CHAPTER 11
WATERSHED MANAGEMENT IN NEPAL: CHALLENGES AND CONSTRAINTS

Krishna Poudel
Department of Geography Education, Tribhuvan University, Kathmandu

WATERSHEDS: A CONTEXTUAL BASIS

Nepal's terrain is dissected by many rivers and streams to form a complex of watersheds. Natural and human-induced processes operate on these watersheds. The main processes that lead to the degradation of watersheds are landslides, soil erosion, floods, biodiversity loss, and unsustainable water extraction and farming practices. These lead to the loss of soil fertility, the depletion of water tables, the drying up of springs, desertification and sedimentation. A study carried out 20 years ago found that about 10 percent of Nepal's area was covered with very degraded watersheds (Table 1). Only 33 percent of the country was under "very good condition" watersheds.

TABLE 1
Watershed conditions in Nepal, 1983

Watershed conditions	Proportion of land
Very poor	10%
Poor	3%
Marginal	19%
Good	35%
Very good	33%

Source: DSCWM, 1983 referred to in Guragain et al., 2002.

Himalayan watersheds have relatively high population densities with nearly all the people relying on watershed-based resources for their livelihoods. The frequent natural disasters are partly caused by the overexploitation of natural resources and lead to large losses of life and property, principally in downstream southern plain areas (Box 1). Much landscape degradation is associated with the heavy monsoon rains. Parts of Nepal suffer from desertification, glacial lake outburst floods (GLOFs) and avalanches. Watershed management has paid little attention to threats to biodiversity, but it is an important issue.

BOX 1

SOME FACTS ABOUT LAND DEGRADATION IN NEPAL

- About 1 140 ha of land in 35 districts was lost in the 1993 monsoon to landslides and flooding.
- 41 800 ha of land was damaged in 1995.
- 74 000 ha of cultivated area in 16 districts in east Nepal was affected by drought in 2001.
- From 1983 to 2000, about 20 000 lives were lost to natural disasters; landslides and floods accounted for about 30 percent of these deaths.

A watershed is an area above a given point that is drained by a stream system. Watersheds are hydrologic units that have been used as the major spatial units for land, water and soil conservation by planners. Programmes and policies have focused on stabilizing the watershed environment. Integrated watershed management involves working on the natural and human resources in a watershed in accordance with the social, political, economic and institutional factors that operate within the watershed and its river basin (Easter, Dixon and Hufschmidt, 1991).

Himalayan watersheds have a complex physiography from the interaction of physical, biophysical and human activities. They generally have a weak geological structure and shallow soils, and are tectonically unstable and fragile. Most are characterized by steep slopes, large variations in altitude over short distances, incised river and stream beds with scars from landslides and gullies, large boulders in narrow watercourses from mass wasting and floods, sparse vegetation, agricultural fields and scattered human settlement.

Most cropland is carved out of hillsides by building terraces. Mountain farms usually have a few cattle and poultry. Households use their local common lands and forests for livestock grazing and as sources of fuelwood, fodder and timber.

It is only in recent times that roads, salaried jobs, health care and schools have reached these areas. This has had a large effect on natural resource use and management patterns, even in remote mountain watersheds, often disturbing the balance between nature and humans.

Food security and environmental degradation are two of the main challenges facing humanity in the twenty-first century (Lal, 2000). Protecting and strengthening watershed ecosystems is one of the main strategies to address these two issues.

Misconceptions about the causes of environmental degradation and food insecurity have often led to watershed management initiatives failing to deliver. This paper highlights the main watershed management issues concerning Nepal. It covers the approaches of watershed management adopted by the Government of Nepal, the links between population pressure and government policy, the land and food situation, information gaps on watershed management, and policy directions and constraints for watershed management.

GOVERNMENT WATERSHED MANAGEMENT

The indigenous management of Nepal's watersheds revolved around building terraced fields for crop production. Formal watershed management in Nepal began with the establishment of the Department of Soil Conservation and Watershed Management in 1974. Three years of work (1975 to 1977) in the Phewa Tal catchments in west-central Nepal by the Department of Soil and Water Conservation, Agriculture, Forest and Water Supply was the first project to work for the integrated management of a water catchment (Fleming, 1983).

The second half of the 1990s saw the adoption of a participatory and integrated approach to watershed management (Sharma, 1999). This involves the use and conservation of land, water and forest resources at the farm household and community or watershed level to improve livelihoods and human development (Sharma *et al.,* 1997). Chapter 10 of the government's Tenth Five-Year Plan (2002–2007) says, "Priority will be given to integrated watershed management to conserve the underground water and soil in the Chure-Bhawar and Terai areas by coordinating the work of agriculture and water resources sectors" (NPC, 2003). The plan significantly recommends the integrated watershed management approach, although it only names the Chure hills and the Terai areas.

POPULATION PRESSURE AND MACROLEVEL POLICY

Nepal's population has grown from 9.4 million in 1961 to more than 23 million in 2001. The 2001 census recorded about 7 percent of these people living in the mountains, 44 percent in the hills and 48 percent in the Terai plains. Much of the population growth has occurred in the Terai, as it has grown from more than 3 million in 1961 to more than 11 million in 2001.

In the 1950s, the government focused on relieving population pressure on the steep and environmentally fragile hill and mountain areas. The First Five-Year Plan 1956–1961 promoted a rehabilitation programme in the Terai. It sought to settle landless hill people there to provide them with a means of livelihood. The government took unsettled areas of the Terai for the planned resettlement of poor hill peasants. The Rapti Doon Multi-Purpose Development Project was the first such project (NPC, 1963). Successive five-year plans promoted resettlement in the Terai and its foothill valleys. They also promoted off-farm activities for income generation, and the introduction of high-yielding crop varieties and hybrid domestic animals. Most of these programmes were launched with advice from Western experts.

By the time of the Eighth Five-Year Plan 1992–1997, the national priority had turned to alleviating poverty. An important strategy for achieving this was to promote off-farm and foreign employment. Government policies assisted the existing trend of going abroad to work. In 2003 there were between 400 000 and 500 000 Nepalese working in foreign countries, not including the hundreds of thousands working in India. This has brought much foreign currency into the country, but has caused some problems. Although it has relieved population pressure on mountain watersheds, it has deprived these areas of workers. This has led to increasing wages for agricultural labourers. Wages have reportedly doubled in the past decade, from US$0.67 (NR 50) per day in 1990 or 2 *pathis* of grain (6.3 kg) to US$1.33 (NR 100) per day in 2000 (grain is now rarely accepted as payment). Over the same period, the price of agricultural products only increased by about 50 percent. This has led to decreasing labour

inputs in the farming sector, which in turn has led in many places to the abandonment of basic tasks such as terrace maintenance and the subsequent environmental degradation of mountain watersheds (Poudel, 2000; 2003).

Other important trends have been urbanization, the reluctance of young people to do farm work, the increasing use of modern amenities and the increasing use of manufactured goods. This has reduced the self-reliance of local communities.

The mass movement of people away from the hills and mountains has reduced population densities in some areas. It has been estimated that in 1952 to 1954 rural-to-rural migration (mostly from the mountains and hills to the Terai) accounted for 65 percent of total migration in Nepal. That figure stood at 91 percent in 1961, increasing to 93 percent in 1971 (Kc, 1983). The 1981 census reported 26 042 people having migrated from the mountains and hills to the Terai in the previous ten years. Among all migrants to the Terai, 67 percent were from mountain and hill districts. This trend continues, as the 2001 census reported that 16 percent of the Terai's population were internal migrants and 4 percent international migrants (who had moved there since 1991).

The population increase in the Terai has led to the destruction of swathes of Terai forests, especially along riverbanks. This has exacerbated riverbank cutting and flooding. The continued loss of life and environmental destruction is due to the failure to carry out integrated watershed management.

LAND AND FOOD

Nepal covers an area of 147 181 km^2. It has three main ecological belts in its mountain, hill and Terai areas that extend from west to east. The mountains and hills make up about 83 percent of the area, and the Terai 17 percent. Less than a quarter of the land is suitable for agriculture, and forest covers just over a third of the area. A considerable area is covered by steep and rocky terrain. Much of the hill and mountain areas are very fragile and vulnerable to landslides and mass wasting. Terai lands are regularly threatened by flooding and sedimentation.

Nepal, therefore, has only a limited amount of land that is suitable for mechanized farming. The National Sample Census of Agriculture, Nepal 1991/1992 (CBS, 1994) reported that about 2 597 400 ha of Nepal's land was under private ownership, of which 6.8 percent was in the mountains, 40 percent in the hills and 52 percent in the Terai. Of that total, 2 323 400 ha (89.5 percent) was arable land, of which 162 300 ha was in the mountains, 871 300 ha in the hills and 1 289 700 ha in the Terai. The average holding size was 0.96 ha, varying from an average of 0.68 ha in the mountains to 1.26 ha in the Terai. The mountains and hills have comparatively smaller landholdings.

The Nepal Living Standards Survey (CBS, 1996) recorded 83 percent of Nepalese households practising agriculture, including 98 percent of all mountain households, 87 percent of hill and 76 percent of Terai households. Agriculture is therefore a major source of livelihood for most Nepalese and it is the amount of land that often determines people's livelihood security. The same survey found that more than 50 percent of total households had less than adequate food consumption, with mountain people as the most deprived at 63 percent with inadequate food.

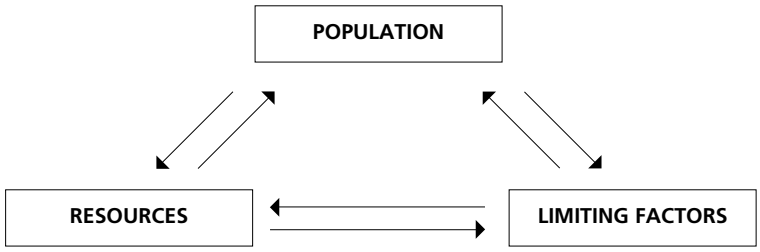
By calculating the total crop production per district and its calorific value, Subedi (1995) recorded that only one mountain district, one hill district and two Terai districts had relatively good food security. Eight of Nepal's 16 mountain districts, 13 of the 39 hill districts and three of the 20 Terai districts had poor food security. A 1997 ranking of Nepal's 75 districts ranked 25 as poor and deprived, of which nine were mountain districts, seven hill and nine Terai districts (ICIMOD, 1997).

The reliance on agriculture and the poverty and hunger of many Nepalese means that sound land management should be a government priority. But the periodic five-year plans have failed to give enough attention to this. Measures need to be taken to make the distribution of land more equitable and the land more productive, and to counteract land degradation. These can be achieved through the sound management of watersheds.

INFORMATION GAPS

It is difficult for proposed management activities to achieve their goals without a proper understanding of the many interrelated physical, biophysical and human factors that act on watersheds. However, this is often lacking in watershed management.

FIGURE 1
Relationship of population, resources and limiting factors

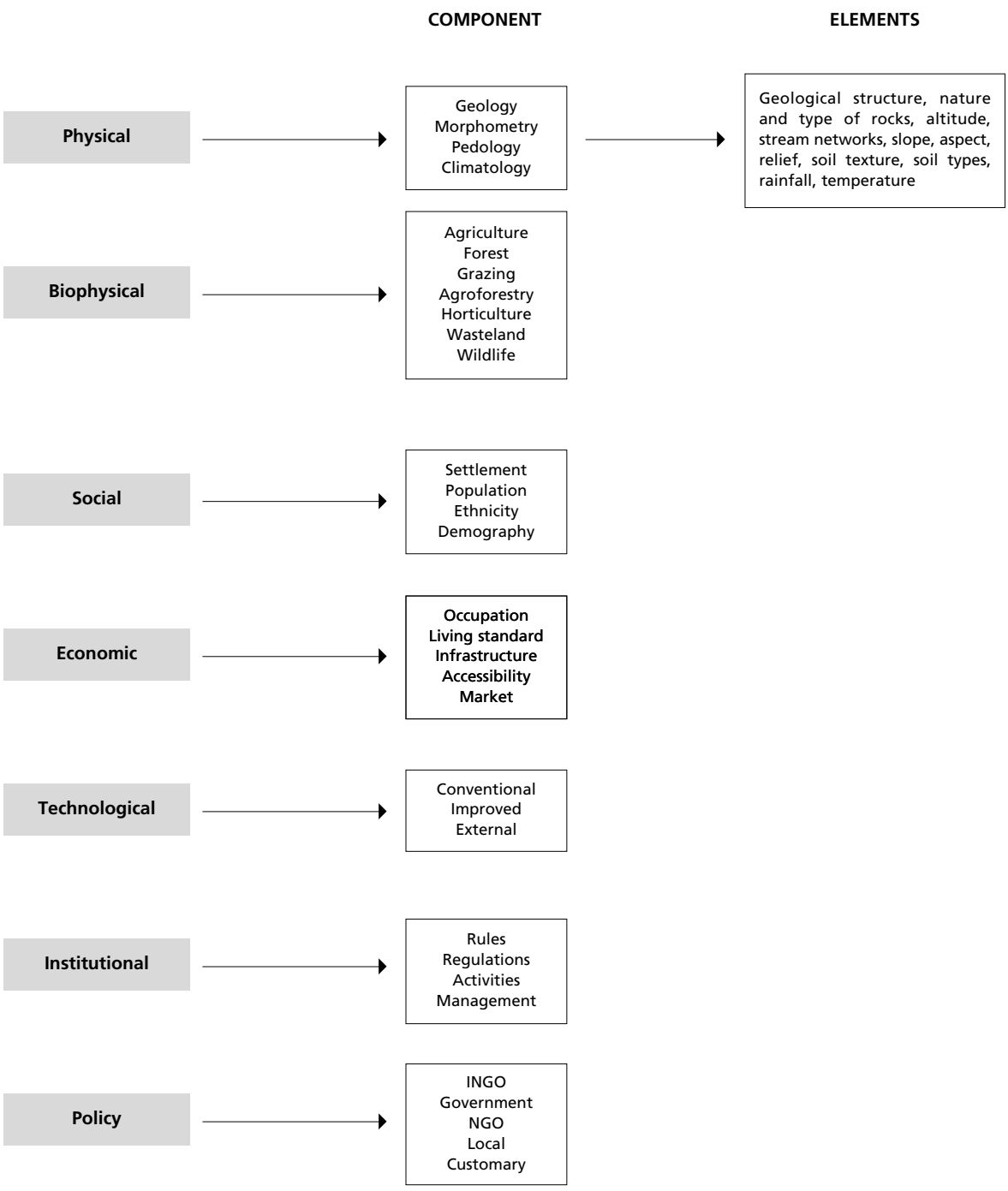


Source: Poudel, 2003.

Figure 1 illustrates the interrelationships among population, resources and limiting factors in mountain watersheds. In a watershed, the local population demands various services from a watershed's resources. Various physical, legal and institutional policies regulate demand and supply. For example, steep slopes and large rivers restrict the flow of resources and goods and services. A high demand will cause pressure on resources, and once this pressure passes a certain threshold, watershed environments begin to deteriorate. Studies of watershed management therefore need to gather information about the population, resources and limiting factors.

Planners and managers can use watersheds as functional units to consider physical, socio-cultural, economic and institutional factors, and develop comprehensive and integrated development plans to achieve specific objectives (Figure 2). GIS-based tools and techniques are very useful for analysing the situation in watersheds. Information provided in this way helps to increase understanding about environmental processes and to analyse and assess the impact of interventions (Michalak, 1993).

FIGURE 2
Watershed-based sources of information



Source: Poudel, 2001; 2003.

In Nepal, there is a lack of information and management plans at the watershed level. Achet (1999) points out that "benchmarks and changes resulting from an intended watershed management intervention need to be quantifiable". Quantitative indices of watershed parameters need developing for different sizes of watersheds within different regional contexts. For Nepal, 5- to 25-km^2 sub-basin areas have been suggested as the size range of a sub-watershed (Achet, 1999). The "micro-catchment development model" should be adopted to solve local-level problems.

Nepal's watersheds have not been properly evaluated according to their resource endowment and degree of fragility. The Nepalese government does not have a land parcel system that delineates land by most appropriate use. Watershed-based data are available only by administrative unit, and these units only sometimes coincide with physical boundaries. Time series data for human-induced factors are lacking, and most studies have failed to separate out natural and human causes.

In mountain watersheds, energy and matter flow downwards with gravity. This has on- and off-site effects from source to sink, and watershed management has to account for these flows. In Nepal, the devastating landslide and mass wasting in the upper watersheds are usually blamed on local people overexploiting natural resources. But many catastrophes are natural events. In the Terai, floods and heavy sedimentation are partly the result of mass wasting in the hills and mountains. The overall causes are complex. Dams are also responsible for floods in lower watersheds. The accumulation of sediments in river channels, intense human pressure on riverbank areas, construction, and excavation of channels increase the risk of downstream flooding. Watersheds need to be studied to scrutinize multi-layer, multisectoral, and multi-date interactions.

POLICY DIRECTIONS AND CONSTRAINTS

Watershed management needs to consider every sector and component relating to a watershed in order to be able to plan for integrated management. Many policy documents stress the need for watershed management for poverty alleviation, environmental sustainability and nation building, but many of these documents are silent on implementation strategies.

In Nepal, watershed management is covered in seven pieces of legislation: Soil and Watershed Conservation Act, 1982; Land Act, 1964; National Parks and Wildlife Conservation Act, 1973; Environmental Protection Act, 1996; Forest Act, 1993; Water Resource Act, 1992; and Local Self-Governance Act, 1999. However, this legislative framework suffers from overlapping responsibilities, unclear jurisdiction for implementation, lack of clear-cut resource allocation for watershed management and lack of emphasis on ground-level coordination. Specifically, the Soil and Watershed Conservation Act has not been effective owing to overlapping responsibilities, lack of resources and poor coordination (Guragain et al., 2002).

The separate acts are directly related to the sectoral ministries, departments and local bodies, whereas watersheds are composite units. For example, the Local Self-Governance Act, 1999 gives the right to protect or manage local resources to local bodies (VDCs and district development committees), but other acts work through central bodies and district line agencies. This leads to overlapping of responsibilities on jurisdiction, accountability and liability.

Management strategies have usually been given in an abstract form of the theoretical point of view by watershed managers and planners. There has also been the conceptual issue of perceiving watershed problems in a subject-wise way, in terms of, for example, forestry, agriculture, land development or poverty alleviation. Management strategies have called for people's participation, but there is a gap in understanding about the level of participation. Policy documents have failed to explain who is to gain and who could lose from participation. The interests of people living along a watershed vary, from upstream source to downstream sink vary, and implementation must:

- identify who the stakeholders are;
- make it clear whether watershed management is the responsibility of local people, stakeholders outside the watershed or central-level managers;
- specify the appropriate size of area for forming focus groups or community-based organizations; and
- specify how interboundary resource use disputes are tackled.

Another serious problem is that the Department of Soil Conservation and Watershed Management's district offices often lack adequate resources and skilled personnel. Strategies are needed to cope with these problems with clear "do's" and "don'ts" (Table 15.2).

TABLE 2
Do's and don'ts of watershed management

Do	Don't
Stress positive aspects and promote win–win solutions	Use reductionist discipline-based solutions to complex problems
Help participants generate lasting success to justify political decisions	Provide unnecessary financial incentives, with hidden agendas
Adopt holistic approach to natural resource management, linking biophysical and socio-economic issues	Use excessive instrumentation to analyse water, soil and biota
Encourage the two-way flow of information	
Ensure long-term continuity	
Improve marketing systems	
Generate non-farm income	
Strengthen institutional support	
Attend to farmers' real needs	
Aim to benefit non-farmers	

Source: After Lal, 2000.

CONCLUSIONS

Maintaining environmental quality and food security is the major challenge of the twenty-first century and is directly related to watershed management. Watershed territorial units cover a large part of the world's land area. The ultimate target of watershed management is to improve environmental quality and food security. Participatory integrated watershed management has become the accepted approach to managing watersheds.

The major challenges for adopting participatory integrated watershed management lie at the policy formulation level, in information gaps, identifying watershed parameters, integrating the various parameters and taking a holistic approach. The main problems in the legislation are overlapping responsibilities, unclear jurisdiction for implementation, lack of clear-cut resource allocation and inadequate attention paid to grassroots coordination. These problems can be overcome by clearly identifying the responsibilities of individual users, defining watershed resource stakeholders, delineating the appropriate size of watersheds to implement watershed management activities and forming community-based organizations to allow for people's participation and promote sound indigenous practices.

RECOMMENDATIONS

Watersheds have several components. The most difficult part of analysing watersheds is to combine several spatial factors to give the overall picture of the processes at work. To combine factors in this way involves rating each one. Future studies need to build consensus on how to carry out this rating. This is quite difficult and often involves subjective judgments.

The most pressing issue concerning watershed management is inconsistencies in socio-economic databases. Even single-date socio-economic databases of watersheds are not available, never mind time series information. Watershed studies collect socio-economic information only as per need at the time of a study. Such data cannot give information over time about people, as illustrated in Figure 1. Census data are only available for administrative units and not for micro-watersheds. This needs recording at the VDC level. It would greatly help if VDCs – the lowest statutory unit for census survey and local-level planning – were delineated according to watershed boundaries.

A general consensus needs to be developed by watershed managers and planners on the scale of operation, where there are clearly defined physical boundaries. All parts of a watershed may not need urgent attention. The micro-catchment development model should be adopted to solve local watershed-related problems according to the need of discrete areas.

REFERENCES

Achet, S.H. 1999. An ecosystem approach to integrated resource management: Building from experience in participatory watershed management in Nepal. *In* P. Mathema, I.C. Dutta, M.K. Balla and S.N. Adhikari, eds. *Proceedings of International Seminar on Sustainable Forest Management*, 31 August–2 September 1998, pp. 268–274. Pokhara, Nepal.

CBS. 1994. *National sample census of agriculture Nepal 1991/1992* (Highlights). Kathmandu, Central Bureau of Statistics (CBS), Government of Nepal

CBS. 1995. *Statistical year book, 1995*. Kathmandu, CBS, Government of Nepal.

CBS. 1996. *Nepal living standards survey report 1996*. Kathmandu, CBS, Government of Nepal.

CBS. 2001. *Statistical year book, 2001*. Kathmandu, CBS, Government of Nepal.

CBS. 2002. *Population census 2001, national report*. Kathmandu, CBS, Government of Nepal.

DSCWM. 1983. *Watershed condition of the districts of Nepal*. Kathmandu, Nepal, Department of Soil Conservation and Watershed Management (DSCWM).

Easter, K.W., Dixon, J.A. & Hufschmidt, M.M., eds. 1991. *Watershed resources management, studies from Asia and the Pacific.* Honolulu, Hawaii, USA, East-West Center, Environment and Policy Institute.

Fleming, W.M. 1983. Phewa Tal Catchment Management Program: benefits and costs of forestry and soil conservation in Nepal. *In* S.H. Lawrence, ed. *Forest watershed development and conservation in Asia and the Pacific,* pp. 217–288. Boulder, Colorado, USA, Westview Press.

Guragain, C.P., Singh, S.L., Shrestha, B.D. & Wagley, M.P. 2002. Watershed management in Nepal. *In* Praksh Mathema (ed.). *Proceedings of Regional Workshop on Watershed Management: A South Asian Perspective 19-21 November 2002*, pp 15-21. Kathmandu, Nepal

Hufschmidt, M.M. (1991) A conceptual framework for watershed management. *In* K.W, Easter, J. A. Dixon and M.M. Hufschmidt, eds. *Watershed resource management: studies for Asia and the Pacific*, pp. 17–31.Singapore, Institute of Southeast Asian Studies and Honolulu, Hawaii, USA, East-West Center.

ICIMOD. 1997. *Districts of Nepal: Indicators of development.* Kathmandu.

Kc, B.K. 1983. Causes and consequences of rural-to-rural migration in Nepal. Paper presented at the International Symposium on Mountain Population Pressure, 10–12 February 1983. Kathmandu.

Lal, R., ed. 2000. *Integrated watershed management in the global ecosystem.* Florida, USA, CRC Press.

Michalak, W.Z. 1993. GIS in land use change analysis: Integration of remotely sensed data into GIS. *Applied Geography,* 13: 28–44.

NPC. 1963. *The Second Three–Year Plan, 1962–1965.* Kathmandu, National Planning Commission (NPC), Government of Nepal.

NPC. 2003. *The Tenth Five-Year Plan, 2002-2007.* Kathmandu, National Planning Commission (NPC), Government of Nepal.

Poudel, K. 2000. Mountain environmental management: a paradox on macro–micro linkages of government policies. *Studies in Regional and Urban Planning*, 8: 5–11.

Poudel, K.P. 2001. *Resource utilisation and management strategy in the selected watersheds of Annapurna Region, central Nepal.* Delhi, Department of Geography, Delhi School of Economics, University of Delhi (Ph.D. thesis).

Poudel, K.P. 2003. *Watershed management in the Himalayas: a resource analysis approach.* Delhi, Adroit Publishers

Sharma, P.N. 1999. People's participation in mountain watershed management: Lessons for the 21st century. *In* P. Mathema, I.C. Dutta, M.K. Balla and S.N. Adhikari, eds. *Proceedings of International Seminar on Sustainable Forest Management*, 31 August–2 September 1998, pp. 298–303. Pokhara, Nepal.

Sharma, P.N., Mishra, B., Dent, F.J., Achet, S.H., Escano, J., Gamage, H. & Gunawardhana, E.R.N. 1997. Key elements of participatory processes for integrated watershed management. *In* P.N. Sharma, ed. *Participatory process for integrated watershed management*. Field Doc. No. 7, PMWTA/FAO. Kathmandu, FAO.

Subedi, B.P. 1995. Population and environment in the context of sustainable development in Nepal. *Population Monograph of Nepal,* pp. 403–440. Kathmandu, CBS, Government of Nepal.