Chapter 3
Agriculture

3.1 The Setting

The agriculture and forestry sectors, which contribute significantly to the day-to-day livelihood of the Nepalese people, constitute the very foundation of Nepal's economy (NPC 1992). Agriculture covers 16.5 per cent of the country's total land area, while the corresponding shares of forests and pastures are 16.5 and 42.4, per cent, respectively (LRMP 1986). The Eighth Five-Year Plan (1992-97) recognised the need to formulate land utilisation policies for the development of pasture, arable land, forests, national parks, settlements, and urban areas (see NPC 1992:641). Similar views are expressed in the current Ninth Plan (NPC 1998).

Agriculture is by far the largest sector in the Nepalese economy, contributing 40.5 per cent to the total GDP (1995/96) (MOF 1998) and 81.2 per cent to the employment of the 'economically active' population (CBS 1994b). About twenty years ago, these proportions were 71.6 per cent in the GDP (1974/75), 94.4 per cent in employment (1971), and 82.5 per cent in export earnings (1974/75).

The real 'top priority to agriculture' in terms of actual financial resource allocation began from the Sixth Plan (Annex 1, Table 1). This was in recognition of the predominant role of the agricultural sector and the potentials it offers for broad-based sustainable development and poverty alleviation. Concurrently, a number of new institutions in the form of government departments, parastatals, schools, colleges, and other educational institutions were created and expanded. Many bilateral and multilateral agencies contributed to this process. A list of agencies and institutions concerned with agriculture, created after 1951, is presented in Annex 2.

The other aspect, that is rarely reflected in the national accounts or the government budget, but which is an important factor affecting development, including agricultural development, land ownership, and management, is the legal instruments. Several laws, rules, and regulations were

promulgated to provide a legal framework in which various institutions and entities were to operate. A list of the existing laws that influence agricultural decisions is presented in Annex 3.

Prior to 1985, when the country started the process of economic liberalisation under the aegis of the World Bank, policy instruments such as laws, rules, and regulations were designed in such a way as to keep the government's control over most of the economic sectors. Many of these instruments, and the entities created therefore, are still active. The aggregate objective of the present policies is to move the management of the economy from a government-guided mixed economy towards a private sector-driven economy.

3.2 Past Efforts

The persistently lagging growth in the agricultural sector has prompted the government, often with donor encouragement, to prepare a number of plans and sector strategy, apart from the routinely formulated five-year periodic plans. These are briefly described below.

3.2.1 Perspective Study of Agricultural Development for Nepal (1970-90)

The Food and Agriculture Organization of the United Nations (FAO) initiated the first comprehensive perspective plan for the agricultural sector for the period from 1970-90 (FAO 1974). This twenty-year plan, consisting of a central policy paper and twenty-one appendices, each dealing with different subsectors, commodities, and policy issues, emphasised increasing cropping intensities and crop yields.

The plan recommended expansion of horticulture and livestock in the hills and mountains, and field crops in the *Terai*. The recommended policy package included: (i) improving north-south linkages through the development of growth axes that would better integrate the *Terai*, hills, and mountains; (ii) reducing pressure on the land by transferring excess people from the hills and mountains to the *Terai* through planned resettlement[1]; (iii) launching land reform and institutional changes that would allow local communities to play a greater role in managing resources, discourage land fragmentation, and encourage consolidation; (iv) subsidising rural public works in order to generate employment; (v) improving soil fertility through the introduction of fertilizers and new production technologies; (vi) emphasising the development of feeder roads; and (vii) mobilising resources through local institutions.

The 1974 study was, however, neither endorsed nor implemented by the government, although it was prepared with the latter's participation.

Perhaps influenced by the FAO study, the government published a policy document called the Agricultural Development Policy, 1972. Accordingly, Nepal was divided into 12 agro-ecological zones (three ecological regions–mountains, hills and *Terai*–in each of the then existing four development regions–East, Centre, West and Far-West). Each zone was then prioritised for specific enterprises (field crops, fruit, and livestock).

The mountain belt was in general recommended for livestock production, the hills for horticultural crops and the *Terai* for cereals and cash crops. The actual programmes implemented, however, were

[1] The government during that period was actively encouraging migration of the hill and mountain people to the *Terai* which still abounded in forest lands that could be cleared and converted into agricultural production.

only remotely congruent with this official policy.

3.2.2 Ten-Year Agricultural Development Plan

Concurrent with the FAO study, a Ten-Year Agricultural Development Plan was prepared by the government in 1973 (MFAI 1973) and put into effect with the start of the Fifth (Five-Year) Plan in 1975. In order to give an initial thrust to the implementation of this plan, fiscal 1974/75 was heralded as the Year of Agriculture. As a preparatory exercise, the then Ministry of Food and Agriculture was restructured in 1972. That year, the Department of Agriculture was established by merging the existing five departments (Agricultural Research and Education, Agricultural Extension, Horticulture, Livestock Development and Veterinary, and Fisheries). The then Department of Irrigation, Hydrology, and Meteorology under the Ministry of Water Resources was transferred to the renamed Ministry of Food, Agriculture, and Irrigation. The Department of Food and Agricultural Marketing Services was newly created (it was subsequently dissolved in 1992). Four (later five) Regional Agricultural Directorates were established.

Apparently, the Ten-Year Plan saw the main problem area as organizational structure, and hence these major changes were made. The plan again emphasised regional specialisation (animal husbandry in the mountains, fruit production in the midhills, and field crops in the *Terai*). Policies were laid out in general terms for each major subsector, treating agricultural credit, marketing, pricing, food distribution, and soil fertility as essential ingredients. Ten-year targets were specified for the major products, inputs, and production of trained manpower.

Implementation of the plan lost steam in subsequent years and irrigation was eventually transferred back to water resources.

3.2.3 Nepal Agriculture Sector Strategy Study

In 1982, the Nepal Agriculture Sector Strategy Study was prepared with technical assistance from the Asian Development Bank (HMGN/AsDB 1982). The main report with recommendations was contained in the first volume of this two-volume study while in-depth reviews of leading subsectors were provided in the second volume.

The study concluded that "*a well-defined operational strategy for agricultural development is missing*". It stated that the lack of growth in agriculture was mainly due to weaknesses and deficiencies in Nepal's organizational and institutional arrangements. The strategy study had five key objectives: (i) to increase food production and improve nutrition; (ii) to increase income and employment by generating an additional 75-100 thousand jobs annually; (iii) to promote import substitution and increase exports so as to improve the balance of trade; (iv) to undertake massive afforestation and development of hydroelectric power; and (v) to begin emphasising environmental protection.

Major areas of emphasis contained in the AsDB study included land-use planning and environmental protection; development of irrigation and power; improved crop production technologies; development of livestock, forestry, and fisheries; strengthening and integration of agricultural support services; land tenure reforms; pricing and trade policies; macro-economic policies; and management capabilities.

The government did not endorse this study, nor was it implemented, although it was

prepared jointly by the government and the bank.

3.2.4 Perspective Plans

Yet another series of perspective plans were commissioned by the government in 1985 for the period 1985-2005 (APROSC 1986a, b, c) through the Agricultural Projects' Services' Centre for three interrelated areas: land use, agriculture, and food grains. These plans were not taken up seriously for implementation.

3.2.5 The Basic Needs' Programme

Soon after preparation of the AsDB-sponsored sector strategy and the government-initiated perspective plans, the government launched an ambitious Basic Needs' Programme in 1986 to meet the minimum basic needs of all Nepalese by the year 2000. Six key elements of the basic needs' package included food, clothing, shelter, primary health, basic education, and security.

Separate programmes were prepared for agriculture and irrigation, envisaging a doubling of cereal production by 2000 (NPC 1986). The hallmark of the Basic Needs' Programme was its emphasis on decentralized planning and implementation and strengthening of service centres at the subdistrict level for enhanced local-level institutional capacity.

Despite the inherent shortcomings of the programme, such as its overly ambitious targets, there was an unusual seriousness in its implementation since it was started on the initiative of the King of Nepal, an absolute ruler at the time. There were indications of commitment to significantly increase the budgetary and human resources in favour of the agricultural sector. However, the programme was completely abandoned with the restoration of democracy in 1990.

3.2.6 Master Plans

In addition to the various plans described above, five separate master plans have been prepared, each for forestry, irrigation, horticulture, dairy, and livestock. Since these master plans were prepared with the support of various donors, they have received high levels of support from the donor community.

3.2.7 The Agricultural Perspective Plan

The Agricultural Perspective Plan (APP) (APROSC/Mellor 1995) is the latest in a series of long-term plans and strategy studies. Major aspects of the plan are summarised below.

3.3 The Agricultural Perspective Plan (APP)

The APP stipulates that dynamic and commercially-oriented agriculture has the potential to have a significant and positive impact in terms of both increased income and protecting the environment. This is possible mainly in three ways. First, highly productive and competitive agriculture implies intensification of cropping systems and input utilisation in order to economically optimise the existing resource endowments at the household and community levels. Such optimisation would make it economically less attractive for farmers to continue cultivating unproductive marginal lands. Once farmers start applying expensive purchased inputs on their fields, the expected returns from poor quality lands become unattractive.

Second, commercial and high growth agriculture would be able to generate enough employment and income opportunities within the sector itself in order to absorb a growing number of the hitherto unemployed or underemployed rural labour force. More intensive–both in terms

of cropping intensity and application of purchased inputs–farming operations would require not only an increased supply of better quality inputs and ancillary services, such as extension and equipment repair, it will also demand more labour.

Third, a vibrant and growing agriculture means continuously rising rural household incomes, to be spent on goods and services provided from outside the agricultural sector. There would be more demand for manufactured products and processed agricultural goods, triggering and augmenting a multiplier effect in the rest of the economy. The APP states that, when agriculture grows at a respectable rate, the value of such multiplier has been empirically established to be 1.5. This means that, with each percentage point growth in agriculture, the non-agricultural sector will grow at 1.5 per cent. Hence a strong case for agriculture to play the lead role in the overall transformation of the entire economy.

Considering the subsistence trap in which Nepal's agriculture is currently caught, it will not be possible to set the growth process in motion if business is conducted as usual. Rather, it would require complete reorientation and redirection of the strategy, combined with the identification of a small number of priorities and corresponding reallocation of resources. The APP specifically prescribes such a strategy and priorities, namely, focussing on a few inputs and outputs and policy and institutional interventions that could have a significant aggregate impact across the entire country.

The APP is a prioritised plan of action in which a small number of key priorities is carefully packaged together into a prioritised productivity package (PPP). Accordingly, there are four priority inputs (irrigation, fertilizer, technology, roads and power), four priority outputs (livestock, high-value crops, agribusiness, forestry), three targetted areas of focus for impact (poverty reduction and food security, environment, regional balance), and a number of policy interventions, institutional arrangements, and investment decisions.

The following six points summarise the APP strategy.

- A technology-based green revolution in **agriculture** becomes the initial engine of accelerated growth.
- Accelerated agricultural growth creates a demand-pull for the production of high-value commodities in agriculture, as well as for non-agricultural commodities, with consequent large **multiplier effects** on other sectors of the economy.
- Broadly-based high employment **growth** then becomes the mechanism for achieving societal objectives.
- Public policy and investment focus on a small number of **priorities**, building on past investment in human capital and physical and institutional infrastructure.
- A **package approach** to development is introduced, which in Nepal's case would be differentiated for the *Terai*, hills, and mountains, and would recognise the powerful complementarity between public and private investment and priorities and would ensure their coordination.
- To achieve broad-based participation, the strategy is **regionally balanced** and explicitly ensures the **participation of women**.

The APP differs from the past plans in that it focusses on a small number of priorities so as to produce a tangible impact and to realise scale economies essential for commercialisation. Nepal's agricultural research has historically harboured a misconception about what constitutes agricultural research. Research has been treated in a restricted sense to include

biological, physical, and mechanical sciences as these apply to plants and animals. Thus, only the traditional outfits of Khumaltar (agronomy, soils, plant pathology, entomology, botany, agricultural engineering, vegetables, animal husbandry, and animal nutrition), Tripureswar (veterinary science), and Kirtipur (pomology) remained within the ambit of research. The farmer's knowledge and awareness, his/her resource endowments, the culture and the community he/she lives in, the economic environment that determines his/her farming practices and resource utilisation, and the constraints that prevent him/her from realising better returns are issues that shape and influence his/her behaviour. These concerns fall into realms of social sciences that have conspicuously been excluded as relevant areas of investigation. True, some outfits within the larger agricultural bureaucracy (viz., the now dismantled Department of Food and Agricultural Marketing Services) were set up to address some of these areas (viz., farm management, price analysis, and marketing), but they could not be effective because they were isolated from 'mainstream' research.

The APP focusses on limited inputs such as irrigation, seeds, rural roads, electricity, fertilizer, and appropriate technology. As a result, it envisages increasing agricultural productivity, increasing employment, and reducing poverty levels.

However, it does not give adequate attention to issues related to land ownership, tenurial arrangements, and potential impacts on soil fertility as intensive farming expands into the hill and mountain areas. Since the APP is just another of the series of sectoral plans, it is hard to tell how effectively it would succeed in achieving the stated objectives. Its impact on land management and land degradation is similarly uncertain. One likelihood is that, given the resource constraints and mass poverty, such a policy relying on purchased inputs and intensive agriculture could be more suitable to resource rich farmers and the majority of the poor may still be left behind.

3.4 Agricultural Extension

Nepal's agricultural extension service is the oldest of all the public services targetted at the rural people. The historical reason for this is that the first external assistance (from the United States) was received in 1952 in the agricultural sector and it went to the establishment of the Tribhuvan *Gram Vikas* (Village Development) Service for extension. A number of Village Development Centres were subsequently established across the country to deliver extension services (Skerry *et al.* 1991). Until the 1970s, the emphasis was on extending the organizational network as far as possible so that larger sections of the rural population could be reached and 'taught' to improve their live standards by adopting the recommended modern and improved technological packages. Junior technicians and junior technical assistants (JT/JTAs)[2], who symbolised the ultimate harbingers of progress, were deployed at the local level and had to cover several thousand households in a cluster of villages. Obviously, their ability to respond to the specific needs of the farmers in different socioeconomic and agro-climatic conditions was severely limited, and hence they remained largely ineffective.

The next stage of extension, initiated in the 1980s with the assistance of the World Bank, took the form of the 'Training and Visit (T&V)' system, in which the focus was on requiring

[2] The JT/JTA is a middle-level technician, with training in agriculture and livestock-related fields, ranging from two years/one year after high school.

the JTAs to deliver one message at a time, depending on the most important agricultural practice in a given area. This required the establishment of a subdistrict level network of service centres where the JTAs could be given a new message at an interval of a fortnight. As expected, such a mode of technology transfer could be possible only in the accessible *Terai* districts, and hence the T&V system was applied only in those districts. A variant of this system was also tried in the hills, but it was largely ineffective. Evidence suggests that it was ineffectual even in the *Terai*. As Jha *et al.* (1994) state, these approaches have been introduced through the support of many donor agencies (Swiss Development Corporation, USAID, Asian Development Bank, Japan International Cooperation Agency, the World Bank). Often, this has resulted in the operation of multiple approaches in the same district at the same time, confusing the programme implementors and reducing the clarity of the objectives, roles, and targets of extension. The bureaucracy regards this as a wide gap between policy and implementation, but the real problem seems to be the absence of a clear and coherent policy.

The current mode of extension relies on the so-called group approach. Accordingly, farmers' groups are constituted according to the main commodity they grow or species they keep, viz., rice group, dairy group, goat group, and so on.

More than forty years of past history have seen several experimentations and adoption of a number of extension approaches, but concrete achievements remain as elusive as ever. 'Extension models' tried thus far include the following: (a) traditional approaches based on the conventional diffusion model in which the JTA is expected to provide assistance to anybody for any problem; (b) the T&V system, applied mostly in the *Terai*; (c) the IRDP approach, followed in areas covered by various integrated rural development projects; (d) *tuki* (a Nepali term for the widely used typical kerosene lamp) approach, followed in the Swiss-assisted districts of Dolakha and Sindhu Palchowk, in which the JTA acted both as a source of information as well as a commission agent for the purchased inputs he/she supplied; (e) a block production programme, concentrating extension services in 28 selected districts; (f) a farming systems' approach, further concentrating service delivery in selected sites of districts rated as highly potential (Jha *et al.* 1994); and (g) the current group approach.

All these approaches suffer from various weaknesses (Jha *et al.* 1994). One of the prominent problems often cited by the farmers is that of 'political interference', meaning *ad hoc* tampering with the system by political workers from the central to the local levels.

Various donor-supported studies have suggested alternative approaches such as a combination of group and outreach approaches involving the NGOs, women, and the private sector.

The present group approach is justified since it is regarded as cost-effective, participatory, potentially demand-driven, broad-based in terms of taking care of all sections of the rural community, and consistent with the 'one umbrella' policy adopted by the government in the 1990s.

Similarly, the outreach approach has been justified on the basis of farmer-based, clientele-oriented research, with a potential for immediate technology transfer through direct demonstration effect and better interaction among researchers, extensionists and farmer.

There is a general admission of the past failure of extension to give due attention to the real constraints and opportunities faced by the farmers. A strong case is then made

for a more relevant and responsive extension service with an increased role for specialised subject-matter specialists (SMSs), together with a more interdisciplinary approach involving extensionists, research scientists, and farmers.

Women farmers have particularly been neglected by all the past programmes, except in the current group approach. But the cadre of women extensionists remains extremely meagre. The emphasis all along has been to treat all the farmers (rich and poor, large and small) equally.

The poor education of JT/JTAs makes them professionally inadequate to be of relevance in the existing realities of the country's rural areas. In 1994 the World Bank recommended to gradually phasing out the JT/JTA cadre through natural attrition and requiring all field extension workers to be at least agricultural graduates (Jha *et al.* 1994). No initiative has been taken thus far in this regard.

Agricultural development efforts are still target-oriented and based narrowly on increasing production, with insufficent attention to market potentials. A very generalist approach is followed without due regard to the diverse peculiarities of different agroecological regions and farmer categories. Technical service and input delivery mechanisms have been weak.

Beginning with the Eighth Plan, a much more expanded and definitive role was emphasised for the private sector. The underlying justification seemed to be that the private sector had an inherent motivation to carry out most of the production, processing, transportation and marketing functions more efficiently than the public sector.

The contemporary agriculture-related policies, elaborated upon in the APP and reiterated in the Nepal Environmental Policy and Action Plan (EPC 1993), are summarised in Table 3.1.

3.5 Impact

Nepal's agricultural development strategy has historically emphasised promotion of so-called improved farming practices, dominated by promotion of high-yielding varieties of crops, cross-bred livestock, chemical fertilizers, and irrigation. The seed-fertilizer technology suitable to irrigated flat lands has also been pushed to the hills and mountains where the fragile ecological conditions and resource endowments are quite different. Crop-dominated farming systems have not proven effective in these areas, in terms of both increased food production and soil fertility maintenance. Crop yields have declined consistently over time, threatening the food security of the small landholders and marginalised farmers particularly. These trends have a direct relationship to the deteriorating fertility of soil (EPC 1993; Shrestha and Katwal 1992). Intensive cultivation and insufficient application of nutrients to the soil have led to situations where the farmers are forced to completely abandon their land because of the extremely low yields. Carson (1992) estimates that between 10 to 20 per cent of such lands may have been abandoned.

Citing evidence from a hill village in the Central Hill Region – Dhuskun, in Sindhu Palchowk, Shrestha and Katwal (1992) report: "*The cropping intensity is already considerably high (172%). Due to the lack of soil nutrients, stones and rocks have begun to surface on cultivated land. The supply of compost materials, from both private and public land, and manure from livestock has decreased significantly over the past 20 to 30 years.*"

On the other hand, work carried out at the British-supported Lumle Agricultural

Table 3.1: **Agricultural Land Management Policies and Action Plan**

Policies	Action Plan	Responsible Agencies
Improve soil fertility management by increasing supplies of farmyard manure and reducing the stock density of livestock on arable land	Encourage planting of trees, shrubs, and grasses on private land to provide an additional source of fodder for livestock	DOA, DLS
	Where appropriate, encourage stall-feeding of livestock using fodder from trees on private land	DLS, NARC
	Promote low-cost, vegetative, and cultural soil conservation measures to reduce soil erosion	DSC, DOA, NARC
Promote policies to directly increase soil fertility	Encourage modification of farming systems to include nitrogen-fixing species to enhance nutrient cycling	MOA, NARC
	Remove constraints to greater private sector involvement in the purchase and distribution of chemical fertilizers to improve their availability	DOA, NPC
	Develop recommended fertilizer applications, including the use of agricultural lime on acidic soils, based on particular agro-ecological conditions	DOA, NARC
Develop an extension system capable of responding to farmers' needs	Improve participation in agricultural extension through the use of the "group approach"	DOA, DLS
	Finalise arrangements for pilot scheme for contracting-out extension services to the private sector	MOA, NPC
	Promote the use of adaptive research techniques on farms as a method of rapidly disseminating information	DOA, DLS, NARC

Source: EPC (1993, 10)

Centre (LAC) in the Western Hills demonstrates that significant progress is possible with respect to vegetable seed production, rice production, and cattle and buffalo rearing on a sustainable basis when the research and extension system properly integrated five key elements: a strong institutional foundation, a comprehensive understanding of farmers' conditions, the participation of farmers in all stages of research and dissemination, the interdisciplinary interaction of all sections of LAC, and the synergistic effect of having research, extension, and training in one organization (Pound *et al.* 1992). Similar experiences are reported from the Pakhribas Agriculture Centre in the Eastern Hills (Chand and Thapa 1992).

All periodic plans, strategic documents, and action plans have invariably emphasised the need for giving high priority to soil fertility maintenance, particularly in the hills and mountains. However, the continuously declining crop yields and ever worsening process of land degradation indicate that these policies have failed.

Major indicators of unsustainability and declining trends in Nepal's hill and

mountain agriculture are summarised in Table 3.2

Partap and Watson (1994) elaborate on the important contributing factors and issues among the range of causes and symptoms of decline. The two critical problems commonly faced by mountain farmers, in general, and Nepalese farmers in particular are: degradation of land and the extent of land degradation. The area of degraded lands in Nepal is estimated of be 1.8 million hectares. Similarly, estimates of the magnitude of soil erosion from the hill and mountain areas of Nepal are compiled from various sources and presented in Table 3.3 below.

A study conducted by Banskota (1992), cited in Partap and Watson (1994), indicates that the total amount of nitrogen lost from level terraces (365,000 ha) and sloping farm lands (816,00 ha) is about 27,000 metric tonnes, whereas the total amount of nitrogen fertilizer used in 1987/88 was only 24,320 metric tonnes. The total loss of combined nutrients exceeded the level of inputs used in 1987/88.

The value of nutrient loss has been estimated at over six million rupees for paddy and over 54 million rupees for maize, at 1987/88 market prices. The implications in terms of equivalent food grain loss are even more significant. The total losses were equivalent to about 75,000 MT of paddy and 747,000 MT of maize. These large losses indicate the difficulties experienced in sustaining food production when soil fertility is being depleted at rapid rates.

3.5.1 Declining Crop Yields

A large body of literature cited in Partap and Watson (1994) identifies several causes of land degradation. Farmland productivity in the upland areas measured in crop yields has either remained steady or declined. For instance, average crop yields declined within the range of five to 30 per cent during the past few decades in a number of mountain watersheds in Nepal, in the Indian Himalayas, and in the Tibet Autonomous Region of China (Banskota 1992; Shrestha 1992; Bajracharya 1992; Singh 1992; Yanhua 1992; and Swarup 1991).

3.5.2 Increasing Food Insecurity

An ICIMOD study in the mid-hills of Nepal (Panday 1992) highlights the increasing food insecurity situation among the mountain farmers in resource poor areas. The study revealed that 86 per cent of the households in Bhardeo village were experiencing food deficits to varying degrees. Among them, over 50 per cent suffered food deficits for at least six months each year. It further concluded that the production of adequate amounts of food on small landholdings, with ever–declining farm productivity, is almost impossible. Bhardeo depicts the worsening trend of food insecurity in resource poor, heavily populated mountain areas (Partap and Watson 1994).

3.5.3 Gaps in the Demand and Supply of Biomass

The decline in productivity is not limited only to farmlands. Acute shortages of biomass production are widely reported, in the form of fodder, fuelwood, or other forest products on which the sustenance of the mountain people depends.

Keeping in view all the basic requirements of farm families, Wyatt Smith (1982) calculated that about three to four hectares of support lands (forests and grazing land/pastures) are required to maintain one hectare of cultivated land for normal production in the middle mountains of Nepal. Studies indicate that in many areas, the ratio of support land to agricultural land has gone down to 0.5 ha from four hectares (Shrestha 1992).

Table 3.2: **Indicators of Unsustainbility/Decline in Hill and Mountain Agriculture (Time frame: approximately four decades spanning the period from 1954-91)**

Indicators	Rates of Change	Indicators	Rates of Change
I. RESOURCE BASE		**II. PRODUCTIVE FLOW**	
1. Landslides	100-300%	18. Fall in average crop yields on sloping lands: (a) Maize and wheat, (b) Millet	(a) 9-15% (b) 10-72%
2. Gully formation on sloping lands	High-Medium	19. New land under cultivation	5-15%
3. Soil erosion rates on sloping lands	20-30%	20. Human population	60-65%
4. Abandonment of agricultural land due to decline in fertility	3-11%	21. Decline in the application of compost (organic manure)	25-35%
5. Appearance of stones/rocks on cultivated land	130-200%	22. Additional labour demand due to falling land productivity	35-40%
6. Decline in the size of livestock holding per family (LSU)	20-55%	23. Forestry-farming linkages	Weak
7. Decline in the area of farmland per household	30-10%	24. Food grain purchases from shops	3-50%
8. Decline in forest area	15-85%	25. Need for external inputs for crop production	High-Medium
9. Decline in pasture/grazing area	25-90%	26. Fuelwood and fodder scarcity in terms of time spent in collection	45-200%
10. Decline in good vegetative cover on common property lands	25-30%	27. Fodder supply: (a)decline from common land, (b) increase from private land	(a) 60-85% (b) 130-150%
11. Fragmentation of household farmland (in number of parcels)	20-30%	**III. RESOURCE MANAGEMENT**	
12. Decline in the size of land parcels of families	20-30%	28. Emphasis on monocropping	High
13. Distance between farm land parcel and home	25-60%	29. Cultivation expansion on steep slopes (above 30%)	10-15%
14. Decline in food grain production and self-sufficiency	30-60%	30. Use of weeds and herbaceous crop products as fuelwood	200-230%
15. Permanent outmigration of families	None-5%	31. Conversion of marginal lands into cultivation	15-40%
16. Seasonal migration	High	32. Decline in fallow periods	From 6 to 3 months
17. Conversion of irrigated land into dry farming due to water scarcity	7-15%		

Source: Shrestha (1992)

Table 3.3: **Soil Erosion from Different Land Use Types**	
Type of Land Use	Soil Erosion (MT/Ha/Yr)
Grazing lands (support lands)	100
Rainfed terraces (slopping terraces)	5
Irrigated terraces (level terraces)	0
Sloping farm lands under farmers' practice	38
Source: Partap and Watson (1994)	

Further, assuming that an average of 2.5 ha of supported land is needed to maintain one hectare of agricultural land, the degradation of 1.5 million ha of agricultural forests will affect more than 0.5 million ha of agricultural land. If this is further calculated in terms of food grains, the magnitude of loss is likely to be enormous (Partap and Watson 1994).

Trends of chemical degradation are also appearing in Nepal. Among others, some of the important processes are given below.

3.5.4 Soil Acidification

Evidence of increasing soil acidification are found in the soils of the hill and mountain areas. It is mainly due to the use of pine needles for bedding materials for livestock. The bedding materials are being used for manuring the fields. The practice of using pine needles for compost is quite common in the high mountain areas where it is abundantly available (Joshy *et al.* 1997).

3.5.5 Siltation

Land degradation caused by siltation has also been noticed in the country, especially in the Pokhara Valley. This is mainly due to the irrigation water drawn from the Seti River that carries heavy loads of fine sediment. Both the water and sediments are calcareous in nature, and this has brought changes in both the physical and chemical properties of the soil, thereby causing the degradation of cultivated lands in the valley (Joshy *et al.* 1997).

3.5.6 Flooding

While the heaviest incidences of flooding occur in the *Terai*, low lying areas in the hill valley bottoms are also affected. The total area affected by floods in the country is estimated roughly at 9,000 sq. km. (NPC 1994).

3.5.7 Land Affected by Erosion, Landslides and Floods

Data on lands affected by erosion, landslides, and floods have become available in the last few years. They are presented in Table 3.4.

The Soil Science Division of NARC has made a soil resource inventory of the country. This inventory shows that, in

Table 3.4: **Total Land Area Affected by Erosion, Landslides, and Floods**			
Year	Land Affected (ha)	Year	Land Affected (ha)
1984	1242	1991	283
1985	1355	1992	135
1986	1315	1993	5584
1987	18858	1994	392
1990	1132	1995	41867
Source: HMGN (1996), cited in Wagley (1997)			

general, the soils of Nepal are deficient in nitrogen, phosphorus, and sulphur. Potassium is on the higher side. Results from long-term fertility experiments have shown indications of response to potassium after 15 years of continuous rice-wheat cultivation. Deficiencies in micro-nutrients (zinc, boron, and molybdenum) have been observed to be increasingly widespread in high-yielding varieties of rice, wheat, and maize crops, as well as vegetables. Thus the soil fertility resources of the country will not be rich enough to sustain increased agricultural productivity if not properly managed.

Despite the rather pessimistic scenario described earlier, various researchers (Joshi 1995) report some positive impacts from livestock and tree crops. A rough estimation provides some figures on employment generated by the fodder sector (some 1.2 million persons per year). The benefit of this opportunity is derived mostly by smallholder farmers. In addition to these, fodder and tree crops have intangible values as well. These include soil conservation and watershed protection, protection of biodiversity, and stabilisation of slopes. Fodder and tree crops also provide tangible benefits. Marginal and small farmers plant fodder and tree crops for multipurpose usage. Recently, plantation of tree crops such as *chyuri* (*Bassia butyracea*), *lapsi* (*Choerospondias axillaris*), and *amala* (*Emblica officinalis*) has become common for cash income. Their fruits have market values. Producing ghee from *chyuri* fruit has been a traditional source of income for the people of Baitadi, Doti, and Dadeldhura in the Far-Western mid-hill districts. A total of about 600,000 *chyuri* plants are estimated to be in a productive phase in different parts of the country. At present, local farm families can earn Rs six to 10 thousand annually by selling *chyuri* products (NCS Nepal 1995, cited in Sharma 1996b).

In many instances, fruit, legumes, herbs, cardamom, tea, coffee, ginger, turmeric, niger, and companion trees are mainly grown in wastelands and are found well developed. Partap (1995) reports a very productive use of marginal lands through the use of various kinds of horticultural cash crops. Some micro-watershed areas such as Kapurkot and Sejwal Takura (Sallyan District) present success stories of productive use of degraded lands through the introduction of high value crops (Shrestha *et al.* 1996, cited in Sharma 1996a).

Suwal *et al.* (1991) state that, although a new crop in the Western hills, lentils have been found to be a promising crop even in the higher hills. Under farmers' management conditions, this crop contributes a substantial amount of nitrogen to the succeeding crops. Likewise, intercropping of soybeans is also gaining popularity in the western hills. Such an integrated plant-nutrient management system helps to maintain the soil biological dynamics with the activities of living micro-organisms (Sharma 1996a).