Restoration Cases Flagship Collection

Case #13

Rupa Lake: Restoring communal fisheries and landscapes in the Nepalese Himalaya

RESTOR

ETH zürich | CROWTHER LAB

FORESTORATION INTERNATIONAL

Rupa Lake in 2008 post-restoration activities. Photo credit: T. Gurung

Contents

In brief

Overview

Rupa Lake, in the Nepalese Himalaya, was the main source of livelihood for the diverse fishing communities surrounding it. But by the 1990s, poor management combined with upstream deforestation and agricultural runoff led to a sharp decline in fish populations. A grassroots community initiative, the Rupa Lake Restoration and Fisheries Cooperative, restored the lake to its previous vibrant and clear state with abundant fish harvests and tourism opportunities. The Cooperative converted the lake from an open-access resource to a communally managed and regulated commons, replaced individual fishing activities on the lake, and brought together diverse stakeholder groups. Starting in 2001, membership dues were used to fund lake restoration using a combination of direct interventions on the lake and landscape initiatives upstream. With the help of a local NGO, they established a payment for environmental services arrangement between fishing communities and upstream farmers—upstream farmers share in the dividends in exchange for installing agroforestry systems, practicing organic farming, and restoring forests. These activities dramatically reduced aquatic plants, increased fish harvest and revenues, and improved water quality. Forest cover increased in the watershed and locals adopted less polluting agricultural methods.

Exemplary practices

The Cooperative funded activities through membership dues and fish sales, built on existing initiatives, and worked with other community groups, regional NGOs, and government organizations in the watershed. Their innovative PES arrangement effectively linked upstream land use with downstream lake health. Lake users belonged to an impressive range of different ethnic groups. Poorer, lower-caste fisher families were more reliant on lake resources, and hesitant to give up individual fishing rights. The Cooperative granted them a transition period where individual fishing was permitted, ensured they were represented on the executive committee, and gave them first priority for employment opportunities.

Key lessons learned

- *Converting an open access resource to a community-managed commons can foster restoration.*
- *Sharing the benefits from downstream lake use with upstream land users can effectively promote land and lake restoration and better land management.*
- *Social harmony is key for collective restoration, and requires planning and ongoing negotiation.*
- *Areas where environmental resources and services are critical for local livelihoods and arenoticeably in decline make good candidates for restoration.*
- *Capacity building and decision-making power can effectively empower and engage community members; common interests can bring diverse stakeholders together to restore.*

4

Restoration narrative

Visit restor.eco

Rupa Lake in the Nepalese Himalaya

Visit and learn more about the project's ecological analytics here:

Rupa Lake Restoration & Fisheries Cooperative

RESTOR

Background and context

Rupa Lake (located at 600 masl), an iconic stream-fed lake in the Annapurna Himalayan range, was shrinking. Between the early 1970s and 2000s, the lake area decreased by nearly 30% (135 ha to 100 ha), and the maximum depth decreased from 6 m to 4.7 m from sedimentation and poor upstream land use (Ferro and Swar, 1978; Pillai and Swallows, 1980; Rai et al., 1995; Gurung, 2007; Chaudhary et al., 2015). Low water levels and copious aquatic plant growth indicated a nascent transition from lake to swamp (Gurung, 2007). Combined with relatively unregulated fishing practices, this degradation threatened the livelihoods of many local people reliant on fish from the lake. So, in the early 2000s, a diverse group of lake users and upstream farmers formed the Rupa Lake Restoration and Fisheries Cooperative (RLRFC) to create a communally managed and regulated commons to restore Rupa Lake and the surrounding landscape (Figure 1).

The landscape surrounding the lake—in the Pokhara Valley, Kaski district of Gandaki province—was once covered with highly diverse subtropical, premontane forest. Lake and forest provide habitat for many animal species, including over 150 species of birds (Chaudhary et al., 2015; Kafle et al., 2008).

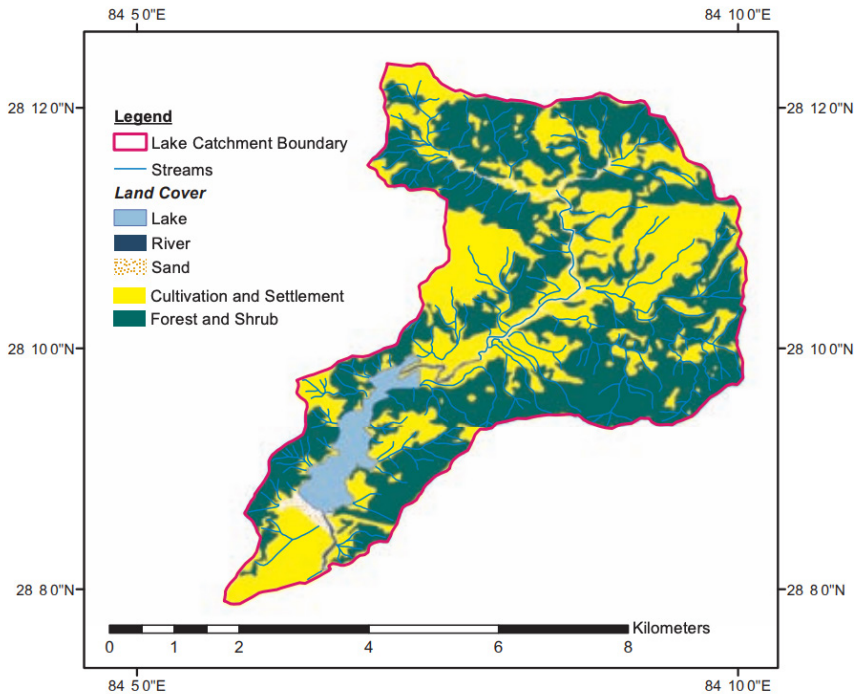
The Rupa Lake watershed covers 30 km2 (2,707 ha) of steep and hilly terrain ranging from 580 to 1,420 masl (28°08'N to 28°10'N and 84°06'E to 84°07'E) (Chaudhary et al., 2015; Rana et al., 2020)(Figure 2). There is a pronounced monsoon season, and the region receives nearly 3,500 mm of rain annually (DHM/Nepal, 2015). Climate change is already impacting the watershed: from 1981 to 2011 the maximum average temperature increased by 0.81°C (Dixit et al., 2014; Rana et al., 2020). Most of the watershed's forests are managed by 14 community forest user groups (Rana et al., 2020).

The Rupa Lake watershed is home to 1,200–1,900 households (Rana et al., 2020; Bai et al., 2022). Residents are diverse and include "marginalized and impoverished traditional fishers (Jalari or Pode), local elites (Brahmin and Chhetri), the indigenous community known as Janjati (i.e., Gurung, Magar, Newar and Gharti ethnic castes), and the 'untouchable' Dalit . . . a socially ostracized, economically deprived and politically excluded Hindu caste in Nepal" (Gurung et al., 2019a, p. 52). Fishing households fall into three main groups: fishing-dependent, traditional fishers (Jalari, Pode); opportunistic fishers with less financial means (Dalit); and those with more stable finances (although sometimes of less than $2 US/day) (Brahmin, Chettri, Newar) (Gurung, 2007, p. 240).

Figure 1. Rupa Lake in 2018. Photo credit: T. Gurung

Prior to the 1950s, Rupa Lake was essentially an open-access resource used by a few fishermen living along its shores. Net and rod fishing were both common and formal management was minimal. In 1975, cage fishing was introduced with support from the national government (Chaudhary et al., 2015). Both cage and open water fishing were productive, and harvests peaked in 1990 at 50 metric tons (mt) (Gurung, 2007, p. 238). But in the 1980s and 1990s, an influx of local inhabitants besides the traditional fishers became involved in cage fisheries operation, which created an added burden on the lake as new arrivals began to fish alongside traditional fishers. A new road provided access to non-local markets, leading to an incentive to harvest more. People began to overfish, taking as much as they could in the face of declining stocks. Conflict grew over lake use rights. The Nepalese Government also introduced new aquaculture activities, leading to more pressure on the lake and confusion among its users (Chaudhary et al., 2015). The northern inlet and southern inflow became filled with sediment discharged from upper hills of surrounding catchment areas used to grow rice, further contributing to the lake's decline.

At the same time, land use in the Rupa Lake watershed increased and intensified. Prior to the 1980s, the Rupa watershed was sparsely populated and residents used integrated farming systems with crops, forests, livestock, and water resources. Forests—largely on public



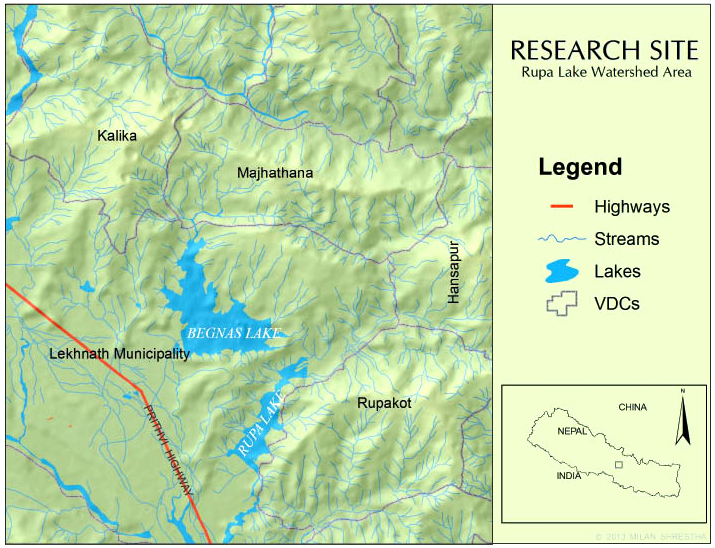


Figure 2. (top) Rupa Lake and Catchment Area. Source: Gauli, Dhakal, & Khanal, 2016. (bottom) Map of Rupa Lake Watershed area. Source: Chaudhary et al., 2015

forest land—were used for firewood, fodder, and timber. People were highly forest dependent. But by the mid 1980s, overharvesting for fodder, fuel, and timber, and burning to allow grazing had depleted most of the region's forests (Rana et al., 2020). Farmers also diverted streams (Pradhan et al., 2010). These changes in land use were linked to 'modernization' efforts by the Nepalese government, including constructing dams and hydropower plants, introducing 'modern' agricultural techniques, and promoting commercial development (Chaudhary et al., 2015).

Deforestation led to erosion, landslides, and increased flooding and sediment loads during the monsoon season, while water became increasingly scarce in the dry period and natural streams would run dry. By the 1990s, farmers had switched from traditional farming to 'green revolution' technologies, including chemical inputs and new crop varieties. Many local crop varieties nearly became extinct. Few residents understood the importance of maintaining diverse natural ecosystems and diverse crops and cultivars for farming (Rana et al., 2020).

Changes to the surrounding landscape had an enormous impact on the lake. Following deforestation, landslides and floods deposited silt and sediments in the lake and wetlands causing low water levels (Gurung, 2007; IUCN, 1996; Rai, 2000a, b).

Nutrient run-off from chemical fertilizers also caused eutrophication and an overabundance of aquatic plants. By 2000, the lake was covered with aquatic plants (e.g., invasive water hyacinth, blue green algae, pickerel weed, lotus) to the extent that boating was impossible (Gurung, 2007), and fish populations declined sharply. Road and building construction and nonpoint source pollution also contributed to the ecological decline of the lake (Chaudhary et al., 2015). Water quality declined and cage fisheries were no longer possible. Many people lost their livelihoods (Gurung, 2007).

The consequences of ecological deterioration and overexploitation were apparent by the early 1990s, but neither the local government nor communities ceased exploitation. Government policies still favored using and clearing land for agriculture, creating tension between lake-dependent communities and upstream land holders who continued to deforest land amidst increasing landslides and erosion (Basnet, 2008; Chaudhary et al., 2015). In the mid-1990s, the government devolved control of forest resources to local communities under their nation-wide community forest network. Initially this action did little to reduce pressure on the lake (Oakley, 1991; Pokharel and Nakamura, 2012). In the late 1990s, a collaboration between the government, NGOs, and international donors began operating in the region to reinstate and conserve agricultural diversity (Rana et al., 2020).

Restoration baseline conditions

Prior to restoration, local fishing livelihoods had been destroyed. The cage fisheries collapsed because of seasonally anoxic conditions. Thick mats of weeds made boating impossible, and people were unable to harvest fodder or transport food on the lake (Table 1). Immediately prior to restoration (in 2000) the watershed was 51% forest, 45% agricultural land, and 4% water bodies. Siltation and rice farming in shallow areas were further degrading and 'shrinking' the lake. Animals around the lake were hunted illegally, and water quality became so poor that migratory birds no longer visited the lake. Rupa had become a tourist destination, but this industry was threatened by deteriorating conditions (Chaudhary et al., 2015, p. 750). As Cooperative co-founder Tek Gurung put it, the degradation "made people unrestful. . . Rupa means 'beautiful lake', but...contrarily, the lake had turned ugly" (such as riverbanks or steep mountain slopes, forming the *favelas* (Stålhammar and Brink, 2021). Between 2000 and 2010 the population growth of the *favelas* (19%) was almost four times higher than that of the formal city (5%) (Sanholz et al., 2018).

Indicator	Pre-restoration 1978	Post-restoration 2002
Area (ha)	117	100
Max depth (m)	6.5	4.7
Vegetation (percent coverage)	5%	90%
Surface dissolved oxygen (mg/L)	7.5-15 (range in 1978)	0.6-9.2 (range)

Table 1: Indicators of lake health for Rupa Lake in 1978 and 2002 (immediately pre-restoration). Note that all point to deteriorating lake conditions (Gurung, 2021, personal communication).

The turning point

"Rupa Lake was completely deteriorating," recalls Lakpa Sherpa, long-time practitioner in the region. "People could hardly see the lake area as it was completely covered by the water hyacinth" (Sherpa, 2022, personal communication). Many fisher families left the region for work elsewhere. "At the time, I was in charge of Pokhara Fisheries Research Station," says co-founder Tek Gurung. "We used to offer the subsistence fishery cages to landless farmers. But the lake was in serious condition in 2000. Some 100 fisher families had lost their income and livelihood opportunities, so most migrated to gulf countries for jobs. That was shocking. The remaining farmers were contacting me for optional employment opportunities" (Gurung, 2021, personal communication). "So, a few locals around the lake, along with the fisheries research station, NGO LIBIRD, Rupa VDC and Lekhnath Municipality initially discussed the ideas of cleaning the lake and utilizing the water resource for income generation" (Sherpa, 2022, personal communication). They formed the Rupa Lake Restoration and Fisheries Cooperative in 2001 with the hope that restoring the lake was possible and would generate income opportunities.

Modern tech-based restoration was too costly, so the Cooperative applied a low cost, bottom-up approach involving biomanipulation, collective governance, sharing knowledge, and a payment for environmental services (PES) scheme that rewarded upstream land users for adopting lake-friendly practices (Gurung et al., 2019a). The Cooperative's structure was similar to community forest management groups established by the Nepalese government (Pradhan et al., 2010).

Despite the obvious need to restore the lake's fisheries, creating the Cooperative was not straightforward. Bringing together diverse lake users and upstream farmers to a common table was challenging. The two main fishing groups—the 'traditional' fishing communities (Jalari and Dalit) and the higher castes—had different needs and risk tolerance. A key piece of the Cooperative framework would be relinquishing individual rights to fish. The higher castes saw fishing as an asset but were less reliant on it and were generally positive about the potential benefits the Cooperative would bring. But the Jalari people were most affected by the ban on individual fishing rights. Many feared they would lose their livelihoods and be underrepresented, and blamed the Cooperative for taking away their traditional livelihood rights, which led to heated disagreements and conflict.

The Cooperative held a series of meetings to resolve the issue, ultimately creating measures to support Jalari people including reducing their membership fees, reserving posts for Jalari people in the executive committee, and enacting a 6-month transition period where they could still fish. These measures helped to level the playing field and mitigate conflict (Gurung, 2007).

Making the link between land management and lake health was critical but was challenging at times. “It is really difficult to track the clear connection between the upstream and downstream, but what I have seen and experienced is people in both locations were aware of the need to conserve the lake.” says Lakpa Sherpa. Initially, only 36 people signed on and membership was limited to people who fishing-reliant households. Most initial members also belonged to a regional community forestry group, formed in the late 1990s. But as positive results began to accrue, others became interested in joining. “Seeing is believing,” says Tek Gurung. “[Fish stocking for biomanipulation] was very clearly demonstrated, so because of that probably they had a feeling this restoration project would be successful” (Gurung, 2021, personal communication). In 2007, a call was put out to broaden the geographical scope of the membership base, and membership shot up to over 440 in 2008 (Chaudhary et al., 2015).

Actors and arrangements

The Cooperative was formed in 2001 and was composed of two community-based organizations alongside representatives from communities upstream and downstream. The Cooperative worked with different levels of government, including the Pokhara Fisheries Research Station of the Nepal Agricultural Research Council, the District Cooperative Office in Kaski and Lekhnath Municipalities, and the Village Development Committee (VDC). The Cooperative also became a member of Jaibik Shrot Samrachan Abhiyan” (Bioresources Conservation Movement; JSA), an organization founded in 2006 to bring together groups (20+, including farmers groups, NGOs, and cooperatives) working on biodiversity conservation. JSA helped the Cooperative coordinate with these other organizations (Rana et al., 2020).

The Cooperative’s collaborations with various NGOs and private sector groups were vital to its success. In particular, they worked closely with Local Initiatives for Biodiversity Research and Development (LI-BIRD), an NGO that in 1998 began helping local farmers improve their livelihoods through better resource management. LI-BIRD helped develop the benefit sharing mechanism between upstream and downstream users, built capacity, trained farmers in lake-friendly practices, and promoted local leadership (Chaudhary et al., 2015; Gurung et al., 2019a; Pradhan et al., 2010).

Planning and engagement

The main objective of the Cooperative was to restore Rupa Lake and surrounding wetlands, to increase and sustain fish production, and restore local fishing-based livelihoods (Gurung, 2007). The initial founders held a meeting with key local leaders, the Fisheries Research Station, the municipality of Pokhara, village development committee, LI-BIRD, local governments, and the district development committee to prepare a draft of the rules and regulations. The founding organizations convened several public meetings involving fishers, village chiefs, and government officials. Meetings were accessible and held locally. "At the beginning, the fishers were invited either in the premises of the Fisheries Research Station, or we gathered in the southern bank of Rupa Lake for meetings," says Gurung. "The people living up and down stream were very well informed." Smallholder fishers who had previously worked with the FAO's cage fishery initiative were especially attracted to the project (Gurung et al., 2019a). Based on information generated by community meetings, founders created a constitution to guide restoration activities and the Cooperative function.

The Cooperative's 11-member executive committee (EC) was designed on the principle of social inclusion: the vice president and two executive member posts were reserved for Jalari or Dalit (traditional fishing), and remaining 2-year posts elected through a democratic process (Gurung, 2007). The EC is responsible for directing the Cooperative and to "maintain harmony, equal opportunities, and respect for the watershed citizenry having fish handling skills as indigenous knowledge of fishers" (Gurung, 2007, p. 241).

Costs, funding and other support

Funding was initially limited to membership dues (5000NR—about US$70 in 2002). Poor fishers unable to pay in cash contributed labor by removing aquatic plants, mending nets, and other tasks. Dues from the 36 initial members paid for purchasing and erecting fishing nets and lake restoration activities (Gurung, 2007). Later, the Cooperative received partial support for the Rupa Lake Watershed Conservation Fund from LI-BIRD and the Ecosystems Grants Programme of IUCN - Netherlands (Pradhan et al., 2010). Once fish were harvested, revenue from fishing funded most of the cooperative's activities.

The upstream/downstream PES scheme was set up as a voluntary agreement between the Cooperative and upstream land users. The Cooperative paid different users—like community forest user groups (CFUGs), communities, schools, mothers' groups, and youth groups—to support specific land management activities and also contributed in-kind support such as seedlings (Pradhan et al., 2010). Payments supported 17 different CFUGs annually, provided scholarships to 52 students, and funded environmental education at 19 schools (Chaudhary et al., 2015; LI-BIRD, 2009).

Implementation

The Cooperative's first action was to enact new policies for using the lake, including removing individual fishing rights and controlling harvests. Fishing rights were held by the Cooperative, and fish were sold at prices fixed by the executive committee each month. The Cooperative stocked the lake with carp to control aquatic plants and restore other elements of the lake ecosystem including dissolved oxygen levels—and then harvested the carp. They also partnered with existing organizations to support better land management practices upstream, including conserving and restoring forests and promoting organic farming, no-till practices, and agroforestry, to reduce pollution and sedimentation loads in the lake (Pradhan et al., 2010). They worked to prevent human encroachment (e.g., rice fields) in dry or shallow areas of the lake and to increase income from fisheries (Gurung, 2007).

To reduce cover of aquatic plants, in 2002 the Cooperative began stocking the lake with different carp species: grass carp to browse on aquatic plants, common carp to uproot them, and silver and bighead carp to control plankton blooms. Tiny carp fry (2g each) were brought in from a nearby Fisheries Research Center (Gurung, 2007; Gurung et al., 2019b).

Once aquatic plant cover decreased, stocking numbers were lowered (from 6,894 in 2002 to 772 in 2011/12). Floating mats of plants—likely uprooted by carp—were manually removed and the Cooperative also paid people about ~US$1/kg to remove plants that could not be controlled by fish (like water hyacinth) (Gurung et al., 2019b). Ten fishermen were hired to fish and collect data on the carp in the lake, and after the first year, larger carp (over 2kg) were harvested and sold (Gurung, 2007).

The Cooperative also initiated several new fishery projects. In 2012, they constructed six breeding ponds for fingerlings to release into the lake. In 2014, they designated one pond exclusively for indigenous fish and began experimenting with raising them. They purchased a solar fish dryer to preserve excess catches when prices were low. Fishing operations were patrolled by Cooperative staff to enforce rules, tend to fishing nets, and perform other lake maintenance (Chaudhary et al., 2015). They also recorded water quality monthly from 2000-2006 with the support of the Fisheries Research Station including water temperature, water transparency, chlorophyll-a, and dissolved oxygen concentrations— and recorded fish catches (Gurung, 2007; Gurung et al., 2019b).

Figure 3. Fishermen on Rupa Lake. Photo credit: T. Gurung

Box 1: Timeline of initiatives and key events in the Rupa Lake watershed

- ***1985-1998:*** *Begnas Tal Rupa Tal Watershed Management project. Aimed at improving watershed land management by creating tree plantations, conserving natural drains, protecting forests, building trails, cultivating sustainable coffee; and forming Community Development Conservation Committees, Community Forest User Groups, and local agricultural associations. Funders: DGIS Netherlands and GoN. Implementer: CARE Nepal.*

- ***1997-2001:*** *Strengthening the Scientific Basis of In-situ Conservation of Agricultural Biodiversity On-farm project. Activities included identifying and breeding local crop varieties, managing seeds. Funders: NEDA Netherlands, IDRC Canada and Bioversity International. Implementers: LI-BIRD and Nepal Agriculture Research Council.*

- ***Early 2000s:*** *Crisis point for Rupa Lake, which was covered (>80%) with aquatic plants making boating nearly impossible, had dissolved oxygen levels near 0, and fish kills were common (Gurung et al., 2019a).*

- ***2001/2002:*** *The Rupa Lake Restoration and Fishery Cooperative was formed.*

- ***2002:*** *The Cooperative stocks the lake with several carp species to control plants, and installs a mesh net across the outlet of the lake. Individual fishing rights revoked.*

- ***2003-2005:*** *Community Biodiversity Register Project. To understand and draw attention to the region's biodiversity, implementers and communities documented and monitored local genetic resources and built capacity through training, meetings, workshops, field visits, etc. Funders: UNDP/ GEF-SGP. Implementer: LI-BIRD.*

- ***2006:*** *Jaibiksrot Samrakchan Abhiyan (JSA) was formed.*

- ***2006-2007:*** *Community-based Wetland Management Project. LI-BIRD helped the Cooperative develop a community-based wetland management plan, and payment for watershed services scheme between upstream and downstream users. Specific activities include establishing habitat conservation blocks, producing and planting saplings, constructing dams to reduce siltation, removing invasive plants, and introducing income-generating activities. Funder: IUCN. Implementer: LI-BIRD.*

- ***2006 onward:*** *e Cooperative pays 17 Community Forest User Groups to conserve and sustainably manage forest resources upstream (LI-BIRD, 2009).*

- ***2007-2011:*** *Enhancing Benefits to Smallholder Farmers by Linking Agrobiodiversity to Niche Market project. This initiative helped advance biodiversity conservation and biodiversity-based agricultural production systems. Funder: The Development Fund Norway. Implementer: LI-BIRD.*

- ***2008 onward:*** *The Cooperative begins contributing ~25% of its annual net profit to sustainably managing the lake's watershed (previously ~10%) (LI-BIRD, 2009).*

- ***2012:*** *Six nursery ponds were constructed by the Cooperative to breed fry (Chaudhary et al., 2015).*

- ***2014:*** *A Savings and Credit Scheme was set up by and for Cooperative members (Rana et al., 2020).*

- ***2014-2017:*** *Mobilizing Local Resources and Institutions for Integrated Management and Utilization of Watershed Services in the Mid-Hills of Nepal project. This initiative aimed to scale up Payment for Watershed Services active in Rupa Lake, building a biodiversity Information Center and view tower, capacity building activities on integrated pest management, improving vegetable farming and cattle rearing practices, and implementing measures to control landslides. Funder: Swiss ReSource Foundation. Implementer: LI-BIRD.*

Restoration of the lake took place in the context of other watershed-wide initiatives in the mid-1990s and early 2000s when several initiatives began working to improve rural livelihoods and environmental conditions (Box 1). Work with upstream users was implemented in a series of phases. The Community-based Wetland Management Project (2006-2007) was implemented jointly by the Cooperative and LI-BIRD. Activities connected upstream users, who were generally unaware of their impact on the lake and received few livelihood benefits from it, with downstream users to share both responsibility and benefits. The Cooperative made voluntary payments to upstream land users to implement more environmentally friendly practices with revenues from fish sales (Rana et al., 2020). PES payments to upstream users increased Cooperative membership by broadening the user groups and included cash, seedlings, 'gabion boxes' to reduce sedimentation (Figure 4), capacity building, and collaborative activities (Pradhan et al., 2010).

The Cooperative collaborated with several local organizations to plant trees and implement sustainable agricultural practices in the upper watershed (Figure 5). One quarter of the Cooperative's proceeds were invested in upstream conservation and education. With the assistance of LI-BIRD, they established nurseries for native trees and introduced environmentally sustainable income-generating activities including organic farming, bee keeping, goat raising, cultivating broom grass, growing vegetables, and collecting lotus seed and chestnuts (LI-BIRD, 2007). Capacity building to rear goats both improved livelihoods and increased demand for tree fodder, providing further motivation to plant trees. They also helped downstream communities create a 'green belt' around Rupa Lake and trained local people to conduct species inventories in wetlands and surrounding ecosystems which formed the basis for development plans, a bird breeding center, and a strategy for restoring bird habitat. They engaged women's organizations, youth groups, and other marginalized populations to help implement various practices in exchange for financial support.

Figure 4. Gabion box filling, one of the activities supported by the Cooperative and carried out by upstream communities in order to decrease sedimentation in the lake and stabilize landslides. Source: LI–BIRD, 2009

Collaborators	Activities
Mothers' group	1. Preservation of indigenous plant species in the watershed 2. Management of wetlands surrounding Rupa Lake 3. Awareness for biodiversity conservation 4. Hands-on training on organic farming 5. Low tech and high reward income-generating activities
Community forestry user groups (CFUGs)	1. Protection of natural forest for healthy watershed 2. Bio-engineering activities to stabilize active landslides (Figure 3) 3. Afforestation of degraded lands 4. Protection from forest fire
Schools	1. Increasing awareness on the importance of wetland biodiversity 2. Education of the importance of eco-tourism in the area 3. General information on the consequences of climate change 4. Essay competition on local and global environmental issues 5. Scholarship support to the children of economically marginalized members of the community such as Jalari
Youth clubs	1. Community development through engaging youth 2. Skill training on income generating activities such as bee keeping 3. Training on the value of biodiversity conservation 4. Hands-on training on home gardening

Table 2: Activities performed by the collaborators supported by the Rupa Lake Restoration and Fishery Cooperative (Chaudhary et al., 2015, p. 763).

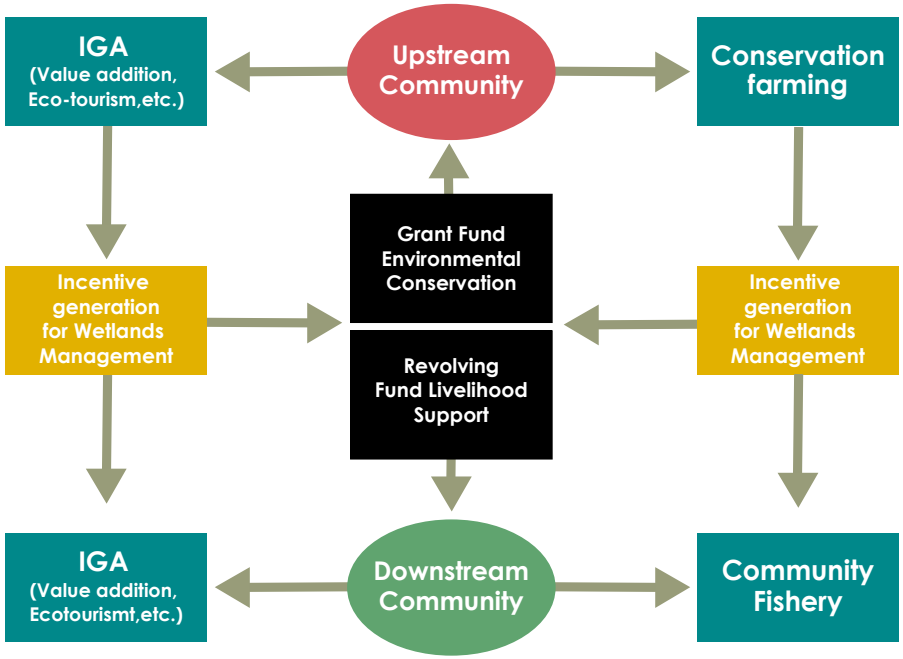


Figure 5. Integrated wetlands management model used at Rupa Lake, including benefit-sharing scheme between downstream and upstream users. Source: LI-BIRD, 2007

Outcomes and impacts

From the early 2000s to early 2020s, the ecology of the lake improved dramatically. Cooperative activities helped to restore native lake and landscape biodiversity, reduce aquatic vegetation, halt encroachment of cultivated areas into lake wetlands, restore fisheries to increase fish production, and improve the water clarity and dissolved oxygen levels in the lake. The Cooperative also created employment, including 20 new permanent positions. Communities have more control over their shared resources and benefit from increased revenues and yields from fishing. Although tension remains between higher and lower castes over some decisions, as of 2022, the Cooperative was still operating with a large membership base, and restored areas are well maintained.

The Cooperative grew rapidly, effectively drawing in a diverse range of stakeholders. Between 2002 and 2008, membership increased from the initial 36 member households to 444 when membership eligibility was expanded. By 2013 there were 746 and 955 as of 2021 (Chaudhary et al., 2015; Gurung, 2021, personal communication). People became more aware of the linkages between the importance of water, land use, and resource sustainability.

This large and diverse group, many of which did not previously interact with the lake, are now connected to it and aware of how human actions can degrade it (Chaudhary et al., 2015).

A household survey of Cooperative members showed most were satisfied with the degree of transparency, decision-making processes, general assembly meetings, and benefit sharing—all members received an equal share of the benefits annually, regardless of caste, position, etc. (Gurung et al., 2019a). Problems cited include membership limitations based on geography, lack of attention to the needs of resident non-members, and failing to meet the needs of indigenous communities (Gurung et al., 2019a). Despite the efforts made to include members of the Jalari community, some still expressed grievances: "'We are the real indigenous people dependent on the lake and in the past survived on the income from selling fish harvested from the lake. But the cooperative forced us to give up our livelihood. This is a government order and we have no choice other than to completely surrender or accept their proposal to be a member." (Dalit communities)" (Gurung et al., 2019a, pg. 58)

The aquatic plants that once choked the lake were largely eradicated.

Initially occupying only 5% of the surface in the 1950s, plant cover had increased to 80-90% in 1999, but by 2021 plant cover declined again to pre-pollution levels (Figure 6). Boats could once again travel on the lake. Dissolved oxygen levels increased from nearly zero during the lowest month (April) in 2000 to 3.4 mg/L in 2010, and seasonal fish kills no longer occurred. Qualitative assessments indicate that water flow increased and fish habitat was created (Gurung et al., 2019a).

By 2010, more than 50% of the communities in the watershed had adopted practices to reduce environmental impact on the lake including agroforestry, organic farming, and measures to reduce landslides (Pradhan et al., 2010). Payments from the Cooperative helped approximately 5,000 households adopt "conservation-based income generating activities such as bee-keeping, forage/fodder plantation for livestock, broom grass cultivation, organic farming, coffee production, zero tillage, and permaculture" (Pradhan et al., 2010, p. 33). After 2000, forest cover increased in the Rupa Lake catchment area (Acharya et al., 2020; Rana et al., 2020), a change that was not mirrored in nearby watersheds Begnas and Phewa (Acharya et al., 2020). Many upstream households rely on community forests for fodder, fuel, food, and other forest products, and some reported that the forest quality improved significantly in the past 30 years (Shrestha, 2017). Forest expansion had other benefits, including reviving local springs and wells, improving the local microclimate, and providing a source of non-timber forest products and "wild foods" (Pradhan et al., 2010).

Figure 6. A) Rupa Lake in 1997/8 covered in plant growth, B) Rupa Lake in 2017 after restoration. Photo credits: Gurung et al., 2019

Many farmers switched from chemical pesticides and fertilizers to compost, manure, and bio-pesticides, and began planting local crop varieties and diversifying on-farm production (Rana et al., 2020).

A study in 2020 compared the livelihoods and asset holdings of households that were members in a watershed management cooperative versus those that were not (Rana et al., 2020). Participants generally had similar amounts of agricultural land and financial capital to non-participants but much more valuable homes, more education, slightly higher social capital, and were more likely to own their own business (Rana et al., 2020).

Natural capital in the region increased noticeably through the restoration of forests, wetlands, agricultural systems, and Rupa Lake. Residents of the Rupa Lake watershed evaluated the availability of different ecosystem goods and services, from wildlife habitat to fuelwood to cultural, recreational, and scientific use, in a recent survey (Rana et al., 2020). Watershed inhabitants from all income levels noted an increase in all services—including those from agricultural land, forests, and lakes/rivers—between 2013 and 2018 (Rana et al., 2020). Erosion, sedimentation, and dilation decreased, and agricultural productivity increased as farmers adopted new methods (including agroforestry systems) and traditional crop and seed varieties (LI-BIRD, 2020).

Land type	Year		
	1977	2000	2020
Forest area (ha)	965.81	1,383.51	1,673.23
Agricultural land (ha)	1,634.45	1,210.88	909.20
Surface water (incl. Rupa Lake) (ha)	107	103	100
Uncultivated/abandoned agricultural land (ha)	0.00	9.51	24.10

Table 3: Land use and cover change in Rupa watershed, 1977 – 2020. Source: Rana et al., 2020

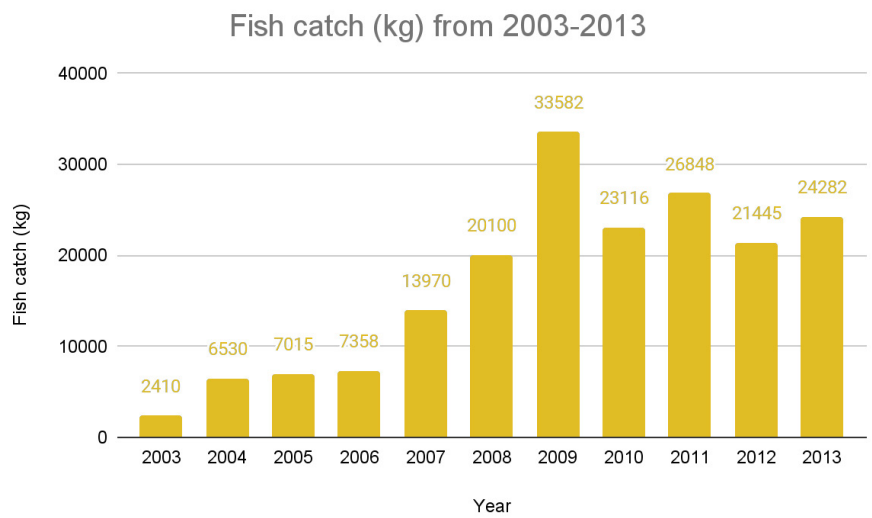


Figure 7. Fish catch (kg) from 2003-2013. Data from Chaudhary et al., 2015

Figure 8. View of Rupa Lake post-restoration. Photo credit: T. Gurung

Fish capture and profits increased dramatically following lake restoration efforts (Figure 6). The policy for fixing a monthly set price for fish replaced the former bartering negotiations, and the Cooperative saw increased profits from fish sales immediately: in the first year (2003), annual revenue increased by 2% and fish yields by 35% (Chaudhary et al., 2015). By 2009, the Cooperative was catching about 100 kg of fish at a market price of about NPR 145 (~US$2.00/kg) (Pradhan et al., 2010). Profits from fishing increased from nearly NPR 1,500,000 (~US$19,200) in 2003 to over NPR 6,000,000 (US$67,000) in 2013 and NPR 25 million (US$360,000) in 2019. Membership fees mirrored increasing profits, from NPR 5000 (US$71) in 2003, NPR 16,000 (US$178) in 2013, and NPR 40,000 (US$350) in 2019 (Chaudhary et al., 2015). The annual income taken in by the Cooperative in 2019 was about US$150,000. The Cooperative employs 24 full-time staff and several part-time staff, and the restoration work has opened up tourism opportunities on the lake (Rana et al., 2020). In 2014, the Cooperative also established a credit scheme to allow access to financing for its members. The Cooperative continues to meet monthly to set fish prices, membership fees, and plan lake rehabilitation and maintenance (Chaudhary et al., 2015; Gurung, 2021, personal communication). They hold an annual general meeting once a year where they present their progress and receive feedback from members.

Figure 9. Local fisherman at Rupa Lake. Photo credit: T. Gurung

Key challenges

Creating and maintaining harmony between diverse castes and ethnic groups during the transition from open-access to communally managed (and restricted) access was immensely difficult. Reconciling the needs of fishing-reliant households with higher caste households is an ongoing challenge. The Cooperative implemented several measures specifically to help level the playing field, which brought many minority households on board at inception. However, minority membership has been decreasing in recent years, which could weaken their influence (Gurung et al., 2019a). Working to maintain membership and participation from minority groups is a Cooperative priority.

Defining membership eligibility is also an ongoing challenge, complicated by limited interaction between upstream and downstream users. As revenues increase, downstream users outside the demarcated membership boundary are contesting these boundaries (Gurung et al., 2019a). In the past, a similar conflict was resolved by expanding the membership area, but this put a huge administrative burden on the Cooperative.

Preventing the elite capture of natural resources and striving for equity was achieved by helping marginalized groups and lower castes recognize that shared resources are the property and responsibility of all community members. The Cooperative organizers effectively spread the message: “Look, if this is your property you pay attention to conserve it, you pay attention to hold it. It is your duty to not just use but also do conservation and restoration....” (Gurung, 2021, personal communication).

Empowering women and youth to have a voice in decision making was critical but difficult. Although women represent over a third of the members, their participation is still more passive, and they are less vocal than men. Empowering women to participate remains a major challenge (Gurung et al., 2019a), as does “a lack of interest among youth to lead the cooperatives ...,” notes Lakpa Sherpa (Sherpa, 2022, personal communication).

The hatchery created by the Cooperative required more work than anticipated and currently still needs improvement to work properly. But producing their own fish provides employment and they have been successful in breeding and stocking some species, albeit less than they had hoped.

Enabling factors and innovations

People were highly dependent on the lake and could clearly see it was in decline. Its degradation had a huge impact on their livelihoods. This provided a clear incentive to take action to restore the lake.

At the time the Cooperative formed, the political environment was unsettled. Co-founder Tek Gurung speculates that this leveled the playing field between castes and opened the door to collaboration: “In 2001, the Mao insurgency was at its height. Community leaders and others received threats from Maoists every day. This created a social pressure for people to stand united across different castes, and a feeling of wanting to be united...This psychology of seeing beyond castes... that mindset at the time helped the Cooperative join together. Otherwise, this may have been more difficult.” The Rupa Lake watershed was also the focus of ongoing work to restore crop and forest biodiversity, and the Cooperative was able to synergize with existing organizations and build on the foundation left by previous projects.

Linking upstream and downstream residents through a benefit sharing program was a remarkable and replicable innovation of the Cooperative.

Few examples exist where a community-based fisheries project has connected upstream and downstream users; in most cases, benefits are limited to the households that are actively involved in the lake resource, and not the surrounding communities (Gurung et al., 2019a). This landscape-level, inclusive approach was critical to restore water quality and to connect and unite people around lake and landscape restoration.

Navigating the cultural needs and differences between different ethnic groups was key to the success of this initiative, and required a sensitive and adaptive approach with explicit concessions for minority groups. “a win-win approach was essential...to manage a common resource in a heterogeneous society without causing social conflict. This approach...judiciously prioritizes citizenry, traditional knowledge, occupations, skills and the economic status of the cooperative members. This understanding and perseverance was the real strength behind this approach” (Gurung, 2007, p. 238).

Starting small with a community-funded model was another key innovation. Critical to its success was the belief that restoring the lake would bring back an economically beneficial resource and the flexibility to include members who were not able to pay full dues in cash.

A relatively low cost yet effective restoration approach (biomanipulation using carp) was also important as it produced visible outcomes in a short period with few resources.

Key lessons learned

- ***Converting an open access resource to a community-managed commons can support and sustain lake restoration.*** *Freshwater lakes and rivers are often treated as open access. Managing these common use resources is important to sustain and conserve them, and since communities have a collective stake in them, working together to restore them is a good way to both engage people and produce impactful outcomes.*

- ***Work in areas where environmental resources and services are critical for local livelihoods and are noticeably in decline.*** *Areas experiencing the effects of unsustainable resource use from environmental degradation provide the motivation for local communities to engage. Working in these areas increases the benefits that local people receive from the restoration.*

- ***A common interest can bring diverse local communities together to restore ecosystems, and working at the right scale is critical for community management.*** *Smaller areas are easier to control and manage, and communities within them are also more likely to share similar challenges and needs. Remote, sparsely populated areas are less well suited to communal restoration as the proximate livelihood benefits are fewer (Rana et al., 2020).*

- ***Benefit sharing between upstream landholders and downstream lake users can promote restoration and better watershed management.*** *An informal PES scheme made the quality of the lake relevant for upstream as well as downstream users and promoted better stewardship. This type of arrangement is especially important in mountain environments, where surrounding land use has a dramatic effect on the quality of lakes (Pradhan et al., 2010).*

- ***Social harmony is key for collective restoration, but requires careful planning and ongoing maintenance and negotiation.*** *Striving for equity in decision making is essential for restoring a common resource. Effectively restoring Rupa Lake required the collaboration of many different types of users and people from different cultural groups, including traditional fishers, lower income households, high income households, women, men, high castes, and lower castes. Bringing these groups to the table required listening to needs, providing mechanisms to include minority groups in a meaningful way, and frequent renegotiation and adaptation.*

- ***Capacity building and decision-making power can effectively empower and engage community members.*** *The most marginalized members of the fishing communities were given opportunities for employment, training, and to have a significant voice in decision making processes. These members now know more about natural resource management and have more confidence to conduct business transactions (like selling fish).*

- ***Benefits from restoring commons should be shared among all stakeholders.*** *This includes broader community benefits, like giving scholarships to deserving low income students, and supporting local youth programs, mother's groups, and when the need arose, a local COVID-19 relief fund.*

- ***Community cooperatives should synergize with other organizations and leverage resources.*** *The Cooperative worked with government organizations at multiple levels, and various NGOs, INGOs, and private sector groups with similar goals and interests. Through such relationships they were able to fill gaps in capacity, receive in-kind support, and connect to markets and other resources.*

Parting shot

"To save local resources, local people should be aware themselves, not just from the outside."

—Tek Gurung, 2021.

Figure 10. Rupa Lake post-restoration.
Photo credit: T. Gurung

Learn more

Further information and resources

Conserving by using: the story of Rupa cooperatives
https://www.youtube.com/watch?v=za0IynFeNEc

Rup Ferdai Rupa
www.youtube.com/watch?v=UO2inj_F8Wo

Literature cited

ACHARYA, S. 2020. Land use and land cover changes in the catchments impact the ecosystem in Phewa, Begnas, and Rupa lakes, Nepal. *Journal of Nepal Geological Society*, 60, 195–205.

BAI, Y.-L., FU, C., THAPA, B., RANA, R. B. & ZHANG, L.-X. 2022. Effects of conservation measures on crop diversity and their implications for climate-resilient livelihoods: the case of Rupa Lake Watershed in Nepal. *Journal of Mountain Science*, 19, 945-957.

BASNET, A. 2008. Understanding the causes of decline in the health of Rupa Lake, Nepal. Proceedings of Celebrating Dialogue: An International SAS2 Forum. Ottawa, Canada: Carleton University.

CHAUDHARY, P., CHHETRI, N. B., DORMAN, B., GEGG, T., RANA, R. B., SHRESTHA, M., THAPA, K., LAMSAL, K., & THAPA, S. 2015. Turning conflict into collaboration in managing commons: A case of Rupa Lake Watershed, Nepal. International Journal of the Commons, 92, 744–771.

DHM/NEPAL. 2015. Study of Climate and Climatic Variation over Nepal. Ministry of Science, Technology and Environment, Department of Hydrology and Meteorology, Kathmandu, Nepal.

DIXIT, A., KARKI, M. AND SHUKLA, A. 2014. Vulnerability Impact Assessment and Adaptation Planning in Panchase Mountain Ecological Region, Nepal. Institute for Social and Environmental Transition (ISET)-Nepal, Kathmandu, Nepal.

FERRO, W. & SWAR, D. B. 1978. Bathymetric maps from three lakes of Pokhara valley, (Nepal). Journal of the Institute of Science, 1, 177–188.

GAULI, S. B., DHAKAL, M., & KHANAL, R. 2016. Lake Cluster of Pokhara Valley. Department of National Parks and Wildlife Conservation and International Union for Conservation of Nature and Natural Resources.

GURUNG, T. B. 2007. Restoration of small lakes through cooperative management: A suitable strategy for poverty-laden areas in developing countries? Lakes and Reservoirs: Research and Management, 12, 237-246.

GURUNG, T. B., CHAUDHARY, P., & BHATTA, K. P. 2019a. Restoring lake fisheries and rural livelihoods through rights-based inclusive governance in Nepal. In WESTLUND, L. & ZELASNEY, J. eds. Securing sustainable small-scale fisheries: sharing good practices from around the world. FAO Fisheries and Aquaculture Technical Paper No. 644. Rome. 184 pp. License: CC BY-NC-SA 3.0 IGO.

GURUNG, T., NEPAL, A., BISTA, J., WAGLE, S., SAH, S. & HUSEN, M. 2019b. Chapter 11 A Case Study on Restoration Using Biomanipulation by Cooperative for Fish Production in Lake Rupa, Nepal, in GIRI S. S., BOKHTIAR, S. M., PAUL, B. N. and SAHOO, S .K. Eds. Diversification in Aquaculture: Towards Achieving Sustainability. SAARC Agriculture Centre,SAARC, Dhaka, Bangladesh, 192 p.

UCN. 1996. Environmental studies of Nepal's Begnas and Rupa Lakes. A collaboration between the National Planning Commission and IUCN. p. 156
.

KAFLE, G, COTTON, M, CHAUDHARY, J. R, PARIYAR, H, ADHIKARI, H, BOHORA, S. B, CHAUDHARY, A, RAM, A & REGMI, B. 2008. Status of and Threats to Water Birds of Rupa Lake, Pokhara, Nepal. Journal of Wetlands Ecology 1(1/2): 9–12.

LI-BIRD. 2007. Annual Report 2005-2006. Local Initiatives for Biodiversity, Research and Development (LI-BIRD), Pokhara, Nepal
.

LI-BIRD. 2009. Annual Report 2007-08. Local Initiatives for Biodiversity, Research and Development (LI-BIRD), Pokhara, Nepal.

LI-BIRD. 2020. Annual Report 2019-20. Local Initiatives for Biodiversity, Research and Development (LI-BIRD), Pokhara, Nepal.

OAKLEY, P. 1991. Projects with People: The Practice of Participation in Rural Development. Geneva: International Labor Office.

PILLAI T. G. & SWALLOWS J. D. 1980. Cage culture of fish in Nepal. A report prepared for the integrated fisheries and fish culture development project, Nepal, Rome, FAO, F1:DP/NEP/73/025, Field Document 8, 28p.

POKHAREL, S. &NAKAMURA, M. 2012. Integrated Lake Basin Management (ILBM) for the Sustainable Conservation of Himalayan Lakes of Nepal. IPSI.

PRADHAN, N., PROVIDOLI, I., REGMI, B., & KAFLE, G. 2010. Valuing Water and its Ecological Services in Rural Landscapes: A Case Study from Nepal. Mountain Forum Bulletin. 32-34.

RAI, A. K. 2000a. Limnological characteristics of subtropical Lakes Phewa, Begnas and Rupa in Pokhara valley, Nepal. Limnology 1, 1–13.

RAI, A. K. 2000b. Evaluation of natural food for planktivorous fish in Lakes Phewa, Begnas, and Rupa in Pokhara Valley, Nepal. Limnology 1, 81–9.

RAI, A. K., SHRESTHA B. C., JOSHI P. L., GURUNG T. B. & NAKANISHI M. 1995. Bathymetric maps of Lakes Phewa, Begnas and Rupa, Pokhara Valley, Nepal. Mem. Fac. Sci. Kyoto Univ. Ser. Biol. XVI. No. 1, 49–54.

RANA, R., MALLA, Y., BHANDARI, B., BISHWAKARMA, P., SHERPA, L., PUDASAINI, N., PAUDEL, I., BHUSAL, A. & SHRESTHA, P. 2020. Case Studies on Sustainable Livelihoods in Rural Areas of Nepal: Ecosystem Restoration and Conservation for Resilient Livelihoods in the Rupa Lake Watershed of Nepal. UNEP & LI-BIRD.

SHRESTHA, S. 2017. Contribution of Rupa Lake for Sustainable Food Security and Local Climate Change. Journal of Food Science and Engineering, 7, 151-160.

Appendix 1. Timeline of Rupa Lake Watershed projects, 1985–2017.

Time period	Project name, funding agency/ collaborators	Project objective/s	Participants
1985–1998	Begnas Tal Rupa Tal Watershed Management Funders: DGIS Netherlands and GoN. Implementer: CARE Nepal	Environmental protection and poverty alleviation through rehabilitating the Begnas and Rupa watersheds	Begnas and Rupa Lake watershed residents
1997–2001	In-situ Conservation of Agricultural Biodiversity; Funders: NEDA Netherlands, IDRC Canada and Bioversity International, Implementers: LI-BIRD and Nepal AgricultureResearch Council	- Understand farmer decision-making processes that influence agricultural biodiversity - Strengthen national institutions to conserve agricultural biodiversity, and - Help farmers adopt agricultural biodiversity practices	22 groups (759 households)
2003–2005	Community Biodiversity Register Project Funders: UNDP/ GEF-SGP, Implementer: LI-BIRD	Strengthen local capacity to document and manage biodiversity.	17 groups (854 households, 2 cooperatives, etc)
2006–2007	Community-based Wetland Management Project Funder: IUCN Implementer: LI-BIRD	Implement community-based wetland and watershed management to conserve biodiversity and enhance livelihoods.	RLRFC (the Cooperative) (854 members)
2007–2011	Enhancing Benefits to Smallholder Farmers by Linking Agrobiodiversity to Niche Market Project Funder: The Development Fund Norway, Implementer: LI-BIRD	Increase the productivity of biodiversity-based production systems, and strengthen the capacity of farming communities to conserve, use & benefit from agriculture biodiversity	Pratigya Cooperative and 150 smallholder households
2014–2017	Mobilizing Local Resources and Institutions for Integrated Management and Utilization of Watershed Services in the Mid-Hills of Nepal Funder: Swiss ReSource Foundation Implementer: LI-BIRD	Strengthen 'Payment for Watershed Services' mechanism for managing biodiversity and natural resources to benefit conservation and livelihoods	1,000 households; Begnas and Rupa watershed area

Acknowledgements

This case study is made possible by funding from the World Economic Forum and was edited and managed by Rebecca J Cole and ETH Zurich's Crowther Lab. .

Authors: Sarah Jane Wilson and Sophie McCallum; Forestoration International
Contributors: Tek Bahadur Gurung, Lakpa Sherpa

www.Forestorationinternational.org

ETH zürich | CROWTHER LAB