia in this region but can envisage that the real prevalence of anemia in this area could be much higher.

In conclusion, the prevalence of IPI and anaemia in pregnant women varies greatly for asymptomatic infection to severe infection. The effect depends on parasitic load and immune status of the pregnant women. Based on results obtained from this study, we would like to recommend for early diagnosis and treatment of IPI and anaemia in order to maintain proper health among pregnant women.

### Acknowledgements

We are greatly thankful to all pregnant women who participated in this study and sincere thanks to Koshi Zonal Hospital for providing Laboratory facilities for the microscopic observation. We are also extremely thankful to Mr. Rajesh Chaudhary and all staff of KZH, for every kind of assistance.

### References

- Abebe, Y., Bogale, A., Hambidge, M., Stoecker, J., Arbide, I., Teshome, A., et al. 2008. Inadequate intakes of dietary zinc among pregnant women from subsistent households in Sidama, Southern Ethiopia. *Public Health Nutrition* **11**(4): 379- 386.
- Adak, M. and Nazri, S. 2006. Prevalence of anaemia among young girls and pregnant women of Birgunj, Nepal. *Journal of Institute of Medicine* **28**(2): 1993-2979.
- Bondevik, G.T., Ulstein, M., Lie, R.T., Rana, G. and Kvale, G. 2000. The prevalence of anemia in pregnant Nepali women- a study in Kathmandu. *Acta Obstetriciat Gynecologica Scandinavica* **79**(5): 341-349.
- Brooker, S., Hotez, P.J. and Bundy, D.A.P. 2008. Hookworm- Related Anaemia among Pregnant women: A Systemic Review. *PloS Neglected Tropical Diseases* **2**(9): e 291.
- Crompton, D.W.T. 2000. The Public health significance of Hookworm Disease. *Parasitology* **121**: s39-50.
- Dreyfuss, M.L., Stoltzfus, R.J., Shrestha, J.B., Pradhan, E.K., Leclercq S.C., Khatry, S.K., et al. 2000. Hookworms, Malaria and Vitamin A Deficiency contribute to anemia and iron deficiency among pregnant women in the plains of Nepal. *Journal of Nutrition* **130**(10): 2527-2536.
- Fuseini, G., Edoh, D., Kalifa, B.G., Hamid, A.W. and Knight, D. 2010. Parasitic infection and anaemia during pregnancy in the Kassena-Nankana district of Northern Ghana. *Journal of Public Health and Epidemiology* **2**(3): 48-52.

- Kunwar, C.B., Chapagain, R.H., Subba, B., Shrestha, M., Jha, B., Subedi, J., et al. 2006. Occurrence of soil-transmitted helminthes in women at the Himalayan region of Nepal. *Kathmandu University Medical Journal* **4**(4): 444 - 447.
- Magar, D.T., Rai, S.K., Lekhak, B. and Rai, K.R. 2011. Study of parasitic infection among children of Sukumbasi Basti in Karhmandu Valley. *Journal of Nepal Medical Colledge* **13**(1): 7-10.
- Marahatta., R. 2009. Study of anaemia in pregnancy and its outcome in Nepal Medical College Teaching Hospital, Kathmandu,Nepal. *Nepal Medical Colledge Journal* **9**: 270-274.
- Mata, L., 1982. Sociocultural Factors in the Control and Prevention of Parasitic Diseases. *Reviews of Infectious Diseases* **4**: 871-79.
- Montresor, A., Crompton, W., Bundy, A., Hall, A. and Savioli, L. 1998. Guidelines for the evaluation of soil-transmitted helminthiasis and schistosiasis at community level. [http://whqlibdoc.who.int/hq/1998/WHO\\_CTD\\_SIP\\_](http://whqlibdoc.who.int/hq/1998/WHO_CTD_SIP_)
- Mordi, R.M. and Ngwodo, P.O.A. 2007. *African journal of Biotechnology* **6**(19): 2201- 2207.
- Nepal Demographic and Health Survey Fact Sheet (NDHS) (2006). Family Health Division, Department of Health Services, MOH, HMG. Nepal.
- Nauvilsky, R.C., Dreffuss, M.L., Shrestha, J., Khatri, S.K., Stoltzfus, R.J. and Albonico, M. 1998. *Ancylostoma duodenale* is responsible for hookworm infections among pregnant women in the rural plains of Nepal. *Journal parasitology* **84**: 347-651.
- Oziumba, U.C., Nwora, A.O. and Samuel, A. 2005. Helminthiasis in pregenancy in Enegu, Nigeria. *Journal of Health Science* **51**(3): 291-293.
- Quihui, L., Valencia, M.E., Crompton, D.W., Phillips, S., Hagan, P., Morales, G. 2006. Role of the employment status and education of mothers in the preva lence of intestinal parasitic infections in Mexican rural school children. *BMC Public Health* **6**: 225.
- Rai, S.K., Kubo, T., Nakamishi, M., Sumi, K., Shibata, H., Matsuoka, A., et al. 1994. Status of Soil Transmitted Helminthic infection in Nepal. *The Journal of Japanese Association of infectious Disease* **68**(5): 625-630.
- Rodriguez-Morales, A.J., Barbella, R.A., Case, C., Arria, M., Ravelo, M., Perez, H., et al. 2005. Intestinal Parasitic Infections Among Pregnant Women in Venezuela. *Infectious Diseases in Obstetrics and Gynecology* 2006: 1-5.
- Sehgal, R., Reddy, G.V., Verweij, J.J. and Subba Rao, A.V. 2010. Prevalence of intestina parasitic infections among school children and pregnant women in a low socio-economic area, Chandigarh, North India. *Reviews in Infection* **1**(2): 100-103.
- Shah, B.K. and Baig, L.A. 2005. Association of anemia with parasitic infestation in pregnant Nepalese women: results from a hospital-based study done in eastern Nepal. *Journal of Ayub Medical Colledge, Abbottabad* **17**(1): 5-9.
- Shah, B.K. and Gupta, P. 2002. Weekly versus daily iron and folic acid supplementation in adolescent Nepalese girls. *Archives of Adolescent Pediatric Medicine* **156**(2): 131-5.
- Stephenson, L.S., Holland, C.V. and Cooper, E.S. 2000. The Public Health significance of *Trichuris trichira*. *Parasitology* **121**: s73-95.
- Ulstein, M., Rana, G., Yangzom, K., Gurung, R., Karki, A., Gurung, G., et al. 1988. Some fetal and pregnancy parameters in Nepal. *Acta Obstetriciat Gynecologica Scandinavica* **67**: 47-52.

- Vaidya, U. and Acharya, G. 1998. Parasitic infection among pregnant women: A hospital based study. *Journal Of the Nepal Association for Medical Laboratory Sciences* **1**: 59-60.
- Van Eijk, A.M., Lindblade, K.A., Odhiambo, F., Peterson, E., Rosen, D.H., Karanja, D., et al. 2009. Geohelminth Infections among Pregnant Women in Rural Western Kenya;a cross-sectional study. *PLoS Neglected Tropical Diseases* **3**(1): e370.
- World Health Organization. 1987. Public health significance of intestinal parasitic infections. *Bulletin of the World Health Organization* **65**(5): 575-588.
- World Health Organization. 1992. The prevalence of anaemia in women: a tabulation of available information, 2<sup>nd</sup> Ed., Geneva: WHO.
- World Health Organization. 1994. Report of the WHO informal consultation on hookworm infection and anaemia in Girls and women. WHO/CDC/IPI/95.1. WHO, Geneva, Switzerland.
- World Health Organization, UNICEF & UNU. 1998. Iron Deficiency: Indicators for Assessment and Strategies for Prevention. World Health Organization, Geneva.
- World Health Organization. 1999. Monitoring Helminth Control Programmes (WHO/CDC/SIP/99.3). Guidelines for monitoring the impact of control programmes aimed at reducing morbidity caused by soil-transmitted helminthes and schistosomes, with particular reference to school-age children, WHO, Geneva, Switzerland.
- World Health Organization. 2000. Nutrition in South-East Asia. New Delhi, WHO. Regional Office for South-East Asia: New Delhi.

# Semi-intensive Fish Farming in Madhyapur Thimi, Kamerotar, Bhaktapur

Bikash Prajapati and Surya Ratna Gubhaju

Central Department of Zoology, Tribhuvan University, Kirtipur, Kathmandu, Nepal

## Abstract

The physico-chemical parameters like temperature, transparency, water depth, pH, dissolved oxygen (DO), carbon dioxide and alkalinity of pond water were recorded to range between 18 – 28 °C, 18 – 21 cm, 46 - 95 cm, 6.7- 7.5, 4.7 - 8.5 ppm, 5.0 - 17.6 ppm and 24 - 32 ppm respectively. Exotic carps like 3000 common carps, 3000 grass carps and 4000 silver carps were released into ponds with the average weight and length of all fishes about 8.0 gm and 4.0 cm. The average weight of fishes were 740 gm, 700 gm and 630 gm of silver carp, common carp and grass carp respectively at a time of harvesting. The average lengths of silver carp, grass carp and common carp were 35 cm, 25 cm and 22 cm respectively. The specific growth rate (SGR) of experimental fishes were ranging from 0.421 – 0.437 %. Only 15% of total fishes survived with a total weight of 1050 kg. The condition factor of silver carp was found highest after one month of fish release in the pond (12.5) and dropped consistently in second (8.2) and third months (3.4). From fourth to ninth months, the condition factors were recorded more or less similar ranging from 1.5 to 1.9.

**Key words:** Aquaculture, Carps, DO, Fish culture, SGR

## Introduction

Aquaculture is the fastest growing food producing sector in the world and it is responsible for approximately 50% of all human consumed fish (Diana 2009). Fish culture of both indigenous and exotic species is practiced in Nepal also and the area under fish culture is expanding with improved technology inputs intensifying production and higher yields. Aquaculture sector had seen a marked increase in production in Nepal over the last 40 years (Pradhan 2013).

The expansion of fish culture will certainly increase the availability of animal protein rich food along with socio-economic development among rural communities. In Nepal, semi intensive aquaculture package is suitable for local poor communities utilizing indigenous knowledge of management and local low cost inputs. The system is more appropriate for rural aquaculture to satisfy the needs of small scale farming households and poor consumers (Edwards and Demaine 1988). Aquaculture will help to integrate rural development by generating employment opportunities for many unemployed and under employed people in the rural areas of developing country. Aquaculture in ponds seemed to have emerged as the most popular and viable activity in the overall aquaculture development endeavor in the Asian region, particularly in poor country like Nepal where people are undernourished. Several small aquaculture projects in the country have had positive results regarding issues such as income generation and women empowerment (Bhujel et al. 2008).

## Materials and Methods

The experiment was performed at Madhyapur Thimi, Kamerotar. It lies at the altitude of about 1300 m above sea level. The total fish farms area covered about 0.13 ha with 3 ponds and total water surface area of about 0.1 ha. Remaining area close to ponds was used for vegetable growth like tomato. The farm is supplied with boring water. Exotic carps like 3000 common carps (*Cyprinus carpio*), 3000 grass carps (*Ctenopharyngodon idella*) and 4000 silver carps (*Hypophthalmichthys molitrix*) were released into ponds with the average weight and length of all fishes about 8.0 gm and 4.0 cm. The fish were fed with the rice bran, soybean oil cake and wheat flour along with banana

leaves and locally available grass species at 3-5% body weight. In this study, about 640 kg feed was prepared for the carps. The fishes are also given blood of cattles to increase the protein level in food from nearby slaughter house. The cost of feed was about Rs. 28/kg. The total cost of feed was Rs. 15000. The carps were given 40% of protein during fry and fingerling stage and 25% during grow out stage. In April 2013, 75 ducks were also reared in the farm to supply organic manure in the ponds.

The physico-chemical parameters such as temperature, transparency, dissolved oxygen, hardness, pH of water and growth measurement of fishes were recorded every month. For growth measurement, few fishes were collected with the help of a scoop - length and weight was measured with the help of a meter scale and weighing balance. After measurement, all fish were released into the respective ponds. The condition factor of highest growth fish (Silver carp) was calculated from the relation of length and weight.

## Results

### Physico-chemical parameters

The water temperature ranged between 18-29°C whereas air temperature ranged between 18-29°C. The monthly variations of average water transparency were not very high ranging from 18 to 21 cm, but variations of water depth was significantly high ranging from 46 – 95 cm in the month of June and July. DO ranged from 4.7 to 8.5 ppm; the lowest DO was recorded in May and highest in July. There was slight monthly variation in pH throughout the study period and the highest pH was found in early August which might be due to the increased photosynthetic activities of phytoplankton growth. The total alkalinity and free carbon dioxide were found to be between 20-35 ppm and 6.0 to 17.6 ppm respectively (Table 1).

**Table 1.** Monthly variation of Physicochemical Parameters

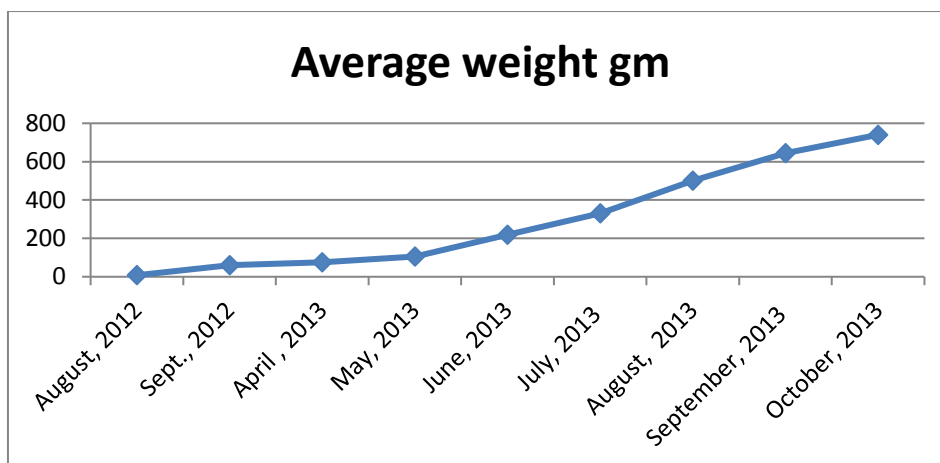
Parameters	2012		2013						
	Aug	Sept	April	May	June	July	Aug.	Sept	Oct.
Air Temp (°C)	21	23	25	28	27	20	18	21	20
Water Temp (°C)	20	24	27	29	28	21	19	23	18
Depth (cm)	50	48	48	53	46	95	90	84	60
Transparency (cm)	18	19	20	18.7	21	18	18.5	20	21
Dissolved Oxygen	6.9	4.9	5.8	4.7	7.3	8.5	6.0	5.3	6.2
Free CO <sub>2</sub> (ppm)	15	9	13	8	6	7.1	10.2	9.7	17.6
Total Alkalinity (ppm)	20	23	30	35	26	29	32	27	31
pH	6.9	7.1	7.3	7.2	7.5	7.5	6.7	7.2	6.7

### Growth of Fish

A total of 1050 kg of fishes was harvested at the end of study. Average weight of silver carps grass carps and common carps reached 840 gm, 630 gm and 700 gm respectively. The specific growth rate (SGR) of experimental fishes were ranging from 0.421 – 0.437 %. The average lengths of silver carp, grass carp and common carp were 35 cm, 25 cm and 22 cm respectively (Table 2 and 3).

**Table 2.** Average growth of fish

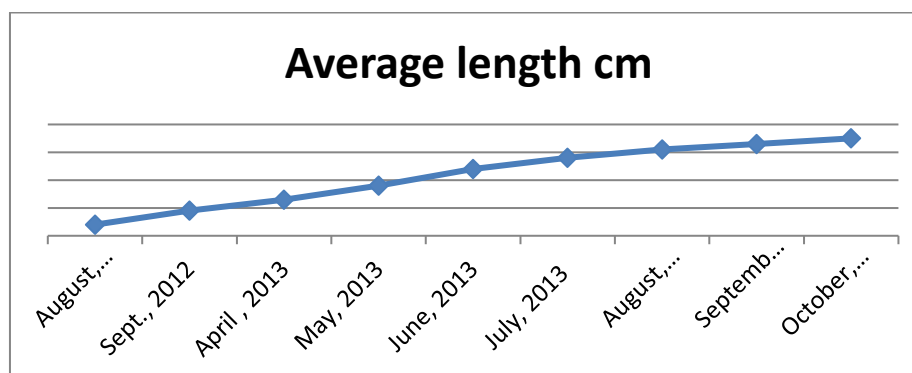
Fish species	Average wt at stocking (gm)	Average wt at harvesting (gm)	Average growth /day (gm)	SGR %
Common carp	8	700	1.53	0.431
Silver carp	8	740	1.62	0.437
Grass carp	8	630	1.38	0.421



**Figure 1.** Average weight of Silver carp

**Table 3.** Average length of fish

Fish species	Average Length stocking (cm)	Average Length harvesting (cm)
Common carp	4	22
Silver carp	4	35
Grass carp	4	25



**Figure 2.** Average length of Silver carp

### Condition factor

The condition factor of silver carp was found highest after one month of fish release in the pond (12.5) and dropped consistently in second (8.2) and third months (3.4). From fourth to ninth months, the condition factors were recorded more or less similar ranging from 1.5 to 1.9 (Table 4).

**Table 4.** Condition factor for carp (Silver carp)

Month	Average length (cm)	Average weight (gm)	Condition factor
August, 2012	4	8	12.5
Sept., 2012	9	60	8.2
April, 2013	13	75	3.4
May, 2013	18	105	1.8
June, 2013	24	219	1.6
July, 2013	28	330	1.5
August, 2013	31	500	1.6
September, 2013	33	645	1.8
October, 2013	35	740	1.9

## Discussion

### Physico-chemical parameters

The water temperature of experimental ponds was found to range from 18 - 29°C and it was within optimum range for all the experimental exotic carps studied. Water temperature did not affect adversely the feeding pattern and growth of fish. The DO was found to be between 4.7 to 8.5 ppm which was ideal for the growth of the fish. Dissolved oxygen is by far the most important parameters in aquaculture. Low dissolved oxygen levels are responsible for high fish kills. Chakraborty (2009) stated DO of 3.1 - 5.6 ppm is good for fish growth and productivity. Carbon dioxide is commonly found in water from photosynthesis. Fish can tolerate concentrations of 10 ppm provided dissolved oxygen is high (Swann and LaDon 1990). The concentration of free CO<sub>2</sub> ranged between 6.0 to 17.6 ppm which was not hampering growth of fish in the present study. Alkalinity neutralizes acids without an increase in pH. This parameter is a measure of the bases, bicarbonates and carbonates. The alkalinity of the pond was found between 20 to 35 ppm which was also within permissible level. Similarly the pH ranged from 6.7 to 7.5.

### Growth and survival of carps

Nearly about 3000 common carps, 3000 grass carps and 4000 silver carps were reared. Only 15% of total fishes survived at the end with nearly 1050 kg of fishes were harvested. The survival rate could have increased if fencing for snakes and other predatory birds maintained.

The average weight of fishes were 740 gm, 700 gm and 630 gm of silver carp, common carp and grass carp respectively at the time of harvesting. The average lengths of silver carp, grass carp and common carp were 35 cm, 25 cm and 22 cm respectively. The specific growth rate (SGR) of experimental fishes were ranging from 0.421 – 0.437 %. Toyub et al. (2010) reported that the specific growth rate of *H. molitrix* was determined 0.21 to 2.84 fed on fishmeal and mustard oil cake. Similarly, the growth studies carried out in India and other countries have indicated that daily weight gains of grass carp vary from 1.7 to 14.7 gd<sup>-1</sup> (Chander and Madan 1984).

The high mortality in experimental fishes was recorded in present study. The survival of the fish depends on the stocking density, good feed-water supply and oxygen content. The growth rate is also influenced by physiochemical parameter, biotic factor like population density and availability of food in water. The physico-chemical parameters were found within permissible levels so it can be sorted out as adverse factor. The provision of feed to fishes was also well taken care with providing sufficient protein and other required nutrients.

The release of 10,000 fingerlings in 0.1 ha pond area was extremely high, that is, 100,000 fingerlings in a hectare pond area was not advised in any literature. The harvest of 1050 kg of fishes from 0.1 ha pond area, reaches 10 ton of carps in a hectare. The production 10 ton of carps in a hectare in semi-intensive aquaculture is a promising outcome of study.

## References

- Bhujel, R.C., Shrestha M.K., Pant, J. and Buranrom, S. 2008. Ethnic women in aquaculture in Nepal Development **51**: 259-264.
- Chakraborty, B.K., and Miraza, M.J.A. 2009. Effects of stocking density on survival and growth of endangered bata, *L. bata* (Hamilton-Buchanan) in nursery ponds. Aquaculture Res. **35**, 548-556.
- Chandra, J. and Madan, M.L. 1994. Studies on the growth of grass carp *C. idealla* (Val) fed on cattle yard fodder waste under composite fish culture J. Filand Fish, Soc. India, **16**: 1. 6
- Diana, J.S. 2009: Aquaculture production and biodiversity conservation Bioscience **59**: 27-29.

Edwards, P, Demaine, H. 1997. Rural Aquaculture: Overview and framework for country review. FAO of the United Nation/Regional office for Asia and the Pacific (FAO/RAP). Bangkok, 61PP FAO/RAP Publication No.36

Pradhan, G. 2013. National aquaculture sector overview Nepal-National aquaculture sector overview fact sheets. Retrieved March 25, 2013 from: <http://www.far.org/fishery/country> sector/FI-(P NP/en).

Swann, L. 1990. A fish farmer's Guide to understanding water quality, Aquaculture Network Information Centre (<http://aquanics.org>/Purdue University, West Lafayette, Indiana)

Toyub, M.A., Miah, M.I. and Habib, M.B.A. 2010. A research on growth performance of *H. molitrix* and *Barilius gonionotus* fingerlings by feeding microalgae cultured on fertilizer factory effluent, Bangladesh Journal of scientific and Industrial Research 45.