A watershed conservation success story in Nepal: Land use changes over 30 years

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This article reports on changes in land use and in land degradation between the 1970s and 2006. In the middle hill region of west central Nepal in 1977, part of a watershed experienced erosion rates exceeding 30 Mt/ha/yr due to high rainfall intensities, unstable soils, steep slopes, deforestation and severe overgrazing. However, since the 1970s an innovative national government policy of handing over forest management to local people was put in place, resulting in conversion of nearly all the eroded grazing and shrub land to managed pasture and forest, a fivefold increase in grass and fodder and a near-doubling of forest productivity. While 43% of project costs were spent on user group formation and vegetative restoration, this provided most of the social, environmental and economic benefits, compared to structural measures.

The objectives of the study are fourfold: 1) to document land use changes resulting in improved ecological health of the watershed and increased productivity of forests and grasslands; 2) to demonstrate the livelihood and economic benefits resulting from improved watershed health; 3) to show that participatory forest and range management policies are more effective than structural measures in restoring a watershed in the middle hills of Nepal; and 4) to demonstrate the efficacy and validity of using land use changes as a rapid project evaluation method.

Keywords: community forestry, erosion plots, land use, watershed management, evaluation, social fencing.

THE POSSIBILITY OF REVISITING an international project begun 30 years ago is rare, and when presented should be considered as a unique opportunity for reflection and observation of success and failure. Such an opportunity arose in 2006 when the Food and Agriculture Organization of the United Nations (FAO) encouraged a return to the Phewa

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Tal watershed (Kaski District, Nepal), the site of an FAO-assisted project that had assessed water quality, land use and hillside stability in 1977–78.

Introduction

The watershed, 140 km west of Kathmandu and adjacent to the town of Pokhara, covers 113 km^2 and drains into one of the country's most prominent lakes, Phewa Tal (Figure 1). Topography is steep; slopes average 40%, and elevations range from 850 m at the lake to 2,500 m at Panchase Peak. The lake, the town and treks into the nearby Annapurna range make the area a popular tourist destination. In 1977, forest land, including that classified as shrub, composed 28% of the watershed, all owned and controlled by the national government of Nepal (Fleming, 1983). While terrace land was beautifully maintained,

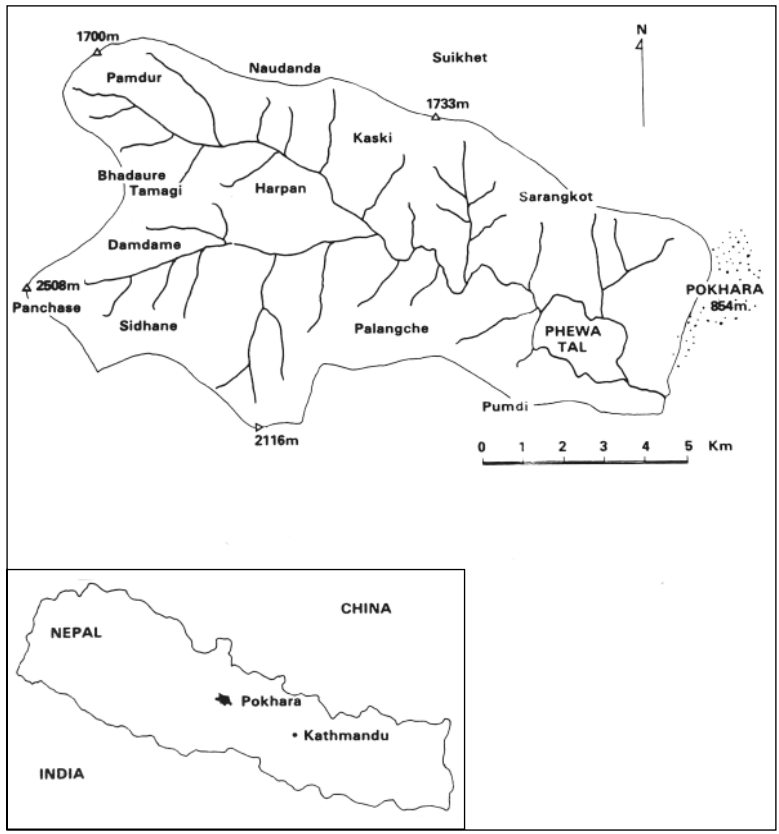


Figure 1. Location of Phewa Tal in Nepal

While terrace land was well maintained, overgrazed land was eroding, and forests were being stripped for firewood

overgrazed land was eroding, and forests were being stripped of even small trees for firewood and fodder. Of the watershed population of 21,000, over 90% were engaged in agricultural activities. Subsistence agriculture was the main economic activity with principal crops of rice, corn, millet, wheat, potatoes and vegetables (mustard and soybeans). Most families kept four or five buffalo for the production of manure and milk and for ploughing. Forests supplied fuelwood and timber for building but were not managed on a sustained-yield basis.

In late 1978, the future of the forest and pasture lands was in doubt. The project final report recommended a watershed plan but also contained pessimistic long-term projections based on then extant land and natural resources use practices. Uncontrolled grazing and indiscriminate firewood collection with subsequent erosion were likely to devastate hillside farmland, pasture and forest cover (Fleming, 1983).

Instead of open grazing, animals were now stall-fed

By 2006 the population had grown to 37,000, most still employed in agriculture. Buffalo ownership had declined to one or two per family, and instead of open grazing, animals were stall-fed. In addition to the traditional crops, kitchen gardens had expanded to include an array of vegetables for family consumption and for sale in Pokhara (Nepal Bureau of Statistics, 2006). Reports by government scientists, international aid groups and NGOs since 1978 as well as interviews with forest officials and local residents tell the continuing story of an innovative forest policy that, with advice and ongoing evaluation by district forest officers, progressively turns over management responsibilities to groups of local people, Community Forest User Groups (CFUGs), living adjacent to the forested areas. The shift in management included an end to open grazing and a programme to improve livestock (FAO, 1987). By 2004, CFUGs had come to manage 25% of Nepal's forest land (Kanel, 2004). In the Phewa Tal watershed the percentage was much higher, exceeding 60%. Observations in the field, reinforced by aerial photographs and satellite imagery, were that forest and grazing land had not only recovered but improved markedly under the community forest policy.

By 2004, Community Forest User Groups had come to manage 25% of Nepal's forest land

How forest policy has developed

The devolution of control over the forests in Nepal has followed a zigzag path, evidenced by a brief history of forest policy. As early as the 1600s a royal edict of King Ram Shah recognized the importance of forests in the protection of the environment:

> Maintain trees around water springs. In the absence of trees, water will not last all through the year and the spring will run dry. If forests are cleared on a massive scale, there will be many land-

> slides. Landslides will bring floods that could wash away even *khet* [level terraces]. Thus five rupees fine to whosoever cuts trees around water sources (Bhattarai and Khanal, 2005).

The period was one of active forest clearing and alienation of communal rights

The Rana Period (1846–1950) was one of active forest clearing for agriculture, alienation of communal rights and concentration of forest rights in the hands of the ruling class, along with increasing timber sales (Bhattarai and Khanal, 2005). With the overthrow of the Ranas in 1950 and the establishment of new government institutions, forests were considered a part of national wealth and forest protections a duty of the state with a top-down model of governance. The Forest Act of 1961 along with other laws reinforced the government's ownership rights and made many traditional resource uses illegal (Bhattarai and Khanal, 2005). National ownership was not combined with management, and as the policy of protections from deforestation was unenforceable, disruption of community-led governance resulted in accelerated use by villagers who were not given incentives for sustainable use (Fleming, 1983). This policy was inappropriate for fuelwood and fodder management because land tenure tradition regarded forests as part of the resources of particular villages even though these lands were not registered for legal ownership.

With the enactment of the National Forestry Plan of 1976 and the Panchayat Forest Law of 1978, individual panchayats (village councils) could establish CFUGs and control up to 125 ha of shrub land for reforestation and could manage up to 250 ha of government forest on a sustained yield basis, receiving 40% of the net income from forest products (Fleming, 1983). By 1978, these first steps toward devolution of forest management had yet to significantly affect conditions in the watershed.

The panchayat system proved ineffective in protecting the forests

After the panchayat system proved ineffective in monitoring the protection of the forests and in ensuring equitable distribution of forest products, a new system was initiated by the 1993 Forest Act that recognized CFUGs as independent entities, separate from local government, allowing their forests to overlap political boundaries of villages and districts (Bhattarai and Khanal, 2005). Users desiring to manage a forested area as a group must file an application including a constitution identifying members and a work plan. Components of the work plan include: a map of the forest area, a description of the condition and type of forest, objectives for sustainable management, proposed conservation methods, sale and distribution of forest products, wildlife preservation, and special programmes for women and underprivileged classes. CFUGs are structured to promote cooperation in protecting the common forest resources.

At a national workshop in 2004, major stakeholders in community forestry gathered in Kathmandu to evaluate the programme's

Social or even forestry reform is not linear, but an iterative and 'muddling through' process

past and guide its future. Kanel (2004) addressed the challenges of co-ordinating collective action in the area of community forest management, from resistance to change to formulation and enforcement of rules. Communication and the social relationships of trust, reciprocity and commitment to group decisions facilitate the process.

> Social or even forestry reform is not linear, but an iterative and 'muddling through' process... Intervention and innovation is a slow process since all the stakeholders have to agree on innovations and reforms... There is a critical mass of committed government staff in the forestry sector, members of civil society and forest users who agree for the need of such reforms (Kanel, 2004).

The watershed and observation sites

Land use analysis of the watershed, determined from aerial photographs and field observation in 1977, showed nearly half the land in terrace, 28% in unmanaged forest, 11% in open grazing, 7% in degraded shrub and at least 1% in gullies or landslides. Shrub and forest land was also grazed and/or used for fodder. About 10% of the basin is flat to rolling (0–10% slope), 60% has slopes between 20 and 60% (averaging 40%) and 15% is very steep (60–100% slope). The rainfall pattern is monsoonal, with 85% of the annual total of 5,400 mm falling between June and September, often in brief, intense and erosive storms (Fleming, 1983).

Terraces in the Phewa Tal were well constructed, and runoff from arable land under terraces was slight, causing no significant erosion damage. In 1977, erosion from forest land at 8 Mt/ha/yr was five to ten times greater than that from natural forests because of grazing activity and intensity of rainfall. The estimated soil loss from shrub land was even higher at 15 Mt/ha/yr. The most critical category was grazing land. Although constituting only 11% of the area, it could be credited with as much as 29% of the soil loss (Fleming, 1983). Demonstration erosion plots were constructed at Banpale in 1977 on open grazing land and on pasture protected by a fence, and these showed protected pasture lost 9.2 Mt/ha/year, while open grazed land lost 34.7 Mt/ha/year. Without a watershed conservation programme and population growth exceeding 2% per year, forest land could have disappeared by 1996 (Fleming, 1983).

The demonstration plots compared protected pasture with open grazed land

In 2006, terraced lands still covered 46% of the land and remained in excellent condition. Shrub and forest cover had improved, and protected pasture had replaced unrestricted grazing land. Observations of the demonstration plots showed that vegetation cover had increased

dramatically, erosion was minimal, and forest and range resources were largely controlled by community user groups (see Box 1).

Recommendations for a watershed management plan to address soil erosion, land degradation and economic sustainability grew from experience in the Phewa Tal in 1977–78 (Fleming, 1983). Measures included protection of existing forest and management on a sustained-yield basis, conversion of open grazing land to protected pasture, reforestation on selected sites, check dams in gullies, river control structures, training of local individuals as conservation assistants, and a balance between national and local objectives.

Methods to assess environmental changes and economic benefits

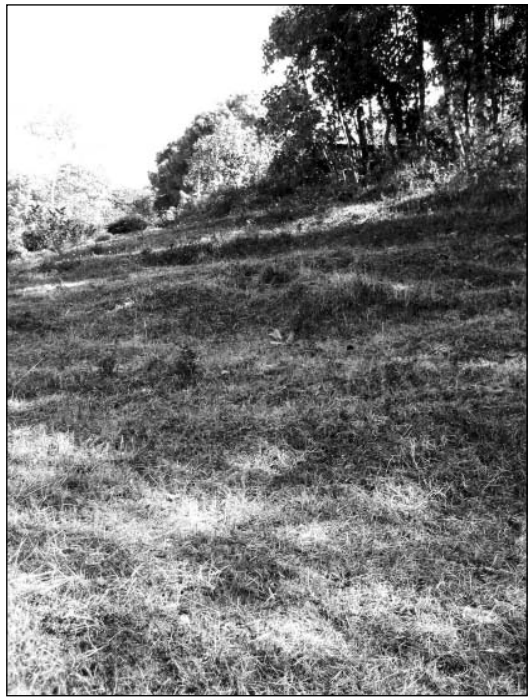
The erosion plots were maintained for three years and soil losses measured after each precipitation event

Erosion plots and soil loss equations were used to measure and estimate erosion rates as an indicator of watershed health and to identify land use categories as priorities for watershed restoration (Fleming, 1983). Two 10 m^2 erosion plots were established in 1977 (the first in the country), one inside an area protected from grazing and a second on the same slope outside the enclosure. The plots were maintained for three years and soil losses measured after each precipitation event. Significant variations in monsoonal rainfall during these years provided a range in runoff and soil loss. Based on these data, increases in vegetation cover and soil loss equations were used to estimate erosion rates from the plots in two subsequent time periods and again in 2006. Maintaining the nutrient pool in the soil is the key to long-term agricultural productivity, and when soil is lost the nutrients are also depleted (Brown et al., 1999).

Box 1. Revisiting the erosion plots in 2006: Banpale, Kaski District

The scattered houses that constitute the settlement of Banpale sit just below the ridge that marks the northern boundary of the Phewa Tal watershed. Word spread quickly that visitors with questions had arrived, and soon a knot of interested villagers gathered around to examine photos of the 1977 erosion plots. One man remembered them, and moments later, the group was hiking up and down the slope above the new schoolhouse. It took less than half an hour to locate remnants of the plots, mostly hidden by vegetation. The wire fence was gone, unneeded in the current era of social fencing in which grasses and fodder are cut and carried to stall-fed animals. The former fenced area had evolved into forest, and a mat of thick grass covered the formerly denuded grazing land. The plots had done their job, providing scientific data on erosion rates through 1982, showing farmers the need for land use changes, and decades later provided a graphic indication of improved watershed health (see photos).

(a) Overgrazed land, Banpale 1978



(b) the same Banpale pasture in 2006

Production rates for fuelwood and fodder from managed and unmanaged forest were measured in 1977 and 1978 by professional foresters (Fleming, 1983). Grass production from open grazing land and protected pasture were monitored by a range management specialist in 1977 and 1978 (Van Swinderen, 1978).

Monetary values were assigned to land use categories of varying productivity

Estimating increases in land productivity and resulting livelihood benefits with the watershed management programme was the basis of an economic analysis. Monetary values were assigned to land use categories of varying productivity (open grazing land, protected pasture, unmanaged forest and managed community forest). The analysis then compared the value of the land without the programme to its value with the proposed conservation plan. The differences between the two values are assumed to approximate the monetary benefits of watershed management interventions. Benefits that are difficult to value, such as domestic water supplies and their associated health benefits, have not been included. The calculations are based on the values in Tables 1, 2 and 3.

Table 1. Production of wood and fodder (per hectare per year)

Land use	*Grazing land*	*Protected pasture land*	*Shrub land*	*Unmanaged forest*	*Managed forest*
Grass (kg)	1,200	6,000	500	–	–
Tree foliage (kg)	–	–	1,500	3,000	5,000
Wood (m3)	–	–	4	12	20

Table 2. Production and value of fertilizer from cattle fed on grass and fodder foliage

Fertilizer from animal dung	*Production/animal/year (kg)*	*Value (Rs/kg)*[1]
Nitrogen	15	6
Phosphorus	2	18

[1] US$1 = Rs76 (exchange rate on 6 November 2008)

Table 3. Production and value of milk from grass and fodder foliage

	Milk	
	Production/1,000 kg feed (litres)	*Value (Rs/litre)*
Grass feed	60	1
Foliage feed	120	1

Production of grass from protected pasture is approximately five times greater than from open grazing land, resulting in a fertilizer value of Rs55 per ha and a milk value of Rs360 per ha (Fleming, 1983). Fodder production from the enclosure yielded 6,000 kg/ha/year of green fodder, compared with 1,200 kg/ha/year from open grazing land in the watershed.

Fuelwood is produced on both shrub lands and forest lands. Two methods were used to estimate fuelwood values (Fleming, 1983). First is a direct market value approach based on the 1978 fuelwood price in Pokhara (Rs13 for a 37 kg bundle). Assuming an average wood density of 500 kg/m^3, fuelwood would be worth Rs174/m^3 (500 kg/m^3 × Rs13/37 kg = 174). A second method was an opportunity cost approach based on the time families spend carrying fuelwood from the forest (Fleming, 1983). This method assumes that: 1) 30 kg of fuelwood are collected daily by each family; 2) each family spends an average of 132 worker-days/year collecting fuelwood; 3) 30 kg of fuelwood is the energy equivalent of 20 kg of dry wood with a volume of 0.04 m^3. Therefore, each family gathers 5.3 m^3 of fuelwood annually and at a daily gathering wage of Rs5 (the opportunity cost of labour

based on other employment), the value would be Rs125/m^3 (5 Rs/day × 132 days/year/5.3 m^3/year). The average of the results from the two methods is Rs150/m^3. Other potential benefits of the proposed management plan were not calculated, such as hydroelectric power, tourism and fisheries.

Nearly 60 interviews were conducted in 2006 with government forestry officials, community forest practitioners, NGO workers and villagers living in CFUGs located in the watershed. Villagers were asked whether their livelihoods had improved during the past 30 years and in what ways. They were questioned about the impacts of water supply projects, soil conservation structures, stall feeding of animals, local control over forest and range resources, and government resource management policies on their lives.

Findings

By 2006, 2,739 ha or 24% of the watershed area had been handed over to 95 Community Forest User Groups (CFUGs), and each group had developed a plan for sustainable management approved by the district forest office (Kaski District Forest Office files, 2006). Previously unmanaged forest land had decreased to 12% of the watershed area. Although no comprehensive analysis comparing the quality of community forests with unmanaged forest land were available for the Phewa Tal, community forests were observed in 2006 to have a dense vegetation cover and a wide diversity of species for fuelwood, fodder and other uses.

Community forests contained a wide diversity of species for fuelwood, fodder and other uses

Land use changes between 1978 and 2006 were documented with two periods of aerial photograph and satellite imagery interpretation,

Table 4. Estimated land values in the Phewa Tal Watershed (Rs/ha/yr), derived from production of milk, manure fertilizer, and fuelwood

Land use	*Grass*		*Fodder leaves*		*Fuelwood*	*Total*
	Fertilizer	*Milk*	*Fertilizer*	*Milk*		
Grazing	11	72				83
Protected pasture	55	360				415
Shrub	5	30	27	180	384	626
Forest (unmanaged)			53	360	1,152	1,565
Forest (managed, after 6 years)			89	600	1,900	2,609
Plantation forest (5–10 years)			22	144	480	646
Plantation forest (after 10 years)			44	288	960	1,292

combined with field observations (Table 5; Fleming, 1983). Terraced arable land remained constant while forest land increased from 28% to 36%, mainly resulting from conversion from unmanaged forest and degraded shrub and grazing land to managed community forest (Table 5). Degraded grazing and shrub land, nearly 20% of the watershed in 1978, was converted to managed pasture or community forest by 2006. Unproductive shrub land, 7% of the watershed in 1978, was managed pasture or forest by 2006.

Most of the critical landscapes identified in 1978 had become managed pasture or community forest

Most of the critical landscapes identified in 1978 (19% of the watershed) had become managed pasture or community forest where social fencing restricts open grazing. Some unrestricted grazing still occurs in parts of forested landscapes, particularly in Bhadaure-Tamagi and Chapakot villages and farmers often allow grazing on terraces following harvests. The conservation and watershed management programme, begun in 1974, included a variety of protection and rehabilitation measures encouraging this positive shift in land use from open grazing to protected pasture and forest. Also important was the Livestock Development Programme of the Ministry of Agriculture, encouraging fewer animals but better dairy producers (FAO, 1987).

By 2006, erosion rates on the same grazing land had decreased substantially because it was no longer grazed and the vegetation cover had increased to 100%. Because the erosion plots had not been maintained after the first two years of measurements, soil loss in 2006 was estimated with the 'modified universal soil loss equation'. Results from 2006 transects ranged from 1.4 to 2.7 Mt/ha/year, more than ten times less soil loss than the measured values from 1978–79 and consistent with Impat's conclusions using both measured plot and estimated soil loss equation methods (Impat, 1981).

Table 5. Land use changes from 1978 to 2006 in the Phewa Tal Watershed (% of total watershed area)

	1978[1]	2006[2]
Terraced arable land	46	46
Unmanaged forest	28	12
Community forest	0	24[3]
Unrestricted grazing	11	1
Degraded shrub	7	1
Managed pasture	1	9
Gullies/landslides	1	1
Lake/urban	6	6

[1] Determined from aerial photographs
[2] Estimated from field observations, interviews and LANDSAT imagery
[3] 2,739 ha or 24% of the watershed has been handed over to Community Forest User Groups (Kaski District Forest Office files, 2006)

In addition to continuous activity by Nepal's Department of Watershed Management and Soil Conservation between 1974 and 2006, three international agencies provided funding: the Food and Agriculture Organization of the United Nations (FAO) from 1975 to 1984, the Finnish International Development Agency (FINNIDA) from 1985 to 1994, and the Japanese International Cooperation Agency (JICA) from 1997 to 2004 in a small part of the watershed. Costs of the services provided by all four agencies were estimated from unit costs of activities in the watershed (DSCWM, 1992).

Costs

The actual costs of the project were more than double those projected in the 20-year plan

Table 6 shows that the actual costs of the project were more than double those projected in the 20-year plan (about Rs54 million, compared with a projection of about Rs26 million).

It is significant that nearly 60% of the costs were spent on structural measures, such as check dams and river training gabions, which did not result in significant land use changes. The underlying assumption of this analysis is that land use changes from less productive uses to more productive uses result in improved livelihood and economic gain by watershed stakeholders. While there were benefits from structural activities, in economic and livelihood terms they were small, compared to those resulting from the conversion of land use from open grazing to protected pasture and from government forest to community forest. Treating eroding gullies did not result in land use changes and often failed after the first season of monsoon rains (Fleming, 1983). Economic analyses of other projects in the Middle Hills of Nepal showed that the costs of building torrent control structures, treating landslides and building embankments in riparian zones far exceeded the economic benefits valued in terms of conserved agricultural land (Achet and Fleming, 2006).

Treating eroding gullies did not result in land use changes and often failed after the first monsoon

Preventive vegetative measures constituted 39% of project costs, mainly conservation plantations, fruit tree planting, water source protection, and nursery establishment. Although these measures would be likely to result in future livelihood gains, the benefits in terms of land use changes are difficult to estimate. Only 4% of the project funds were spent on the formation of user groups, farmer

Table 6. Documented project costs: 1974–2006 (millions of Rs)

Activity	*Cost (Rs millions)*	*% of total*
Preventive measures (mainly reforestation)	20.7	39
Rehabilitation measures (mainly structural)	30.9	57
Extension and education	2.2	4
Total	53.9	100

Only 4% of the project funds were spent on the formation of user groups, training and community mobilization, while many of the benefits resulted from these activities

training, household training, and community mobilization through conservation education and extension, while many of the benefits resulted from these activities. In terms of cause and effect, evaluating the impacts of agricultural and forestry extension projects and education (4% of project costs) are perhaps more straightforward. A partial accounting of the substantial economic benefits accruing in improved livelihoods from conversion of open grazing land to protected pasture and from government forest to community forest is provided in this analysis.

These preventive measures and extension/education activities, valued at 43% of the project costs, resulted in substantial land use changes from grazed land to pasture and from unmanaged forest to mainly community forest (66% of forest land). The benefits of these land use changes were livelihood enhancement, valued in terms of additional production of grass, fodder and wood, in turn resulting in increased milk, fertilizer and forest products.

Benefits

The benefits exceeded the costs by a substantial amount

Benefits of the 32-year life of the project are calculated on the basis of the productivity of different land uses (milk, fertilizer and forest products), for the projected 20-year plan (see Table 4). Table 7 shows that the benefits still exceeded the costs by a substantial amount, even with costs that were more than double those predicted in the earlier plan projection.

With benefits of Rs37 million and costs of Rs25 million, the ratio of benefits to costs is positive, although not as high as the 1.7 ratio projected in 1978:

Benefits of Rs37 million / Costs of Rs25 million = 1.5

Many environmental services are left out of this calculation, including water quality and improved fishery, flood control, increased seasonal and spring flow, reduced lake sedimentation and hydropower benefits, ecotourism recreation and aesthetics, carbon sequestration, biodiversity and species conservation.

Table 7. Benefits over 32 years of management (millions of Rs discounted at 10% over 32 years)

Benefits with management	73
Benefits without management	36
Difference	37

Box 1. Interview with the school teacher

Seated on his front porch before classes begin, the local school principal describes the Ghata Basuli Bari and Banpale Community Forest User Group of which he is member. The group includes 95 households which meet in a general assembly twice a year. Of the 11 committee members who meet bi-monthly, three are women who often add comments. He has seen an enormous improvement in the condition of the forest and surrounding lands near Naudanda since his childhood when the hills were denuded and overgrazed. The Department of Soil and Water Conservation planted trees, a species of *Alnus*, he says, and the Department of Forestry handed over the land to the community forest user group. One small forest of only a hectare provides fuelwood which is collected twice a year. Everyone goes into the forest for this task, unlike before, when one woman per family used to spend all day everyday searching for wood to bring home. Since the forest is small, families belong to a second forest user group, and still must purchase supplementary wood. The user group does not collect membership fees, but takes up a collection for a forest watcher who guards against illegal wood gathering. Grazing on communal land has ceased; families used to own four buffalo but now have two, and these are stall-fed. 'Another change: all children go to school', he says with satisfaction.

Life in the area has improved since his parents' generation, another resident of the upper watershed says decisively. The land has a much better vegetation cover than previously, and while terraces occupy about the same area, farming on terraced land has intensified, and many farmers use chemical fertilizer to compensate for declining soil quality. His neighbours used to own a dozen free-grazing livestock, but now the number has decreased to two at most, all of them stall-fed and more effective milk-producers. Dung collection is more effective now that animals are stall-fed, but he says that chemical fertilizer, though more expensive, works faster.

Box 2. Interviews with women

Women and disadvantaged minorities are encouraged to participate in CFUGs, but roles change slowly. The president of one Phewa Tal CFUG said three women are members of the core committee, but they never speak and none is an officer. On the other hand, their forest of 61 hectares is in much better condition and produces far more than in his father's time.

In the lower watershed, a grandmother seated on her front porch joins the 165 members of her CFUG to collect wood on designated days in their communal forest near Phewa Lake. 'It isn't enough. We have to buy extra wood, but we are managing,' she says with a shrug. Her family was able to buy land near the lake and water and so moved down from the upper watershed about 15 years ago. In the last 30 years her family's life has improved. 'We are healthier. We eat better because of our vegetable garden and some money earned from outside.' All of her grandchildren, 'even the girls', can read and write, skills she herself never learned. As a younger woman she spent hours fetching water and fuelwood every day. Now her daughters and daughters-in-law, freed from those tasks, do the farming. One son works in Malaysia and sends money home; two others work in the town of Pokhara. She smiles when she says they have a television and that now she has 'time to watch. I enjoy whatever comes on.'

An example of rules bent to tolerate the very poor is the situation of a low caste woman washing clothes at a village water spigot while her young child sits in the dirt nearby. She moved to the community from higher ground 10 years ago, but has not joined the CFUG because she claims the admission fee was too high. Her solution, she says with a laugh, is either to buy fuelwood a few pieces at a time or wait until the forest watcher goes off duty so she can sneak into the forest for downed wood. So far no one has stopped her, though they know how she survives.

Box 3. Interviews with Banpale CFUG

Three members of the Banpale community forest user group sit on the dry winter grass and describe how the surrounding land has changed in the last 30 years. The days of open grazing are gone, they say, as are the denuded slopes. Families used to own four or five livestock, but now the 180 households in this community forest user group each own at most two animals. One man pats the protective layer of vegetation growing on the formerly eroded hillside and points to nearby terraces edged with bunds that prevent soil loss. 'This land is much better than then', he says. 'We know more.' The current problem of their CFUG is food for livestock, he says. Since open grazing is not permitted, and their 5 hectare forest is a pine plantation that does not provide fodder leaves, extra fodder must be purchased. 'Fodder trees that have sprouted in our forest are still too young to be useful.' Another man is optimistic: 'We will wait; they're growing.'

Findings from the interviews, 2006

Excerpts from interviews with farmers and forest users in 2006, provide snapshots of how the participatory programme functions in the Phewa Tal watershed. An open-ended question, 'How have living conditions for your family changed in the last 30 years?' led to a range of observations on land and forest use, farming techniques, water supply, electricity, diet, children's education, outward migration of young men, women's participation in decision making, even the novelty of television. They were also asked if they belonged to a CFUG and how it functioned. Answers revealed an understanding of conservation principles and technical applications as well as a glimpse into the evolving process of group dynamics (see Boxes 1, 2 and 3).

Discussion

The impacts of participatory collaboration in watershed management projects are enormous

The impacts of participatory collaboration in watershed management projects are enormous, but often undervalued by both social and economic measures. Community forest user groups now control over 60% of the forest land in the Phewa Tal watershed, resulting in increased productivity and sustained yield management. Fodder and fuelwood productivity is nearly twice as great as in formerly government-controlled protected forest. The cost of the community forest programme is small compared with the environmental, social and economic benefits from the change.

Agricultural productivity on terraced farm land has increased to provide sufficient food for a 36% population increase between 1981 and 2001, with little or no increase in the area of intensively farmed landscape. More efficient farming methods and an increase in the use of compost and mineral fertilizers were important reasons for increased production.

Women spend less time gathering fodder and fuelwood and carrying water

Watershed residents interviewed all told us that life is better now than it was 30 years ago and that watershed projects have provided services to help improve their livelihoods. A sense of well-being, respect for their achievements, and pride in their farms were evidence of positive changes. Migration has had an effect on many families in the watershed, according to information from interviews in 2006. Money has been sent home and many women have become the primary farmers in the family. More data are needed to confirm the quantitative impacts of migration on livelihoods in the watershed.

Women interviewed said they now have time for more meaningful work and productive farm projects because they spend less time gathering fodder and fuelwood and carrying water. Their sense of satisfaction in vegetable gardens, biogas units and other improvements was a positive indicator of social progress. More children, in particular girls, attend school than 30 years ago.

Monitoring land use change is a critical part of evaluating the impacts of a watershed management project. Land use changes in the Phewa Tal watershed over the past 30 years are key indicators of many environmental benefits. The change from 100% government-controlled protection forest to 60% community production forest has resulted in increasing forest diversity and sustained yield management. The 95 forest user groups in the watershed manage their own fuelwood resources, relieving pressure on using animal dung for fuel and instead using it to fertilize fields.

The change from degraded grazing and shrub land to protected pastures and plantations has reduced erosion, downstream sedimentation and landslides, while benefiting the hydrologic regime. Villagers told us that springs now flowed longer in the dry season. Stall feeding has kept livestock on farms rather than on open grazing land, conserving manure and allowing degraded grazing land to recover and produce harvestable grass to feed animals. Landslides and gullies are recovering.

Phewa Lake continues to eutrophy from excess nutrient inflows from municipal sewage

With less erosion and sedimentation, water quality in village ponds has improved and they do not fill up as rapidly with silt. While Phewa Lake continues to eutrophy from excess nutrient inflows, most loading of nitrogen and phosphorus is from municipal sewerage, not from farm runoff (Gurung and Dhakal, 2003) Vegetation cover is a reliable indicator of watershed health and surveys indicate that the watershed is much greener than 30 years ago.

Conclusions: Getting the most from watershed management

The Phewa Tal watershed in 2006 was a tapestry of productive terraces and healthy forest, with reliable if limited supplies of water. Changes

in land use were the key to the success of the project. These changes were largely brought about by a shift in government policy that allowed 95 forest user groups to gain control of most of the forest (60%) and pasture land (90%). These user groups had an economic incentive to manage the resources sustainably. A summary of observations in the watershed includes:

1. Watershed health improved significantly from 1978 to 2006, reversing apparent trends.
2. Water quality in Phewa Lake has deteriorated over the past 30 years with increasing nutrient loading, mainly from municipal sources in Pokhara, rather than from upland watershed agricultural runoff. Recent road construction contributes significant amounts of sediment to the lake.
3. Nearly all formerly eroded grazing and shrub lands (25% of the watershed) became protected pasture or community forest. Grazing control, stall feeding and increased vegetation cover were effective in improving soil and water conservation.
4. Both benefits and costs were underestimated in the 1978 plan, but benefits still greatly exceeded costs nearly 30 years later.
5. Land use changes are key indicators of benefits because they result in valuable products (fuelwood, grass and fodder leaves), providing critical economic incentives for local user groups.
6. While local forest user groups were a major factor in watershed improvement, collaboration with NGOs and government agencies is important for ongoing technical advice and mediation services. Lower income and caste groups, as well as women, need encouragement to participate in community user groups.
7. A sense of well-being and pride in watershed improvements was expressed by many farmers in the watershed, both men and women.
8. Development activities in the watershed began with a top-down emphasis on structural conservation measures, requiring funding from donor agencies. Now activities rely mainly on user groups and collaboration with conservation agencies and NGOs for continuing management.

Collaboration with NGOs and government agencies is important for ongoing technical advice and mediation services

While agricultural extension education efforts consumed a minimum of project expenses, these activities led to substantial economic benefits in improved livelihoods through conversion of open grazing to protected pasture land and converting government forests to com-

munity forests. We believe that a combination of project activities, nearly all in the categories of conservation extension and education combined with preventive vegetation measures, were responsible for the majority of the livelihood benefits calculated in the economic analysis.

Vegetative measures were more effective, but needed user group involvement for long-term maintenance

Structural measures were sometimes effective in slowing runoff and flooding for short periods of time, but interventions such as check dams were quickly washed out and did not protect enough land to be economically viable (Achet and Fleming, 2006). Grazing control through social fencing and stall feeding were far more effective in erosion control and increased production of grass and fodder leaves. The changes in land use were accomplished through the government policy shift, education (such as small demonstration sites), and the formation of conservation and forest user groups. Vegetative measures were more effective, but needed user group involvement for long-term maintenance.

The impacts of participatory collaboration in watershed management projects are enormous, but often undervalued by both social and economic measures. Community forest user groups now control over 60% of the forest land in the Phewa Tal watershed, resulting in increased productivity and sustained yield management. Fodder and fuelwood productivity is nearly twice as great as in formerly government-controlled protection forest. The cost of the community forest programme is small compared with the environmental, social and economic benefits from the change.

References

Achet, S. and Fleming, W.M. (2006) 'A watershed management framework for mountain areas: lessons from 25 years of watershed conservation in Nepal', *Journal of Environmental Planning and Management* 49(5): 1–19.

Bhattarai, A.M. and Khanal, D.R. (2005) *Communities, Forests and Law of Nepal: Present State and Challenges*, Federation of Community Forest Users, Nepal, Kathmandu; Pro-public, Kathmandu; CIEL, Washington, DC.

Brown, S., Schreier, H., Shah, P.B. and Lavakulich, L.M. (1999) 'Modeling of soil nutrient budgets: an assessment of agricultural sustainability in Nepal', *Soil Use and Management* 15: 101–108.

DSCWM (1992) *Watershed Management Plan of Phewa Tal Watershed*, Integrated Watershed Management Project, Technical Paper No. 1/1992, Department of Soil Conservation and Watershed Management - FINNIDA Joint Venture, Kathmandu, Nepal.

FAO (1987) *Watershed Management and Conservation Education Project, Nepal*, Interim Report, FAO, Rome.

Fleming, W.M. (1983) 'Phewa Tal catchment management program: benefits and costs of forestry and soil conservation in Nepal', in L.W. Hamilton (ed.),

Forest and Watershed Development and Conservation in Asia and the Pacific, pp. 217–88, Westview Press, Boulder, Colorado.

Gurung, T.B. and Dhakal, R.P. (2003) 'Seasonal variations of dominant phytoplankton, chlorophyll-a, total phosphorus levels in a shallow basin of Lake Phewa', in *2002/03 Annual Report Agriculture Research Centre (Fisheries)*, Pokhara, Kaski, Nepal.

Impat, P. (1981) *Hydrometeorology and Sediment Data for Phewa Watershed*, Department of Soil Conservation and Watershed Management, HMG/UNDO/FAO, Integrated Watershed Management Project, NEP/74/020.

Kanel, K.R. (2004) 'Twenty-five years of community forestry: contribution to millennium development goals', in K.R. Kanel, P. Mathema, B.R. Kandel, D.R. Niraula, A.R. Sharma and M. Gautam (eds.), *Proceedings of the Fourth National Workshop on Community Forestry*, pp. 4–18, Kathmandu, Nepal.

Nepal Bureau of Statistics (2006) *Nepal census data*, Kathmandu.

Van Swinderen, H. (1978) *Notes on Fodder Production in the Middle Hills of Nepal*, FAO Sheep and Goats Project Report, FAO, Rome.