Community-based lake restoration increases income from fisheries, Nepal

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Short title: Restoration of Lake Rupa, Nepal

Key Message: A cooperative's restoration measures of a collaboratively managed lake in Nepal ensure water quality and increase fish stocks to support local livelihoods.

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1. What was the problem?

Lake Rupa is a shallow lake with a surface area of about 100 ha, located in the Central Himalaya in Nepal. Cultivated crop terraces cover the slopes north of the lake, while rice fields, grasses and floating aquatic vegetation fringe the shoreline (Udas and Team, 2007). The total catchment area is about 30km² (Gurung, 2007). The water body itself is regarded a common-pool resource, with no private ownership.

About 15,000 individuals from different ethnic communities like Majhi, Jalahari and others live in the settlements in the catchment area of the lake and depend on the wetland resources for their livelihood. Apart from its rich biodiversity, Lake Rupa also has religious, social and economic value to the local population (Udas and Team, 2007). The fisheries in Lake Rupa traditionally had a flourishing, plankton food-based cage fish culture, and open-water fishery (Gurung, 2007).

However, ecosystem functions in Lake Rupa have gradually deteriorated over the last few decades (Pradhan et al, 2010) due to human interventions, such as unregulated construction of roads, inefficient farming practices on steep slopes, and application of chemical treatments and pesticides (Udas and Team, 2007). These practices increased soil erosion processes (Udas and Team 2007). The subsequent gradual deposition of silt in the lake, exacerbated through landslides, floods, and nutrient run-off, resulted in eutrophication and heavy infestation with aquatic plants (Gurung 2007). A seasonally based decomposition of aquatic plants, and resulting oxygen depletion caused the collapse of the cage fishery, and destroyed the livelihoods of fishers dependent on this industry (Gurung 2007).

2. Establishment and management of a cooperative

To tackle the problems leading to the reduced fisheries production, a cooperative of local villagers was established in 2002 by the Fisheries Research Station, Pokhara and the Nepal Agricultural Research Council, in cooperation with government offices on district, municipality and village level, as well as several NGOs (e.g. LI-BIRD-Local Initiative for Biodiversity Research and Development; Seed Foundation) (Tek Gurung, pers. comm., 2013).

The Fisheries Research Station Pokhara, which was the main source of support for the cooperative, assisted communities in realizing the importance of community solidarity when addressing issues of conservation and development (Tek Gurung, pers. comm., 2013). The Fisheries Research Station worked towards a better understanding of core environmental functions and values of Lake Rupa in terms of wetlands biodiversity, hydrology, socio-economic aspects and livelihoods.

To initiate the establishment of the cooperative, a number of draft regulations were discussed, with active participation of people living both upstream and downstream of the lake. Several workshops and public meetings, involving fishers, village chiefs and government officials, were convened. The cooperative finally involved active participation of 329 local households located in close vicinity of the lake, both upstream and downstream of the lake (Gurung, 2007).

First-hand objectives of the cooperative were prevention of human encroachment in the dry and shallow parts of the lake, increase of the financial income by the management of fisheries, and implementation of restoration practices from funds derived by fish management activities (Gurung, 2007).

When the cooperative started, each cooperative member invested 5000 Nepalese Rupiah (approx. 70US$) for lake restoration, purchasing of fish nets, and other activities. Poor fishers and other members of the cooperative who could not afford making a financial contribution to the cooperative involved themselves through activities such as weed removal, mending of nets, and transportation of fish seed for the cooperative (Gurung, 2007).

Additionally using financial resources generated through capture fishery, the cooperative removed silt from the lake bottom and planted trees in the catchment to prevent further erosion, landslides and resulting siltation of the lake (Gurung, 2007). These measures constitute a collective action based on a principle of “community solidarity”. Lacking the institutional arrangement of the cooperative, each individual by themselves would hardly have been motivated to make such an effort, one concern being others becoming free-riders.

A remarkable principle of the cooperative is the consideration of equity of opportunities and democracy. While the chairperson of the cooperative is elected according to democratic norms, the posts of the two vice-presidents are reserved for a traditional fisher and a female member of the cooperative respectively (Gurung, 2007).

3. Which ecosystem services were examined and how?

In order to investigate the provisioning of fresh water as well as food services, several monitoring studies were conducted. Particularly, total fish production and the water quality were targeted. Water quality changes were monitored from 2000 until 2006, using water samples from fixed sites, collected on a monthly basis. The main parameters measured were water temperature, water transparency and dissolved oxygen (DO) concentration (Gurung, 2007).

The duration of the period of low DO concentrations in the lake between March and May decreased after 2003, which is considered a positive development. Aquatic macrophytes decreased from 90% lake surface coverage in 1999 to only 10% in 2007, after the cooperative’s measures (Gurung, 2007).

4. What actions did the cooperative take and what were the impacts?

Fish seeds of 0.5 – 2.0 g (average individual body weight) were available from the nearby Fisheries Research Station and were stocked beginning in 2002. To control the stocked fish, a mesh net was placed across the outlet of the lake (Gurung 2007).The stocking number of fry could be decreased by about 2.5 times from 689,400 (in 2002) to 276,320 (in 2007) (Tek

Gurung, pers. comm., 2013), as the wetland ecosystem was lead towards stabilization and required less external stocking of fry (Gurung 2007).

Financial incentives also played a role in the improvement of the lake ecosystem. Every kilogram of water hyacinth (*Eichornia* sp.) collected from the lake was rewarded with NRs 75 (nearly $US 1.05) by the cooperative (Gurung 2007).

The total fish production was 18.5 mt in the year 2004 (Gurung 2007:241), but with the improved management the yield reached approximately 70 mt in year 2010/11, valuing approximately 7 million Nepalese Rupiah (equals approx. 90,000 US$) (Tek Gurung, pers. comm., 2013). The income of capture fisheries provided direct and indirect jobs and employment to 80% of the cooperative members (Gurung, 2007).

At present (2013), the number of members has reached 721 households, probably representing the largest cooperative in the agriculture sector in Nepal (Tek Gurung, pers. comm). A highly increased number of households are now involved in weed removal, fish harvesting and value addition and marketing activities.

A fish hatchery of indigenous species has been initiated in collaboration with the cooperative, Nepal Agricultural Research Council (NARC), and Network of Aquaculture Centres in Asia (NACA) and Fish Farming Project to (NARC) supported by Norway (Tek Gurung, pers. comm., 2013). This hatchery will help to initiate indigenous fish propagation activities and restocking species in the lake for biodiversity conservation.

To ensure the catchment's sustainability in the long term, trees were planted in the catchment area by more than 19 community forestry organisations until present (2013) (Tek Gurung, pers. comm., 2013).

In addition, the cooperative has several charity activities: e.g. scholarships that are given yearly to promising school children, and grants to 19 local village schools within the catchment area (Tek Gurung, pers. comm., 2013).

The present approach of lake management has been adopted for the conservation of several other wetlands in the country. The Government of Nepal has meanwhile formed a "National Lake Management Committee" under the leadership of Ministry of Tourism.

5. Lessons learned

One of the key aspects is that management of common resources such as lakes needs strong principles of equity to support a powerful institutional mechanism. In the case of Lake Rupa, the inclusion of traditional fishers, other population groups with low income and women in the Cooperative's Executive Committee was a key highlight, and has improved harmony and stability in the management of the Lake.

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