

Fisheries and Aquaculture Activities in Nepal

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Fish production in Nepal

Nepal lies between India and China. The country touches with India at its southern, western and eastern borders, while the northern boundary is with China. In the south the altitude is about 50 metres above sea level, while at northern end the elevation goes up to the highest peak 8848 m (Mt. Everest) of the world. Being landlocked, the country is deprived of any oceanic resources and overwhelmed by mountains, which comprise about 83% of the total area of 147,181 sq. km. Approximately, 5% of the total area of the country is known to be occupied by different freshwater aquatic habitats¹ where some 186 fish species are reported to thrive². In general, the aquatic habitats and fish species can be viewed as prospects for fisheries and aquaculture development in the country. This also implies that aquatic resources located at different altitude and climatic zones can offer potential for different fisheries and aquaculture activities in Nepal.

Fishing is traditional in Nepal but modern aquaculture techniques for fish production started with the introduction of exotic carps in the early 1950s. To utilize fish resources about fourteen state owned fish farms were established in different parts of the country during 1960-65, where spawning and seed production technologies of carp (*Cyprinus carpio*, *Ctenopharygodon idella*, *Aristichthys nobilis*, *Hypophthalmichthys molitrix*, *Labeo rohita*, *Cirrhinus mrigala* and *Catla catla*) were successfully developed in the warm southern region. At present, technology of subsistence carp farming in ponds has been widely disseminated in the southern part of the country. However, it is necessary to improve productivity by increasing our understanding and increasing inputs. In the 1960s, attempts to introduce trout in the country failed, perhaps due to inadequate technical and management skills. Rainbow trout (*Onchorynchus mykiss*) was later introduced in Nepal in 1989 from Japan³. Now, trout can be successfully propagated and the farming practices are slowly disseminating among the farmers in the mountains.

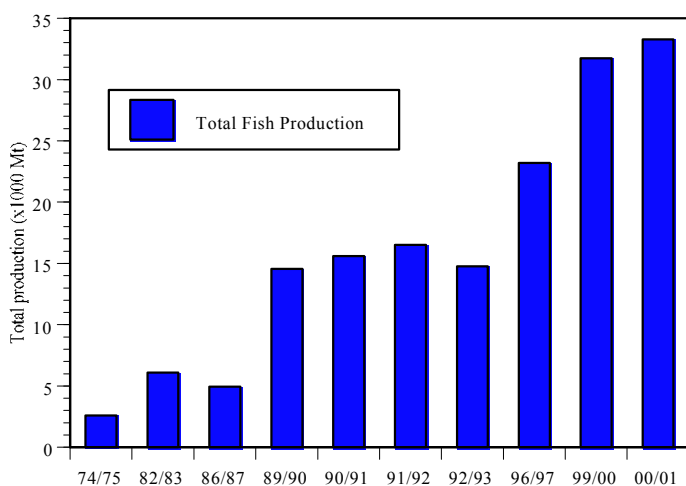


Figure 1

Fishery

The Directorate of Fisheries Development (DOFD) under the Department of Agriculture is one of the main Government organizations for fisheries and aquaculture development. National production was 33,270 metric tonnes of fish in 2001/01 through capture fishery and aquaculture. The data reveal that about 49% of total production is achieved by capture fishery (Fig 1 and Fig 2), where both exotic and indigenous species are caught from different water bodies. It is mostly in the mid-hill lakes and reservoirs where exotic carp contributed higher in capture fishery. However, in rivers and streams the catch of indigenous fish is high as these waters have only very rarely been stocked with exotic fish.

Among the fishes reported from Nepal about 90 species are known from the mountains⁴. It is speculated that this high fish diversity in the country is due to the diverse agro-ecosystem zones providing suitable habitats for different fish species. Since the natural fish stocks may deplete rapidly due to over fishing, and aquatic pollution, efforts should be made for conservation of habitats and fish species by educating local communities. A migratory eel *Anguilla bengalensis* is also found in rivers, lakes and ponds of hill regions. Native fish are known to be disappearing at an alarming rate due to damming, over fishing, destruction of habitats, chemical and physical water pollution^{4,5}. Further studies on native fish populations, their catch and socio-economics of fisher communities depending on fishing can give foresight to develop strategies to sustain and develop the capture fisheries in the country.

Traditional fishing and fisher folk

Traditional fishing is carried out by different methods using cast net, gill net, loop, line and hook and basket⁵. Some unconventional fishing has emerged in recent years using explosives, electricity, and poison, which is destroying the aquatic life indiscriminately. In Nepal, about 142,000 males and

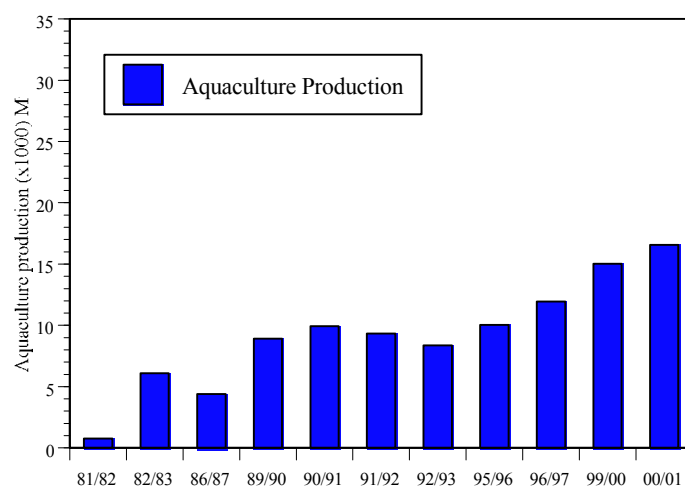


Figure 2

223,000 females depended on subsistence capture fisheries in rivers, lakes and swamps during 2000/01⁷. In the 1980s, people engaged in fisheries were estimated to be about 80,000 (Swar 1980). The recent dramatic increase in the population engaged in capture fishery probably reflects the unemployment due to increased population in the country. Water bodies in Nepal are usually uncontrolled for local access, and usually, the poorest most deprived people are known to harness nearby natural resources such as water bodies or forest for their livelihood. Nowadays, most forests are managed through a community approach involving local inhabitants, for conservation as well as for the benefit from the forest. However, rivers and few natural water bodies have yet been managed in such a way and most remain a “free-for-all”.

A few lakes in the mid-hills have been stocked with cultivable carp for increased production as strategies to reduce the fishing pressure on thinly populated native species without losing the fisher’s employment and income opportunities, until measures for conservation practices of locally vulnerable species are developed. The capture fishery also includes rivers, streams, rice-fields, and swamps. However, rivers and streams were never viewed for commercial aquaculture production or development as recreational fishing grounds. Development of fish sanctuaries for commercial recreational places such as wildlife resorts might help to conserve fisheries resources.

By tradition, Nepalese society has distinctly identified ethnic communities for fishing, which, entirely depend upon fishing and water related occupations such as boating and fishing net mending as a family profession. However, with few exceptions, such traditional occupations are not financially rewarding enough for sustaining a family. The ethnic communities involved for fishing traditionally are the Jalari or Pode, Majhi, Malaha, and Bote. They live in villages near the water resource. The fishing occupation within the caste system by tradition can be attributed both to abundant water resources in the country, and honoring fish as a valuable food resource in past. In general, all



Setting the nets on Lake Rupa, Pokhara

communities in the country accept fish as delicious food and considered auspicious among many communities.

Fish diversity and conservation is one of the neglected areas of research and development in fisheries sector. For conservation of the aquatic life the “Aquatic Conservation Act-1961” was promulgated. However, due to insufficient enforcement, the rules and regulations set out in this act are hardly followed. Poisoning of water bodies for fishing and other destructive fishing practices are known to have increased in recent years^{9,10}, which have not only threatened the aquatic life but also the lives of the people associated with it.

Aquaculture and related research activities in Nepal

There are only a few institutions and limited human resources involved in fisheries and aquaculture research in Nepal. Some of these are Fisheries Research Division of Nepal Agriculture Research Council, (NARC), Tribhuvan University (TU), and RONAST (Royal Nepal Academy of Science and Technology). These institutions have contributed to an understanding of aquaculture, fishery, fish diversity and awareness about fish in Nepal. The credibility of aquaculture expansion in the last 50 years is mainly due to the Ministry of Agriculture and a few international agencies such as Food and Agriculture Organizations of United



For sale: This bighead carp was caught by net from Lake Rupa (above)



Mahseer (*Tor putitora*) broodstock, reared in the pond environment

Nation Development Agencies (FAO/ UNDP), Asian Development Bank (ADB), Japan International Co-operative Agency (JICA), United States Assistance for International Development (USAID), International Development Research Centre (IDRC), Hill Agriculture Research Program of DFID (Department for International Development) for financial and technical support. Considering the potential of fisheries and aquaculture research and development, additional investment with a more autonomous large organization established for decision-making is needed in the country.

Aquaculture in Nepal is predominantly subsistence in type except trout farming. Carps are emphasized to grow as they can sustain on natural food. Fish are cultivated in pond, cage, pen, rice fields and raceways. Presently, the productivity in ponds ranges from 2-3 Mt/year and 3-5 Kg in cage fish farming. According to DOFD the aquaculture production in 1999/2000 reached about 14000 Mt (Fig 2). Carp farming in suitable southern warm water areas contributes the highest aquaculture production in the country, where major fish species used are big head carp (*Aristichthys nobilis*), silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), common carp (*Cyprinus carpio*), rohu (*Labeo rohita*), mrigala (*Cirrihinus mrigala*), and bhakur (*Catla catla*). In the northern cold water region cultivation of rainbow trout has been initiated.

At present the main topics of fisheries and aquaculture research are: development of suitable technological package of sustainable rice-fish farming and studies on a technological package for rearing high value native species such as Himalayan Mahseer (*Tor putitora*), Katle (*Acrossochilus hexagonolepis*), Asala (*Shizothorax* spp), and Magur (*Clarius batrachus*). The major achievement in this area is successful demonstration and community mobilization for rice-fish farming in mid hill mountain¹¹ and captive breeding of pond reared Mahseer¹⁴ (Fig 3). Previously, it was suggested that Mahseer do not mature in captivity but only breed in running waters¹³. At present, up to 0.2 million hatchlings of the species can be produced in the hatcheries (Fig 4). Early

observation showed that Mahseer grow slowly with artificial feeds in experimental tanks¹⁵, but recent experiments showed more encouraging results when early fry were grown in fertilized ponds (Bista et al. in prep). In the near future Mahseer will be examined for polyploidy population production. Recently, semi-natural spawning success of Magur (*Clarius batrachus*) without sacrificing the male has been demonstrated at Pokhara Fisheries Research Center, Nepal¹⁸.

Research on technological package development for rice-fish farming practices in the hills has been recently completed¹⁷. The findings showed that rice-fish farming is one of the simplest and most beneficial approaches to increase the rice and fish production. The study also revealed that rice production was increased by up to 12% in rice-fish integrated plots, despite of the loss of the rice cultivation area through the rice-fish integration for trench construction as life giving system to fish during emergencies such as drought, predation and heat shock (Box-1). As a consequence of the successful research demonstration, rice-fish farming is spreading in many mid hills areas. However, mechanisms of fish seed supply in remote areas have yet to be developed to full functional efficiency. The rice-fish farming technology was known to have started 30-40 years back in Nepal, but inadequate technology such as variety of rice appropriate to use for rice-fish integration, increased use of pesticides, social and technical problems



Fig. 4. About 60 days old Mahseer (*Tor putitora*) fingerlings reared in pond environment



Lake Begnas, Pokhara Valley. Fish farming is just one of many activities for the people here

constrained its rapid adoption. To resolve most of the problems outlined above group or community involvement for scaling up rice-fish farming is now recommended.

Nepalese cage fish farming completely depends on natural productivity of the water bodies. In cages, silver carp (*H. molitrix*) and bighead carp (*A. nobilis*) are used as the main species for production. Sometimes, rohu (*L. rohita*) are stocked in small numbers as they help to keep the cage clean because of their browsing activities for feeding on detritus attached to the cage mesh. The dimension of the cage usually used in Nepal is 5m long, 5m wide and 2m deep. At present the productivity of cage fish culture ranges from 3.0- 5.0 kg per m³. The cage is stocked with 10-20 g size fish at the rate of 10 individuals/m³ for harvesting once a year. The stocked planktivorous fish reach approximately 0.5-1.0 kg each with about 80-90% survival. A collaborative research through farmer's participation for the possibility of productivity enhancement in cage fish culture is ongoing in the lakes of Pokhara and the reservoir at Kulekhani region. Under this study testing of high-density stocking and multiple harvesting in the cage are expected to improve the productivity.

“...usually, the poorest most deprived people are known to harness nearby natural resources such as water bodies or forest for their livelihood.”

The cultivation of reintroduced rainbow trout, after nearly ten years of testing inside the government farms, outreach research with direct farmer's collaboration in three mid-hill districts is now smoothly going on for the possibility of large-scale adoption of trout farming. Relatively, the production cost of trout is higher than for carp even though the market demand at present is increasing day by day in the main urban areas of tourist destinations, which is highly encouraging for trout farmers.

Recently, a research project has been initiated to restore the diminishing Lake Rupa (135 ha) of the Pokhara Valley. Under this project a lake, which is turning into marsh due to silt deposition, is scheduled to be restore to its original condition through engaging the people living around it by establishing a co-operative for lake conservation and income generating fisheries activities. A cooperative comprising of 292 people has been established for the purpose, and a large share of the benefit from fish harvest from the lake will be utilized for cleaning and restoration of the lake. If this lake restoration is successful this model can be applied to other wetlands of the country for restoration, economical, environmental and social benefits.

If abundant water resources and fish diversity could be attributable to higher scope for fisheries and aquaculture development, then it can be concluded that the future potential of fisheries and aquaculture sector is high despite the



Formerly transient fisher-folk have adopted cage culture in Lake Begnas, near Pokhara, Nepal. They have established permanent settlements nearby and their children can now attend school on a regular basis

mostly terrain features of the country from the fisheries perspective. For proper utilization of its aquatic resources investment and skilled human resources are essential. Only a few scientists are engaged in fisheries research. This clearly shows that the social and economic potential of fisheries and aquaculture research remain under a low profile and are yet to adequately recognized and prioritized in national policies.

Future areas of fisheries and aquaculture research

Mountain fisheries and aquaculture for increased production

Fishing plays an important role in providing food and income to the people in the mountain areas. Therefore, fish resources, people and their environment should be integrated for an overall ecosystem and rural development approach.

Intensive aquaculture in southern warm water region

Aquaculture at present provides subsistence employment and income to the nation despite of the higher potentiality. The existing pond aquaculture, which is mostly extensive, can be intensified by for increase productivity. Research should be focused on increasing production by strengthening existing aquaculture practices. Fish species such as prawn and Tilapia should be included for aquaculture production as these species are suitable for the warm water zone of southern terai for their growth and production.

Study on the possibilities of riverine habitat for commercial aquaculture

There are about 6,000 large and small rivers in Nepal, but the fisheries and aquaculture potential in these rivers have not yet been assessed. In many countries, rivers have been used for aquaculture production, and so efforts should be made to assess the riverine potential for aquaculture development.

Indra Gurung of Baradi, Tanahun

Mr. Gurung of Baradi, Tanahun started fish farming in ponds around 1992/93. He also used to farm fish in his rice field without any technical assistant from a research station. He didn't know about the trench and its benefits. When a HARP (Hill Agriculture Research Project) funded project on rice-fish culture was implemented in the Baradi area, he participated as one of the research farmers out of 6 in the area. He started growing fish in his rice field with a proper trench. He recalls when the technicians asked him to dig the trench in the middle of his paddy field. He was not very comfortable with the purpose at that time. But later when the function of the trench in rice – fish farming was explained to him and the importance of having the trench as the 'life saving place' for fish, he agreed to follow the instructions. After the completion of the project, he was convinced with the technology, as he was able to harvest about 12 kg of fish from his 1 Ropani (1 Ropani is 500m²) rice field with no reduction in the rice yield. He then converted his original fishpond (about 3 Ropani) into a paddy field and integrated fish on it in 2000. In the spring of 2001, he harvested about 40 kg of fish and 10 Muri of paddy (no reduction in yield) from the one parcel (about of 2 Ropani) of his rice – fish farm. He is very pleased to have the extra income from integrating fish in his paddy fields almost same as to the total economic value of the paddy. Convinced by the result, he has now extended his rice fish farming to 7 Ropani from this year main season rice. He believes that demonstration of the successful farming is the most convincing tool for other farmers to adopt the technology.

Source: Gautam¹¹

Research on community based riverine fish conservation and development

Conservation and utilization of forest resources through community mobilization is a major success story in Nepal. Research on participatory exploitation of riverine aquatic resources, emphasizing conservation and utilization needs to be carried out.

Study on the lacustrine fishery resources and their restoration

Nearly 5000 small to medium sized lakes are known to be scattered throughout the country from the southern plains to the high mountain region. Most lakes in the southern plain are known to be highly encroached and environmentally degraded negatively affecting the local biodiversity. The lakes of glacier origin in the high mountains have not yet been studied from a fisheries perspective. Therefore, a review of lacustrine resources, their potential for restoration and use for community development, and their academic values also needs to be highlighted.

Recreational and ornamental fishery resources

Sport and recreational fisheries are highly regarded in many societies. Fish species that occur in Nepal are highly renowned for sport and recreational purposes, such as Mahseer and Asala. Similarly, many species possess considerable ornamental value for garden and aquariums. Such fishes of high value should be studied for income and employment generation opportunities.

Research on socio-economics aspect of aquaculture and fisheries

Socio-economic aspects of aquaculture and fisheries are one of least developed topics in Nepal. Research on socio-economics perspective is highly desirable for identification of social values and issues of different aquaculture and fisheries related activities in relation to communities and group of people.

Community or group based rice-fish farming with carps and other species

A rice-fish farming methodological package has been developed recently. To overcome a number of technical and social constraints implementation of rice-fish farming by involving communities or groups has been recommended. Research on the difference between isolated and community or group based rice-fish farming should be performed in near future to develop a "social shield" to avoid the social problems such as poaching and poisoning¹². In addition there would be many other advantages of rice-fish farming in-group or community in terms of management, services and marketing.

Fish biodiversity and introduction of native species in culture practices

Little attention has been paid to fish diversity in Nepal due to limited human resources. The area of fish diversity in relation to socio-economical perspective of community living near by water resources is prerequisite for the development fish diversity conservation strategies and. High valued potential fish species should be studied for inclusion for commercial cultivation because they fetch higher prices in local market and this could be a means for fish conservation.

Conclusion

The per capita consumption and contribution of aquaculture and fisheries in Agriculture Gross Domestic Production (AGDP) is low (1.8%). This is due to inadequate priority for the promotion of the fisheries and aquaculture sector in national policies and implementation, inadequate skilled human resource, awareness and effective training mechanisms. Therefore, the main focus at present should be to increase total production through effective research and extension mechanism by involving the farmer, fisher community, planners, entrepreneurs, consumers and donors. In general, extensive orthodox farming systems seem to be the main backbone of present aquaculture enterprise in

Nepal. Aquaculture production is known to increase by adding inputs such as feed, manure, and fertilizers. Therefore, further research and development should be focus on intensification of aquaculture production system in addition to mountain aquaculture and the above mentioned research areas.

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Handling Mahseer broodstock at the Fisheries Research Centre, Pokhara