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## CHALLENGES OF FRESHWATER FISHERIES IN NEPAL: A SHORT OVERVIEW

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### Abstracts

Abundant freshwater resources originated from Himalayas and high geographical variations in Nepal are two factors which might be positive benefits to improve the aquaculture in land locked country. Low labor cost is also another plus point to get better management in fisheries sector. Freshwater fisheries in Nepal are mostly dominated by catch up fisheries of indigenous fish species available in rivers, lakes and paddy fields but exotic and sophisticated species been also introduced in small scales. Beside these, poly cultural pond fish farming is most viable. Carp fishes are the major species and uncontrolled unmanaged capture fisheries dominants over systematic aquaculture. Poor technological implementations, poor budgetary plan, not proper management strategies, lack of quality fish feed and fingerlins, lower market availability are some of the major challenges of Nepalese freshwater fisheries. Long-term sustainable plan, scientific and technological study on indigenous fish species, proper hygiene management and better disease control might improve the current aquaculture status of Nepal.

Keywords: Aquaculture; Freshwater Fisheries; Challenges; Nepal

### Introduction

Nepal, a landlocked country, has large numbers of rivers and fresh water lakes. Water supply to these fresh water bodies are melting snows of Himalayas. There are a lot of water resources in Nepal with about 6,000 rivers flowing north to south. These rivers are characterized by low water temperature, high dissolved oxygen, high turbulent fast current in higher mountainous and hilly region. On the other hand, high water temperature, low dissolved oxygen, low turbulence is normal for the river in *Terai* (low land) region (Petr, 1999). There are many inland water resources like water reservoir, lakes, rivers, fish ponds, irrigated field and marginal swams suitable for aquaculture and fisheries development and it has been noted that improvement of fish farming and aquaculture was done by government of Nepal in recent times with the help of international agencies like ADB, UNDP, JICA, FAO etc. (Shrestha, 1999).

Due to high geographical variation, more than 182 fresh water indigenous and exotic fish species have been found in Nepal (Shrestha, 1999; Shrestha, 2001; Subba and Ghosh, 1996). Talking about history, it is difficult to find the exact history for introduction to systematic fisheries in Nepal. Aquaculture practices are quiet new trend but it starts with pond culture of Indian carps (FAO, 2012). Paddy field aquaculture practice was started in 1960s (FAO, 2012). There was initiation of aquaculture programme in 1972 by

Nepal government in Phewa lake of Pokhara and implementation of participatory approach of fisheries management improved the production and economic income of poor people (Gurung *et al.*, 2005). It has been mentioned that for salmonoid species there was unsuccessful attempts for Atlantic salmon, rainbow trout, brown trout and sockeye salmon before 1988. Afterwards breeding, rearing and production of rainbow trout have been successful with gradual improvement in technological and production practices (Gurung and Basnet, 2003). There are several new rainbow trout farms, which are emerging now so it necessitates the commercial and technological production of trout (Gurung, 2008) and other fish. It has been found and suggested by many previous studies (Rai *et al.*, 2008) and practical implementation of participatory management (Gurung *et al.*, 2005) improves the economic status and living standards of fisher man's family. So this makes fisheries important incomes sources and they need to be improve. This paper will give overview of history and present status of fresh water fisheries with their major challenges in Nepal. In addition, some suggestions and comment has given in authors perspectives.

### Water Resources and Human Resources

Taking about farming systems it differs between different water resources like rivers, lakes, fish ponds, swamps, paddy fields or water reservoir. Water areas covered by

different water resources for fish are presented in table 1. Rivers, lakes and reservoir and paddy fields are the major water resources. Village ponds are in very small amount they covers only 0.8 % of total water area. The cold freshwater resource is highly abundant and Nepal is one of the major countries for cold freshwater resources (Rai *et al.*, 2008).

**Table 1:** Distribution of water resources area for fish farming. These all water bodies for fish will covers 3 % of total surface area of Nepal.

Water resources	% of total water area
Rivers, lakes and reservoir	48.8
paddy fields	49
Swamps around irrigated field	1.4
Village ponds	0.8

(Source: Shrestha, 1999)

Going abroad for employment is common practices in Nepal and economic status is shifted from agriculture based economy to remittance based economy. If agricultural sector along with fisheries production will increase the production value, this may increase the job opportunities for Nepali people and migration rate will be lowered. It was suggested that there was three to five fold increase of fisherman from 1980 to 2005 in Nepal due to population growth (Gurung *et al.*, 2005). Due to increase in aquatic activity 504,000 people are employed and 741,000 people are benefited in 2003/2004 (FAO, 2012). Also number of farmers for trout production by raceway culture in mid hill area are also increasing every year (Swar, 2008). Increasing the involvement of community based organization for legal matters, support service, market and delivery service matters increases more people to engage in this sector. Now 3 % of total population are involved to fishing and aquaculture productions (FAO, 2012).

### Important Fish Species

Economically most valuable indigenous species are katle (*Neolissochelius hexagonolepis*), Chuchee asala (*Schizothoracichthys spp.*), Snow trout (*Schizothorax spp.*) locally also known as asala, mahseer (*Tor spp.*). *Schizothorax moleshowrthii* and *S. progastus* are considered as delicious fish in Nepal. Snow trout are herbivorous but *Tor spp.* are omnivorous. High altitude lakes in Himalayas are characterized by snow trout fish also there are some undescribed species of snow trout are found in these lakes. There was successful artificial rearing for the species *N. hexagonolepis*, *Tor tor*, *T. punitora*, *Schizothorax spp.* by stripping the pituitary secretion (Shrestha, 1999). These and other different species might be commercially important for rearing and aquaculture development and production. There are other indigenous fish species possible for commercial production. Species like karange (*Puntius chilinooides*), gurdi (*Labeo dero*), Jalkapur (*Clupisoma garuwa*), Fageta (*Barillius spp.*) (Shrestha, 1999) etc. are

tasty but consumed at local level without aquaculture knowledge and management.

Rainbow trout, grass carp, common carp, bighead carp, silver carp were introduced from different country in Nepal (Gurung and Basnet, 2003; Shrestha, 1999; Swar, 2008; FAO, 2012). Successful breeding in captivity of Chinese exotic fish silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Aristichthys nobilis*) and grass carp (*Ctenopharyngodon idellus*) was the great achievement in Nepali aquaculture sector. Common carp (*Cyprinus carpio*) farming gets popular in private sector after successful breeding. Breeding of three commercial indigenous carp rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigala*) and catla (*Catla catla*) was also successful with important commercial value (FAO, 2012). Now there are pond and cage culture practices for carps in private sector.

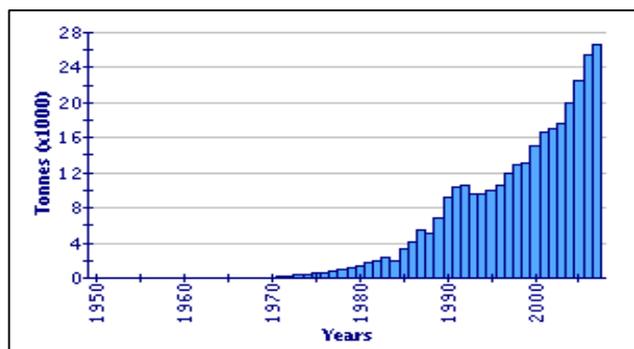
### Farming Systems, Fishing Methods and Production Statistics

Inland waters are the only way of farming in Nepal. Poly culture pond carp farming is the viable and common fisheries in Nepal (FAO, 2012). More than 95 % of total fish production is contributed by carp fishes (Gurung and Basnet, 2003; FAO, 2012). Capture fisheries dominants but they are not well organized and controlled. The gear for fishing are traditional and there are no available statistics relative to number of fisherman dependent on traditional fishing (Shrestha, 1999). Nets, bembo traps, rod and line are some traditional way of fishing but there are also some non-indigenous method like poisoning and blasting the explosives have been practicing by capture fisheries (Shrestha, 1999). Pond aquaculture is supported by Asian Development Bank (ADB) and United Nation Development Programme (UNDP). Cage culture in reservoir and lakes are also in successive pathway with the help of FAO/UNDP and International Development Research Centre, Canada (FAO, 2012). Rice – fish culture is also potential culture systems for commercial production but less practiced (FAO, 2012).

Now a day's cage farming is also increasing in some lakes and there is very low data available on capture amount because they are not economically traded in market but consumed locally in community. The annual trout production was about 16 to 17 metric ton (Mt.) and increasing each year (Swar, 2008). Annual production of total fish in Nepal was only 3,530 tons in 1981/82 which increases to 21,879 tons in 1995/96 (Shrestha, 1999). Increasing trend of fish production is also shown by figure 1. There is continuous increase of fish production from 1970 to 2000. Total fish production was 42,463 Mt. with 47 % from capture fisheries (Swar, 2008). Over 2 % of domestic gross production of agricultural product is contributed by aquaculture production in 2003/2004 (FAO, 2012).

In year 2009/2010 total production was 49,730 Mt., contributed 28,230 Mt. by aquaculture production and

21,500 Mt. by capture fisheries (MOAC, 2010). There is increasing trend of fish production per area of pond culture from 1714 Kg/hectar area (Ha) in 1991/92 to 2577 Kg/Ha in 2000/01 and finally to 3604 Kg/Ha in 2009/10 (MOAC, 2010).



**Fig. 1:** Fisheries production statistics from 1950. (Source: FAO, 2012)

### Trade and economy

All fish produced are sold as fresh fish in market or kept by preservation techniques smoking and sundrying due to lack of fish processing factory. Also market demand and consumption are not well studied (Shrestha, 1999) but major fish to fulfill market demand comes from India and China (Dahal, 1998; Shrestha, 1999). The consumption of fish is very low 2 kg per capita in Nepal as compared to 5 kg per capita in India and 25 Kg per capita in China (Bhujhel, 2009). Price of exotic and important commercial species rainbow trout is comparatively higher than local species (Rai *et al.*, 2008). The market demands for indigenous and exotic fish are high and insufficient from internal production of country. Fish are perishable food so they should be kept in freezing or chilling condition or should be marketed as soon as possible (Swar, 2008). Exporting is not feasible on the present situation because production even does not meet the demand. There is no organized database in import and export of fresh fishes but there are some fish traders in Nepali fish markets. Fish marketing infrastructures are available in Kathmandu and only some cities. Certification procedure for fresh fishes and labeling systems are not developed but monitoring is done by Municipality consumer's forum and Department of Food Technology and Quality control in random basis. Co-operative way of marketing has been successful but they needs to be wider application and extend the market (FAO, 2012).

### Importance, Management Issues, Developments and Policies

Fishing is one of the important and traditional ways of sustaining for low economic community like tharu, Majhi, Malaha, Dunuwar, Kewat, Bote, Musahar, Mukhiya, Darai, Kumal, Dangar, Jalari and others (Gurung *et al.*, 2005). Development, production strategies and policies for aquaculture are strongly affected by budgetary plan of

country, which targets on production and gross domestic production (GDP) (FAO, 2006). There were some early fish cage culture programme started in 1972 by Nepal Government in collaboration with FAO, UNDP and Ministry of agriculture and co-operatives (Gurung *et al.*, 2005). In 1990s the aid agency from Japan and Nepal government worked together and formulated a plan for prevention of exploitation of water bodies and establishment of efficient type of aquaculture farming for lake, reservoirs and river system fish species. The object of that project was to work for indigenous fish species, establish the raceway fish culture and socio-economic perspective of possible fish production in potential water bodies. Nepal Agriculture Research Council (NARC) is also working for breeding and culturing technology for fish species like rainbow trout (Gurung, 2008). Nepal government established 13 fisheries development centre with four centres dedicated for cold water fishery. Economically important fish were identified and rearing had been started with training for people working for cold water fisheries (Shrestha, 1999). In the Nepal government three year interim plan of 2007/08 to 2010/11 it was given prime importance for fisheries development and sustainable fish production (NPC, 2007). The current fisheries development policies are to increase commercialize production with proper management and conservation of indigenous fish species, also improved marketing network for fresh fisheries product along with good post-harvest techniques (FAO, 2012).

### Challenges of fisheries and fish production

In salmonids rearing and farming disease like fin rot, hepatoma, fungal problems in fertilized eggs, presence of watery fluid in stomach and physical disordered like blunt snout, twisted alevins, abnormal gills, degenerated operculum and blindness were observed by Godawari Fisheries Research Centre during introduction of salmonids like rainbow trout (Gurung and Basnet, 2003).

There is no good technological development in fish and fisheries management. No proper management strategies applied for water bodies' management throughout country for indigenous and other fish but there was a case of successful participatory fisheries management in PhewaLake (Gurung *et al.*, 2005). Lack of skilled and experienced manpower, poor management and unhygienic practice of fish farming are the major cause of disease to fish and failure of commercial high monetary value salmonids aquaculture (Gurung and Basnet, 2003). Also low investment monetary and lack of good quality cage and net material (Gurung *et al.*, 2005) are other challenges of fisheries management in the developing country like Nepal. There are many fish species which would be commercially and economically important but there is lack of research on behavior, propagation, population dynamics and biology of these indigenous species. Availability of fingerlins of exotic

fish like rainbow trout is very low and available only in some region (Rai *et al.*, 2008). Limited supply of nutritional and quality feed are also other bottle neck of aquaculture production. Traditionally fishing is all based on wild fish species and population dynamics of wild population are not well studied in natural water resources like rivers and lakes of Nepal.

Continuous flow of water, maintaining oxygen level, avoiding undesirable pollution residues for fish farming might also be challenging task for good and hygienic fish production. Landslide in hilly region and higher clay and turbid water in some river systems can be problem for aquaculture based on river water systems. No road and transport facilities, lack of electricity, infrastructure in possible sites for aquaculture and aquatic tourism are very frustrating and challenging issues in Nepal.

### Sustainability

Low economic opportunities for local people in hilly area (Shrestha, 1999) high dependency on wild fishing could be the reason for overexploitation of wild fish population. Poly culture techniques and small pond culture fisheries have beneficial effect in people of low income status in hilly area and this opens the door for further improvement and expansion of small scale aquaculture (Bujhel *et al.*, 2010).

Eutrophication of some water bodies like lakes and reservoir due to rainfall, landslide, washing of agricultural farm manure is also an ecological problem for sustainability. But cage fish culture in highly eutrophicated lakes like phewa lakes are beneficial as environmental friendly due to transfer of nitrogen and phosphorus from water load to land through plankton-fish-man way (Gurung *et al.*, 2005).

### Conclusion

Abundant fresh water resources are very poorly utilized in Nepal. Much effort has been made by research institute, international aid agencies, government for aquaculture development but they are limited in terms of high biomass and quality production. Besides these, many private fisheries are running successfully in small scale production making profit. Participatory types of management have been successful in some reservoirs and water systems in many parts of country. In author's perspective, poor scientific knowledge on indigenous fish species, poor and unskilled manpower, lack of transportations and infrastructures, electricity facilities at local level are major problems for sustainable development of aquaculture. Lack of proper post-harvest facilities at local level are challenging issue for expanding the market demand and trade management in national and international market for produced fish. It needs to study on market behavior, interaction of fish with other market commodities, surveillance of consumer preference. They needed to be harmonized with fish production. But lack of concrete

economic plan, policies, low economic status of a people, and political instability affects the market trend and this ultimately makes difference in price of fish produced and consequently the sustainability of those fish producing farms. Research and information regarding fish population dynamics needs to be study for cold water river, lake and reservoir fish. Fingerling availability is limited so it need to be fixed the standard mass production of fingerlins for commercial important species. Fishing method is all based on traditional no emission gears but they are less efficient, less scientific, difficult to control the mesh size etc. Fishing gear should be monitored and controlled by responsible authorities to prevent from over exploitation of fish stock from natural water resources.

Planning of sustainable socio-economic policies is important for good market of agricultural products. It can be suggested that proper long-term and concrete vision of infrastructure development along with scientific study, development on indigenous fish species, hygiene maintain, disease control are important for improvement of production and ultimately economic status of people who are dependent on fishing. Also managing and monitoring the local market, expanding the economic criteria like investment and annual turnover by exporting by producing good quality Nepali fish are some suggestible managerial comments for responsible authorities or person.

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