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Economic and Natural Resource Conditions in the Districts of Bagmati Zone and Their Implications for the Environment: An Adaptive Simulation Model

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Economic and Natural Resource Conditions in the Districts of Bagmati Zone and Their Implications for the Environment

An Adaptive Simulation Model

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Preface

This discussion paper was produced as one of the background papers for the preparation of an integrated economic and environmental development plan for the Bagmati Zone. The main purpose of the paper was to develop a better understanding of the economic and natural resource conditions in the districts of Bagmati Zone and their implications for the environment through use of an adaptive simulation model. Understanding these conditions is very important for the purpose of being better prepared to cope with the problems of rapidly deteriorating resources and the impact on food and fodder supplies, among others. Given the inability of small farmers to produce sufficient food on very small plots of land, together with the lack of off-farm employment opportunities, these farmers are forced to borrow at high interest rates from informal sources, worsening their economic condition with every passing year. The result of this is increasing marginalisation. A solution to the food and energy problem is essential. In order to come up with solutions a proper understanding of the interactions and interdependencies is necessary. It is hoped that this paper will be helpful in this respect.

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1

INTRODUCTION

Problem

Poverty is a growing phenomenon in most areas of Nepal, especially in the hill and mountain regions. Negative impacts on agricultural productivity and loss in the quality and quantity of forests have, therefore, direct implications for the well-being of rural households who depend on these two primary resources for their sustenance. Throughout Nepal, serious environmental problems have already emerged. These environmental problems are particularly noticeable in the country-wide unprecedented degradation and depletion of forest resources. Forests provide large quantities of fuelwood and fodder resources to households. Over time, population growth rates in the country have increased, along with demand for these forest resources, at similar rates. Poor management of forests, primarily public forests, as well as laxity in the use of fuelwood and fodder for livestock have reduced the forest stock. Other reasons for the depletion of forests are related to the pre-1950 policies of the Government which encouraged deforestation. Since forest lands play an important role in maintaining agricultural productivity, loss in the quality and quantity of forest resources is believed to have had negative effects on agricultural productivity as well (Wyatt-Smith 1982).

Over time, the depletion of natural resources has resulted in food shortage among households, and this is perhaps the harshest problem. The food deficit problem faced by households has become an annual phenomenon, especially among small and marginal farmers who constitute the bulk of farm households. Given their inability to produce sufficient food to sustain themselves and their families throughout the year on the very small plots of land that they possess, coupled with the lack of off-farm employment opportunities, these farmers are forced to borrow at high interest rates from informal sources, thereby worsening their economic situtation with every passing year. The vicious cycle begins with the leakage of income on interest payments, leading to larger loan gaps, and eventually to a progressive disaccumulation of assets. As a result, a large number of small and marginal farmers is increasingly becoming marginalised and is forced to adopt unsustainable practices (e.g., cultivation on steep slopes). Marginalisation is most often characterised by a household slipping into tenancy and then attempting to make up for the loss in production by employment in the non-farm sector. Historically, a hill farmer's response to food deficit has tended to be outmigration, but this has its own limits.

Migration occurs largely as a result of marginalisation of households in its area of origin. Usually, the first attempt to escape from the marginalisation process is to search for off-farm employment opportunities, which are seldom available in the rural areas. If and when available, the very low returns from off-farm work worsens the economic status of the households. Money earned throughout the year is mostly used for consumption, meeting natural calamities and distress, and for religious expenses. This situation, therefore, increases the possibility of households' alienation from their productive assets (Banskota and Sharma 1993). Lacking alternatives, these households (without sufficient food to sustain themselves and their families throughout the year) can hardly withstand the economic stress without mortgaging and then selling their productive assets, e.g., land. Therefore, food deficits and poverty are closely related and further interlinked with the quality and quantity of land and forest resources on which households depend. Agriculture and forest development can therefore be seen as crucial factors for improving the rural economy and weaning it away from poverty and environmental degradation. Given the dependency of the rural areas on these sectors, it is obvious that further deterioration in the productive levels of these sectors will exacerbate poverty.

The food and energy needs of the rural population in Nepal are increasing along with the population. The rural economy is based primarily on the extraction of food and energy from renewable natural resources such as land, forests, pastures, and water. Complex interactions take place in the extraction of food and energy from these resources. Food and energy are becoming more difficult to extract due to the degradation and depletion of renewable resources. Thus, a solution to the food and energy problem requires a proper understanding of the interaction and interdependence, and it is a necessary precondition for the attainment of environmentally and ecologically sound development (World Bank 1992 and WCED, 1987).

Issues

The greatest challenge facing developing countries with poor natural resource bases and rapidly increasing populations, e.g., Nepal, is sustainable development. The term sustainable development is used to define an economic growth process that is environmentally sound, so that at any given time the process of economic growth does not result in degradation of natural resources. Natural resources are those resources that, when used, entail an opportunity cost, and they include air, water, forests, land, and genetic diversity of flora and fauna. Sustainable development is a challenge not only to developing countries but also to developed countries; their challenges are greater in the sense that resources to meet these challenges are limited. In the past, the issue of sustainable development failed to focus on the environmental aspect, primarily because economic policies and programmes did not assess the total cost of natural resources. Since costs of such

resources were not adequately taken into account, the true scarcity value of such resources was never reflected in the process of economic development. As a result, overexploitation of resources has gradually led to their degradation and depletion.

Thus, promoting environmentally sustainable development is one of the major issues facing the developing world today. Sound management of the environment and the natural resource base has become a vital prerequisite, not an obstacle, to sustainable development. Development policy-makers have begun to realise that failing to take the costs of environmental damage into account will prove to be inefficient and often ineffectual in raising the income as well as the well-being of the large numbers of people that depend on these resources. Development and environment are interrelated and in many cases reinforce each other (World Bank 1992; WCED 1987; Nijkamp, Bergh, and Soeteman 1990).

While there is a strong agreement at conceptual level regarding the need to integrate developmental and environmental policies, a large gap exists between rhetoric and practice. This gap arises primarily because of the scarcity of resources, the diversity and magnitude of the problems in terms of space (spatial dimension) and time (short-term versus long-term), and conflicting objectives between different sectors and institutions of the economy. In addition, the gap has further widened due to a poor information base, and information is crucial for understanding the dimensions of the problems and monitoring the environmental effects, let alone advocating remedies. The lack of a strong information base results in the belief that economic growth and environmentally sustainable development are not compatible. In the case of Nepal, many examples that tend to reinforce this belief can be cited. For example, some studies have shown that increasing fertiliser use tends to reduce the dependency of livestock on forests for fodder. If this contention can be unambiguously proved in other parts of nepal, then encouraging higher fertiliser use appears to be rational in terms of saving a portion of the forest cover. However, if the other issues regarding the use of chemical fertiliser are examined, then soil acidification over time has been identified by some studies as a problem. In addition, encouraging higher fertiliser use perhaps entails larger subsidies, and the subsidy policy is not acceptable for various reasons. From an environmental and growth point of view, this cannot be readily resolved, primarily because our existing information base is weak, incomplete, and not representative. Excluding the equity aspects of the fertiliser policy, there is no guarantee that higher fertiliser use will reduce the pressure on the forests of Nepal.

The rural population is often attracted to urban areas, perhaps by the relatively higher economic growth in urban areas, i.e., the pull factor. The motivation for migration also stems from the growing hardships in rural areas where the incidence and magnitude of poverty are increasing, i.e., the push factor. Migration from the

hills and mountains of Nepal to urban areas and the *terai* has been going on for quite some time, and the magnitude of migration is considerable. Whether migration has had any positive impact on the migrants' place of origin and what impacts it has had on the place of destination are unknown. Clearly, the issues and conflicts resulting from different policy options need to be identified and better understood. In addition, the tradeoffs that have to be made by not taking any action should be clear, since taking action may now, when problems have just begun to manifest themselves, be economically more cost-effective from a long-term point of view.

Closing this gap requires a substantial shift in policies and priorities through proper identification of sustainable development options, and this entails (a) a proper understanding of the physical, biological, and social impacts of environmental damage; (b) a sound estimate of the economic value of environmental damage and design of policies and projects to arrive at environmentally- sound investment decisions; and (c) development of policy tools to implement viable strategies and manage natural resources on a sustainable basis.

Given the complex interdependencies and the dimension of the problems, improving the environmental and economic situation (poverty) calls for a holistic and integrated multisectoral approach. Since there are both positive and negative links between development and environment, identifying the underlying causes of environmental damage and poverty involves both harnessing the positive links as well as minimising the negative ones. A broad set of policies that can promote positive links between development and environment includes: (a) abolishing policies that foster excessive resource use; (b) clarifying property rights; (c) accelerating educational and population control programmes; and (d) promoting agricultural research and extension programmes. While it must be ensured that policies and programmes to harness the positive links do not affect growth, curbing other forms of environmental damage resulting from greater economic activities (i.e., negative consequences of development) does require certain tradeoffs, at least in the short-term. It is therefore essential that these tradeoffs are identified, the costs and benefits of alternative policies assessed, priorities and standards set, and that cost-effective policies to counter market and policy failures become vital elements in accelerating development in an environmentally responsible manner.

Objectives of the Study

The general objective of the study is to develop a systematic framework to integrate and analyse the economic and natural resources and environmental sectors of the study area in order to address some of the issues that have been discussed above. It is hoped that such a framework will also aid district planners to understand more fully the complexity of an apparently simple district economy in a simplified manner,

thereby ensuring that priorities are set according to the resource constraints faced by them.

The specific objectives of the study are as follow:

- to integrate the major economic and environmental sectors of the districts;
- to develop a systematic framework for assessing the effects of alternative policies on the economy;
- to forecast the demand and supply of major food and non-food resources;
- to develop some environmental indicators;
- to examine the time paths of resource consumption and supply and their implications for the environment under the *status quo* situation;
- to simulate the *status quo* or baseline situation by providing policy shocks;
- to carry out an evaluation of the policy shocks; and
- to provide recommendations based on the results.

Limitations

The adaptive policy simulation (APS) model (or a multi-market simulation model) developed for the purpose of integrating economic and environmental linkages is based primarily on secondary data and parameters available from different sources. Lack of adequate parameters on various economic and environmental activities have made it difficult to incorporate more sectors. Given the poor information base, a study of this kind cannot be considered as an in depth study of a district's economy and environment. Therefore, this study should be viewed as providing general guidelines for policy action. Interdistrict (or regional) movements of goods and services, including the migratory trend, have not been incorporated in the present exercise owing to the lack of information. Furthermore, income generated by the model is based on the major economic activities for which aggregate district level information is available. Income from commercialised agricultural activities, e.g., vegetable production in some districts (e.g., Dhading) has not been incorporated due to the paucity of such information. Similarly, remittances (which are also one of the major sources of income, especially in the hills) are also not included. Thus, the results on income may be slightly downward-biased in this study. In addition, due to the lack of parameters as well as the relationship between important variables, information has been borrowed from many sources which are identified in appropriate places and these parameters may not fully reflect local conditions. Regarding the functional relationships that are crucial to the model, relationships have been improvised based on intuition, experiences gathered from other studies, and experts' opinions.

Area Covered by the Study

This study covered five rural districts of the Bagmati Zone. These five districts include Kabhrepalanchok, Sindhupalchok, Rasuwa, Dhading, and Nuwakot. Small urban centres are located within some of these districts. In the present study the urban areas in the rural districts have not been taken into account separately, since they are too small and information on urban centres is not available.

Time Frame

The starting year for the study is generally 1991. However, the starting year to develop the baseline varies across sectors, depending on the historical data series available. In the case of the land use sector, information is available for only 1978 (Land Resource Mapping Project, LRMP). Thus, for land use, the LRMP data were used and linkages developed. The changes over time were forecasted using a sub-model. The results from 1991 were used in the main model. In other sectors, relationships were drawn from the data series available (some of which start in 1974 and others much later). The Multi-Purpose Household Budget Survey Report proved to be useful in filling information gaps. All the information based on cross-sectional studies was updated to 1991. Details are explained in the respective sections. The base year for the model is 1991 and the time-frame is up to 1998 to coincide with the end of the Eighth Five-Year Plan Period (1993-1998). In the case of Dhading district, the time-frame has been extended to 2005, primarily to highlight the role of certain policies whose impacts have a long gestation period.

Organisation of the Study

The conceptual framework and methodology employed for the study are given in Chapter 2. The usefulness of the multi-market or the APS model and its detailed specification encompassing different sectors are elaborated along with the policy evaluation framework. Chapter 3 to Chapter 7 contain the results and analysis of the APS model applied in the five districts selected for study. Chapter 8 contains the conclusion.

2

FRAMEWORK FOR AN ADAPTIVE POLICY SIMULATION MODEL

Introduction

This section describes how some important sectors of the five districts are each separately integrated in order to assess their effects of the environment. Some indicators have been developed to assess the impacts of different policy action on the environment.

Conceptual Framework

Quantitative evaluation of alternative policies is of major concern to policy-makers. Formulating appropriate agricultural and natural resource policies requires a proper understanding of the internal characteristics of the area under study, its sectoral interactions, and relevant external relations. A complicated pattern of interactions exists between the various sectors of these five districts.

The hill farming system is complex and crop production, animal husbandry, and forestry are intricately linked. They simultaneously determine the living standards of the farm families, income, and employment levels, as well as affect their surrounding environment. Forest lands provide fuelwood, fodder, and timber. Croplands provide food, fodder, and crop residue. However, crop lands also require manure (and thus fodder) and litter from forest lands. Thus, livestock connect these land resources by converting fodder into draught power and dung nutrient, in addition to providing food and income to households.

Large parts of these districts are still isolated pockets which are insulated from market forces. Transport network and communication facilities have not reached many parts of these districts. Movement of people and farm products to urban centres is difficult. Tourism plays an important role in some of these districts. Areas that are relatively close to the road head are able to sell excess produce, but, by and large, the majority of households are many days' walk away from the road or market centres. Since such households are predominant in all districts, it is a major assumption of this study that market forces are weakly active in these areas, primarily because markets for many of the resources consumed and produced in the areas are non-existent.

Traditional techniques used for policy analysis, such as single market studies, frequently fail to evaluate the impacts of changing policy alternatives and

exogenous assumptions over the broad range of economic variables and performance measures. Single market studies are limited in their abilities to evaluate cross commodity effects. General equilibrium models are extremely complex and require comphrehensive data, which are generally not available, especially at the district level, as in this study. Recently, more attention has been focussed on multimarket and multicommodity models. Multi-market models extend the more simplistic single market models to include distribution and some general equilibrium analysis (Braverman et al. 1983). These models, by relating commodity and market factors, more realistically trace the effects of policy change in different sectors than do single market studies. Environmental concerns can also be integrated within this framework, depending upon the extent of information that is already available. The essence of multimarket and multicommodity models is a set of consistent equations reflecting the technological, behavioural, economic, and institutional characteristics of producers and consumers, and market equilibrium conditions for both commodities and factors. The system is useful for determining different values of variables that can be influenced directly by policy. The system of equations can be developed econometrically.

Adaptive policy simulation (APS) models provide alternative, flexible methods by which multicommodity and multimarket interactions may be evaluated. Indirect, feed back, nonlinear, time-delayed, and other kinds of relationships can be dealt with appropriately within a logical framework if APS models are used. Another advantage of the APS model is that it allows the incorporation of many theoretical and empirical results of partial studies (Mayers 1988; Jensen et al. 1991; Low and Kelton 1982; Nijkamp et al. 1990; Braverman et al. 1987), i.e., the system is flexible.

This chapter outlines the development of an APS model used in this study which has the following three basic components.

- The first part of the model involves the external assumptions that define the current state of technology in each district, the set of policy/impacts and the behavioural parameters for supply and demand.

- The second component of the model includes the domestic supply and demand of food and natural resource products (crop, forest products, and livestock production), trade (import/export), and some exogenous variables (population, price, etc.) and their forecast over time.

- The third component of the model provides estimates of various performance/sustainability indicators derived from the model to evaluate the effects of policy shocks on selected performance/sustainability indicators.

Major Assumptions

Some major assumptions of the model are as follow:

- producers and consumers are price takers in both the product and factor markets, and
- relative prices of important products and factors will increase over time in relation to national price trends.

The other assumptions that have been made are reported in the respective sections that follow.

Linkages and Specification of Model

The APS model employed in this study establishes linkages between various sectors through several behavioural, structural, and accounting relations.[1] The model can thus provide information about the consequences of relative changes in prices and other policy actions on production, consumption, natural resources, and the environment. The ultimate impact of any policy interventions will be reflected in income and other indicators of social wellbeing as well as the environment, e.g., carrying capacity.

The APS model consists of different sectors and sub-sectors. The districts considered are essentially rural in nature. Some pocket areas classified as urban are too small to have any significant impact and, hence, are not treated separately. The sub-sectors include agriculture, livestock, forestry, food, trade, income, and employment among others and are interrelated through exogenous variables (prices, population) and also through supply and demand and market clearing relationships.

Each sub-sector is represented by supply and demand relationships. The supply side is defined in terms of factor prices and/or quantities, thus allowing for policy interventions. In certain cases, the supply side is composed of diaggregates, for example in the case of fuelwood, where a district's fuelwood demand is met by supply from different sources (forests, shrublands, farmlands, etc) across different regions (high mountain, mid-mountains, Siwaliks, etc).

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1 The behavioural demand and supply equations used in the model have micro-economic foundations. The parameter estimates used in the behavioural equations have been borrowed from studies carried out by various scholars in the Nepalese context. In limited cases, where such parameters were not available, estimates for the *teral* and rural India (non-food demand) have been used.

The demand side of the model depends primarily on population size and growth. Furthermore, income and prices are important determinants of the consumption levels of different commodities. Income and prices are used to influence demand depending on the availability of parameters. By incorporating income and prices on the demand side, this study deviates from the traditional method commonly used in Nepal where demand projections are based on per capita needs and population growth, i.e., constant coefficient method. Therefore, the method employed in this study (on the demand side) addresses, for example, households' access to food as constrained by their income and relative prices (food security) as well as food (calorie) needs (food sufficiency).

The demand and supply systems in each subsector can be further classified into three main sectors, namely, food, natural resources, and other activities/sectors. The food sector consists of those subsectors that provide food to households. It consists of the fuelwood, fodder, and timber resources as well as the different subsectors that are related to land use. In addition, the model consists of other sectors that are related to these two sectors on both the demand and supply sides as well. The other sectors include labour use, income, and trade which interact with the other two sectors. Furthermore, some activities that are not common across districts are also included in this sector, e.g., tourism in Rasuwa. Such activities are discussed separately below. Finally, the environmental sector consists of a set of outcomes resulting from food, natural resources, and other activities as well as the influence of the exogenous sector. Certain indicators have been developed to assess the environment, e.g., carrying capacity. In this study, therefore, the environment is viewed in terms of the outcomes of the integration of different sectors and subsectors in an economy along with the influence of the exogenous sector. Each is discussed in turn below. Figure 2.1 illustrates a simplified relationship between these major sectors. Figure 2.2 provides a more detailed diagram of the sectors and subsectors and their linkages that are taken into account in this study.

Exogenous Variables

Price

Foodgrain prices and other important prices are forecasted over time up to 1998 on the basis of a simple time trend relationship. The assumption made in forecasting prices is that district prices will change according to the national trend. Time-series' data (1975-1989) collected by the Department of Food and Agriculture Marketing Services (DFAMS 1990) have been used for this purpose. Since district prices may have been different from the national prices in the base year (1991), calibration to the intercept term of the regression equation was made using price information

available for the district or the closest district in question as reported by DFAMS.[2] In addition, some aggregate price series have also been derived for each district on the basis of each district's production and individual commodity prices.[3] These aggregate prices vary across districts and are used in the food demand sector.

Population

The population forecast made by the National Planning Commission (NPC) using the most recent Population Census (1991) has been directly used for each district. The high variant projection scenarios have been used.

District Area

The land area of a district is assumed to remain constant throughout the study period, but land use within a district can change. The areas under Langtang National Park and Shivapuri watershed that fall within a district are assumed to have remained unchanged. In addition, natural resources from such areas are assumed to be unavailable for harvesting and private consumption. Furthermore, in some districts, where the high Himalayas are located, the second grazing that is allowed has been incorporated in the analysis.

Figure 2.1: Relationships between the Major Sectors

2 Time-series' data on prices is not available for all districts. Many of the series that exist are also not complete (DFAMS 1990).

3 The details are given later in the appropriate section.

Food Sector

Agriculture

Supply Side. Six crops have been considered in each district, namely, paddy, maize, wheat, millet, oilseeds and potatoes. These six crops account for over 90 per cent of the cropped area in most of the districts. Foodgrains are supplied by this sector.

Constant Area Forecast. Based on past trends, the cultivated area of each crop is assumed to grow over time at some constant rate, independant of prices. Such independent or exogenous growth assumptions are shift factors. The constant area growth of each of these crops is forecasted using a simple trend (semi-logarithm) based on historical data reported by DFAMS 1990 (Equation 1).

$$\text{Crop Area}_{i,t} = a_{i,} + b_{i,} \text{ Ln (Year)} \qquad (1)$$

where i = crops (paddy, maize, millet, oilseeds, and potatoes)

Behavioural Yield Response. Crop yield was assumed to be influenced not only by the shift factor (i.e., the constant yield growth assumption[4]) but also by changes in the relative crop prices in question as well as the relative prices of competing crops. To what extent farm households respond to changes in the relative prices depends very much on the relative strength of supply yield elasticities (own and cross prices). Crop yield can also be influenced by changes in the relative quantity of agricultural inputs (e.g., use rates of chemical fertiliser, bullocks, and labour) and changes in irrigated area.[5] For base yield rates, an average yield rate has been used. The results are given in Chapters Three to Seven. The behavioural equations describing the yields of different crops are specified in Cobb-Douglas form. Crop yield is assumed to be a function of the relative prices of crops, relative changes in area irrigated, and relative changes in the quantity of three variable inputs (labour, bullocks, and fertiliser). All crops are assumed to be irrigated except millet, and fertiliser is assumed to be used for all crops except millet. The estimating yield equations used are reported below (Equation 2).[6] Table 2.1 provides the values of the elasticities used in Equation 2. Separate elasticities are not available for each rural area considered. Bullocks input is not included in the valley's crop yield function since bullocks are not traditionally used in the valley.

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4 Note that the shift factor could be negative if some crop yields show negative trends over time.

5 Quantity elasticities had to be used in the absence of price elasticities.

6 Note that for all the rural areas, the same parameters are used in the yield function. No parameter estimates for each crop on a district basis are available. However, the variables associated with these parameters change across districts.

Production: The domestic (district) production of each crop is determined as the cropped area (Equation1) multiplied by the crop yield (Equation 2). Net production from domestic sources is domestic production minus allowances for seeds and other loss factors, including the milling factor (Table 2.2).

$$Y_{i,t} = BY_{i,t-1} \cdot \left(\frac{P_{i,t}}{P_{i,t-1}}\right)^{p_i} * \left(\frac{R_{i,t}}{R_{i,t-1}}\right)^{r_i} * \left(\frac{F_{i,t}}{F_{i,t-1}}\right)^{f_i} * \left(\frac{L_{i,t}}{L_{i,t-1}}\right)^{l_i} * \left(\frac{B_{i,t}}{B_{i,t-1}}\right)^{b_i} \quad (2)$$

Where:

Y_i = yield of crop i (i=1,..,6);
$BY_{i,t-1}$ = lagged yield rate of crop i;
P_i = price of crop i;
R_i = irrigated area of crop i;
F_i = fertiliser use rate of crop i;
L_i = labour use rate of crop i;
B_i = bullock use rate of crop i.

Superscript are elasticities (see Table 2.1).

Cultivation Cost. Data on the cultivation cost per hectare were obtained from the Irrigation Master Plan Report (DOI 1989) for the eastern hilly and mountainous regions and was adjusted to reflect conditions in the Bagmati Zone. Labour, bullocks, seeds, manure, and pesticides were the major variable inputs used for deriving cultivation costs. The prices for these agricultural inputs were obtained from field visits and have been forecasted to grow at the rate of the agricultural GDP deflator reported in the Economic Survey (1990). Table 2.3 provides the per hectare use rate of inputs used in the study.

Table 2.1: Own and Cross Price and Input Quantity Supply Elasticities

	Elasticities with respect to						
	Crop prices			Input quantities			
	Own	Cross		Irrigation	Fertiliser	Labour	Bullock
Crops	P_i	P_j	P_j	r_i	f_i	l_i	b_i
Paddy	0.272	na	na	0.130	0.250	0.250	0.050
Maize	0.180	na	na	0.043	0.048	0.160	0.150
Wheat	0.282	-0.012[1]	-0.08[2]	0.311	0.25	0.147	0.180
Millet	0.050	na	na	na	na	0.092	0.070
Potatoes	0.250	-0.010[3]	na	0.150	0.123	0.125	0.150
Oilseeds	0.200	-0.080[4]		0.275	0.030	0.097	0.170

Notes: 1 refers to wheat yield w.r.t. to potato price
2 refers to wheat yield w.r.t. to oilseed price
3 refers to potato yield w.r.t. to wheat price
4 refers to oilseed yield w.r.t. to wheat price
na refers to not applicable

Source: Pudasaini 1984

Figure 2.2: Schematic Diagram Depicting the Linkages of the Model Kathmandu Valley

Gross Margin. Gross margins for different crops were then derived simply by subtracting the variable cultivation costs from gross farm revenue (gross crop revenue plus value of by-products [DOI 1989]. Gross crop revenue is the sum of gross revenue of each crop. Gross revenue of a crop was obtained by multiplying crop production by crop price. Assumptions regarding the quantity and prices of crop residue are given in Table 2.4.

Demand Side. As with the supply system, the demand side of the model specifies a set of demand response equations for different groups of food commodities consumed in rural and urban areas, in order to project their future demand growth pattern. The basic outcome of the model employed in this study is, therefore, determined not only by the supply response but also by the consumption response to prices and income.

The food demand of rural households depends on their dual functions, i.e., as households and as firms (Singh, Squire and Krichner 1984). As households, their demand depends on income, household size, and relative prices, but unlike other (e.g., urban) consumers, their incomes also depend on changes in relative farm prices because these also change their farm income through crop supply functions.

The present exercise limits itself to five types of food commodities cereals (paddy, wheat, maize, and millet); vegetables (potatoes); milk; meat; and oils and fats (mustard oil and ghee). Meat and oils and fats are supplied by the livestock sub-sector. The per capita domestic consumption of these food groups was derived from the total production adjusted for losses and seed allowances.

The per capita demand of these food commodities is assumed to be a function of relative prices, per capita income, the strength of prices (own and cross), income elasticities, and base period per capita availability. The demand parameters required for this study were derived from a more recent demand study (Mudhbary 1988).[7] The parameters derived from this study are for low, average, and high income households (Table 2.5). The demand functions used are also of the Cobb-Douglas type. The specifications of the behavioural demand equations used in the study are given in Equation 3.

Table 2.5 provides the values of the demand and price elasticities used in the demand equations for different areas. It is worth noting that the income generated by the model is introduced in the model's demand equations. Thus, for farm or rural households, changes in food prices affect demand directly as well as indirectly through income because changes in food prices will affect crop income and, thereby, household income. The model works out the net effect automatically

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7 This is the only study of its kind carried out in Nepal. Mudhbary used the Almost Ideal Demand System (AIDS) to estimate his demand coefficients based on NRB Multipurpose Household Budget Survey data.

Table 2.2: Loss Factor Assumptions

Grains	Seed Requirements	Milling Loss	Other Losses and Damage
Paddy	53 kg/ha	38%	10%
Wheat	120kg/ha	4%	10%
Maize	24kg/ha	3%	10%
Millet	20kg/ha	7%	10%
Potatoes	800kg/ha	0	15%

Source: DFAMS (1990) Annual Bulletin on Food Accounts (in Nepali)

Table 2.3: Input Use Per Hectare

Inputs	Paddy	Maize	Wheat	Millet	Potatoes	Oilseeds
Labour (mandays)	222	160	128	140	217	91
Bullocks (pairdays)	51	38	38	36	45	25
Fertiliser (kg)	18	16	24	na	14	10
Manure (MT)	3.62	3.87	3.75	2.50	7.80	2.16
Seeds (kg)	49	24	120	20	900	15
Others (Rs)	47	20	50	na	20	na

Notes: na = not applicable
Source: Basic data from Irrigation Master Plan (1989)

Table 2.4: Quantity and Price of Crop Residue by Crops

Crops	Paddy	Maize	Wheat	Millet
Residue (MT/ha)	1.3	1.1	0.8	0.8
Price (Rs/MT)	500	500	500	500

Source: Irrigation Master Plan (1989)

because changes in farm profits (gross margin) are fed in through income. Per capita base consumption values of the different foods consumed were derived from the availability section.

$$PD_{i,t} = PD_{i,t-1} * \left(\frac{I_t}{I_{t-1}}\right)^{d_i} \prod_{j=1}^{5} \left(\frac{PR_{j,t}}{PR_{j,t-1}}\right)^{e_{i,j}} \qquad (3)$$

Where:

$PD_{i,t}$	= per capita demand of ith food;
$PD_{i,t-1}$	= lagged per capita demand;
I_t	= per capita income;
$PR_{j,t}$	= price of jth food;
d_i	= income elasticity of demand for ith food;
$e_{i,j}$	= price elasticity of demand for ith food

(i=1...5; j=1...5).

Livestock

Livestock are a key component of hill farming systems, connecting crop lands and forests by converting fodder into draught power and dung nutrient. Hill farmers who cultivate land also raise livestock and depend heavily on forests to support both. Given this interdependence, the livestock population can be linked with different land categories (croplands, forests, and grazing lands). By linking livestock with land use data, the model can capture the effects of changing land use patterns on the livestock population and hence on livestock products and livestock income.

Table 2.5: Demand Elasticities' Estimates

Food Commodities	Elasticities with Respect to Commodity Prices					
	Cereal	Vegetables	Meat	Milk	Oils	Income
	Estimates for Low Income Households					
Cereal	-0.82	0.06	-0.05	0.13	-0.03	0.351
Vegetables	-0.59	-1.10	0.26	-0.96	-0.12	1.650
Meat	-1.68	-0.26	-1.35	-1.10	0.50	2.615
Milk	1.26	-0.15	0.19	-0.50	0.44	0.766
Oils/Fats	-0.28	-0.08	0.21	-0.20	-0.76	1.421
	Estimates for Average Income Households					
Cereal	-0.63	0.05	-0.10	0.06	-0.02	0.308
Vegetables	-1.06	-1.10	0.24	-0.64	-0.18	1.764
Meat	-1.76	-0.17	-1.05	-0.52	0.34	2.480
Milk	0.15	-0.18	0.10	-0.52	0.36	1.227
Oils/Fats	-0.45	-0.06	0.23	-0.04	-0.69	1.152

Note: Low, average, and high income households refer to Rasuwa and Kabhre; Sindhu; Nuwakot, and Dhading households respectively.

Source: Mudhbary 1988

Livestock Population Forecast

The livestock sector is driven primarily by the four land uses categories, namely, cultivated areas, forest areas, grazing areas (shrubs area + grasslands), and adjacent non-cultivated inclusions (NCI). Regression analysis was conducted by using cattle population as the dependent variable and land use data for 38 hill and mountain districts of the Eastern, Central, and Western Development Regions as explanatory variables. After estimating different models, a model that reasonably captured the relationship between cattle population and land use categories was selected to integrate the livestock population with land use. The regression equation (corrected for heteroscadasticity) estimated was in double log form (Eq 4). What Equation 4 basically states is that cultivated area has the strongest influence on cattle population, followed by adjacent NCI, forest area, and finally grazing areas. A ten per cent increase in cultivated area leads to almost five per cent increase in cattle population. All the four types of land use categories affect cattle population positively. Similar exercises could not be conducted for other types of livestock since data were not available. However, for the few years of data on other types of livestock population reported in the DFAMS 1990 report, regression on other livestock population was conducted by considering cattle population as the independent variable. Using these results, the other types of livestock population were linked with cattle population. As a result, changes in land use in a district not only lead to changes in cattle population but also to changes in other types of livestock population, and, hence, livestock products' supply. The other types of livestock included are buffaloes, goats, sheep, pigs, and chickens. Pig and chicken populations are assumed to be independent of land use and are forecasted on the basis of time trends.

Ln(Pop) = 1.9516+0.4788*ln(A_1)+0.2966*Ln(A_2)+ 0.0298*Ln(A_3)+0.1310*Ln(A_4) (4)

The t-ratios are: intercept (4.21); (A_1), (3.79); (A_2), (2.10); (A_3), (0.80); (A_4), (1.72).

R^2=0.93; and where: Area_1,Area_2,Area_3,and Area_4 represent cultivated, non-cultivated inclusions, shrub and grass, and forest areas respectively.

Livestock Products' Supply

DFAMS (1990) collected data on livestock products' supply for each district over a five-year period. Conversion ratios between livestock and adult population and livestock products were calculated to obtain livestock products' supply. Milk yield rates were also derived to obtain milk supply. Ghee supply was also calculated by assuming that 30 per cent of the milk production goes into ghee production. The

milk to ghee production factor was assumed to be four and five per cent respectively for cow and buffalo milk. Finally, wool production was estimated by assuming that about half a kilogramme of wool can be harvested from each adult sheep in a year.

Bullocks

Fifty per cent of the cattle population are assumed to be males and out of this 66 per cent are assumed to be bullocks. The resulting bullock numbers were divided by two to obtain bullock pairs. Each bullock pair was multiplied by 219 days (working days) to arrive at the bullock pairdays' supply to be used in crop yield response function and cost of cultivation.

Manure

Manure supply was obtained by multiplying each adult grazing animal by 1.13MT manure/year (Irrigation Master Plan). The conversion factor of grazing animals of adults is 0.66.

Natural Resources' Sector

The natural resources' sector consists basically of forest products that are harvested by households to meet their consumption needs, including those of livestock. Natural resources refer to three forest products, namely, fuelwood, fodder, and timber. Since forests are one type of land use category competing with other land use categories (agriculture, grasslands, and others), the natural resources were first developed in terms of land use to account for the land use changes that occur over time.

Land Use Dynamics

The forestry sector use data collected by LRMP (1986), the Forestry Master Plan (MPFS 1988a, and 1988b, and 1988c), and the Water and Energy Commission Secretariat (WECS 1987). The forestry sector is the most complex and, as a result of the lack of information, various simplifying assumptions have had to be made which are discussed below. LRMP (1986) reported several different land-use categories, namely,[8]

- natural forest: accessible and inaccessible;
- area planted to forest;
- shrublands;
- grasslands;

8 Refer to LRMP (1986) for details on the definition of these land categories.

- adjacent NCI;
- NCI within gross cultivated area;
- net cultivated areas; and
- other waste lands.

Land-use changes in many hill districts of Nepal are closely associated with deforestation. As the destruction of open access forests takes place, forest land is changed into shrub and grass lands and eventually into barren and agricultural lands (Shrestha 1989). Not all natural forests in the hill districts are accessible. Hence, the accessible forests were first derived by using the accessibility factor reported in MPFS (1988a), and this class of forest was assumed to have declined at one per cent per annum during the period from 1978 to1989. From 1992 onwards, the extent of deforestation was assumed to depend on firewood deficit (explained below). The net reduction in accessible forest area that takes place in each district in the above manner leads to change in land use, and this change affects the environment, depending on the direction and magnitude of interclass land transfers as a result of deforestation.

Given the lack of time-series' data on land flow between various categories, some simplifying assumptions regarding inter-class land transfers have been made on the basis of the field observations of experienced foresters and of case studies. The annually deforested areas were assumed to have been transferred into different land use categories in different ecological belts (Table 2.6). The reasons for making the assumptions (Table 2.6) regarding the distribution of deforested area are that, firstly, land in each region is assumed to remain constant throughout the period under study; secondly, even though land use changes within the above classes of land use take place, the net result appears to be a declining trend in forest area, and an increasing trend in other uses, although small; and thirdly, after deforestation takes place, the area generally turns into shrubland. Since the rate of migration from the hills to the inner *terai* (Siwaliks) has been high and the terrain less harsh than in the hills, a 50 per cent conversion factor has been assumed for the Siwaliks in the case of agricultural land. In the mountain region, a lower conversion factor was assumed because of relatively harsher terrain. According to the above assumptions, land use in each class, therefore, changes over time with the total land area in each belt remaining constant.[9]

In addition, mapped cultivated areas, which are the sum of gross cultivated areas (i.e., net cultivated plus NCI within gross) and adjacent NCI, also change over time. Within gross cultivated area, the NCI within gross (NCIG) is assumed to remain constant. This is because the area under NCIG includes trails, paths, irrigation channels, terraces, and so on within farm lands, school compounds, and other public use areas, and it is assumed that such areas do not change over time. The

9 Also see Forestry Master Plan (HMG/ADB/FINNIDA, 1988a, 1988b) on these issues for more details.

total forest area calculated is then the sum of accessible, inaccessible, and planted forest area (presently zero in most cases).[10]

Table 2.6: Assumption on Land Transfers due to Deforestation by Ecological Belt

Land Class	Siwaliks	Mid-mts and Other
Shrublands	15%	50%
Grasslands	15%	15%
Agriculture	50%	20%
Adjacent NCI	15%	10%
Residual	5%	5%

Note: Other includes high mountains.

Finally, all the above categories of land use in the district's sub-regions (Siwaliks, mid-mountains, high mountains, and high Himal) were added together to derive the district land use classes. The resulting value was then deducted from the total land area of the district to arrive at the residual land use class. Residual value was then derived at the district level. Protected areas or natural parks were treated accordingly.

Forest Area Adjustments

Species' Composition

LRMP (1986) defined hardwood, conifer, and mixed wood as constituting forest composition. The area under each species was then derived for use as base year weights. Species' composition is gradually undergoing a change because most useful and wanted plants and grasses are being harvested and grazed, and they are being replaced by unwanted species and weeds such as *Eupatorium.*

Crown Cover

Three classes of crown cover exist (D2, D3, D4)[11]. Crown cover is based on canopy density. On the basis of base year values, projections were made for each type of crown cover forest. One assumption that warrants rethinking is that the crown

10 Information on annual planted area was not available for all the districts and therefore could not be accounted for. However, the model developed has provisions to account for area planted in the forestry sub-model.

11 D2, D3, and D4 refer to 10-40%; 40-70%, and above 70% crown densities respectively.

density of each time period is assumed to remain constant throughout the forecasted period based on the base year density. Over time the crown density is also likely to change, with higher density forests being converted to lower density forests. The densities of planted and protected areas may improve over time from low to high density. If appropriate assumptions or parameters can be provided, this can be incorporated into the model.

Water and Energy Commission (WECS 1987) reported the yield rates of forests of different densities and composition on the basis of a 100 per cent crown density assumption. Factors have been provided to adjust for species and density composition in order to adjust the forests to 100 per cent crown density. The factors are as follow:

- density class 2 = .25;
- density class 3 = .55; and
- density class 4 = .85.

By multiplying the areas under different density classes for each region by these factors one can arrive at the 100 per cent adjusted, crown density forest area.

Forest Products' Supply and Demand

Fuelwood

Yield Rate Assumptions. WECS (1987) reported the fuelwood yield rates for different forest species from forests and other lands as follow:

- hardwood forests - 5 air dry tonnes (adt)/ha;
- conifer forests - 1.25 adt/ha;
- mixed forests - 3.75 adt/ha;
- shrublands - 0.69 adt/ha;
- grasslands - 0.10 adt/ha;
- NCI adjacent - 0.69 adt/ha; and
- farm trees - 3.5 adt/ha.

Fuelwood Supply and Demand.

The yield rates assumed above were multiplied by adjusted crown density areas for each forest species in each region. The sum of the values of fuelwood from all sources in turn gives the total fuelwood supply. The demand for fuelwood was estimated to be 588kg (290kg from forests, 194kg from private trees, and 104kg of crop residue) per person per year (MPFS 1988b). The total demand was derived by mutiplying this value by the total population. The fuelwood balance was then derived as the difference between supply and demand.

Fodder

Yield Assumptions. Fodder is supplied from various sources that have varying yield rates. The yield rates assumed for fodder supplied from different sources are defined in Table 2.7. Furthermore, it was assumed that one per cent of net cultivated area will provide fodder in the Siwaliks and five per cent in other mountain regions. Fodder yields from cultivated land were assumed to be 1.4 TDN/ha and 1 TDN/ha respectively in the Siwaliks and other mountain regions (MPFS 1988b and WECS 1987).

Supply and Demand.. Supply of fodder in a district is the sum of the production (yield multiplied by area) from different sources and sum across regions. Demand is based on the number of LSU for grazing animals adjusted to the adult livestock population. Details on livestock projection are given later. The demand per adjusted LSU was assumed to be 0.6327 TDN/LSU/year (MPFS 1988a). Fodder balance is the difference between supply and demand.

Timber

Yield Assumption. Average timber yield rates assumption made on the basis of MPFS 1988a (Table 2.8) were used to project timber supply.

Supply and Demand. The total timber supply was calculated as the sum of the yield rates times area under forest adjusted for density. The per capita timber demand was assumed to be equal to 0.079 cu.m/year (MPFS, p 51) in all districts. The total population multiplied by this per capita equals the total timber demand. The balance is the difference between supply and demand.

Table 2.7: Fodder Yield Rates from Different Sources (MT/ha in TDN)

	Siwaliks	Mid-mts	High Mountains
Forests	0.56	0.43	0.54
Grasslands	0.58	0.28	0.76
Shrublands	0.77	0.77	0.77
Adj NCI	0.24	0.24	0.24
Tree Plantation	--	1.44	1.44
Crop Residue:			
paddy:	0.66	TDN/MT of harvest	
maize:	0.28	TDN/MT of harvest	
wheat:	0.28	TDN/MT of harvest	
millet:	0.61	TDN/MT of harvest	

Source: HMG/ADB/FINNIDA 1988a

Table 2.8: Timber Yield Assumptions

Siwaliks	Mid-mts and Others
0.714 cubic metres/ha	0.286 cubic metres/ha

Source: HMG/ADB/FINNIDA 1988b

Deforestation

Given the biomass supply and demand, it is possible to provide an estimate of the rate of deforestation that may occur. The difference between supply and demand of biomass (fuelwood, fodder, and timber) can be negative or positive. If the balance is positive, no pressure will be exerted on forests, hence, deforestation is not likely to occur. If the balance is negative, i.e., there is an excessive demand for biomass, and this situation persists over time, forest degradation will take place and eventually lead to deforestation. The process of degradation and deforestation depends on biomass stock, annual incremental stocking rate, and excess demand. This study defines deforestation occurring when the biomass stock is depleted to meet excess demands.

The existing biomass stock at any time determines the annual stocking rate and, consequently, the annual (sustainable) harvest rate. As biomass stocks depleted over time, the annual stocking rate also depleted at a faster rate, thus reducing the annual sustainable harvest rate. Deforestation takes place when the excess demand is met from the existing biomass stock. Therefore, it is essential to have an idea of the biomass stock per hectare of forest land for a given species, maturity, and crown density class. As already discussed above, all the accessible forest areas were adjusted to 100 per cent density assumption. The biomass yield assumption described above is the sustainable yield possible from the given biomass stock adjusted to 100 per cent density. In addition, an estimate of the biomass stock per hectare of the adjusted accessible forest area is also necessary to get an idea of the rate of deforestation that is likely to occur.

It is likely that the biomass deficit will somehow be met by households to fulfill their biomass needs. Biomass is supplied by different sources and unfulfilled demands will be met through the depletion of forest biomass stock, i.e., overexploitation under an open access regime. Thus, on a hectare of forest land, the depletion of stock over time will eventually lead to deforestation if excess demand continues. Therefore, the rate of deforestation will depend on the magnitude of unfulfilled, excess demand for biomass. If the unfulfilled, excess demand equals the biomass stock of a hectare of forest land, then one hectare of forest land will be deforested. If, on the other hand, the excess demand is less than the biomass stock of a

hectare, then deforestation will be less than a hectare. Likewise, if excess demand exceeds one hectare of biomass stock, then deforestation will also exceed one hectare.

The model allows estimation of excess demand. The biomass (firewood, fodder, and timber) yield issues have already been dealt with above. Now an estimation of the biomass stock of a hectare of forest land is required. The estimate of biomass stock per hectare varies in Nepal. For example, in the Arun Valley in East Nepal, where population pressure on forest land is not as severe as in most districts in the Bagmati Zone and where forest density is also greater, the estimated average biomass stock per hectare of forest land is fairly high (Table 2.9). In the case of the districts in the Bagmati Zone, the population pressure is greater and forest density is lower for various reasons (see Mahat 1987). Thus, it can be assumed that the average biomass stock per hectare of forest land in the different districts of the Bagmati Zone will be 25-50 per cent less than the estimated average biomass stock of hill forests (149MT/ha) in the Arun Valley (Bhadra et al. 1991). If there is excess demand, it leads to deforestation and the extent of area deforested is fed back to the accessible forest area as a loop, and use changes due to this effect are updated leading to new biomass supply estimates. This cycle continues over the time frame of the model.

Other Activities

The three sectors discussed above do not include all the economic activities of each district. Other activities, such as labour use, trade, and income generation, are also important. These activities and how they are linked to the above sector and subsectors are discussed in this section. In addition, some activities that are not common to all districts are also discussed in this section. Despite including all these activities, the model has not been able to cover all the activities/sectors that exist in a district. The major reason for this is the lack of information. For example, Dhading's increasing success in vegetable cultivation has not been incorporated in the model. The absence of such activities, especially if such activities are important for recognising this limitation of the model when results are being interpreted. Firstly, activities/sectors that are common to all districts are discussed and the last two sections deal with tourism and horticultural activities that are specific to Rasuwa.

Labour Use

Integration of this sector into the model enables us to derive important information about the extent of labour use (employment) and its simple change estimate over time in a district. Integrating the labour use sector involves the following simple method of estimating labour availability and its utilisation in different sectors. As

already indicated, population figures were obtained from the NPC. Only active population was taken into account to determine labour supply. The participation rate was not considered. Each active household member is assumed to have at his/her disposal 250 working days per year.[12] The active members were multiplied by the normal duration of work to derive the total labour supply in the district. Members are assumed to allocate their time to crops, livestock, and other off-farm activities. The total labour days used for crops was derived from the cost of cultivation data. Households are assumed to devote 100 mandays of labour to one LSU (NRB 1988). The other activities are based on the distribution of economically active population by occupation (NRB 1988). These factors for the low and average income districts are reported in Table 2.10.

Table 2.9: Estimated Biomass by Forest Type and Canopy Closure

Forest Type	Biomass Stock (MT/ha)			
	Class A	Class B	Class C	Average
Hill Forest	250	133	63	149
Lower Slope Mixed Hardwood	303	190	102	198
Upper Slope Mixed Hardwood	246	162	105	171
Temperate	316	200	120	212

Note: Class A, B, and C refer to canopy closure of >75%, 75-50%, and 50-20% respectively.
Source: Bhadra et al, Table 4.9, p.57 (1991).

Table 2.10: Distribution of Economically Active Population

District	Professionals	Office	Sales and Services	Production	Construction	General Labourers
Low Income	1.8	1.1	2.7	2.0	0.04	7.5
Average Income	1.6	1.8	3.8	4.2	1.00	8.7

Source: NRB 1988

12 This is the normal duration of work in the hilly and mountainous regions of Nepal estimated by the Nepal Rastra Bank-Multipurpose Household Budget Survey (NRB 1988).

Trade

Food

The model's trade sector is composed of import demand and export supply. Export supply consists of only food commodities that are domestically (in the district) produced. The excess food that remains after subtracting the total demand from the total supply is assumed to be exported. If, however, the balance is negative, then that amount is assumed to be imported. It should be noted that food import/export are affected by product and factor prices as well as income and population growth. Stated differently, commodity prices and per capita income affect food demand, and crop and factor prices and other inputs affect food supplies.

Non-food

Non-food import is driven by population growth, income elasticity of demand for non-food, and growth in income. The extent to which import demand is influenced by the growth in income depends upon the strength of income elasticity of demand for non-food.[13] The growth rate of import demand was specified to equal population growth plus per capita income growth multiplied by income elasticity of demand for non-food (Equation 5). Base year, non-food import demand was then multiplied each year by this growth rate to obtain the value of total non-food imports. Per capita income growth was derived from the model explained below.

NRB 1988 reported the import content in monthly household expenditures broken down into domestic imports and imports from India and the rest of the world (ROW). The figures were added to arrive at the value of total non-food import. Since the survey refers to 1984, the per capita value of non-food imports was inflated by the real income growth rate obtained from the model to arrive at the 1991 value. NRB (1988) estimates for rural mountains have been applied in the case of Rasuwa and rural hill estimates have been applied in the other four districts. To reflect the higher economic status of the Central Development Region, the resulting value for 1991 was multiplied by a factor of 1.25 based on the per capita income difference derived from NRB 1988.

The demand for non-food imports is assumed to be elastic. Engel's law states that income elasticity of demand for a luxury is generally elastic, i.e., the demand for a luxury is very sensitive to changes in income. Thus, we assume that non-food imports are a luxury relative to food, and also that imports originating from the rest of the world (ROW) are relatively more luxurious than imports originating from

13 The income elasticity demand for non-food is not available for Nepal. An estimate for rural India, based on results reported by Ray (1987), has therefore been used.

India. Imports originating from domestic sources are assumed to be the least inelastic but more elastic than food demand.

$$IDG_t = PG + IR_{t-1}*E \qquad (5)$$

where: IDG is the non-food import demand growth rate;
PG is population growth rate;
IR is the per capita income growth rate; and
E is the income elasticity of demand for non-food.

The base figures assumed for the value of non-food imports and the corresponding elasticities for non-food imports originating from domestic, India, and the ROW were derived from different sources and are reported in Table 2.11. The basis for assuming the elasticity values was the estimate of such values derived for India and Pakistan (Ray 1986 and Sarmad and Mahmood 1987).

Table 2.11:Average Monthly Household Expenditure and Income Elasticity of Demand for Non-food

	Expenditure (Rs)	Elasticity
Domestic	271.75	0.90
India	83.59	1.30
Rest of the World	51.66	2.00
Total	407.00	

Source: NRB 1988

Income

Households are assumed to derive their income from crops, livestock, wage labour, occupational sources, and exports. Crop income is the sum of gross margin from each crop considered in the model. Likewise, livestock income is the sum of gross margin from each livestock product. Off-farm employment (see labour use section above) also generates income. Income accruing from different off-farm employment categories is also based on NRB (1988) and has been adjusted to reflect the 1991 income levels. Thus, the total household income is the sum of income accruing from the various sectors discussed above.[14] Per capita income and growth rates

14 In the case of some districts where additional information on other economic activities is available, income accruing from such activities is also included in the total district income. For example, in the case of Rasuwa district, incomes from the tourism and horticultural sectors are

were also derived. Each year's per capita income feeds the equations that determine the import growth and food demand equations discussed below.

Tourism

The flow of tourists was forecasted by using the information reported in the Tourism Statistics of Nepal (Equation 6). It was assumed that the number of tourists visiting Langtang National Park (LNP) in Rasuwa district will be a fixed percentage of the total number of trekking tourists that visit Nepal. Past trends indicate that the average share is about 11 per cent.

The number of days a tourist stays in LNP is assumed to be seven days (Banskota and Upadhyay 1989). It is further assumed that one tourist hires, on an average, 1.04 porters but only 60 per cent of the porters are assumed to be hired locally. Assuming that a porter's wage was twice the agricultural wage, porter income was estimated. A third source of local income from tourism in the district is the expenditure of tourists on food and lodging. However, not all tourists visiting the LNP use these facilities. Survey results indicate that only 70 per cent of the tourists depend on local food and accommodation (Banskota & Upadhyay 1989). In 1989, the estimated food expenditure per day by a tourist in LNP was about Rs 1,000 and an additional Rs 377 was spent on accommodation. These figures were then updated to match values for 1991. The total tourism income accruing to the local people is then the sum of the total wages, food, and accommodation expenditure made by a tourist during the seven days he spends in LNP.[15]

$$\text{Ln (TT)} = 9.59 + 0.1077^{*}\text{Year} \qquad (6)$$
$$(81.6)\ (11.9)$$

R_2=0.93 and where: TT is the number of trekking tourists and t-values are presented in parentheses.

Horticulture

Rasuwa district is believed to have considerable potential for horticultural development (Shrestha 1991).[16] At present, horticultural development in this district

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also included.

15 Some tourists spend time on the Helambu side of LNP which is located in Sindhupalchok district. Lack of information on the number of tourists visiting LNP by this route and days spent prevented us from accommodating the tourism income flow for Sindhupalchok district. The expenditure values used are reported in Banskota and Upadhyay (1989).

16 See Shrestha (1991), 'Horticultural Development in Rasuwa.'

has only just started. Primarily apples, peaches, and walnuts were planted. Other types of fruits are also cultivated in the district.

The areas covered by apples, peaches, walnuts, and other fruits total 224, 69, 45, and 194 ha respectively. This area is assumed to grow at two per cent per annum based on three years' data on the area under fruits as reported by Shrestha. Shrestha also provides the cost of cultivation and returns per hectare. These figures were used to derive the Rasuwa horticultural income. More details are provided by Shrestha (1991).

Environmental Sector

A set of indicators was also developed to summarise the performance of the districts. These performance indicators were derived from different sectors of the adaptive policy simulation model and result from the interaction of the sectors and subsectors. Thus, environment is observed to be an outcome of the various forces at work in the food, natural resources, and other sectors of the district. Three different indicators of carrying capacity were developed to assess the environmental conditions.

Carrying Capacity in Terms of Calories

Calories are supplied by the crop sector. Seed allowances, milling losses, and other losses incurred on the farm and during storage are taken into account to arrive at the net food availabiility in edible form. Calory suppliy is assumed to be derived from paddy, maize, millet, wheat, and potatoes. Calorie supplies from other sources, which definitely exist, have not been taken into account. As a result, the calorie supply and demand reported in this exercise are underestimated. However, since foodgrains provide most of the calories to households, it can be reasonably assumed that the calorie supply and demand derived by the model account for a large part of the calorie supply.

Each type of food grain and potatoes provides a different calorie level (Table 2.12). The total of foodgrains and potatoes available in edible form multiplied by the calorie factor gives the total calorie supply of a district. On the demand side, an adult is assumed to require 2,410 calories per day.[17] The district population was converted into adult units by using the adult consumption unit (ACU) of 0.8223 reported by DFAMS (1989) for the hill regions of the country. Then supply as a percentage of demand was determined, and this reflects the calorie situation of a district in relation to its population expressed in adult units.

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17 This 2,410 calorie requirement per person per day is recommended by the FAO for the South Asian Association for Regional Cooperation (SAARC).

Table 2.12: Calorie Supply from Different Foodgrains and Potatoes

Foodgrains	Calorie/kg
Rice	3,450
Maize	3,410
Wheat	3,420
Millet	3,280
Potatoes	970

Source: DFAMS 1989

Furthermore, the calorie supply was divided by the total cropped area to arrive at the per hectare calorie supply of a district. The calorie need was also divided by the same area to arrive at the load on a unit of land cultivated to support the population, given an adult's need of 2,410 calories per day. From such an exercise, it is possible to quantify the number of persons that can be supported by one hectare of agricultural land.

Carrying Capacity in Terms of Fuelwood

The total fuelwood supply discussed above was divided by the different areas which supply fuelwood to determine the capacity per hectare. On the demand side, the per capita needs per year (0.588 air dry tonnes) were multiplied by the population to determine the aggregate demand. The load per hectare was derived by dividing the total demand by the total area that supplies fuelwood. The load factor defines the pressure on a hectare of land to meet the fuelwood demand and the capacity defines the current fuelwood supply from a hectare of land.

Carrying Capacity in Terms of Fodder

The fodder supply and demand per hectare of land, supplied from different sources, were derived from the model. The total fodder need was obtain by multiplying the per LSU need (0.6327MT of total digestible nutrient [TDN] per year) by the total LSU. The figures were then converted into per hectare supply and demand. Per hectare capacity and load were then determined in a similar manner to that described above.

Calibration

After defining the structural relationship and allowing the model to forecast different values, the results were calibrated to match the basic aggregate facts for each

district and for the valley for 1991. Calibration is a process used to choose the parameter values which fit the available information concerning an economy for a base year (1991). The information sources used are varied and not all the structural relationships defined fit the observed values exactly. Therefore, calibration is necessary. Calibration involves two major tasks. The first is to ensure that all equations used in the model hold; i.e, all production and demand equations as well as market clearing equations must be satified for the level of income, prices, land area, etc, used in the model. In the present exercise, to ensure that base year observed values and values generated by the model match, simple interpolation of the intercept term was carried out.

Secondly, it is important to ensure that theoretical requirements of demand and production theory are met by the values of the selected variables and parameters. It is possible that the selected parameters and variables may not guarantee that such requirements are not violated in the base year by the functional forms, variables, and parameters selected. Therefore, first of all, base year values that are generated by the production or demand functions must be non-negative (non-negativity of quantities). Both approaches were used to calibrate the model in the present case[18].

Sensitivity Analysis

The role of sensivity analysis is to appraise the reliability of the results and to ensure that the results obtained from the full model simulation are not unduly sensitive to errors of magnitude that might be expected in the basic data, assumptions, or parameters used. Sensitivity analysis was carried out to test the robustness of the model by allowing output and input prices to reduce and increase by 10 per cent, one at a time, separately and jointly, together with changes in some important selected parameters used in the model.

Policy Scenarios and Impact Analysis

The adaptive policy simulation model can be used to evaluate different policy scenarios, therefore, it is useful for policy-makers. Given the structural features of the model, policy interventions can be made in different sectors and during time periods. The results of the interventions can then be compared with the baseline scenario and evaluation and ranking of different policies can be carried out. Selected policy interventions were analysed for each district. The main policy options that were evaluated are discussed below.

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18 A detailed discussion of the calibration method is given by Braverman et al. (1983).

Population

The population growth in some of the districts is already high and it exerts increasing pressure on the district's carrying capacity. Food availability is below demand in most of the districts. The forests are already under stress and unable to meet the firewood and fodder demands of the increasing human and livestock populations. Unemployment or underemployment is already high and means to generate employment appear to be fairly limited in the present situation. Some scope exists for generating employment in the agricultural sector, but, given the already large population, it is unlikely that much of the underemployed and unused labour can be further absorbed by the agricultural sector.

An exercise was conducted to examine the impact of population reduction on the economy and environment of Kabhre district. The Eighth Five Year Plan envisaged a one per cent reduction in population growth from the present level. Therefore, it was assumed that, by the end of the Eight Five Year Plan, population growth in each district would be one per cent less than the current level. To achieve this reduction, population growth was reduced gradually starting from 1993 and was increased annually to reach one per cent by 1998, i.e., the year the Plan ends.

Crop Sector Policies

Irrigation Policy

Food deficit is already a major problem in Kabhre, as stated above, and can perhaps be considered to be the singlemost important indicator of poverty and environmental degradation in the context of Nepal. Bringing more areas under cultivation does not appear to be a viable option in the context of the districts considered. Most of the cultivable land has already been brought under cultivation. Land in the non-cultivated inclusions (NCI) class can perhaps be brought under cultivation if adequate investments are made, but investment constraints do not make this option viable. Therefore, an irrigation policy intervention was examined. Irrigated area is assumed to increase in the district based on the potential of expansion estimated by LRMP. The impact of this policy is transmitted through the yield function and spreads throughout the model. Crop production, food supplies, and income all increase. Increase in income has implications for food demand as well as non-food imports, among other things.

Fertiliser Policy

Fertiliser policy includes increased use rates on the crops by 25 per cent. The impact of this policy is also realised through the yield functions. Also, additional fertiliser costs incurred were deducted to arrive at gross margins. Here onwards,

the effect will be transmitted in a similar manner to what is described above under irrigation policy.

Irrigation and Fertiliser Policy

The irrigation and fertiliser policies discussed above were then jointly examined.

Irrigation, Fertiliser and Potato Policy

In this scenario, additional areas were brought under potato crops. The additional area brought under potato crops is equal to the new irrigated area. The additional area brought under irrigation enables more areas to be brought under potato crops. The reason for selecting potatoes is the fact that currently potato yields the highest gross margin per hectare.

Natural Resource Policies

Forest Supply Management Policy

Most of the accessible forests in the district are unmanaged. The Nepal-Australia Forestry Project has pointed out that old growth forests, which characterise most of the accessible forests, can yield greater amounts of fuelwood, timber, and fodder from the first year of management. If appropriate management policies continue, yield rates will further increase. *Therefore, it was assumed that a certain percentage of the accessible forests came under improved management.*

Fuelwood Demand Reduction Policy

Another policy alternative considered for the natural resource sector consists of a 10 per cent curtailment in the per capita fuelwood consumption. Reports have indicated that the introduction of new stoves has tended to result in reduced fuelwood consumption by 10 to 25 per cent, depending on the continuation of the use of improved stoves by households.

Forest Supply Management and Fuelwood Demand Policy

This policy consists of joint supply management and demand curtailment.

The above policy scenarios and their impacts were examined for most of the districts. The new policy analysis carried out has been mentioned in the respective chapters. The evaluation of the impacts of the above policy interventions was conducted against the baseline scenario. The time-frame over which policy impact evaluation was carried out is from 1993-1998 for most of the districts, except in the case of Dhading where the time-frame was extended to 2005.

3

KABHREPALANCHOK DISTRICT

Performance of the District Economy

Introduction

This section provides a summary of the district's economy. The economic base of Kabhre district is primarily agricultural with strong linkages to the forestry and livestock sectors. As a result, these three sectors play an important role in Kabhre. Available historical data series for almost all the districts of Nepal are limited in most cases to crop area, yield rates, and livestock. District level information on other aspects of the district economy is not available, except for studies confined to smaller areas that are not usually representative of the district.

Crop Area

Six crops generally dominate the agricultural land use pattern in Kabhre. These crops are paddy, maize, millet, wheat, oilseeds, and potatoes. The areas under these crops for different years are given in Table 3.1, which indicates that the areas under paddy, maize, wheat, and potatoes increased by about two-fold during the last 14 years (1975 to 1989). This increase in area was very marked between 1981 and 1982 for paddy, when it increased from 9,600 ha to 11,620ha, i.e., 21 per cent. However, in 1989 the area again decreased to 10, 100 ha, i.e., by 13 per cent. The area under maize shows even greater variations. For example, it can be observed that the net gain has been only five per cent. The area under maize shows even greater variations. For example, between 1980 and 1981 it increased from 9,300 ha to 22,310 ha, i.e., 140 per cent increase. Again in 1984 the area declined to 10,100 ha (over 50% decline relative to 1983). These sudden changes in cultivated area are difficult to explain. The areas under wheat and potatoes also show similar trends. The area under millet declined by almost half between 1975-1989. The area under oilseeds shows the least change (see the coefficient of variation) over time. The area under potatoes increased very rapidly almost seven-fold over the period.

In order to project the areas under different crops, a semilog time trend equation was fitted to historical data (1980/81-89/90) obtained from DFAMS. The semilog function was selected to reflect the fact that land is an inelastic input and that growth in crop area over time has to decline, and the historical data also exhibited a semilog trend. The equations fitted are presented in Table 3.2.

Crop Yield

There does not appear to be a consistent trend in the yield pattern of crops over time. Data on the yield rates for the six crops are given in Charts 3.1, and Table 3.3. The trends in crop yields are difficult to explain. While weather plays a crucial role in productivity in any given year, there is little doubt that improving irrigation facilities could reduce dependency on weather (seasonal rainfall) and increase productivity. However, it is difficult to relate the erratic trend to the weather alone. If the observed trends are the outcome of policies, there is scope for formulating appropriate policies. But such a relationship has so far not been established. One plausible explanation for this could be reporting errors, but this point also remains to be validated.

According to yield data given in Table 3.3, yield rates have remained either constant or declined over the years. The food situation in the district, which is believed to be getting worse, supports this declining yield trend. For the last three years, yields have been increasing. However, this does not provide an adequate basis for assuming that yields in Kabhre will continue to increase in this manner, given the technology practised in this district.

Fertiliser Use

The actual use of fertilisers by households on different crops in Kabhre is not known. Information on fertiliser sales reported by the Agricultural Inputs' Corporation (AIC) for Kabhre is given in Table 3.4. The results indicates a very erratic trend. This erratic trend could be the result of a relatively lower fertiliser quota provided to the district in years when imports were low. The average sale per hectare of cropped area (six crops) is also given in Table 3.4. The sale rates per hectare of cropped area are very high, and this is hard to justify unless large quantities of fertilisers are being used on other secondary crops. The sale rates presented are much higher than the rates reported in the Irrigation Master Plan (1980) for the Eastern Stratum which are 19kg/ha for paddy, 17kg/ha for maize, 24kg/ha for wheat, 14 kg/ha for potatoes, and 10 kg/ha for oilseeds. This rate deviates substantially from the per ha sale rate and cannot be explained easily.

Livestock

Information on the livestock sector is available from 1984 only. Livestock numbers and production of meat and milk from different types of livestock are given in Table 3.5 (DFAMS). In general, the existing livestock population for all major categories of livestock appears to be very large. The reasons for this are not very obvious.

Only a small percentage of the total buffalo population provides milk. The amount of buffalo meat production is also small. Buffaloes are not used for ploughing. It is also unlikely that households keep unproductive buffaloes for manure, given the large quantities of fodder required by these animals. Regarding the cattle population, the large number is perhaps due to religious factors. In general, the large number of all types of livestock in the district is hard to justify, given the extremely low levels of meat and milk outputs. This factor emphasises the need for

policy interventions to reduce the livestock population and increase its productivity. The large, minimally productive livestock population in the district has negative impacts on the carrying capacity of available natural resources.

Land Use Changes

The forestry sector is an integral part of the overall land use and agricultural systems in the district. The basic source of information is LRMP 1986, which dates back to 1978. The forestry information from 1978 to 1990 was updated by using the various assumptions given in Chapter 2.

Generally, forest lands are encroached on by the people to meet various needs that can be met by forests. This results in gradual deterioration of forest lands. Forest lands can also be converted into agricultural land if the topography permits. Slash and burn agriculture is not common in the districts of Bagmati Zone, although it is found in small pockets.

The Forestry Master Plan (FMP) classifies forests by accessibility. The forest accessibility factor varies by region. In the Siwaliks, all forests in Kabhre are assumed to be accessible whereas, in the mid-mountains, the accessibility factor for Kabhre is 94 per cent. Thus, only accessible forests are assumed to be used by households to meet firewood, fodder, timber, and grazing needs. Deforestation is, therefore, assumed to be concentrated mainly in accessible forests.

LRMP reports the composition of natural forests by types of species, crown cover, and maturity class for the different regions (Table 3.6). In the absence of time-

series' data on the changes in forest area by crown density and species, it was assumed that the distribution of species and density class of forests change as a result of the changes in accessible forests, which are assumed to decline at one per cent per annum (Chapter 2). Table 3.7 presents the projected accessible forest area by species, crown density, maturity class in the Siwaliks, and the mountainous regions of Kabhre for the 1978-1990 period.

In order to project the fuelwood supply from different species and density classes of forests, adjustment factors reported in WECS (1987) were used. Fuelwood yield rates from different species and classes of forest are based on 100 per cent crown density. Tables 3.8 provides information on the land use over time in the Siwaliks and mid-mountains respectively from 1978-1990. The changes in land use time in the Siwaliks and mid-mountains of Kabhre indicate a decline in forest area and marginal increase in other types of land uses. It must be noted that non-cultivated inclusions (NCI) within the gross settlement areas are assumed to remain constant. Over time, the residual category increases. Table 3.10 provides information on the total land use changes in the district as a whole.

Prices

Time-series' data on prices are not separately available for all the districts of Nepal and only retail level prices are reported. Produce price information is not available. Information on crop prices reported in DFAMS was used. Food grain (paddy, maize, wheat, millet, potato, oilseeds) and livestock products (mutton, chicken, buff, pork, and milk) prices were projected by using the time-series national average data (1975-1989) reported by DFAMS. Several functional forms were fitted to the historical data and it was found that the national price trend for all crops showed an exponential pattern of growth over time. Hence, exponential time trend equations were fitted. The estimated results are presented in Table 3.11. The results indicate that the prices of all agricultural commodities have been increasing over time. The times are all statistically significant and over 80 per cent of the variation in the prices of these commodities is explained by time as indicated by R^2.

Economic and Natural Resource Conditions: Baseline Scenario

Various sectors have been linked in the multi-market model framework discussed in Chapter 2 to evaluate the economic and natural resource sectors of the district in order to generate the baseline results. The baseline results are important as it is against these results that policy impacts will be evaluated when shocks are given to the model.

Prices

Ramechhap district prices were used to calibrate the prices of Kabhre. This is presented in Table 3.12. The growth rates of prices calculated by using the end points are given in the last column of Table 3.12. Among the food grains considered, millet and paddy have the highest growth rates. Wheat price is forecasted to have the lowest growth. The aggregate cereal grain price has a growth rate of about 7.4 per cent. Aggregate meat and oil and fat prices are also given in Table 3.12, and it can be observed that the aggregate meat price has the highest growth (11 per cent) among the food commodities.

Crop Area and Yield

Table 3.13 provides results of the area forecasted for different crops and Table 3.14 provides the respective crop yield projections based on the assumption of non-constant crop prices and variable inputs. Area growth follows a time trend based on historic data series.

The growth rates forecasted for crop area over time indicate almost negligible growth. The highest positive growth rate is for paddy (1.4 per cent) and the lowest is for oilseeds. The millet area is seen to decline over time. The changes in the area under irrigation, which was assumed to grow at two per cent per annum, are also presented in Table 3.13. Fertiliser sales are expected to grow at about three per cent per annum based on fertiliser sales in the district over the past years.

Table 3.14 provides future yield trends of the six crops in Kabhre on the basis of past trends. Forecasting was based on the assumption that crop technology would remain the same over time. This is another area where policies could influence yields changes. The forecasted crop yields are not encouraging. All the crops considered show a stagnant or even negative yield trend over time.

The results indicate that, over time, Kabhre faces a declining trend in the foodgrain output under the existing state of technology. The declining trend in the crop yields of major foodgrains, such as paddy and maize, has important implications for the economic future of the district.

Crop Production

According to the model, crop output or production is determined by the area and yield outcome. The resulting growth in the production (Table 3.15) of different crops is positive except in the case of millet. The moderate positive growth observed in the production of other crops is due to the marginal increase in area over time.

Gross Margin

Gross margins were calculated for each crop considered. Table 3.16 presents the total gross margin and cost of cultivation per hectare of cultivated crops. All crops registered positive gross margins. Oilseed gross margin has the highest growth rate despite the fact that its area and yield have remained almost stagnant over time. The increases in gross margins reported in Table 3.16 are primarily the result of an increase in the nominal crop prices over time. Potatoes, however, have the highest per hectare gross margin in Kabhre, followed by oilseeds and paddy. The per hectare gross margin for millet is the lowest, but its growth rate is the highest (16.8%) among the crops. After millet, maize and wheat have the lowest per hectare gross margins.

The results reported in Table 3.16 indicate that, over time, if only gross margins are considered, wheat and millet could gradually be replaced by other more promising crops. However, such substitution cannot take place if people do not grow sufficient food nor have access to food. Thus, despite low per hectare returns, cultivation of staple food crops (paddy, maize, and wheat) is likely to continue. The gross margins calculated for paddy, wheat, maize, and millet also include the value of crop residue.

Livestock

The results indicate that the average annual growth in LSU in the district is less than one per cent (Table 3.17). The average LSU holding per household declines over time, because the number of households increases at a faster rate than LSU over time.

According to the results derived from the model, deficit supply of bulllock days exists in the district and this will increase in the course of time from 579 pairdays in 1992 to 726 pairdays in 1998. This deficit could be the result of the number of working days (219) assumed for bullocks. If the number was increased marginally, the deficit situation could change. This indicates that the availability of bullock pairdays in the district is perhaps not a production constraining factor.

Trend equations were fitted to the livestock product data series and the results were linked to the forecasted livestock population to project livestock products for Kabhre. The average annual increases in different types of livestock products are given in Table 3.18. Ghee and milk production show the same rate of growth because the ghee output is based on milk production. The growth rates for pork and chicken meat production are also the same. These two products are not linked to the land use sector. Simple time trends were used to forecast the future chicken and pig populations. Gross margin analysis indicates that the average increase in

LSU cost over time is about seven per cent, whereas the average annual increase in per LSU gross margin is about 11 per cent (Table 3.19).

Food Availability and Demand

By assuming different waste, loss, and seed allowance factors, the total cereal availability in the district was derived from the total production of the four cereal grains (rice, wheat, maize, and millet). The per capita availability/supply was then derived. A similar exercise was carried out to obtain the per capita domestic (district) supplies of meat (mutton, buffalo, pork, and chicken), oils and fat (derived from oilseed production and ghee), vegetables (assumed to be potatoes only), and milk. Tables 3.20, 3.21, and 3.22 provide estimates of the forecasted food supply/availability, demand in per capita terms, and aggregate food balance for the district.

The almost constant or even declining crop yield rates and increasing population have resulted in deteriorating food balance over time in Kabhre (Table 3.22). The per capita supply of cereal grains currently exceed demand resulting in net surplus, but this surplus has declined rapidly at about 1.2 per cent per annum. Milk, oil, and fat supply already suffers from deficit. Vegetables (potato) are also surplus, but this has also declined slightly over time. The milk deficit problem appears to have improved over time but enough for surplus supplies to be generated.

Land Use

Table 3.23 provides details on the changes in land use over time in Kabhre. It indicates that land use changes are small. The share of forest area declines one per cent annually. Some gains are made by adjacent NCI, shrub and grasslands, and cultivated area. Other land use categories tend to remain unchanged over time based on the assumptions of the model.

The cultivated area given in Table 3.13 and 3.10 appears to vary by a small amount. This discrepancy in the two figures is because the net cultivated area of the district could not be obtained from the data collected by DFAMS.

Forest Products

Fuelwood

The demand for fuelwood exerts the maximum pressure on forests. Fuelwood is assumed to come from different sources, i.e., accessible forests, farmland, and non-cultivated inclusions. Yield rates from these sources vary and they are based on density and maturity classes. Table 3.24 provides estimates of fuelwood supply in Kabhre from different sources. Accessible forests are the primary source of

fuelwood in the district and will continue to be so for a long time in the future. However, its share declined marginally over time. Adjacent non-cultivated inclusions, are the second important source of fuelwood for households in Kabhre. These two sources account for over 95 per cent of the fuelwood supply in the district and will continue to remain important sources in the future. The forecasted supply of fuelwood from different sources is given in Table 3.25. The per.capita demand for fuelwood is assumed to remain constant over time. The district faces increasing shortages under the present fuelwood harvesting system.

Timber

Table 3.26 shows the changes in timber supply and timber demand in Kabhre over time. Timber deficit is already a serious problem. In 1991 only about 66 per cent of the demand was met from the present district sources, and this has gradually declined over time.

Fodder

Fodder is supplied from various sources as highlighted in Table 3.27. Forests are not the most important source of fodder, as they contribute only about 13 per cent at present and this share may decline over time. Adjacent NCI, shrublands, and others (risers and bunds, plantation, fallow grazing) are the more important sources of fodder. Grasslands make a very small contribution to fodder supply in the district. Fodder supply from all these sources currently meets only about 73 per cent of the requirements (Table 3.28).

Labour Supply and Use

Labour supply is determined by the size of the active population. Household labour is needed for crop production, livestock raising, and other activities. An active person is assumed to have at his/her disposal 240 working days. The Multipurpose Household Budget Survey of Nepal Rastra Bank (M-NRB) has collected data on the percentage of the population engaged in other activities for the hill region of Nepal. It was assumed that persons were engaged in other activities 240 working days per annum.The number of persons engaged in other activities (Table 3.29) was multiplied by the number of working days in a year to provide an estimate of employment in other sectors. The results are presented in Table 3.30. Labour use as a percentage of availability declines marginally over time as indicated by the "Labour Use" in Table 3.30. Subsistence activities were not taken into account in the present exercise, nor were the labour force participation rates, both of which could reduce the percentage of unutilised labour.

Trade

The amount of imports into the district are not known. However, the Multipurpose Household Budget Survey provides information on the average monthly household expenditure on non-food items originating from domestic sources, India, and Rest of the World (ROW). The results are for 1984, i.e., the year the survey was conducted. The important values were aggregated allowing for inflation, then updated to 1991 (base year). It is important to emphasise that the growth in import demand is driven by the growth in income and the growth in population. The results are presented in Table 3.31. The average rate of growth in non-food demand is about one per cent annually and is solely determined endogenously. The per capita value of non-food imported in 1992 was Rs 895 and it had increased to Rs 906 by 1998 at a growth rate of less than one per cent.

Value of food imports is also presented in Table 3.31. Food imports are derived from the excess food demand determined from the model. The demand for food imports is the difference in domestic supplies (district) and domestic demand. Negative values indicate imports and positive values indicate exports. The value of food imports, including cereals, meat, milk, vegetables, and oils and fat, was multiplied by the aggregate price of cereals and other respective food prices. The value of per capita food imports has increased over time by about 10.9 per cent in nominal terms. In real terms, this growth is between two and three per cent per annum.

Income

Income is also determined endogenously by the model. Each year the gross margins originating from the crop and livestock sectors and income accruing from other employment activities were aggregated to derive the total income for the district. Table 3.32 presents the incomes originating from different sources and Table 3.33 provides the income shares from different sources. The income share of the crop sector has remained more or less constant over time, but that of the livestock sector has improved over time. The income share from other off-farm activities has declined over time. The income shares of the crop and livestock sectors together account for over 90 per cent of the income in Kabhre.

Nominal income (given in Table 3.32) is converted into real income by dividing the nominal income by the agricultural GDP deflator. The per capita nominal income growth rate is 8.8 per cent per annum, while the growth rate in real per capita income is 1.6 per cent per annum (Table 3.34)

Environment: Sustainability and Carrying Capacity

The performance of the district in terms of some selected sustainability indicators can be judged from the results presented in Table 3. 35. In the hill farming systems,

forests are an important source of fodder required by livestock, which in turn, provide nutrients (manure). In addition, forests also provide fuelwood and timber to households. Besides these three resources, forests also provide leaf litter as a nutrient supplement to the fields. As the accessible forest cover declines over time, the supply of fodder and leaf litter also declines, and this has a negative impact on agricultural productivity. The forest-cultivated land ratio in a district, therefore, provides an idea of the amount of forest resources that can be harvested sustainably to meet household needs.

Wyatt-Smith (APROSC 1982) in his study estimates that 3,5 hectares of accessible, unmanaged forest are required to support one hectare of agricultural land in the hill farming system. Wyatt-Smith further broke down the three forest resources (fodder, fuelwood, and timber) needed to support one hectare of agricultural land. One hectare of agricultural land requires 2.8, 0.24 to 0.48, and 0.32 ha of unmanaged accessible forest in order to meet fodder, fuelwood, and other needs respectively.

The accessible forest-cultivated land ratio in Kabhre is currently 0.92 hectares, which is very low compared to the Wyatt-Smith estimate of 3.5 hectares. If it is assumed that 3.5 hectares of forest land are required to support one hectare of agricultural land in order to make the hill farming system sustainable, then the derived ratio for Kabhre is alarming and, furthermore, this ratio shows a declining trend by 3.8 per cent (Table 3.35) over time.

The ratio of shrubland to accessible forest land is another indicator that partially indicates the extent of forest degradation. When degradation takes place, forests are converted into shrubland. The shrubland-forest ratio in Kabhre is estimated to be 1.148 at present, indicating that the area under shrubland far exceeds the area under forests and this ratio increases over time at an annual rate of 3.7 per cent. Other results are presented in Table 3.35.

The population of the district continues to grow over time. Table 3.36 presents the size and growth of the population. Despite the low growth of about 0.7 per cent, the growth of the economically active population is about one per cent. Already, the labour use situation indicates that only about 67 per cent of the available labour days are being used.

Currently, the bulk of the employment generated in the district is in the agriculture and livestock sectors. According to the results derived from the model, the agricultural area has not increased sufficiently to utilise the expanding labour force. Bringing new areas under cultivation would mean that more poor quality forest areas would have to be used. This option may not be sustainable, given the already difficult situation in the forestry sector. It is possible, however, that the adjacent NCIs, which occupy vast tracts of land in the district, could be used for agriculture. But the use of such lands would not result in the generation of sufficient

employment opportunities to absorb all the new entrants into the labour force as there would not be enough land in the first place, even if financial and technical constraints were not the limiting factors.

It could be argued that employment could be generated in the livestock sector. Under the current trend scenario, this also does not appear to be a viable alternative. The livestock carrying capacity is already poor (examined below). What appears to be essential in the livestock sector is the reduction in numbers of animals and an increase in their productivity. In this situation, more labourers are likely to be displaced. If a district's sustainability is viewed in terms of labour use, Kabhre clearly faces major problems.

Implications for Food

Table 3.37 provides the calorie demand and availability for Kabhre over time. Under the current trend scenario, the calorie supply will have decreased marginally from 4,006,000 calories per ha in 1991 to 3,962,000 calories per ha in 1998, primarily due to a decrease in crop yields. On the other hand, the calorie demand per ha will have increased from 4,382,000 in 1991 to 4,257,000 calories per ha in 1998.

Assuming that 2,410 kilo-calories are required by an adult, the existing carrying capacity of one hectare of cropped area can also be calculated (Table 3.37). The present supply of calories per hectare could support 5.54 adult persons in 1991, and this has declined marginally over time. On the other hand, given an adult's calorie requirements (2,410), the load on one hectare of land is 6.06 adult persons. This load, however, is seen to remain almost constant over time. The existing situation indicates that about 91 per cent of Kabhre's food needs can be met by its own production system. Although the situation appears to have improved marginally over time, it will never be sufficient to meet all of Kabhre's requirements.

It is worth noting that access to calories may in fact be less than are available. Access to food is determined by income and relative prices. Table 3.21 provides the food demand results, which indicates that the calorie intake is less than is available. Even though there is a large supply of food, income and relative prices constrain people from meeting the requirements of 2,410 calories per day.

Implications for Fuelwood

The fuelwood situation in the district can be assumed from the results given in Table 3.38. The supply per ha decreases marginally over time as accessible forests decrease. The pressure on forest land increases due to population growth. It can be observed that the present demand for forest biomass is already higher than the present supply. This pattern will continue to deteriorate over time. The supply at

present meets only 88 per cent of the demand, by the year 1998, the supply will meet only 85 per cent of the requirements. The carrying capacity remains fairly constant or even declines over time, while the load factor increases marginally. Clearly, the fuelwood situation in Kabhre is very distressing.

Implications for Fodder

Under the current pattern of land use changes and growth in livestock population, land capacity cannot satisfactorily support the livestock population. Currently, the livestock population (expressed in terms of LSU) that can be supported by one hectare of land is about 1.19 LSU, whereas the current load factor is 1.63 LSU per hectare in 1991 (Table 3.39). This indicates that the livestock carrying capacity in Kabhre is unsustainable.

Conclusion

Under the current state of technology and infrastructure, the ability of the district to sustain the ever-increasing human and livestock populations, given the declining trend in crop yields and the limited scope for expanding agricultural land, on the one hand, and the rapid growth of the population, on the other, the magnitude of food deficit will continue to grow at an even more alarming rate in the foreseeable future. The food shortage will have to be met through imports. However, the lack of purchasing power will be a constraint, largely due to the limited economic activities outside the agricultural sector.

The implication of the poor state of agriculture for the environment (forests) is even more alarming, given the combined effects of the ever-increasing demands for fuelwood fodder, timber, and food. Both the areas under accessible forest as well as their quality (densitv) are declining, while the demand for forest products is increasing. As a result, the gap between forest products is widening over time. This growing deficit in biomass supply will have to be met largely through further deforestation, unless immediate action is taken to replenish the forest stock.

The economy of Kabhre, being heavily dependent on the traditional sectors (agriculture, forest, and livestock), has limited potential to generate employment. Already a large percentage of the active population appears to be underemployed. Limited scope exists to generate additional employment opportunities in these sectors, unless new technologies, that can efficiently utilise the increasing pool of redundant labour in the district are introduced. This is obviously a prerequisite for the economic and environmental development of the district. Can some solutions for greater utilisation of the labour force be found by improving natural resource conditions, particularly by rehabilitating degraded lands? Can expansion in basic infrastructure, e.g., roads and irrigation, provide greater opportunities for gainful employment? Will the provision of better services help in promoting self-

employment? These are important questions for which answers must be found if the economic and environmental conditions of the district are to improve over time.

Policy Scenarios And Impact Analysis

Some of the policies discussed in Chapter Two are examined in this section within the framework of the simulation model.

Crop Sector: Policy Scenarios and Impacts

Impact of Food Sector

The unavailability of and accessibility to food are perhaps the most critical aspects of poverty in the context of Kabhre district. Food production activities are strongly interrelated with the natural resources' sector and the interaction between food production and use of natural resources has both positive and negative impacts on many aspects of the economy as well as the environment. It should be noted that, in the absence of an extensive wage economy, large parts of which are operating as isolated pockets, sufficient food production appears to be a major short-term priority even if the comparative advantage of the district lies in other activities. Therefore, it is important in the context of integrated economic and environmental development that district level food production grows at a healthy rate.

The baseline conditions indicate that food demand in Kabhre is not fully met by internal production. Given the present trends, this situation may not improve over time. In fact it may even degenerate to some extent. Therefore, it is important to identify the possible measures that would have a positive impact on the food supply situation in the district.

It has been pointed out that there is potential for almost doubling the extent of irrigated area in the district. This implies increasing the area under irrigation from the current level of 4,076 ha to 7, 958 ha. If this is undertaken without considering its economic feasibility at the moment and merely seeing it as a policy option, this intervention would have an immediate effect on improving food production, emphasising the importance of irrigation development and the management of water resources for this purpose. Therefore, it is a very desirable policy from the point of the view of food supply, provided it is also economically feasible to develop the irrigation potential.

Supposing that the present level of fertiliser use in the district is increased by 25 per cent, this would have a favourable impact on crop output. The emerging changes would not be as effective as the irrigation policy in terms of raising the food supply immediately, but the long-term growth (1993-1998) appears to be better than in the case of the irrigation policy (Chart 3.4). If the irrigation and fertiliser policies are

introduced simultaneously, the impact on food supply would be even greater (Table 3.40).

A fourth policy option considered was to introduce potato crops in the additional irrigated area. The introduction of potatoes (a proxy for cash crops) would have greatest impact on the food supply situation of the district (Chart 3.4). Food availability in the district exceeds the requirement by over 30 per cent compared to the baseline scenario.

The cropping intensity impact, resulting from the proceeding policy, would be as follows. If the additional area is brought under irrigation, the cropping intensity of the district would increase by about seven per cent. It should be realised that the cropping intensity impact of irrigation will be seen during the non-potato growing season as well, hence the net result (cropping intensity impact) will be even more pronounced than the seven per cent increase. The cropping intensity impact will also have positive effects on the district labour use situation as examined below.

Maize is one of the most important crops cultivated in Kabhre, both in terms of area as well as its share in the total food production. What would happen if the maize price was allowed to increase and decrease by 10 per cent? The results are given in Table 3.40. Increasing (decreasing) the maize price for 1993 by 10 per cent has a positive (negative) effect on supply response, but the effect is not so pronounced as to require the advocacy of a price intervention strategy. As a price intervention programme cannot be made specifically for Kabhre alone and the effects of such a programme on other maize-producing areas are not known, advocacy of a price-based policy is difficult to recommend without further analysis.

Chart 3.4

Impacts of Different Policies on Food Availability Situation

Impact on Labour Use

In view of the extremely limited options for enhancing use in non-agricultural sectors and also in view of the poor database, labour use was reviewed only on the basis of changes in the agricultural sector, which is obviously the most important sector in the district. Under the baseline scenario, the labour use situation in Kabhre indicates labour surplus. The effects of different policy actions on the labour use situation are given in Table 3.41 (Chart 3.5). It should be realised that the labour use situation in the district has been determined on the basis of per hectare labour use rates of different crops, labour use per LSU, and labour use in other sectors based upon a fixed proportion of the population. This design indicates that the labour use situation will change only where population changes (negative) and when cropped area and LSU holdings change. As a result, the labour use situation under the different policy options given in Table 3.41 does not reflect much change except in the case of the combined irrigation, fertiliser, and potato policies. Under this policy option, the increased area under potatoes also requires more labour, thereby increasing labour rate.

Given the limited economic activities, it is difficult to increase the overall labour use rate, except by increasing the cropping intensity. Comparing the 3,891 hectares (i.e., additional irrigated area) in relation to the district's overall cultivated area of 35,972 ha in 1993, the cropping intensity increases by seven per cent. Stated differently, increasing the cropping intensity by about 553 ha increases the labour use by one per cent. This implies that there is some scope for increasing the labour use rate by increasing the cropping intensity. If cropping intensity in Kabhre is increased by, say, 25 per cent from the 1993 baseline value, the labour use rate can be increased by about 16 per cent. It is possible to increase cropping intensity in the district, and thus not only have a direct impact on labour use but also on food and income as well.

Impact on Income

Next, the impacts of the different policies on the per capita income and income share of different sources were examined. Both nominal and real incomes were considered. Since only the food sector and price policies have a noticeable impact on the per capita incomes, hence, only these issues are discussed. The results are given in Tables 3.42 and 3.43 (see Charts 3.6 and 3.7 also).

In the baseline scenario, the real and nominal per capita incomes in Kabhre grow at about two and nine per cent respectively. Under different policy regimes, the growth in real income does not change very much as indicated by the long-term growth rates. However, policies have noticeable effects on the per capita incomes relative to the baseline values. For example, under the irrigation policy, the real per

capita income in 1993 increased from the baseline value of Rs 1,914 to Rs 2,042, i.e., an increase of about seven per cent. The greatest impact on the per capita real income was exerted by the combined irrigation, fertiliser, and potato policy action - a 33 per cent increase relative to the baseline value. The effects of the different policy actions on per capita incomes indicate that policies play an important role in increasing the magnitude of per capita incomes. The fertiliser policy, despite its lower impact on the real per capita income in the short-term, has a higher long-term growth of about 2.14 per cent. Charts 3.6 and 3.7 graphically illustrate these results. The contributions of different sources to the total income under the different policy scenarios are given in Table 3.43 and Chart 3.8. The results are self-evident.

Natural Resources: Policy Scenarios and Impacts

Many aspects of natural resources are still not well understood and a greater problem is the lack of adequate information. In this discussion, some of the important aspects that could be quantified and integrated into the model are examined.

Different policies considered in the natural resources' sector include the curtailment of fuelwood demand, improved forest management (supply side), and a combination of these two policies. The other policies, namely, irrigation, fertiliser, and others do not have a perceptible impact on natural resources, hence, they are not examined here. It should also be pointed out that, although on the demand and supply side fuelwood is emphasised, changes in forests also affect the timber and

fodder supply and demand. The impact of these policies on the demand and supply of forest products is given in Table 3.44.

Impact on Fuelwood

Fuelwood deficit is the major source of pressure on the natural resource base resulting in the depletion of growing stock and deforestation as forests are overexploited to meet the excess demand. Currently, about 85 per cent of the total fuelwood demand is met by various sources, namely, farmland, shrub and grazing lands, non-cultivated inclusions, and others. The supply situation, given the harvest and yield rates, will deteriorate over time, meeting only 80.7 per cent of the demand in 1998 (Chart 3.9). If the demand had been curtailed by 10 per cent the supply situation would have improved, and about 94 per cent of the fuelwood demand would have been met in 1993. The long-term performance of this demand policy, however, is not better than the baseline situation, indicated by the growth rate (Table 3.44).

The supply policy will have a much better effect on Kabhre's fuelwood situation over the years. As 50 per cent of the accessible forests come under management, the supply situation remains the same as in the baseline situation in 1993. By 1998, the situation will improve and about 86 per cent of the fuelwood needs will be met, compared to only 81 per cent for the same year in the baseline scenario. Although the net improvement in fuelwood balance under this policy is lower than under the demand policy, the former policy shows a positive trend in percentage balance over time compared to the negative trend under the demand policy. From this perspective, the supply policy will have a more desirable effect in the long run, because incremental fuelwood yield under improved management will increase annually at a faster rate than in the previous year, adding to the stock.

Under the demand policy, the curtailment in demand will bring about change, but as the population continues to grow and the stocking rates of forest do not improve, the supply position of forests will gradually deteriorate over time as indicated by the negative value of the long-term growth rate (-0.8%), and this is similar to the situation under the baseline scenario. On the other hand, under the supply policy, improved management will result in increased stocking rate, and also yield rates. Without compromising demand, Kabhre's population will be able to consume more fuelwood under this management policy than under the baseline scenario within a few years after the policy is introduced, and, at the same time, the long-term sustainability of the forests will increased. The effects of the third policy are more pronounced as can be noticed in Table 3.44. The fuelwood balance situation will improve and the long-term growth in balance will also increase at an annual rate of 0.3 per cent under the third policy.

Impact on Timber

Timber deficit in Kabhre is more pronounced than either fuelwood or fodder (Table 3.44). The annual deficit growth rate is three per cent per annum. The demand curtailment policy appears to be more effective than the supply policy in meeting timber needs. Under the demand policy, as the demand for fuelwood decreases, less forest land will be used to meet fuelwood needs. This land can then be used to meet part of the excess timber demand, resulting in improved timber balance under the demand policy. The supply policy will also affect timber supply, but the effects will be apparent only after 15 years or so, i.e., not within the time-frame of this analysis. The combined effects of the joint demand and supply policy will have a more profound effect on timber balance as may be noticed in Table 3.44 (Chart 3.10).

Impact on Fodder

The curtailment in fuelwood demand has no direct impact on the fodder balance situation, as indicated by the percentage balance under this option and the baseline scenario. As with fuelwood, the effect of the improved forest management policy on fodder balance is much stronger than changes in the demand policy. The effect of improved management of forests on the fodder balance is marginal. The supply of fodder as a percentage of the total fodder demand will increase from 73.2 per cent under the base situation to 74.5 per cent in 1993 under the improved management policy, and this proportion increases at a marginal rate (0.2%) in both scenarios. A similar case can be observed in the case of the joint demand and supply, policy regarding the fodder balance situation (Chart 3.11).

It is important to emphasise that the extent to which improved forest management will result in an improvement in the resource balance situation, particularly fuelwood and fodder, depends very much on the relative share of forests in the supply of these products. Since the share of forests in the total supply of fodder is only 13 per cent, it is quite obvious that the impacts of the forest management policy, as well as the combined policy regarding the fodder balance situation, are not very strong.

What emerges clearly from this discussion is that the time has come to start considering other neglected land resources apart from forests, even for fuelwood and fodder supply. Other land resources include marginal agricultural lands, shrublands, grasslands, and non-cultivated inclusions. Information on these types of land is so poor that it is not possible to consider improvement options for them.

However, given their already significant roles, greater attention should be paid to improved management. It might also be feasible to start commercial production of fuelwood and fodder on these lands. They can provide an important source of income and employment for poorer groups, if they are scientifically managed, in order to support economic and environmental objectives.

Environment and Carrying Capacity

The environmental quality is assumed to depend on the forces that interact in the food, natural resource, and other sectors. It is viewed in terms of the carrying capacity of a hectare of agricultural and other lands to meet food and natural resource demands. In addition, the changing relative pressure on land use will also be examined. Only those policies that had some noticeable impacts will be considered.

Pressure on the Resource Base

The impacts of different policy alternatives on some selected indicators of sustainability, such as changing pressure on the natural resource base, forest-cultivated land ratio, and deforestation, can be judged from the simulation results presented in Table 3.45.

Under the current trend of population growth, the increasing pressure on the natural resource base and the environment, as seen primarily from natural resource deficits (particularly fuelwood), leads to deforestation and land use changes. The results indicate that the population density per cultivated land area remains unaffected by all types of policy intervention carried out in the present exercise. The existing pressure on cultivated land under the baseline scenario, however, declines at a marginal rate over time because cultivated land will increase at a slightly faster rate (1.2%) than the population growth (0.7%). This is also the reason why per capita land increases marginally over the projected period.

Assuming that 0.7 per cent per annum will remain as the population growth rate in the district, the pressure on accessible forest land will continue to grow over the projected period under all policy scenarios. But the population density per hectare of forest land is projected to grow at a relatively lower rate (1.8%) under demand-

induced changes than under supply- induced changes (3.1%). The joint introduction of both the policy scenarios results in an even lower growth in pressure on accessible forests. The positive growth trend of density per forest land area under both scenarios implies that population growth exceeds the growth in accessible area. Similarly, the lower growth of density per forest area under the demand reduction policy is primarily the result of a relatively lower magnitude of fuelwood deficit and, hence, reduction in the area deforested. It is also because of this reason that the livestock population pressure on forest land (LSU/ha) increases over time at a lower rate under demand-induced changes (1.2%) than under supply-induced changes (2.5%). It should be noted that the livestock population density per unit of forest area increases at an annual growth rate of about three per cent under the baseline scenario. When both demand and supply management policies are introduced jointly, the livestock pressure on forests is expected to grow marginally at less than one per cent annually.

The livestock density per unit of grazing land (LSU/ha) is projected to decline over time at the rate of 2.1 per cent per annum, despite the current excessive pressure level on grassland. The impacts of both demand management and improved forest management on minimising the livestock pressure on grassland were not found to be strong as a result of the excessive livestock population.

Forest-Cultivated Land Ratio

Under the baseline scenario, the forest-cultivated land ratio in Kabhre shows a declining trend over time and is below the desired level. Under both the demand and supply side scenarios, the annual growth of cultivated land exceeds the

accessible forest area resulting in a declining trend in the forest-cultivated land ratio. But the rate of decline in this ratio is relatively lower (-2.2%) under demand-induced changes than under supply-induced changes (-3.5%).

Shrubland-Forest

This ratio is often used as an indicator of forest degradation because, as the intensity of use increases and regenerative capacity declines, forest and first changes to shrubland and eventually into other land use categories. Under the demand scenario, the ratio between shrubland and forest increases at a slower rate (1.5%) than under the supply scenario (3.3%), indicating that the conversion process of forest to shrubland (i.e., resource degradation) occurs at a slower rate under the former policy compared to the latter. If both policies are introduced jointly, the ratio will increase from 1.21 in 1993 to 1.28 by 1998 with an annual growth rate of one per cent.

Deforestation

As indicated earlier, natural resource deficit will exert increasing pressure on the natural resource base, leading to overexploitation and even more serious environmental damage. Table 3.46 presents the magnitude and trend of the deforested area estimated on the basis of a simulation exercise under different policy scenarios (Chart 3.12). Under the baseline scenario the extent of deforestation will increase from 552 hectares in 1993 to 679 hectares by the year 1998. With the introduction of the demand side policy intervention, the magnitude of deforestation reduces drastically compared to the baseline situation but the trend of deforestation continues to grow at a much faster rate (about 10% per annum) than the baseline trend (5.3%). When half of the existing forests are brought under improved management from 1993, time is required to improve the situation as incremental yield from improved forest management increases the forest stock over time, yielding a higher flow of resources. During the projected period of five years (1993-1998), the net improvement in fuelwood supply can meet only a small proportion of the fuelwood demand, and, over time, the growth rate of fuelwood supply increases at a faster rate than fuelwood demand. Hence, the deforestation trend gradually declines along with decline in fuelwood deficit.

Carrying Capacity

Food

Agricultural lands provide the required calories. The current levels of calorie supplies are dependent on the technology that characterises the sector. However, given the high dependency on the agricultural sector in the district, the pressure on land to supply more calories will increase over time. This will depend primarily on

the new policies that are adopted. On the demand side, increasing pressure will be exerted on land to supply additional calories to meet the demands of an expanding population. This issue can be viewed from two angles, namely, the supply of calories from one hectare of land and the demand from one hectare to meet the needs of the population. The same pressure also can be examined in terms of the carrying capacity of land and current load in terms of adults. The same kind of evaluation can be conducted in the case of fuelwood, timber, and fodder needs to LSU.

Table 3.47 presents the impacts of different policies on the carrying capacity of crop land and human pressure. Under the baseline scenario, the per hectare calorie supply situation is far below the per hectare need. The long-term growth indicates a scenario in which the supply situation remains stagnant, and in which the demand situation becomes marginally worse as Kabhre's population continues to grow. It should be noted that the calorie demand per hectare under the baseline scenario declines over time, a result that is explained by the fact that the population growth (0.7%) is slightly lower than the growth in cultivated areas (1%).

The food sector policies affect calorie supply only and the calorie demand per hectare remains the same over time as can be observed from Table 3.47. Under the irrigation policy, the per hectare calorie supply increases over time, and this will result in surplus calorie supply in Kabhre. The growth rate observed, however, is the same under the baseline scenario due to the reasons already discussed above. The long-term impact of the fertiliser policy is more pronounced than its short-term effect, since calorie supply under this policy scenario is lower than the per hectare demand. Under the combined policy the situation changes as discussed above, although under this policy scenario the per hectare demand also declines, thus reducing pressure on land to supply calories. This is the result of the increase in cropped area, i.e., the cropping intensity impact.

Each hectare of land can support a certain number of people in terms of their needs and for a given state of technology. On the other side of this picture is the number of people that depend on a hectare of cultivated area for calories. The load factor in all the policy scenarios given in Table 3.47 is the same except in the case of the combined irrigation, fertiliser, and potato policy. Under this policy, additional food supplies increase as a result of the cropping intensity effect, and this tends to reduce the pressure on agricultural land.

Fuelwood

Forest and other lands provide fuelwood. Currently under the baseline scenario, each hectare of land provides an average of 2.01 air dry tonnes (adt), but the per hectare demand is 2.37 adt. for 1993. The supply side picture deteriorates over

time as the demand increases. The results are provided in Table 3.48. As demand decreases as a result of policy interventions, the supply remains the same as under the baseline scenario in 1993. But, over time, the demand policy reduces pressure to a certain extent as indicated by the lower growth rate of -0.3 per cent.

If the management policy is introduced, the supply of fuelwood per hectare will increase at a growth rate of about half a per cent and the demand will remain at the baseline level, thus reducing the pressure on lands to supply fuelwood. Table 3.48 also presents the results of the human pressure on land to meet fuelwood needs. Under the baseline scenario, 3.41 persons' fuelwood demands can be met, whereas the same hectare of land has to bear a load of 4.03 persons currently. This gap widens over time under the baseline scenario.

The introduction of the demand policy reduces human pressure on land to 3.79 persons per hectare. The load factor does not appear to change in the year the policy is enacted, because the land that is saved from deforestation due to demand reduction is converted to forest lands the next year. As a result, the load factor will decrease in 1994 and by 1998 the load factor will drop to 4.14. The carrying capacity of land under the baseline scenario declines at an annual growth rate of 0.7 per cent, whereas the load on forest land increases annually by a little less than one per cent. With the introduction of the demand management policy, both the carrying capacity and load will increase, mainly due to the change in land area. The manner in which the demand policy affects the biomass supply through dynamic interaction has already been described earlier. However, it is worth mentioning that the drastic reduction in fuelwood deficit as a result of this demand policy will lead to increase in the accessible forest area as fewer forest areas are harvested to

meet the demand. In this way, the accessible forest area increases as deforestation declines over time. The decline in deforestation implies that fewer areas will be converted into other land resources and vice versa. Since other land resources dominate the forest area, the overall average growth of these land resources will be lower than the population growth, thereby resulting in a higher load factor. The carrying capacity of land under this policy will increase due to the net increase in accessible forests. When only forests are considered as the source of firewood, the effects of the different policy options are more pronounced. The results are given in Table 3.49. Without considering other land resources under the baseline scenario, forests currently provide 8.38 adt per hectare, whereas the demand pressure is 15.79 adt per hectare (Table 3.49).

Timber

Human pressure on forests and subsequent resource degradation are further compounded by the growing demand for timber (Table 3.50). Timber supply from forests currently meets only 62 per cent of the demand and the percentage balance declines sharply at an annual rate of three per cent. As the load factor increases at a faster rate than the carrying capacity, the scale of timber deficit widens over time. The impact of both supply and demand policy interventions reduces the per hectare timber demand (load factor) at a rate lower than the base line trend. But this reduction in demand pressure is seen to be stronger under the demand policy than under the supply policy. This is primarily the result of drastic reduction in fuelwood deficit under the former policy leading to less depletion of accessible forest areas. The combined impact of both policies will result in a slight improvement.

Fodder

Table 3.51 presents the impacts of different policies on the carrying of land in terms of fodder and livestock pressures. Under the baseline scenario, the estimated carrying capacity of the aggregate land area in Kabhre is only 1.2 livestock unit per hectare for 1993. This implies that the livestock load (or per hectare fodder demand) is about 37 times greater than the carrying capacity (or per hectare supply). Given the marginal increase in carrying capacity compared to load over time, the situation does not improve under the base scenario.

The impact of the supply management policy interventions on the carrying capacity of aggregate land is relatively better than the demand management policy. However, the projected load factor for 1998 under the supply side policy is still 33 per cent higher than the projected carrying capacity.

When only the carrying capacity of forest land is considered, 0.66 livestock units can be supported by one hectare of forest land with the load factor being roughly seven LSU/ha under the base scenario (Table 3.52). Since the share of forests in

the total fodder supply is less than 14 per cent, the drastic reduction in the carrying capacity of forests compared to the carrying capacity of aggregate land is natural. When half of the existing accessible forest areas in the middle mountains of Kabhre are brought under improved management, the carrying capacity of forests is expected to increase by 17 per cent, while the load factor is expected to decrease by two per cent compared to the baseline result in 1998. With the introduction of both demand and supply policies, the load factor (livestock density per hectare of forest land) will grow at a lower rate (0.9%) than the baseline trend (2.7% per annum)

Conclusion

Under the baseline scenario, Kabhre is unable to meet calorie and fuelwood requirements. The situation appears to be deteriorating rapidly despite the low population growth. Several different policies were simulated. In the food sector, the combined effects of irrigation and increased fertiliser usage had the strongest effect. Between irrigation and fertiliser use, the effect on productivity increase was found to be stronger in the case of irrigation. The irrigation policy not only has an impact on yields but also enhances cropping intensity in the district, thereby improving the district's labour use rates and incomes at a relatively better rate than the fertiliser policy. It was also found that the irrigation policy alone was sufficient to make Kabhre marginally surplus in food supplies.

In the natural resource sector, fuelwood and fodder supplies are currently less than the demand, with fodder registering a larger deficit than fuelwood. Currently (1993), less than 85 per cent of the fuelwood demand is being met and this situation is expected to decline to about 80 per cent by 1998. The fuelwood demand reduction policy tends to increase fuelwood supply but not to the extent that all fuelwood needs are met. This is so because, despite reduction in the fuelwood demand, supply will not increase and the population will ultimately catch up to widen the firewood deficit. If the forest management policy is considered, the situation will improve as forest supplies begin to increase. The long-terms prospects for Kabhre in term of fuelwood supply appear to be better, although, in the short-term (within 1998), the situation does not show much improvement relative to the baseline scenario. On the other hand, if the demand and supply policies are jointly implemented, the firewood situation in Kabhre will show a marked improvement.

Table 3.1: Area Under Different Crops (ha)

Year	Paddy	Maize	Millet	Wheat	Mustard	Potatoes
1975	5700	9800	2110	6400	600	450
1976	5810	9800	2046	6528	570	495
1977	6970	9310	1990	6400	560	750
1978	6980	9310	1990	6560	550	1010
1979	6980	9300	2000	6500	410	1100
1980	6950	9300	1930	6500	420	1000
1981	9600	22310	2100	6500	420	1000
1982	11620	22300	1100	8200	400	1840
1983	11620	22000	1100	7000	420	1500
1984	12120	10100	1470	7000	420	1600
1985	12620	22380	1200	8000	430	1500
1986	12500	22300	1100	14740	440	1520
1987	12650	22120	1120	14540	690	1550
1988	10700	22100	1000	14700	750	1630
1989	10100	22100	1150	14000	750	3000
Mean	9487	15888	1590	8541	506	1210
Std	2668	6332	447	3242	111	426
Coef Var	28	40	28	38	22	35

Source: DFAMS 1990

Table 3.2: Regression Results - Area under Different Crops

Paddy Area = 4125.76 + 2904.506 Ln (time)	$R^2 = 0.77$	(499.34)
Maize Area = 4980.21 + 6087.14 Ln (time)	$R^2 = 0.53$	(1586.7)
Wheat Area = 3399.41 + 2959.82 Ln (time)	$R_2 = .43$	(947.78)
Millet Area = 2477.154- 476.76 Ln (time)	$R^2 = .65$	(96.32)
Oilseed Area = 507.80 + 7.633 Ln (time)	$R^2 = .033$	(45.11)
Potato Area =121.655 + 649.485 Ln (time)	$R^2 = .65$	(131.48)

Note: figures in parentheses are standard errors of estimate

Table 3.3: Yield Rates of Different Crops (kg/ha)

Year	Paddy	Maize	Millet	Wheat	Mustard	Potatoes
1975	2767	1938	1175	1180	498	5500
1976	2768	1938	1188	1180	498	5499
1977	2768	1737	1251	1442	500	5493
1978	2765	1737	1251	1300	600	6000
1979	2350	1563	1305	1200	390	5500
1980	2306	1600	1098	1349	595	6486
1981	1880	1600	1100	1400	595	8000
1982	1900	1360	1200	1400	600	8000
1983	2000	1300	1000	1600	595	8000
1984	1529	1012	898	1200	595	7000
1985	1500	1358	792	1100	581	5000
1986	1712	1121	909	1100	614	5263
1987	2488	1350	1000	1300	536	9097
1988	3500	1516	1500	1400	626	9877
Mean	2302	1509	1119	1297	559	6765
Std	558	268	181	139	64	1517
Coef Var	24	18	16	11	11	22

Source: DFAMS 1990

Table 3.4: Fertiliser Sales in Kabhre (MT)

Year	MT	kg/ha
1985	6040	131
1986	6455	123
1987	8430	160
1988	8143	160
1989	8207	160
1990	10377*	na
1991	10721*	na
Mean Std	8339	
	1636	

Note: * Refers to sales based on time trend projection

Table 3.5 Livestock Population by Type of Livestock

	1984	1985	1986	1987	1988	Growth Rate(%)
Number of Buffaloes	59733	61650	63629	65140	65218	2.22
Meat Production (MT)	2261	2334	2408	2588	2591	3.46
Number of Milch Buffaloes	16122	16640	17174	17980	18771	3.88
Milk Production (MT)	14636	15106	15591	18339	19146	6.95
Number of Cattle	100665	101732	102810	102120	101099	0.11
Number of Milch Cows	11536	11658	11782	11328	11102	-0.95
Milk Production (MT)	5359	5416	5473	5911	5793	1.97
Number of Goats	153319	155879	158482	159085	162267	1.43
Goat Meat Production (MT)	473	481	489	491	501	1.45
Number of Sheep	2729	2833	2941	3086	3218	4.21
Mutton Production (MT)	7	7	8	8	8	3.39
Number of Chickens	55	58	61	62	64	3.86
Chicken Meat Production	145	152	159	176	186	6.42
Number of Pigs	5863	6175	6503	6585	6789	3.73
Pork Production (MT)	55	58	61	62	64	3.86

Source: DFAMS 1990

Table 3.6: Percentage Distribution of Natural Forests by Crown Cover, Maturity, and Species in Kabhre District, 1978

Category	Siwalik	Mid-mountains
Crown Cover		
Density 2	13.9	56.4
Density 3	86.1	39.9
Density 4	-	3.7
Maturity Class		
Reproductive	-	0.6
Immature	100.0	82.1
Mature	-	17.2
Species		
Coniferous	-	9.3
Hardwood	100.0	79.2
Mixed	-	11.5
Total Forest Area (ha)	2806	35,967

Source: LRMP 1986

Table 3.7: Changes in Accessible Forest Area in Kabhre by Species, Crown Cover, and Maturity Class (ha)

	1978	1979	1980	1982	1984	1986	1988	1990
Species								
Siwaliks:Hardwood (H)	2806	2778	2750	2695	2642	2589	2538	2487
Mid-mts.:Coniferous(C)	3141	3110	3079	3018	2958	2899	2841	2785
Mid-mts.:Hardwood	26770	26502	26237	25715	25203	24702	24210	23728
Mid-mts.:Mixed	3896	3858	3819	3743	3668	3595	3524	3454
Crown Cover								
Siwaliks:Density 2	390	386	382	375	367	360	353	346
Density 3	2416	2392	2368	2321	2275	2229	2185	2141
Mid-mts.:Density2	19082	18891	18702	18330	17965	17608	17257	16914
Mid-mts.:Density3	13480	13345	13211	12948	12691	12438	12191	11948
Mid-mts.:Density4	1248	1235	1223	1198	1175	1151	1128	1106
Maturity								
Siwaliks:Class I	2806	2778	2750	2695	2642	2589	2538	2487
Mid-mts.:Class R	203	201	199	195	191	187	183	180
Mid-mts.:Class I	27777	27500	27225	26683	26152	25632	25121	24622
Mid-mts.:Class M	5825	5767	5709	5596	5484	5375	5268	5163
Total Accessible Forest Area	36615	36249	35886	35172	34472	33786	33114	32455
Forest Area Adjusted to Density								
Siwaliks-Maturity I & H	1426	1412	1398	1370	1343	1316	1290	1264
Mid-mts. Adj to Density:	13245	13112	12981	12723	12470	12221	11978	11740
Coniferous	1231	1218	1206	1182	1159	1136	1113	1091
Hardwood	10487	10382	10278	10074	9873	9677	9484	9296
Mixed	1526	1511	1496	1466	1437	1409	1380	1353
Adjusted Forest Area	14671	14524	14379	14093	13812	13538	13268	13004

Source: Based on LRMP 1986 and WECS 1987

Table 3.8: Land Use Changes in the Siwaliks of Kabhre Over Time (ha)

	1978	1979	1980	1982	1984	1986	1988	1990
Natural Forests	2806	2778	2750	2695	2642	2589	2538	2487
Change in Accessible Forests		-28	-28	-27	-27	-26	-26	-25
Shrublands	45	59	73	100	127	153	179	204
Grasslands	5	9	13	22	30	38	45	53
Mapped Cultivated	1085	1093	1102	1118	1134	1150	1165	1181
Adjacent NCI	403	407	411	420	428	436	443	451
Gross Cultivated	682	686	690	699	707	715	722	730
NCI within Gross	106	106	106	106	106	106	106	106
Net Cultivated	576	580	584	593	601	609	616	624
Total Siwaliks (calculated)	3941	3940	3938	3935	3933	3930	3928	3925
Siwaliks Total Land	4026	4026	4026	4026	4026	4026	4026	4026

Source: Based on LRMP 1986 and WECS 1987

Table 3.9: Land Use changes in the Mid-mountains of Kabhre Over Time (ha)

	1978	1979	1980	1982	1984	1986	1988	1990
Natural Forests	35967	35629	35294	34635	33989	33355	32734	32126
Accessible (94%)	33809	33471	33136	32477	31831	31197	30576	29968
Deforestation		-338	-335	-328	-322	-315	-309	-303
Inaccessible	2158	2158	2158	2158	2158	2158	2158	2158
Tree Plantation	791	825	858	924	989	1052	1114	1175
Total Forested Area	36758	36454	36152	35559	34977	34407	33849	33301
Shrublands	34191	34360	34527	34857	35180	35497	35807	36112
Grasslands	3741	3792	3842	3941	4038	4133	4226	4317
Mapped Cultivated	60514	60599	60682	60847	61009	61167	61322	61474
Adjacent NCI	24754	24805	24855	24954	25051	25146	25239	25330
Gross Cultivated	35760	35794	35827	35893	35958	36021	36083	36144
NCI within Gross	6417	6417	6417	6417	6417	6417	6417	6417
Net Cultivated	29343	29377	29410	29476	29541	29604	29666	29727
Total Middle-mts. (calculated)	135204	135170	135137	135071	135006	134943	134881	134820
Middle-mountains	136459	136459	136459	136459	136459	136459	136459	136459

Source:Based on LRMP 1986 and WECS 1987

Table 3.10: Land Use Changes in Kabhre Over Time (ha)

	1978	1979	1980	1982	1984	1986	1988	1990
Forest Area	38773	38407	38044	37330	36630	35944	35272	34613
Shrubland Area	34236	34419	34600	34957	35307	35650	35987	36316
Grasslands	3746	3801	3855	3962	4067	4170	4271	4370
Adjacent NCI	25157	25212	25266	25373	25478	25581	25682	25781
NCI within gross	6523	6523	6523	6523	6523	6523	6523	6523
Net Cultivated	29919	29957	29995	30069	30141	30213	30283	30351
Plantation	791	825	858	924	989	1052	1114	1175
Kabhre (calculated)	139145	139144	139142	139139	139137	139134	139132	139129
Residual	1340	1341	1343	1346	1348	1351	1353	1356
Kabhre (given)	140485	140485	140485	140485	140485	140485	140485	140485

Source: Based on LRMP 1986 and WECS 1987

Table 3.11: Estimated Regression Equations for Prices of Agricultural Commodities

Ln Paddy = 0.533 + 0.0861 time (2.78) (9.42)	$R^2 = 0.85$
Ln Wheat = 0.8049 + 0.0641 time = (9.32) (7.22)	$R^2 = 0.76$
Ln Maize = 0.7653 + 0.0699 time (7.43) (8.18)	$R^2 = 0.81$
Ln Millet= 0.5218 + 0.0886 time (6.20) (9.71)	$R^2 = 0.85$
Ln Mustard seed = 1.166 + 0.1045 time (14.30) (11.79)	$R^2 = 0.89$
Ln Potatoes= 0.4598 + 0.0753 time (5.297) (9.92)	$R^2 = 0.86$
Ln Mutton= 2.3319 + 0.1068 time (61.75) (32.03)	$R^2 = 0.96$
Ln Chicken=2.6024 + 0.0933 time (50.53) (31.77)	$R^2 = 0.98$
Ln Buff = 1.533 + 0.1087 time (33.81) (29.04)	$R^2 = 0.98$
Ln Pork = 1.9702 + 0.092 time (66.26) (34.63)	$R^2 = 0.98$
Ln Milk = 0.8324 + 0.0852 time (23.45) (30.19)	$R^2 = 0.98$

Note: figures in parentheses are t values

Table 3.12: Forecasted Product and Factor Prices

Products and Factors (Rs/kg)	1991	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Products									
Paddy	6.76	7.36	8.03	8.75	9.54	10.39	11.33	12.35	0.090
Wheat	6.89	7.35	7.84	8.35	8.91	9.50	10.13	10.80	0.066
Maize	6.58	7.05	7.56	8.11	8.70	9.33	10.01	10.73	0.072
Millet	6.95	7.59	8.30	9.07	9.91	10.82	11.83	12.92	0.093
M.Seed	17.08	18.97	21.06	23.38	25.95	28.81	31.98	35.51	0.110
Potatoes	5.28	5.70	6.14	6.62	7.14	7.70	8.30	8.95	0.078
Mutton	56.87	63.28	70.41	78.34	87.17	97.00	107.93	120.10	0.113
Chicken	60.05	65.92	72.37	79.45	87.22	95.75	105.11	115.39	0.098
Buff	26.37	29.40	32.77	36.54	40.73	45.41	50.62	56.44	0.115
Pork	31.26	34.27	37.57	41.19	45.16	49.51	54.62	59.51	0.096
Milk (Rs/lit)	8.99	9.78	10.65	11.60	12.63	13.76	14.98	16.31	0.089
Price of Mustard Oil (Rs/lit)	59.91	66.37	73.53	81.45	90.23	99.96	110.74	122.68	0.108
Ghee (Rs/lit)	108.26	118.87	130.52	143.31	157.35	172.78	189.71	208.30	0.098
Wool	80.25	85.87	91.88	98.31	105.19	112.55	120.43	128.86	0.070
Price of Cereal Grains	6.70	7.20	7.73	8.31	8.93	9.59	10.31	11.08	0.074
Price of Oils and Fat	99.07	108.81	119.60	131.46	144.50	158.83	174.58	191.90	0.099
Aggregate Meat Price	43.40	48.18	53.49	59.36	65.88	73.10	81.10	89.96	0.110
Factors									
Wage Rate (Rs/day)	33.52	35.87	38.38	41.06	43.94	47.01	50.31	53.83	0.070
Bullocks (Rs/pair days)	26.82	28.69	30.70	32.85	35.15	37.61	40.24	43.06	0.070
Price of Fertiliser (Rs/kg)	4.28	4.58	4.90	5.24	5.61	6.00	6.42	6.87	0.070

Table 3.13: Forecasted Area Under Different Crops (ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Paddy	10569	10745	10911	11068	11217	11359	11494	11623	0.014
Maize	24344	24713	25061	25390	25703	26000	26283	26553	0.012
Millet	1095	1071	1047	1025	1003	983	964	945	-0.021
Wheat	14548	14727	14896	15056	15208	15353	15490	15622	0.010
Oilseeds	759	760	760	761	761	762	762	762	0.001
Potatoes	3084	3094	3121	3148	3173	3197	3220	3242	0.008
Total Cropped Area	54380	55109	55797	56448	57065	57653	58212	58747	0.011
Total Cultivated Land	34913	35458	35972	36458	36920	37358	37777	38176	0.013
Area under Irrigation	3909	3987	4067	4148	4231	4316	4402	4490	0.020
Total Fertiliser Sale in District	9674	10121	10525	10894	11235	11553	11852	12133	0.033

Table 3.14: Forecasted Yield Rates of Different Crops (kg/ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	1974	1972	1969	1967	1965	1964	1962	1961	-0.001
Maize	1464	1464	1464	1464	1463	1463	1463	1463	0.000
Wheat	1388	1346	1344	1342	1341	1340	1339	1338	-0.005
Millet	1023	1023	1023	1023	1023	1023	1023	1023	0.000
Oilseeds	596	601	601	600	600	600	600	600	0.001
Potatoes	7212	7216	7211	7207	7203	7200	7197	7196	0.000

Table 3.15: Forecasted Changes in Crop Production and Average Annual Growth Rates (MT)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	20867	21194	21488	21771	22042	22303	22549	22790	0.013
Maize	35638	36190	36689	37162	37612	38040	38445	38836	0.012
Wheat	20193	19825	20021	20212	20396	20574	20742	20907	0.005
Millet	1121	1096	1072	1049	1027	1006	986	967	-0.021
Oilseeds	452	456	457	457	457	457	457	458	0.002
Potatoes	22100	22325	22509	22686	22856	23020	23175	23327	0.008

Table 3.16: Forecasted Revenue, Costs and Gross Margins Per Hectare of Cultivated Land Under Different Crops (Rs/ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Revenue Paddy	14.00	15.18	16.46	17.86	19.39	21.06	22.88	24.86	0.086
Maize	9.84	10.54	11.28	12.08	12.94	13.86	14.84	15.90	0.071
Wheat	9.76	10.08	10.72	11.41	12.14	12.92	13.75	14.64	0.060
Millet	7.43	8.09	8.81	9.59	10.45	11.39	12.42	13.54	0.090
Oilseeds	10.18	11.39	12.65	14.04	15.58	17.30	19.20	21.31	0.111
Potatoes	38.11	41.11	44.29	47.73	51.44	55.44	59.75	64.40	0.078
Cost Paddy	9.79	10.47	11.21	12.00	12.85	13.75	14.72	15.76	0.070
Maize	7.16	7.66	8.20	8.77	9.39	10.04	10.74	11.49	0.070
Wheat	6.88	7.35	7.86	8.40	8.98	9.60	10.27	10.98	0.069
Millet	6.15	6.58	7.04	7.54	8.07	8.64	9.25	9.91	0.071
Oilseeds	4.33	4.65	4.99	5.35	5.74	6.16	6.61	7.09	0.073
Potatoes	14.84	15.92	17.07	18.32	19.65	21.09	22.62	24.27	0.073
Per Hectare Gross Margin Paddy	4214	4710	5253	5863	6546	7308	8153	9099	0.116
Maize	2673	2873	3082	3309	3553	3816	4098	4405	0.074
Wheat	2287	2732	2863	3004	3155	3315	3483	3663	0.035
Millet	1280	1509	1764	2054	2381	2750	3165	3633	0.161
Oilseeds	5841	6744	7659	8687	9841	11137	12588	14217	0.136
Potatoes	23273	25196	27218	29410	31784	34352	37126	40131	0.081

Table 3.17: Forecasted Livestock Population

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cattle	109797	109869	109937	110001	110059	110108	110147	110173	0.000
Milch Cows	76024	76074	76122	76166	76206	76240	76267	76285	0.000
Bullocks	33772	33795	33816	33835	33853	33868	33880	33888	0.000
Buffaloes (male)	27057	27074	27091	27107	27121	27133	27143	27150	0.000
Milch Buffaloes	152863	152963	153058	153148	153228	153297	153351	153388	0.000
Sheep	3012	3026	3039	3051	3062	3071	3079	3084	0.003
Goats	147999	148013	148026	148038	148049	148058	148066	148071	0.000
Pigs	4194	4320	4450	4583	4721	4862	5008	5158	0.030
Chicken	360674	371494	382639	394118	405942	418120	430664	443584	0.030
Total LSU	227506	227914	228322	228729	229132	229527	229909	230276	0.002
LSU Per Household	4.20	4.18	4.16	4.13	4.11	4.09	4.07	4.05	-0.005

Table 3.18: Forecasted Annual Production and Growth in Livestock Production (MT)

Products	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cow Milk	7405	7410	7414	7419	7422	7426	7428	7430	0.000
Buff Milk	29136	29155	29173	29190	29205	29218	29229	29236	0.000
Ghee	526	526	527	527	527	527	528	528	0.000
Net Milk Supply	25578	25595	25611	25626	25639	25651	25660	25666	0.000
Buffalo Meat	1044.47	1045.15	1045.81	1046.42	1046.96	1047.43	1047.81	1048.06	0.000
Mutton	464.46	464.53	464.61	464.68	464.74	464.79	464.83	464.86	0.000
Chicken	721.35	742.99	765.28	788.24	811.88	836.24	861.33	887.17	0.030
Pork	39.42	40.60	41.82	43.08	44.37	45.70	47.07	48.48	0.030
Aggregate Meat Available	2269.70	2293.28	2317.51	2342.41	2367.95	2394.17	2421.04	2448.57	0.011
Aggregate Meat Price (Rs/kg)	43.40	48.18	53.48	59.36	65.87	73.08	81.08	89.94	0.110
Wool Production (kg)	2008.84	2017.92	2026.59	2034.67	2041.95	2048.19	2053.12	2056.46	0.003

Table 3.19: Forecasted Cost and Returns from Livestock (Rs)

Livestock and Products	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Per Animal Cost:									
Buffaloes	280.37	300.00	321.00	343.47	367.51	393.24	420.77	450.22	0.070
Sheep and Goats	95.33	102.00	109.14	116.78	124.95	133.70	143.06	153.07	0.070
Pigs	142.99	153.00	163.71	175.17	187.43	200.55	214.59	229.61	0.070
Chickens	14.02	15.00	16.05	17.17	18.38	19.66	21.04	22.51	0.070
Milch Cows	420.56	450.00	481.50	515.21	551.27	589.86	631.15	675.33	0.070
Milch Buffaloes	668.22	715.00	765.05	818.60	875.91	937.22	1002.82	1073.02	0.070
Cattle excluding M.Cows	336.45	360.00	385.20	412.16	441.02	471.89	504.92	540.26	0.070
Total Cost (Rs '000)	173083	185451	198705	212909	228130	244444	261927	280665	0.071
Cost Per LSU	761	814	871	932	997	1066	1141	1220	0.070
Total Gross Margin Per LSU	322169	357616	396874	440346	488476	541750	600706	665933	0.109
Gross Margin Per LSU	1416	1569	1738	1925	2132	2360	2613	2892	0.107

Table 3.20: Forecasted Per Capita Food Supply (kg/person)

Food-edible form	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal Grains	178.12	177.66	178.51	179.27	179.95	180.54	181.04	181.51	0.003
Meat	6.99	7.01	7.03	7.05	7.08	7.11	7.14	7.17	0.004
Milk	78.75	78.21	77.69	77.18	76.68	76.18	75.69	75.13	-0.006
Oils and Fats	4.09	4.07	4.04	4.02	3.99	3.97	3.94	3.92	-0.006
Vegetables	53.60	53.74	53.79	53.82	53.83	53.84	53.83	53.82	0.000

Table 3.21: Forecasted Per Capita Food Demand (kg/person)

Food-edible form	1991	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Cereal Grains-edible Form	170.45	173.79	173.65	174.52	175.29	175.98	176.58	177.10	0.004
Meat	6.67	6.52	6.64	6.68	6.71	6.75	6.78	6.82	0.005
Milk	90.49	86.35	86.47	85.96	85.46	84.96	84.45	83.97	-0.006
Oils and Fat	4.24	4.12	4.13	4.11	4.09	4.06	4.04	4.02	-0.006
Vegetables	50.48	50.07	50.75	50.85	50.93	50.99	51.02	51.06	0.001

Table 3.22: Forecasted Total Food Balance Situation (MT)

Food-edible form (+surplus, -deficit)	1991	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Cereal Grains	2488	1263	1598	1574	1554	1535	1514	1505	-0.012
Meat	103	158	126	124	122	121	121	120	-0.010
Milk	-3814	-2663	-2892	-2916	-2938	-2956	-2967	-2988	0.007
Oils and Fat	-728	-699	-711	-713	-714	-715	-716	-718	0.002
Vegetables	1011	1203	1001	985	972	961	954	943	-0.012

Table 3.23: Forecasted Change in Land Use (%)

Land Use Categories	1992	1995	2000
Forest Area	24	24	22
Shrub Area	24	24	24
Grassland	3	3	3
Adjacent NCI	18	18	19
NCI within gross	5	5	5
Net Cultivated	23	24	24
Plantation	1	1	1
Residual	2	2	2
Total (%)	100	100	100
Total Land (ha)	140485	140485	140485

Table 3.24: Fuelwood Share of Different Sources and Total Annual Supply (%)

Sources	1992	1995	2000
Accessible Forest	64	64	63
Adjacent NCI	32	32	33
Plantation	3	3	4
Farmland	1	1	1
Total (%)	100	100	100

Table 3.25: Forecasted Fuelwood Supply from Different Sources (Air Dry Tonnes {ADT})

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Forests	104392	103674	102913	102109	101261	100368	99433	98453	-0.009
Adjacent NCI	53927	54058	54196	54342	54496	54659	54829	55008	0.003
Plantation	5228	5477	5743	6025	6324	6640	6973	7322	0.050
Farmland	1067	1071	1076	1081	1086	1092	1098	1104	0.005
Total Kabhre	164614	164280	163928	163557	163167	162759	162333	161887	-0.003
Per Capita Supply (air dry kg)	507	502	497	493	488	483	479	474	-0.009

Table 3.26: Forecasted Timber Supply from Different Sources and Demand (cum)

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Total Supply	10708	10523	10326	10118	9899	9669	9427	9174	-0.023
Total Demand	16241	16362	16482	16601	16719	16835	16950	17063	0.007
Timber Balance (ss-dd)	-5533	-5839	-6156	-6483	-6820	-7166	-7523	-7889	0.051

Table 3.27: Forecasted Shares of Fodder Supply by Source (%)

Sources	1992	1995	2000
Forests	13	12	12
Grasslands	1	1	1
Shrublands	26	26	26
Tree Fodder: Farmland	4	4	4
Adjacent NCI	33	33	33
Others	23	23	23
Total	100	100	100
Supply as % of Demand	58	58	57

Table 3.28: Forecasted Fodder Supply and Demand and Balance (MT-total digestible nutrient {TDN})

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Supply	103505	103849	104232	104621	105017	105419	105826	106243	0.004
Demand	141896	142150	142405	142659	142910	143156	143395	143623	0.002
Fodder Balance	-38390	-38301	-38172	-38037	-37893	-37736	-37568	-37380	-0.004

Table 3.29: Percentage of Population Engaged in Off-farm Activities

Occupation	Percentage
Professionals	1.6
Office Workers	1.8
Sales and Services	3.8
Production Workers	4.2
Construction Workers	1.0
General Labourers	8.7

Source: NRB - Multipurpose Household Budget Survey 1988

Table 3.30: Forecasted Employment Situation by Sector and Labour Use

Labour Use by Activity	1991	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Labour Days Available	41479	41875	42276	42678	43081	43483	43852	44223	0.009
Labour Use on Crops	8991	9115	9232	9343	9448	9547	9643	9734	0.011
Livestock	10238	10256	10275	10293	10311	10329	10346	10362	0.002
Professionals	637	643	649	656	662	668	674	679	0.009
Office Workers	717	724	731	737	744	751	758	764	0.009
Sales and Services	1513	1528	1542	1557	1572	1586	1600	1613	0.009
Production Workers	1672	1688	1705	1721	1737	1753	1768	1783	0.009
Construction, etc	398	402	406	410	414	417	421	425	0.009
General Labourers	3464	3497	3531	3564	3598	3632	3663	3694	0.009
Total Labour Use	27631	27853	28070	28280	28485	28684	28871	29054	0.007
Labour Use as % of Available	66.61	66.51	66.40	66.26	66.12	65.97	65.84	65.70	-0.002

Table 3.31: Forecasted Values of Food and Non-food Imports (Rs'000)

Imports	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Growth Rate of Non-food Import	0.010	0.010	0.009	0.009	0.009	0.009	0.009	-0.009
Total Food Import (Rs '000)	55169	62705	69677	77325	85702	94784	1049576	0.109
Total N-food Import (Rs '000)	292738	295472	298241	301003	303757	306499	309229	0.009
Value of Net T Imports (Rs '000)	237570	232767	228564	223678	218055	211715	204272	-0.023
Value: Per Capita Food	169	190	210	231	255	280	304	0.101
Value: Per Capita Non-food	895	896	898	900	902	904	906	0.002

Table 3.32: Forecasted Income by Source (Rs'000)

Sources of Income	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	213570	231227	254348	287062	315540	346724	380728	418092	0.105
Livestock	322169	357616	396874	440346	488476	541750	600706	665933	0.109
Professionals	7119	7187	7256	7325	7394	7463	7526	7590	0.009
Office Workers	7439	7510	7582	7654	7727	7799	7865	7931	0.009
Sales and Service Workers	17403	17569	17737	17906	18075	18244	18398	18554	0.009
Production Workers	12276	12393	12511	12631	12750	12869	12978	13088	0.009
Construction, etc	3500	3533	3567	3601	3635	3669	3700	3731	0.009
General Labourers	23161	23382	23606	23830	24055	24280	24486	24693	0.009
Growth Rate of Income	0.113	0.081	0.088	0.098	0.089	0.089	0.090	0.090	0.007
Total Kabhre Income	606637	660418	723481	800355	877652	962796	1056388	1159612	0.099
Per Household Income (Rs/hh)	11206	12109	13168	14463	15748	17157	18697	20388	0.091
Per Capita Income	1868	2018	2195	2411	2625	2860	3116	3398	0.091

Table 3.33: Forecasted Income Shares by Sources of Income (%)

Sources of Income	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	35.21	35.01	35.16	35.87	35.95	36.01	36.04	36.05	0.005
Livestock	53.11	54.15	54.86	55.02	55.66	56.27	56.86	57.43	0.009
Professionals	1.17	1.09	1.00	0.92	0.84	0.78	0.71	0.65	-0.082
Office Workers	1.23	1.14	1.05	0.96	0.88	0.81	0.74	0.68	-0.082
Sales and Service Workers	2.87	2.66	2.45	2.24	2.06	1.89	1.74	1.60	-0.082
Production Workers	2.02	1.88	1.73	1.58	1.45	1.34	1.23	1.13	-0.082
Construction, etc	0.58	0.54	0.49	0.45	0.41	0.38	0.35	0.32	-0.082
General Labourers	3.82	3.54	3.26	2.98	2.74	2.52	2.32	2.13	-0.082
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000

Table 3.34: Forecasted Real Income by Source (Rs'000)

Sources of income	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	193405	194975	199639	209786	214628	219493	224300	229211	0.028
Livestock	291750	301548	311509	321807	332258	342954	353897	365086	0.032
Professionals	6447	6060	5695	5353	5029	4724	4434	4161	-0.061
Office Workers	6737	6333	5951	5594	5256	4937	4633	4348	-0.061
Sales and Service Workers	15760	14815	13922	13086	12294	11549	10839	10172	-0.061
Production Workers	11117	10450	9820	9231	8672	8147	7646	7175	-0.061
Construction, etc	3169	2979	2800	2632	2473	2323	2180	2046	-0.061
General Labourers	20974	19716	18528	17415	16362	15370	14426	13537	-0.061
Real Per Capita Income	1691	1702	1723	1762	1785	1810	1836	1863	0.016

Table 3.35: Performance and Sustainability Indicators

Indicators	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Per Capita Cultivated Land (ha/person)	0.107	0.108	0.109	0.110	0.110	0.111	0.111	0.112	0.005
Per Capita Accessible Forest Land	0.098	0.096	0.093	0.090	0.087	0.084	0.082	0.078	-0.033
Forest-Cultivated Area Ratio	0.913	0.882	0.851	0.821	0.791	0.761	0.731	0.702	-0.038
Shrubland-Forest Area Ratio	1.148	1.180	1.215	1.254	1.298	1.346	1.400	1.459	0.037
Population Density Per Cultivated Land	9.304	9.229	9.164	9.107	9.057	9.013	8.974	8.939	-0.006
Population Per Accessible Forest	10.189	10.465	10.766	11.093	11.450	11.840	12.269	12.741	0.034
LSU Per Cultivated Area	7.466	7.447	7.427	7.406	7.382	7.357	7.330	7.300	-0.003
LSU Per Forest Area	7.136	7.289	7.457	7.642	7.846	8.072	8.321	8.597	0.029
LSU Per Grazing Area	51	50	49	48	47	46	45	44	-0.021

Table 3.36: Forecasted Population and Changes in the Active Population

Population and Composition	1991	1992	1993	1994	1995	1996	1997	1998
Economically Active: Males	96825	97779	98743	99713	100684	101654	102546	103442
Economically Active: Females	69093	69723	70360	71001	71641	72279	72864	73450
Total Active Population	165918	167502	169103	170713	172326	173933	175410	176892
Total: Males	166046	167351	168639	169911	171167	172405	173629	174839
Total: Females	158773	159894	161008	162113	163209	164295	165367	166424
Total Population	324819	327245	329647	332024	334376	336700	338996	341263

Table 3.37: Implications for Calories

Capacity and Load ('000 Calories)	1991	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Per ha Calorie Supply	4006	3973	3970	3968	3966	3964	3963	3962	-0.002
Per ha Calorie Demand	4382	4355	4332	4313	4296	4281	4268	4257	-0.004
SS as % of DD	91.41	91.22	91.63	92.00	92.32	92.61	92.85	93.07	0.003
Carrying Capacity Per ha	5.54	5.49	5.49	5.49	5.48	5.48	5.48	5.48	-0.002
Current load Per ha	6.06	6.02	5.99	5.96	5.94	5.92	5.90	5.89	-0.004

Table 3.38: Implications for Fuelwood

Products and Factors (air dry tonnes)	1991	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Fuelwood Supply Per ha	2.03	2.02	2.01	1.99	1.98	1.97	1.95	1.94	-0.007
Per ha Demand	2.35	2.36	2.37	2.38	2.39	2.39	2.40	2.40	0.003
SS as % of DD	86.19	85.38	84.57	83.78	82.99	82.21	81.44	80.68	-0.009
Carrying Capacity Per ha (person/ha)	3.45	3.43	3.41	3.39	3.37	3.35	3.32	3.30	-0.007
Current load (person/ha)	4.00	4.02	4.03	4.05	4.06	4.07	4.08	4.09	0.003

Table 3.39: Implications for Fodder

Capacity and Load (MT-total digestible nutrient)	1991	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Per ha Fodder Supply	0.74	0.75	0.75	0.75	0.76	0.76	0.76	0.76	0.004
Per ha Fodder Demand	1.02	1.02	1.02	1.03	1.03	1.03	1.03	1.03	0.001
SS as % of DD	72.94	73.06	73.19	73.34	73.48	73.64	73.80	73.79	0.002
Carrying Capacity (LSU/ha)	1.19	1.20	1.20	1.20	1.21	1.21	1.22	1.22	0.004
Current load (LSU/ha)	1.63	1.64	1.64	1.64	1.65	1.65	1.65	1.65	0.001

Table 3.40: Impacts of Different Policy Alternatives on Calorie Balances (Supply as % of Demand)

	1993	1994	1995	1996	1997	1998	Growth
Baseline	91.64	92.00	92.32	92.61	92.85	93.07	0.30
Irrigation Policy	101.53	101.97	102.33	102.64	102.90	103.14	0.30
Fertiliser Policy	94.79	98.70	99.04	99.35	99.61	99.84	1.00
Irrigation, Fertiliser, and Potatoes	115.59	120.16	120.39	120.58	120.72	120.85	0.90
Increased Maize Price Policy	92.44	93.12	93.45	93.74	93.98	94.21	0.40
Decreased Maize Price Policy	90.77	91.39	91.71	92.00	92.23	92.45	0.40
Decreased Fuelwood Demand Policy	91.63	92.00	92.32	92.61	92.85	93.07	0.30
Forest Management Policy	91.64	92.00	92.32	92.61	92.85	93.07	0.30

Table 3.41: Impacts of Different Policy Alternatives on Labour Use (%)

	1993	1994	1995	1996	1997	1998	Growth
Baseline	66.38	66.24	66.09	65.94	65.81	65.67	-0.20
Irrigation, Fertiliser, & Potatoes	68.39	68.22	68.05	67.86	67.71	67.55	-0.20
Irrigation Policy	66.39	66.26	66.11	65.96	65.83	65.70	-0.20
Maize Price Increased	66.39	66.26	66.11	65.96	65.83	65.70	-0.20
Decreased Fuelwood Demand	66.38	66.24	66.09	65.93	65.80	65.67	-0.20
Forest Management	66.39	66.26	66.11	65.96	65.83	65.69	-0.20

Table 3.42: Impacts of Different Policy Alternatives on Income (Rs/capita)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Nominal P-Capita Inc-Policy (Rs)	2195	2388	2601	2834	3088	3368	8.94
Real Per Capita Income (Rs)	1723	1746	1769	1817	1820	1846	1.39
Irrigation							
Nominal P-Capita Inc-Policy (Rs)	2439	2652	2885	3140	3419	3724	8.83
Real Per Capita Income (Rs)	1914	1939	1963	2013	2015	2042	1.30
Fertiliser							
Nominal P-Capita Inc-Policy (Rs)	2274	2571	2798	3047	3320	3619	9.74
Real Per Capita Income (Rs)	1785	1879	1903	1953	1956	1984	2.14
Irrigation, Fertiliser, & Potato Policy							
Nominal P-Capita Inc-Policy (Rs)	2924	3297	3576	3880	4211	4573	9.36
Real Per Capita Income (Rs)	2295	2410	2433	2487	2481	2507	1.78
Decreased Maize Price							
Nominal P-Capita Inc-Policy (Rs)	2097	2288	2493	2718	2963	3234	9.05
Real Per Capita Income (Rs)	1646	1673	1696	1742	1746	1773	1.50
Increased Maize Price							
Nominal P-Capita Inc-Policy (Rs)	2293	2502	2723	2965	3230	3521	8.96
Real Per Capita Income (Rs)	1800	1829	1852	1901	1903	1930	1.41

Table 3.43: Impacts of Different Policy Alternatives on Income Shares by Major Sources (%)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Crops	35.16	35.28	35.37	35.44	35.47	35.49	0.20
Livestock	54.85	55.52	56.16	56.77	57.37	57.93	1.10
Others	9.99	9.20	8.47	7.79	7.16	6.58	-8.01
Irrigation							
Crops	41.65	41.72	41.74	41.74	41.71	41.66	0.00
Livestock	49.36	50.00	50.62	51.23	51.82	52.39	1.20
Others	8.99	8.28	7.64	7.03	6.47	5.95	-7.90
Fertiliser							
Crops	37.42	39.87	39.94	39.97	39.97	39.96	1.30
Livestock	52.94	51.58	52.19	52.79	53.37	53.92	0.40
Others	9.64	8.55	7.87	7.24	6.66	6.12	-8.60
Irrigation, Fertiliser, & Potato							
Crops	51.33	53.12	53.00	52.85	52.68	52.49	0.50
Livestock	41.18	40.22	40.84	41.46	42.07	42.66	0.70
Others	7.64	6.66	6.16	5.69	5.25	4.85	-8.60
Reduced Maize Price							
Crops	32.16	32.45	32.58	32.68	32.75	32.81	0.40
Livestock	57.39	57.95	58.59	59.20	59.79	60.34	1.00
Others	10.45	9.60	8.83	8.12	7.47	6.85	-8.10
Increased Maize Price							
Crops	37.95	38.21	38.27	38.30	38.31	38.29	0.20
Livestock	52.49	53.01	53.64	54.25	54.85	55.42	1.20
Others	9.56	8.78	8.09	7.47	6.84	6.29	-8.00

Table 3.44:Impacts of different Policies on Demand and Supply of Forest Products Originating from All Sources (Supply as % of Demand)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fuelwood	84.57	83.78	82.99	82.21	81.44	80.68	-0.90
Fodder	73.19	73.34	73.48	73.64	73.80	73.97	0.20
Timber	62.65	60.95	59.21	57.43	55.62	53.79	-3.00
Decreased Demand							
Fuelwood	93.97	93.20	92.45	91.70	90.97	90.24	-0.80
Fodder	73.19	73.26	73.32	73.38	73.43	73.50	0.10
Timber	62.65	61.70	60.72	59.70	58.64	57.56	-1.70
Improved Management							
Fuelwood	84.97	85.18	85.08	85.02	85.24	85.78	0.20
Fodder	74.54	74.67	74.81	74.94	75.07	75.20	0.20
Timber	62.65	60.98	59.34	57.72	56.12	54.55	-2.70
Combined							
Fuelwood	94.42	94.77	94.78	94.82	95.20	95.92	0.30
Fodder	74.54	74.59	74.64	74.68	74.71	74.74	0.10
Timber	62.65	61.73	60.85	59.99	59.15	58.34	-1.40

Table 3.45: Changing Pressure on Land Under the Baseline and Policy Scenarios

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Per Capita Cultivated Land (ha/person)	0.109	0.110	0.110	0.111	0.111	0.112	0.50
Per Capita Accessible Forest Land	0.093	0.090	0.087	0.084	0.082	0.078	-3.30
Forest-Cultivated Area Ratio	0.851	0.821	0.791	0.761	0.731	0.702	-3.80
Shrubland-Forest Area Ratio	1.215	1.254	1.298	1.346	1.400	1.459	3.70
Population Density Per Cultivated Land	9.164	9.107	0.057	9.013	8.974	8.939	-0.50
Population Per Accessible Forest	10.766	11.093	11.450	11.840	12.269	12.741	3.40
LSU Per Cultivated Area	7.427	7.406	7.382	7.357	7.330	7.300	-0.30
LSU Per Forest Area	7.457	7.642	7.846	8.072	8.321	8.597	2.90
LSU Per Grazing Area	49.152	48.168	47.169	46.157	45.136	44.110	-2.10
Reduced Demand							
Per Capita Cultivated Land (ha/person)	0.109	0.110	0.110	0.111	0.111	0.112	0.50
Per Capita Accessible Forest Land	0.093	0.091	0.090	0.088	0.087	0.085	-1.80
Forest-Cultivated Area Ratio	0.851	0.833	0.815	0.796	0.778	0.760	-2.20
Shrubland-Forest Area Ratio	1.215	1.229	1.246	1.264	1.285	1.308	1.50
Population Density Per Cultivated Land	9.164	9.107	9.057	9.013	8.974	8.939	-0.50
Population Per Accessible Forest	10.766	10.936	11.119	11.317	11.530	11.761	1.80
LSU Per Cultivated Area	7.427	7.425	7.420	7.415	7.409	7.401	-0.10
LSU Per Forest Area	7.457	7.531	7.616	7.710	7.815	7.931	1.20
LSU Per Grazing Area	9.152	48.819	48.446	48.035	47.587	47.105	-0.80
Improved Management							
Per Capita Cultivated Land (ha/person)	0.109	0.110	0.110	0.111	0.111	0.112	0.50
Per Capita Accessible Forest Land	0.093	0.090	0.088	0.085	0.082	0.080	-3.00
Forest-Cultivated Area Ratio	0.851	0.821	0.793	0.766	0.739	0.714	-3.50
Shrubland-Forest Area Ratio	1.215	1.253	1.293	1.335	1.380	1.426	3.33
Population Density Per Cultivated Land	9.164	9.107	9.057	9.013	8.974	8.939	-0.50
Population Per Accessible Forest	10.766	11.086	11.419	11.770	12.140	12.525	3.10
LSU Per Cultivated Area	7.427	7.407	7.386	7.365	7.343	7.322	-0.30
LSU Per Forest Area	7.457	7.637	7.825	8.023	8.233	8.451	2.50
LSU Per Grazing Area	49.152	48.194	47.281	46.391	45.526	44.701	-1.90
Combined							
Per Capita Cultivated Land (ha/person)	0.109	0.110	0.110	0.111	0.111	0.112	0.50
Per Capita Accessible Forest Land	0.093	0.091	0.090	0.089	0.088	0.086	-1.40
Forest-Cultivated Area Ratio	0.851	0.833	0.817	0.801	0.786	0.772	-1.90
Shrubland-Forest Area Ratio	1.215	1.228	1.241	1.254	1.268	1.280	1.00
Population Density Per Cultivated Land	9.164	9.107	9.057	9.013	8.974	8.939	-0.50
Population Per Accessible Forest	10.766	10.929	11.090	11.253	11.416	11.577	1.50
LSU Per Cultivated Area	7.427	7.425	7.424	7.423	7.421	7.421	0.00
LSU Per Forest Area	7.457	7.527	7.596	7.665	7.737	7.805	0.90
LSU Per Grazing Area	49.152	48.846	48.565	48.288	48.017	47.772	-0.60

Table 3.46: Impacts of Different Policy Alternatives on Deforestation (ha)

	1993	1994	1995	1996	1997	1998	Growth
Baseline (ha)	552	580	606	632	656	679	0.042
Decreased Fuelwood Demand	145	181	216	250	282	312	0.166
Increased Demand	534	519	517	514	498	468	-0.026

Table 3.47: Impacts of Different Policies on the Carrying Capacity of Crop Land to Meet Calorie Needs

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Supply (calorie/ha)	3970	3968	3966	3965	3963	3962	0
Demand (calorie/ha)	4332	296	4296	4281	4268	4257	0
Capacity (adults/ha)	5.49	5.49	5.48	5.48	5.48	5.48	0.00
Load (adults/ha)	5.99	5.96	5.94	5.92	5.90	5.89	-0.40
Irrigation							
Supply (calorie/ha)	4399	4398	4396	4394	4392	4391	0
Demand (calorie/ha)	4332	4313	4296	4281	4268	4257	0
Capacity (adults/ha)	6.08	6.08	6.08	6.07	6.07	6.07	0.00
Load (adults/ha)	5.99	5.96	5.94	5.92	5.90	5.89	-0.40
Fertiliser							
Supply (calorie/ha)	4107	4257	4255	4253	4251	4250	1
Demand (calorie/ha)	4332	4313	4396	4281	4268	4257	0
Capacity (adults/ha)	5.68	5.88	5.88	5.88	5.88	8.88	0.70
Load (adults/ha)	5.99	5.96	5.94	5.92	5.90	5.89	-0.40
Combined							
Supply (calorie/ha)	4677	4846	4841	4838	4834	4831	1
Demand (calorie/ha)	4046	4033	4022	4012	4004	3997	0
Capacity (adults/ha)	6.47	6.70	6.69	6.69	6.68	6.68	0.60
Load (adults/ha)	5.59	5.58	5.56	5.55	5.54	5.53	-0.20
Price Decrease							
Supply (calorie/ha)	3932	3942	3940	3938	3937	3936	0
Demand (calorie/ha)	4332	4313	4296	4281	4268	4257	0
Capacity (adults/ha)	5.44	5.45	5.45	5.44	5.44	5.44	0.00
Load (adults/ha)	5.99	5.96	5.94	5.92	5.90	5.89	-0.40
Price Increase							
Supply (calorie/ha)	4005	4016	4014	4013	4011	4010	0.00
Demand (calorie/ha)	4332	4313	4296	4281	4268	4257	0.00
Capacity (adults/ha)	5.54	5.55	5.55	5.55	5.55	5.54	0.00
Load (adults/ha)	5.99	5.96	5.94	5.92	5.90	5.89	0.00

Table 3.48: Impacts of Different Policies on the Carrying Capacity of Land to Meet Fuelwood Requirement

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Supply (adt/ha)	2.01	1.99	1.98	1.97	1.95	1.94	-0.70
Demand (adt/ha)	2.37	2.38	2.39	2.39	2.40	2.40	0.30
Capacity (persons/ha)	3.41	3.39	3.37	3.35	3.32	3.30	-0.70
Load (persons/ha)	4.03	4.05	4.06	4.07	4.08	4.09	0.30
Decreased Demand							
Supply (adt/ha)	2.01	2.00	2.00	1.99	1.98	1.98	-0.30
Demand (adt/ha)	2.13	2.15	2.16	2.17	2.18	2.19	0.50
Capacity (persons/ha)	3.79	3.78	3.77	3.76	3.75	3.74	-0.30
Load (persons/ha)	4.04	4.06	4.08	4.10	4.12	4.14	0.50
Improved Management							
Supply (adt/ha)	2.01	2.03	2.03	2.04	2.05	2.07	0.50
Demand (adt/ha)	2.37	2.38	2.39	2.40	2.40	2.41	0.30
Capacity (persons/ha)	3.43	3.45	3.45	3.46	3.48	3.52	0.50
Load (persons/ha)	4.03	4.05	4.06	4.07	4.09	4.10	0.30
Combined							
Supply (adt/ha)	2.01	2.03	2.05	2.06	2.08	2.11	0.90
Demand (adt/ha)	2.13	2.15	2.16	2.17	2.18	2.20	0.60
Capacity (persons/ha)	3.81	3.84	3.87	3.89	3.93	3.98	0.90
Load (persons/ha)	4.03	4.06	4.08	4.10	4.13	4.15	0.60

Table 3.49: Impacts of Different Policies on the Carrying Capacity of Forest Land only to Meet Fuelwood Demand

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Supply (adt/ha)	8.38	8.51	8.64	8.79	8.96	9.15	1.80
Demand (adt/ha)	15.79	16.26	16.78	17.35	17.97	18.65	3.40
Capacity (persons/ha)	14.26	14.47	14.70	14.96	15.24	15.56	1.80
Load (persons/ha)	26.85	27.66	28.54	29.50	30.56	31.71	3.40
Decreased Demand							
Supply (adt/ha)	8.38	8.43	8.48	8.54	8.60	8.68	0.70
Demand (adt/ha)	14.21	14.43	14.68	14.94	15.22	15.52	1.80
Capacity (persons/ha)	15.84	15.93	16.02	16.13	16.26	16.40	0.70
Load (persons/ha)	26.85	27.28	27.73	28.23	28.76	29.33	1.80
Improved Management							
Supply (adt/ha)	8.45	8.73	8.98	9.24	9.56	9.96	3.40
Demand (adt/ha)	15.79	16.25	16.74	17.25	17.78	18.34	3.00
Capacity (persons/ha)	14.36	14.85	15.26	15.71	16.26	16.94	3.40
Load (persons/ha)	26.85	27.64	28.47	29.33	30.24	31.19	3.00
Combined							
Supply (adt/ha)	8.45	8.65	8.80	8.96	9.17	9.44	2.20
Demand (adt/ha)	14.21	14.43	14.64	14.85	15.07	15.28	1.50
Capacity (persons/ha)	15.96	16.34	16.64	16.94	17.34	17.83	2.20
Load (persons/ha)	26.85	27.26	27.66	28.07	28.48	28.88	1.50

Table 3.50: Impacts of Different Policies on the Carrying Capacity of Land to Meet Timber Requirement

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Supply (cu m/ha)	0.32	0.32	0.32	0.32	0.32	0.32	0.10
Demand (cu m/ha)	0.50	0.52	0.53	0.55	0.57	0.59	3.20
Capacity (persons/ha)	6.30	6.31	6.31	6.32	6.33	6.34	0.10
Load (persons/ha)	10.06	10.35	10.66	11.01	11.38	11.79	3.20
Decreased Demand							
Supply (cu m/ha)	0.32	0.31	0.31	0.31	0.31	0.32	0.00
Demand (cu m/ha)	0.50	0.51	0.52	0.53	0.54	0.55	1.70
Capacity (persons/ha)	6.30	6.30	6.30	6.30	6.30	6.30	0.00
Load (persons/ha)	10.06	10.21	10.37	10.55	10.74	10.95	1.70
Improved Management							
Supply (cu m/ha)	0.32	0.32	0.32	0.32	0.32	0.32	0.00
Demand (cu m/ha)	0.50	0.52	0.53	0.55	0.56	0.58	2.90
Capacity (persons/ha)	6.30	6.31	6.31	6.32	6.32	6.33	0.10
Load (persons/ha)	10.06	10.34	10.64	10.94	11.27	11.61	2.90
Combined							
Supply (cu m/ha)	0.32	0.31	0.31	0.31	0.31	0.31	0.00
Demand (cu m/ha)	0.50	0.51	0.52	0.52	0.53	0.54	1.40
Capacity (persons/ha)	6.30	6.30	6.30	6.30	6.29	6.29	0.00
Load (persons/ha)	10.06	10.20	10.35	10.50	10.64	10.79	1.40

Table 3.51: Impacts of Different Policies on the Carrying Capacity of Land to Meet Fodder Requirement

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Supply (tdn MT/ha)	0.75	0.75	0.75	0.76	0.76	0.76	0.40
Demand (tdn MT/ha)	1.02	1.02	1.03	1.03	1.03	1.03	0.10
Capacity (LSU/ha)	1.20	1.20	1.21	1.21	1.22	1.22	0.40
Load (LSU/ha)	1.64	1.64	1.65	1.65	1.65	1.65	0.10
Decreased Demand							
Supply (tdn MT/ha)	0.75	0.75	0.75	0.75	0.76	0.76	0.20
Demand (tdn MT/ha)	1.02	1.02	1.03	1.03	1.03	1.03	0.10
Capacity (LSU/ha)	1.20	1.20	1.21	1.21	1.21	1.21	0.20
Load (LSU/ha)	1.64	1.64	1.65	1.65	1.65	1.65	0.10
Improved Management							
Supply (tdn MT/ha)	0.76	0.77	0.77	0.77	0.77	0.77	0.30
Demand (tdn MT/ha)	1.02	1.02	1.03	1.03	1.03	1.03	0.10
Capacity (LSU/ha)	1.22	1.23	1.23	1.23	1.24	1.24	0.30
Load (LSU/ha)	1.64	1.64	1.65	1.65	1.65	1.65	0.10
Combined							
Supply (tdn MT/ha)	0.76	0.76	0.77	0.77	0.77	0.77	0.20
Demand (tdn MT/ha)	1.02	1.02	1.03	1.03	1.03	1.03	0.10
Capacity (LSU/ha)	1.22	1.23	1.23	1.25	1.23	1.23	0.20
Load (LSU/ha)	1.64	1.64	1.64	1.65	1.65	1.65	0.10

Table 3.52: Impacts of Different Policies on the Carrying Capacity of Forest Land only to Meet Fodder Requirement

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Supply (tdn MT/ha)	0.41	0.41	0.41	0.41	0.41	0.41	-0.20
Demand (tdn MT/ha)	4.34	4.45	4.56	4.68	4.81	4.96	2.70
Capacity (LSU/ha)	0.66	0.66	0.66	0.66	0.65	0.65	-0.20
Load (LSU/ha)	6.97	7.13	7.31	7.50	7.72	7.96	2.70
Decreased Demand							
Supply (tdn MT/ha)	0.41	0.41	0.41	0.41	0.41	0.41	-0.10
Demand (tdn MT/ha)	4.34	4.39	4.43	4.48	4.54	4.60	1.20
Capacity (LSU/ha)	0.66	0.66	0.66	0.66	0.66	0.66	-0.10
Load (LSU/ha)	6.97	7.03	7.11	7.19	7.28	7.38	1.20
Improved Management							
Supply (tdn MT/ha)	0.47	0.47	0.47	0.47	0.47	0.47	0.20
Demand (tdn MT/ha)	4.34	0.44	4.55	4.65	4.77	4.89	2.40
Capacity (LSU/ha)	0.75	0.75	0.75	0.76	0.76	0.76	0.20
Load (LSU/ha)	6.97	7.12	7.29	7.46	7.64	7.83	2.40
Combined							
Supply (tdn MT/ha)	0.47	0.47	0.47	0.47	0.47	0.47	0.00
Demand (tdn MT/ha)	4.34	4.38	4.42	4.46	4.50	4.54	0.90
Capacity (LSU/ha)	0.75	0.75	0.75	0.75	0.75	0.75	0.00
Load (LSU/ha)	6.97	7.03	7.09	7.15	7.21	7.27	0.90

SINDHUPALCHOK DISTRICT

Performance Of The District Economy

Introduction

This section contains a brief background of the economy of Sindhupalchok (Sindhu) in terms of the land use, agriculture, livestock, and forestry sectors. The overall performance of Sindhupalchok's economy depends heavily upon the performance of the agricultural sector which is closely associated with the forestry and livestock sectors. The performance of the crop sector, however, depends largely upon the vagaries of the monsoon as only 13 per cent of the cultivated land area in the district is under irrigation. Given the limited area under irrigation, poor monsoon rains always result in a sharp drop in crop production. These conditions, in conjunction with the very low use rate of modern inputs, have severely limited the growth and diversification of this sector.

Crop area

Paddy, maize, millet, wheat, oilseeds, and potatoes are the main crops grown in the district. These crops altogether account for about 95 per cent of the district's total cropped area (the remaining five per cent is shared by sugarcane and barley). The historical data on the areas under these crops reported by DFAMS for Sindhupalchok are given in Table 4.1 and Chart 4.1.

Maize is by far the most important crop, and it accounted for about 40 per cent of the district's total cropped area in 1988/89. Paddy ranks second in terms of cropped area, followed by wheat (17%), millet (10%), and potatoes (10%). The monsoon crops, out of which paddy and maize are predominant, are grown during a period of adequate rainfall. A sharp decline in the areas under these crops (i.e., paddy and maize) between1980/81 and 1982/83 is difficult to explain. A similar decline in the areas under monsoon crops also took place between 1985 and 1986. Despite the annually fluctuating trends, the areas under all crops have been increasing over time. The paddy area increased from 3,900 hectares in 1975 to 5,170 hectares in 1989, an average annual rate of 2.2 per cent. The maize and millet areas show the lowest growth rates (less than 0.5 per cent) during this period. The most rapid growth in area can be observed over three-folds, i.e., from 1,202 ha in 1975 to

4,300 ha in 1989 with an average annual growth rate of 10.3 per cent. The area under potatoes increased during this period at the rate of 3.2 per cent. The oilseeds' area greatly fluctuated as indicated by its coefficient of variation. On the whole, the total crop area in the district increased at the rate of 2.27 per cent per annum. In order to project the areas under different crops, a semilog trend equation was fitted to the historical crop area data. The estimated results are given in Table 4.2.

Crop Yield

The productivity trends of different crops in the district during the past 14 years (1975-1989) are given in Table 4.3. The yields of paddy, maize, and millet have been declining at an annual rate of 0.2, 1.96, and 0.138 per cent respectively. On the other hand, wheat, oilseed, and potato yields show a positive trend with the highest growth rate for oilseeds (3.12%) followed by potatoes (2.3%). A large degree of variation can be observed in the wheat yield even though there is positive growth over time. Wheat productivity declined by almost half between 1982 to 1995 due to the sudden increase in the area. Table 4.3 and Chart 4.2 demonstrate the fluctuating trend in crop yields over the period. Given this erratic trend in crop yields, no satisfactory trend equation could be estimated. Therefore, the average crop yield was used as the base figure for projecting crop yields.

Chart 4.1

Trend in Crop Area (Hectares)

Fertiliser Use

The limited use of fertiliser under declining conditions of soil productivity is one of the main factors responsible for the low level of crop productivity in the district. Although the actual use of chemical fertiliser in the district in terms of the cultivated area by crops is unknown, it is possible to estimate the average fertiliser use per hectare of cropped area based on the annual fertiliser sale reported by the Agricultural Inputs' Corporation (AIC). The time-series' data on fertiliser sales reported by the AIC is given in Table 4.4. The data indicate fluctuating trend of fertiliser sale in the district. One of the reasons for this erratic trend might be the annually changing level of fertiliser imports in the country which determines the fertiliser quota for the district. Despite the fluctuating trend, sales in the district increased from 1624.4 mt in 1982 to 1888.6 mt in 1991, with an annual growth rate of 1.68 per cent. The estimated average sale per ha of cropped area is also given in Table 4.4. The fertiliser sale rate is very high compared to the average use rate reported in the Irrigation Master Plan and cannot be explained easily. On the basis of the average consumption of fertiliser as reported in the Irrigation Master Plan, the consumption of fertiliser by crop per hectare is about 17kg per cropped area (excluding millet area).

Livestock

DFAMS has collected time-series' data on the livestock population by types of product for Sindhu from 1981 to 1988. Table 4.5 presents the total number (heads) of different types of animal and their products. In terms of population, goats rank

first, followed by cattle and buffaloes. The data indicate that the milch cow population is declining at the rate of 1.6 per cent. As a result, the average annual growth rate of the cattle population is among the lowest in the district (0.32%). Among the large animals, the milch buffalo population had the highest growth rate (2.33%), while that of buffaloes was about one per cent per annum. The estimated number of buffaloes in 1988 was 57,350 head compared to 55,114 in 1984. The share of milch buffaloes in the total buffalo population increased from 17 per cent to 20 per cent whereas the share of milking cows in the total cattle population slightly decreased over time. This implies that cattle are gradually being replaced by buffaloes. Among small animals, the pig population registered the highest growth rate (about three per cent), followed by goats (1.51%), and sheep (0.92%). Table 4.5 also presents the trends in livestock products over the period from 1984-1988. The annual production figure was divided by the population to calculate the yields of different livestock projects, which are also given in Table 4.5. The results indicate that the average yield factor for milch buffaloes is relatively higher than that of cows. Milk production from buffaloes increased to 1,036 metric tonnes in 1988 compared to 873 MT in 1984, at an annual growth rate of 3.6 per cent. Milk production from cows, on the other hand, declined as a result of the declining cow population.

Land Use Changes

The land use statistics reported by LRMP (1978) were projected by using the assumptions regarding inter-class land transfers. The deforested area is assumed to be distributed among different land classes such as agricultural land, shrubland, grassland, and adjacent NCI. About 22 per cent of the total natural forest (3,133 hectares in 1978) lies in the mid-mountains and the rest in the high mountains (55%) and high Himal (7.7%) The distribution of population in these ecological belts, however, is just the reverse with excessive pressure on the forests in the mid-mountains and relatively lower pressure in the high mountains. The species composition of forests in the mid-mountains is predominantly hard wood (96%), with a larger proportion under low crown density class (72%) and maturity class I (98%). Both the crown cover and the maturity class of forests improve as one moves from lower elevations to higher elevations in the district. All the natural forests in the mid-mountains are accessible, but only 64 per cent are accessible in the high mountains. Table 4.6 shows the base year (1978) distribution of natural forests by crown density, maturity, and species in different ecological belts of the district. The overall land use change, based upon certain assumptions made for the district (by ecological belts) during the period from 1978 to 1990, is given in Table 4.6. A major portion (50 per cent) of the deforested land area in both the regions is assumed to have been converted into shrubland. In the district as a whole, the natural forest areas decreased at the annual rate of 0.83 per cent, while shrubland, grassland, and cultivated land increased at the rate of 0.98, 0.86, and 0.41 per cent respectively.

Forest Plantation

Table 4.7 presents data on the area reforested in Sindhupalchok during the period from 1975-1990. A total of 8,452 hectares has been planted so far in the district, but the survival rate and condition of the reforested area are not known.

Economic And Natural Resource Conditions: Baseline Scenario

Various important sectors of the district were linked in a multi-market model framework to evaluate the economic and environmental status of the district over time. The baseline results are given in this section. The baseline results are also important for evaluating the changes over time when shocks are given to the model. Finally, the baseline results are used to analyse the human and livestock carrying capacity and its changes over time.

Prices

The national forecasted price was calibrated to reflect the price situation in Sindhupalchok district. Data on prices for Sindhupalchok were not available separately, hence, Ramechhap district prices were used to calibrate the prices for Sindhupalchok as was done for Kabhre. As a result, most of the prices given in Table 4.8 for Sindhu are the same as those for Kabhre, except for minor differences in the prices of cereals, oils and fat, and meat. The growth rate of prices calculated by using the end point values are given in the last column of Table 4.8.

Among the foodgrains considered, millet and paddy prices have the highest growth rates. Wheat prices have the lowest forecasted growth. The aggregate cereal grain price has an average annual growth rate of about 7.7 per cent. Aggregate meat and oils and fat prices are also given in Table 4.8.

Crop Areas and Yields

Table 4.9 provides results of the forecasted area for different crops and Table 4.10 provides the respective crop yield projections based on the assumption of non-constant crop prices and variable inputs. Area growth follows a time trend based on historic data series.

The area of Sindhu is greater than that of Kabhre, but the cultivated area in Sindhu is less than that in Kabhre by more than half, based on the data series used in the study. The areas under all crops in Sindhu are lower than those reported for Kabhre, except for millet. There is only a small paddy growing area in Sindhu.

The forecasted growth rates of crop areas over time indicate almost negligible growth in Sindhu. The highest positive growth rate is for oilseeds (13%) and the

lowest for maize (0.03%). The cropped area increases at about one per cent per annum. The changes in the area under irrigation, which have been assumed to grow at two per cent per annum, are also presented in Table 4.9.

Fertiliser sales are expected to grow at about 1.69 per cent per annum based on the sales of fertilisers in the district over the past years. The sale of fertiliser in Sindhu, as reported by the AIC, is very large. If these sales' figures are assumed to reflect the actual use, they exceed the per hectare use rates observed in the case of Kabhre. Even if use rates per hectare assumed in the model were to increase by several fold, the discrepancy problem would still remain.

The future yield trends of the six crops grown in Sindhu are given in Table 4.10. Forecasts are based on the assumption that crop technology will remain the same over time. The forecasted crop yields are not encouraging, with five out of six crops showing a declining trend. The results indicate that, over time, Sindhu palchok will have to face the problem of a declining trend in food grain supplies under existing technological conditions. Any decline in the crop yields of a major foodgrain such as paddy and maize will have implications for future food supply in the district.

Crop Production

Crop output production is determined by both the area and yield. The resulting growth in production (Table 4.11) of the different crops is positive, except for maize (the secondmost important crop after potatoes), and this is primarily due to the declining trend in yields. Oilseed production shows a strong growth trend, but this is due to an (13.4 per cent) increase in area rather than yield changes (0.09%).

Gross Margin

Gross margins were calculated for each crop considered. Table 4.12 also presents the total gross margin and the cost of cultivation per hectare of cultivated crops. All crops registered positive gross margins. The gross margin for millet has the highest growth rate, despite the fact that its area and yield have remained almost stagnant over time. The increase in the gross margins given in Table 4.12 is primarily due to the increase in nominal crop prices over time. Potatoes, however, have in the highest per hectare gross margin in Sindhu, followed by oilseeds and paddy. The per hectare gross margin for millet is the lowest, but its growth rate is the highest (15.69%) among the crops. After millet, maize and wheat have the lowest per hectare gross margins as well as the lowest growth rates.

Livestock

Analysis of the livestock sector indicates that the average annual growth in LSU in the district is less than one per cent per (Table 4.13) annum. The source of bullock

supply is the adult bullock population, and the population changes over time. An average bullock is assumed to work for 219 days in a year. The demand for bullocks is indicated in the cost of the cultivation sector. According to the model, a number of working days (219) are assumed for a bullock and, if the days decreased marginally, the existing surplus situation could change, i.e., the bullock pairdays supply in the district is perhaps not a constraining factor currently. This, however, is not the case for fodder supply as indicated in the following paragraphs.

Based on data collected by the Department of Food and Agricultural Marketing Services, Agricultural Statistics of Nepal (DFAMS 1990), livestock products (meat, milk, ghee, and wool) and the gross revenue from livestock over time were estimated.

The average annual increase in different types of livestock products is given in Table 4.14. Pork and chicken meat production have the same growth rates, because these two products are not linked to the land use sector. Simple time trends were fitted to the past data to forecast the future chicken and pig population.

Livestock raising costs were calculated after consultation with livestock experts. The raising cost for buffaloes (one LSU) was first estimated and this cost was multiplied by the LSU conversion factor to derive different types of livestock-raising costs. Costs are linked with the price subsector, thus livestock-raising costs also change over time. The average increase in LSU costs over time is about seven per cent. Gross livestock margins were also derived (Table 4.15). The average annual increase in per LSU gross margin is about 11 per cent.

Food Availability and Demand

Assuming different waste, loss, and seed allowance factors, the total cereal availability in the district was derived on the basis of the production of the aforementioned, four cereal grains (rice, wheat,maize, and millet). The per capita availability/ supply was then derived. A similar exercise was carried out to derive the per capita domestic (district) supplies of meat (mutton, buffalo, pork, and chicken), oils and fat (derived from oilseed production and ghee), vegetables (potatoes only), and milk. Tables 4.16, 4.17, and 4.18 provide estimates of the forecasted food supply/availability, demand, and food balance in the district.

Crop yield rates are important determinants of food supplies, given that land is an almost inelastic factor. The almost constant, or even declining, crop yield rates, as well as an increasing population, have resulted in a deteriorating food balance situation over time in Sindhu (Table 4.18). Per capita supplies of the five different food types currently fall short of demand, resulting in net imports. Meat and vegetable (potato) supplies are surplus to a certain extent throughout the period under review. It appears that increased potato cultivation will contribute to

increased food supply compared to similar efforts to increase cereal grain production, given the prevailing technology choices in the district.

Land Use

Land use in the district consists of agricultural land, forests, grazing land, shrubland, non-cultivated inclusions, and others. Due to the interaction between the demand and supply sectors, and also to the influence of the exogenous sectors discussed (see Chapter 2), land use also changes over time in the district. Table 4.19 provides details on the changes in land use over time in Sindhu.

The results given in Table 4.19 indicate that land use changes in the district are small. Over time, the annual decline in the forest area is one per cent. Adjacent NCI, shrub and grasslands, and cultivated areas may possibly increase while other land use categories tend to remain unchanged over time.

Data on the cultivated area (given in Table 4.9 and in Table 4.19) are not exactly the same in the two tables. This discrepancy arises as a result of the different data sets used, namely, those of DFAMS and LRMP. It was not possible to derive the net cultivated area in the district from data collected by DFAMS. The cultivated area is given in Table 4.9 was derived by assuming that the cultivated area is the sum of the areas under paddy and maize, i.e., non-competing crop areas. The discrepancy is not small as in the case of Kabhre. There is, however, no basis on which the accuracy of the data sets may be judged nor a firm basis to bring about a reasonable compromise between the two data sets. The DFAMS data on crops are the only available source. The LRMP data on forests and total land use are believed to be more reliable, hence LRMP data were used for these categories.

Forest Products

Forests are assumed to provide three primary products, namely, fuelwood, timber, and fodder. The supply of these resources over time was derived and then compared with the demand.

Fuelwood

The demand for fuelwood perhaps, exerts the most pressure on forests, especially as stocking forests is an uncommon practice in many parts of Nepal. Fuelwood is assumed to come from different sources, namely, accessible forests, farmland, non-cultivated inclusions, and plantations. Yield rates of these sources vary. Density and maturity classes are important factors and were taken into account to determine the yield rate of different forests.

Table 4.20 provides an estimate of the fulewood supply in Sindhu from different sources. Accessible forests are the primary source of fuelwood in the district but, as can be observed from Table 4.20, their share declines marginally over time. Shrubs and grasslands are the second most important sources of fuelwood supply. Adjacent non-cultivated inclusions are the third source. These three sources account for about 95 per cent of the fuelwood supply in the district and will continue to remain important over time. Farmlands supply a negligible amount of fuelwood.

The forecasted supply of fuelwood from different sources for the mid-mountains, high mountains, and the district as a whole is given in Table 4.21. The high mountains have surplus fuelwood supply, whereas the mid-mountains face a deficit. The different sources of fuelwood supply in the district are given in Table 4.21 and hardwood is the main source. Coniferous and mixed species contribute a smaller percentage. The district as a whole is deficit in fuelwood supply.

Timber

The timber demand was forecasted over time and compared with the timber supply. Table 4.22 shows the changes in timber supply and demand over time. As can be observed, timber deficit is already a serious problem and the deficit tends to get worse over time.

Fodder

Fodder is also an important forest product. Fodder is supplied by various sources. As Table 4.23 and Table 4.24 indicate, forests are not the most important sources of fodder in the district as it contributes only about 24 per cent currently and this share declines over time. Shrubland is the most important source of fodder in the district, followed by the 'other' category, which contributes slightly more than 25 per cent. This category includes fodder sources such as crop residue, fodder from risers and bunds, and fallow grazing. The fodder supply from farmland trees is negligible.

Labour Supply and Use

Labour supply is determined by the size of the active population. Households are assumed to expend labour on crop production, livestock raising, and other activities. An active person is assumed to have at his/her disposal 240 mandays. Each active member supplies labour for crop production and livestock raising (100 mandays per LSU). More specific information on labour use patterns for Sindhu is not directly available. The Multipurpose Household Budget Survey - Nepal Rastra Bank (M-NRB) report, however, provides information on the percentage of population engaged in other activities for the hill regions of Nepal. An assumption was made that 240 mandays a year (of labour) are also supplied by persons

engaged in activities other than agriculture and livestock raising. The number of persons engaged in other activities (Table 4.25) was multiplied by the number of working days in a year to derive an estimate of the employment situation in other sectors. The results are given in Table 4.25. In terms of the labour use pattern in the district, labour use as a percentage of availability declined marginally over time as indicated by the "Labour Use" row in Table 4.25.

It should be noted that household members spend time in collecting fuelwood and water and also in other crop production activities. These activities were not included in the present exercise. As a result, the percentage of unutilised labour in the district appears to be large. Even if these activities are taken into account, it is unlikely that labour utilisation in the district will increase substantially to the extent of making Sindhu a labour deficit district. Currently, only about 60 per cent of available labour in the district is gainfully employed labour. Another reason for the large under-utilisation of labour is that, whereas the active population was taken into account in the model, the participation rate was not considered, and, if accounted for, it would reduce the size of the total active population and, hence, the underemployment rate.

Trade

Many food and non-food items are imported into Sindhu. The exact amount of imports into the district is not known. However, the Multipurpose Household Budget Survey provides information on average monthly household expenditure on non-food items. The results are for 1984, i.e., the year the survey was conducted. The import values were aggregated and adjusted against inflation in order to update these values for 1990 (base year). Data on expenditure for food and non-food imports were also collected.

It is important to emphasise that information on the income growth is required to calculate the import demand growth rate. The growth in import demand is driven by the income growth and population growth. The results are given in Table 4.26.

The average growth in non-food demand is about one per cent per year and is solely determined endogenously by the model. The per capita value of non-food imports in 1992 was Rs 988 and is likely to reach Rs 1,001 by 1988 i.e., at a rate less than one per cent growth rate.

The food import values are given in Table 4.26. Food imports are derived from the excess food demand determined on the basis of the model. More specifically, the food import demand is influenced by the difference in domestic supply (district) and domestic demand. The difference between supply and demand is carried over to the import section. Negative values indicate imports and positive values indicate exports. The food import value, which includes cereals, meat, milk, vegetables, and

oils and fat, was multiplied by the aggregate price of cereals and the other respective food prices. The value of per capita food import increases over time by about six per cent.

Income

Income is also determined endogenously by the model. The gross margins of the crop and livestock sectors and income accruing from the different employment activities were added for each year to derive the aggregate income for Sindhu district. The results regarding the magnitude of nominal and real incomes originating from different sectors are given in Table 4.27 and 4.28 and the income shares of different sources are given in Table 4.29.

The per capita nominal income increases at about eight per cent per annum but, if real incomes are taken into account, the growth in real per capita income is only about 0.5 per cent, indicating negative future prospects for the district.

The income share of the crop sector tends to increase marginally over time. The income share of the livestock sector, however, tends to improve over time. The share of income from other off-farm activities tends to decline over time, as a result of the assumption of constant wage rates. This assumption is relaxed in the case of Dhading district. The income shares of the crop and livestock sectors together account for over 90 per cent of Sindhu's income.

Environment: Sustainability and Carrying Capacity

The carrying capacity of the district is assessed in the section on the basis of the human and livestock populations and the demand and supply of natural resources of the district. In particular, natural resource products are considered, i.e., land-based products required for the human and livestock populations. The previous section (on the baseline results) presented the existing situation of the district and assessed the demand and supply situation as well as the changes over time in various products. In this section, selected components are analysed on an aggregate basis to assess the carrying capacity of the district.

The performance of the district in terms of some selected sustainability indicators can be judged from the results given in Table 4.30. In this hill farming system, forests are an important source of fodder for livestock, which in turn provide nutrients (manure) to the fields. In addition, forests also provide fuelwood and timber to households. Besides these three resources, forests also provide leaf litter as a nutrient supplement to the fields. As accessible forest cover declines over time, fodder and leaf litter supplied also decline, and this has a negative impact on agricultural productivity, given the other prevailing conditions. Therefore, the forest-

cultivated land ratio of a district provides an idea of the amount of forest resources that can be harvested sustainably to meet household needs.

Wyatt-Smith (APROSC 1982) in his study estimates that 3.5 hectares of accessible, unmanaged forest are required to support one hectare of agricultural land in the context of the hill farming system. Wyatt-Smith provides a breakdown of the estimate of three forest resources (fodder, fuelwood, and timber) needed to support one hectare of agricultural land. A hectare of agricultural land requires 2.8, 0.24 to 0.48, and 0.32 ha of unmanaged, accessible forest in terms of fodder, fuelwood, and timber respectively.

Similar estimates were not carried out for this study, but the results derived from different parts of the model provide some idea. For example, the accessible forest-cultivated land ratio in Sindhu is currently 0.16 hectares, which is very low compared to the Wyatt-Smith estimate of 3.5 hectares. If it is assumed that 3.5 hectares of forest land are required to support one hectare of agricultural land in order to make the hill farming system sustainable, then the estimated existing land ratio for Sindhu is alarming. This ratio shows a declining trend over time (2.64 %) (Table 4.30).

The ratio of shrubland to accessible forest land is another indicator which explains partially the extent of forest degradation, i.e., as forests degrade, they are converted into shrubland. The shrubland-forest ratio in Sindhu is estimated to be 0.87 currently, indicating that the area under shrubland far exceeds the area under forests and this ratio increases over time at an annual rate of about four per cent. Other results are given in Table 4.30.

The population of the district continues to grow over the time period covered by the study. The size and growth of population in Sindhu over time is given in Table 4.31. The population increase, labour force, and labour use situation were examined in terms of the employment situation as well as food supplies, among other things, under the current trend scenario. For many years, the district will have to rely on the existing natural resource base to gainfully use the labour force as well as to feed the total population. In addition, the fuelwood demand will also increase due to the population increase.

Currently, the bulk of the employment opportunities generated in the district is in the agricultural and livestock sectors. According to the results derived from the model, the agricultural area does not increase sufficiently to absorb the expanding labour force. Assuming that the new labour force, will be employed in the agricultural sector, new areas will have to be brought under cultivation, i.e., the current land use situation in the district will change. More forest areas can be used for agricultural purposes. This option may not be viable or sustainable, given the inability of the forestry sector to meet even the current fuelwood and fodder demands. It is

possible, however, that the adjacent NCI, which occupies vast tracts of land in the district, can be used for agriculture. However, sufficient employment opportunities cannot be generated to absorb all the new entrants into the labour force. There will not be enough land in the first place, even if financial and technical constraints do not exist.

It can be argued that employment opportunities can be generated in the livestock sector. Under the current trend scenario, this too does not appear to be a viable alternative. The livestock carrying capacity is already very strained. In the livestock sector it is essential to reduce the numbers and increase productivity per animal. More labour is likely to be displaced in this situation in the livestock sector. If a district's sustainability is viewed in terms of its labour use situation, Sindhu clearly does not qualify as sustainable because an increasing number of people will remain unemployed or underemployed given the performance of the agriculture, livestock, and forestry sectors in the district.

Implications for Food

Table 4.32 provides the calorie demand and availability situation over time for Sindhu. Under the current trend scenario, the calorie supply will decrease marginally (from 3,958,000 calories per ha in 1991 to 3,918,000 calories per ha in 1998), primarily as a result of decreasing crop yields. On the other hand, the calorie demand per ha will increase from 7,599,000 in 1991 to 7,842,000 calories per ha in 1998 -- as a result of the population growth.

Assuming that 2,410 calories are required by an adult, the existing carrying capacity of one hectare of cropped area can also be calculated (Table 4.32). The present supply of calories per hectare could support 5.43 adult persons in 1992 and this trend is likely to continue till 1998. On the other hand, given an adult's calorie requirements (2,410), the load on one hectare of land in 1992 was about 10.51 adult persons and it will also remain the same in the future. The reason why the capacity and load factors remain constant despite population growth is because the growth in cultivated land and population are about the same. The existing situation indicates that about 52 per cent of Sindhu's food demand can be fulfilled from its own production and this situation does not improve over time.

It should be noted that access to calories may in fact be less than the availability and demand indicate. Access to food is determined by income and relative prices, given base year consumption levels. Table 4.17 gives data on food demand, which is lower than availability on a per capita basis, indicating that the calorie intake is also lower than indicated by the availability conditions. Sindhu's food situation is alarming when judged both in terms of food sufficiency as well as food security.

Implications for Fuelwood

The results in Table 4.33 provide further details regarding the fuelwood situation in the district. The supply per ha decreases marginally (1.13%) over time as accessible forests also decrease. The pressure on one hectare of forest land increases due to population growth. It can be seen that the present demand is already much higher than the present supply. This continues to deteriorate over time. Currently, the supply position is 76 per cent of the demand and, by the year 1998, the supply situation will decrease to 66 per cent. The carrying capacity will also decline as forest quality deteriorates, resulting in an increase in the load factor. The load factor indicates the number of persons that one hectare of land can support, given the per capita need of 0.588 adt. The fuelwood situation is also alarming, and more so in the mid-mountains than in the high Himal region. Fuelwood is supplied by different sources. If only forest lands are considered, the forest carrying capacity and the load factor worsens, since only 72 per cent of the supply is met, compared to 75 per cent reported in Table 4.34.

Implications for Timber

Analyses carried out for timber supply, demand, capacity, and load also indicate that the timber demand falls far short of supply and the situation gets worse over time (Table 4.35).

Implications for Fodder

Under the existing trend scenario, given the livestock population growth and changing patterns of land use generated by the model, the capacities of forest, grazing, agricultural lands and, other fodder supply sources to sustain the livestock population are declining according to the results presented in the previous section. The analysis indicates that the demand for fodder already exceeds the supply and that this trend does not appear to improve over time. An estimate of the carrying capacity will indicate the number of LSU that can be supported by a hectare of land (from which fodder is supplied), given the per LSU fodder need. The results are given in Table 4.36.

Under the current trend of land use change and livestock population growth, the capacity of land to support the livestock population is not satisfactory. Currently, the livestock population (expressed in terms of LSU) that one hectare of land can support is about 0.79 LSU, whereas the current land factor is slightly less (0.79 LSU/ha). If, however, forests are considered as the sole source of fodder supply, the situation is alarming as only about 25 per cent of the fodder demand is met by the forests (Table 4.37).

The above results highlight clearly that Sindhu's forest resources are rapidly deteriorating. This situation is more pronounced in the mid-mountains than in the high Himal. As a matter of fact, if only the mid-mountains are taken into account the situation will appear to be far worse than has been described above. The high Himal does not face a similar problem. It was, however, not possible to separate the two regions in the analysis because separate information for the two regions was not available.

Conclusion

Under the current state of technology and infrastructure, the district's capacity to sustain the ever increasing human and livestock populations is declining over time. Given the decline in crop yield and the limited scope to expand agricultural land on the one hand and the rapid growth on the other, the magnitude of food deficit will continue to grow at an even more alarming rate in the foreseeable future. The food shortage will have to be met through imports at an average growth rate of 12 per cent per annum. Imports, however, will be constrained by the lack of purchasing power, given the limited economic activities outside the agricultural sector. Thus, the food deficit problem is likely to result in access to food being denied to a growing section of the district's population.

The implications of the poor agricultural state for the environment (forests) is even more alarming given the combined effects of the ever increasing fuelwood, fodder, timber, and food demands. Both the area under accessible forests and its quality (density) are declining, while the demand for forest products is increasing. As a result the gap between supply and demand of forest products will widen over time. This growing magnitude of the natural resource deficit will have to be met largely through deforestation, and this has grave implications for the environment, unless immediate measures are taken to replenish forest stocks.

The economy of Sindhu, being heavily dependent on the traditional sectors (agriculture, forests, and livestock), has limited potential to generate employment opportunities. Already a large percentage of the active population is underemployed. Limited scope exists to generate additional employment opportunities in these sectors, unless new, labour-intensive technologies are introduced.

Policy Scenarios and Impact Analysis

Population Scenario and Impact

Sindhu's population growth according to the 1991 census is about 1.01 per cent, compared to the national average of 2.3 per cent. Despite the low population

growth recorded between the inter-census period (1981-1991), the economy of Sindhu is unsustainable according to the results discussed under the baseline scenario. Thus, a population reduction policy was examined within the simulation model developed for Sindhu.

The population reduction policy is assumed to start in 1993 and continues up to 1998. Initially only a small reduction (growth rate) is envisaged and this is allowed to decrease each year until it reaches 0.532 per cent (1988). The growth allowed in 1998 is about half the existing growth trend and also matches with the overall target of 50 per cent reduction in population growth envisaged in the Eighth Plan Period (1993-1997). The growth assumptions made for each year are given in Table 4.38.

The impact of the population reduction policy, as defined by the growth rate assumptions noted in Table 4.38, indicates that, in terms of the annual population reduction, the impact does not appear to be very significant in the few years considered. Even with a 50 per cent reduction in the existing growth rate, the absolute reduction in the number of people will only be 1,107 in 1998. This small reduction in population should, however, not be considered insignificant as over time the reduction and its impact are cumulative in the other sectors. In the absence of the population reduction policy, the population of Sindhu will increase by 3,199 persons between 1993 and 1998. If the policy is implemented there will be 3,199 persons less in Sindhu between 1993 and 1998. The implications of this reduction for the other sectors are examined in the following paragraphs.

The impact of the population policy on the calorie balance situation is given in Table 4.39. Compared to the baseline results, the impact of the population reduction policy is negligible. The population reduction policy does not have any impact on calorie supply since this variable is independent of population. The change in calorie supply in terms of percentage of the demand as influenced by the population policy is insignificant. This is so because the population reduction within the timespan covered by the model is small and the impacts of the policy are not manifested strongly, relative to the baseline situation. Also there is no significant change in demand. Calorie supply (as percentage of the demand) in 1993 under the baseline scenario was 51.24 per cent and this increased to 52.09 per cent as a result of the policy. This variable will reach 49.97 per cent and 50.08 per cent in 1998 under the two scenarios respectively.

The impact of the population policy on labour use is also insignificant. The population reduction policy does not have any impact on the size of the active population within the timeframe of the study. New entrants to the labour force were already determined prior to the policy, hence the labour use rate does not change. If the impacts were observed for a longer period, they would be more visible.

The population policy's impact on incomes' share is also negligible. The per capita income does not improve significantly since income levels do not change.

The population reduction will have an impact on forest land as aggregate fuelwood demand decreases. The supply and per capita demand remain the same. The results are given in Table 4.40. The population reduction is not large enough to have any significant impact on the fuelwood situation when both total and forest lands (Table 4.41) are considered. The same can be observed in the case of timber (Table 4.42).

The impact on the environment was assessed in terms of the carrying capacity and load factor. As the carrying capacity of land deteriorates over time (other factors remaining the same), the environment will also deteriorate.

Under the existing state of technology, the carrying capacity of agricultural land and the current load factor (i.e., number of adult-equivalents dependent on cultivable land) are given in Table 4.43. Relative to the baseline scenario, the impact of the population reduction policy on agricultural land is negligible. Likewise, the population reduction policy does not have an appreciable impact in terms of reducing pressure on land for firewood as well as timber.

Crop Sector: Policy Scenarios and Impacts

Several different policies are examined in the crop sector. The first policy examined concerns irrigation development in the district, whereby all potential areas that can be irrigated are developed. A second policy examined concerns a 25 per cent increment on the use of fertiliser for paddy, maize, wheat, oilseeds, and potato cultivation. The cost incurred by the 25 per cent increment is added to the production cost, hence the gross margins from crops are the net of this incremental cost. The third policy scenario combines both irrigation and fertiliser policies. In addition, the cropping intensity effect of irrigation is also allowed for. The cropping intensity effect is introduced in the following manner. The additional area that is brought under irrigation is assumed to be under potato cultivation. All other cropping intensity effects that can occur during the non-potato season are held constant to simplify matters. Finally, price alteration policies (+ and - 10%) are separately examined.

Impact on the Food Sector

The potential land that can be irrigated in Sindhu was estimated to be 12,276 ha by the LRMP. Under the irrigation policy, it was assumed that this land area would be brought under irrigation in 1993. In 1990 only about one-third of the potential area was under irrigation by a significant amount (Table 4.44). Under the baseline scenario all crops except oilseeds had negative growth rates, but under the

irrigation policy all crops show positive growth trends, although less than one per cent. Millet output is not influenced by the irrigation policy. The 25 per cent increment in fertiliser use increases yield rates significantly, but not as much as the irrigation policy. The impact of 25 per cent increment in fertiliser use is given in Table 4.44. First, compared to the baseline results, all crops that use fertiliser show a net increase in yield trends. Under the baseline scenario all crops using fertiliser showed negative long-term growth with the exception of oilseeds. The long term growth trends (1993-1998) are higher under the fertiliser policy than under the irrigation policy.

A maize price policy intervention was also considered by allowing the maize price to alter by 10 per cent. The results are given in Table 4.44. The price policy has the desired effect on maize supply as reflected by corresponding changes in yield following changes in prices. The maize price is not assumed to influence the yield of other crops, hence, other crop yields are not affected. The price impact on maize output is not as significant as the irrigation impact but the price impact on yield is higher than the fertiliser policy impact in the year the policy is introduced. However, following 1993, the price impact on yield is not as strong as the fertiliser impact.

Under the price reduction policy, the maize yield rate declines below the baseline value (Chart 4.3).

Finally, the impact of a joint policy option combining irrigation, fertiliser policies, and cropping intensity effect (through increased potato area) was examined, and the different impacts are given in Table 4.44. It can be observed from Table 4.44 that the joint policy option improves crop yield rates significantly. Under the joint policy option, the yield rate of paddy, for example, is 2,484kg/ha in 1993, which is 5.7 per cent, and 19.7 per cent higher respectively than under the irrigation, fertiliser, and baseline scenarios. The registered long-term growth is 1.73 per cent per annum. The yield rates for other crops under the joint policy are also given in Table 4.44.

The food availability situation in Sindhu was found to be alarming, with a large deficit that is increasing over time. The development of irrigation facilities will have a significant impact on the per capita food availability situation as highlighted in Table 4.45, but this impact is not strong enough to fully meet the growing food demand. Under the fertiliser policy, food availability also increases relative to the baselines scenario, but the impacts are less pronounced than under irrigation development. The effects of the price policy on food availability are very similar to those of the above two policies. Minor differences can be observed in the cereal and vegetable availability situation (Chart 4.4). Under the joint policy, significant changes occur in food availability, with vegetable (potato) availability improving greatly. This effect is primarily caused by cropping intensity.

Data on the per capita food demand under each policy scenario are given in Table 4.46. The per capita food demand for all food types under the different policy measures does not change much compared to the baseline situation (Chart 4.5). Food is a necessity and its income elasticity of demand is fairly inelastic, i.e., the food demand does not change proportionately due to changes in income. The effect of price changes on cereal demand is also not very pronounced since the income effect is greater than the substitution effect, and cereals account for a large portion of the food budget share. Table 4.47 highlights the net effects of the different policy measures on the district's food balance. The small variation in the per capita demand under different policy scenarios and the greater variation in the per food availability situation in the district indicate, that the per capita food balance changes primarily as a result of food supply policies (Chart 4.5).

Despite the relatively larger variability observed in the food balance situation under different policies, food deficits persist under most policies, excluding vegetables (potatoes). The food balance improves in comparison to the baseline scenario under all policies, except under the price reduction policy. The smallest deficit occurs under the joint policy, and potatoes no longer register deficits after 1993. The surplus contributes to increasing the district's exports.

The impact of the irrigation policy is that the per capita balance does not change very much compared to the baseline situation under the irrigation policy as highlighted in Table 4.47. The deficit problem faced by the household in the baseline situation is so serious that the increments under the irrigation and the fertiliser policy do not improve the food supply situation (see supply as % of demand) in Sindhu and do not render the district self sufficient in food. It should be

noted that, as under the irrigation policy, the increment in food production increases household incomes and also induces further consumption, thereby decreasing deficit by a small amount only.

The calorie situation was assessed in this section by taking into account the total food availability discussed above, as well as the calorie requirements of the adult population. Only cereal grains and potatoes were considered while determining the

calorie availability. The calorie requirement is independent of income and prices. As a result, this section addresses the issue of whether the district is self-sufficient in food, given that an adult requires 2,410 calories per day. The population was converted into adult equivalent units. Under the baseline scenario, the ability of Sindhu to meet the calorie requirements from its own food production is only about 50 per cent (Table 4.48). The situation deteriorates marginally over time. Under the price policy scenario, the situation does not change. Under the other policy scenario, the district's capacity for self-sufficiency in food improves, but it is the joint policy that has the most positive effect. Under the joint policy, the situation improves from 51 per cent self-sufficiency in 1993 (under the baseline scenario) to over 90 per cent in the same year.

Impact on Trade

Each policy affects the trade sector in different ways. The irrigation policy influences the trade sector in two different ways. Firstly, as food production improves, the net imports decline in terms of value. The decline in the quantity of imports is reflected in the reduction in the per capita deficit discussed above. Secondly, as food production increases, real per capita income also increases, resulting in an increased demand for non-food imports. The results are given in Table 4.49 and Chart 4.6.

The per capita value of food imports in the baseline situation will be Rs 297 in 1994, and the annual growth rate will be 6.49 per cent. The irrigation policy will cause a decline in the per capita value of food imports in 1994 to Rs 151, and this value declines rapidly over time. As a result of the lagged effects, the impact on trade can be observed only in 1994.

The impact on non-food imports is also given in Table 4.49. The irrigation policy increases the per capita income which in turn effects the growth of the non-food import demand. The results indicate that the per capita value of non-food imports increases marginally under the different policy situation compared to the baseline scenario, but the impact is not as strong as in the case of food imports. The per capita non-food imports have an annual growth rate of 0.21 per cent compared to the baseline growth rate of 0.19 per cent.

The irrigation policy also affects both the food and non-food trade. The impact of the irrigation policy on the food trade is more profound than on the non-food trade when the results are compared with the baseline or the irrigation policy scenarios. The value of food imports under the irrigation policy is greater than under the baseline scenario but smaller than under the irrigation policy action from 1994. The per capita food import values in all the other policy scenarios examined above were negative, although they were positive under this policy indicating net exports. The results are given in Table 4.49.

The joint policy affects the non-food sector also (Table 4.49). The non-food sector is almost totally import driven. In 1993, the per capita value of non-food imports was Rs 991 under the baseline scenario, and this increased to Rs 1,022 (30% increase) under this policy. This value will reach Rs 1,033 in 1988 compared to Rs 1,001 under the baseline scenario. The effects of the price policy on trade were not significant.

The cropping intensity impact can be observed under the joint policy scenario. When additional areas are brought under irrigation, the cropping intensity of the district will increase by about 37 per cent compared to the baseline scenario. Irrigation facilities will enable the cultivation of additional areas during the non-potato season. The increased cropping intensity will improve the labour use situation in the district.

Impact on Labour Use

The labour use situation in the district under the baseline scenario indicated that, at present, about 60 per cent of the labour is fully used. The high underutilisation rate for labour is partially due to the fact that participation rates were not taken into account, and only the active population was considered while estimating the labour supply. Even if the participation rates are taken into account, there will still be substantial underutilisation of labour in the district, and this is mainly the result of the district's economic condition.

The labour use rate changes only under the joint policy. Under the joint policy, the cropping intensity impact results in a net increase in labour use in the district. It increases to 64 per cent in 1993 from 60 per cent under the baseline scenario. Over time, however, it will decrease to 63 per cent in 1998. It should be pointed out that, under the irrigation policy, substantial, short-term employment opportunities can also be generated locally as labour will be required to build irrigation infrastructures, but this is difficult to account for in the present exercise.

Impact on Income

All the policies examined above affect income. Data on real income are given in Table 4.50 and on income shares in Table 4.51. The irrigation policy has a major impact on income. Obviously, the income contribution of the crop sector improves, and this is shown in Table 4.51.

Under the baseline scenario, the real per capita income for 1993 is Rs 971 and will increase by only 0.5 per cent to reach Rs 1,011 in 1988 (Chart 4.7).

Chart 4.7

The irrigation policy affects income levels as the total production of cereal grains, potatoes, and oilseeds increases (Tables 4.50 and 4.51). The real per capita income in 1993 increases by about three per cent compared to the baseline scenario. In 1988, the per capita income under this policy scenario will be about 10 per cent higher than under the baseline scenario. Under the baseline scenario, the long-term growth (1993-1998) in real per capita income is 0.50 per cent, whereas under the fertiliser policy scenario, this growth impact of the maize price policy is

confined to crop income. The increased price policy affects crop income, and, under this policy, crop income is higher than under the price reduction policy.

The joint policy affects per capita real income as well as the income shares accruing from different sources. The per capita real income for 1993 under the baseline situation is Rs 971, and, under the joint policy, it increases to Rs 2,183 (125% increase). By 1998 the per capita real income will increase to Rs 2,344 compared to the baseline income of Rs 1,011 (132% increase). The long-term growth in real per capita income under the baseline scenario is 0.5 per cent per annum and under the joint policy this growth rate increases to 1.44 per cent.

It should be noted that per capita income estimates turn out to be lower than the per capita value of imports. In this study, it was not possible to take into account all the income sources of households. A comparison with the Multipurpose Household Budget Survey information provides insight into sources that were not taken into account. For instance, cash incomes from remittance, rent, pensions, etc are sources which were not accounted for in the present exercise.

Most of the income in kind and cash were, however, accounted for. The resulting discrepancy in per capita income between the current and NRB estimates is in the order of 20 per cent, with the current estimate being lower. All expenditures were accounted for (in aggregate form), since NRB estimates were used. This is one reason for the observed discrepancy between the per capita income and per capita value of trade. Second, the per capita value of trade is in terms of money, whereas the income is in real terms. If the per capita value of trade is converted in to real terms, the discrepancy will be considerably reduced.

Natural Resources: Policy Scenarios and Impacts

The impacts of different policies on the natural resource sector are examined in this section. Two sets of policy interventions, mainly concerning both demand and supply aspects of the natural resource sector, particularly forests, have been considered. While the demand policy refers to a 10 per cent reduction in the per capita consumption of fuelwood, the supply policy involves improved management of the existing accessible forests in the mid-mountain region of the district. The effects of these two policies on demand and supply of fuelwood, fodder, and timber have been evaluated independently, as well as jointly, against the baseline scenario.

Impact on Fuelwood

Under the baseline scenario, the total supply of fuelwood from different sources is estimated to meet about 73 per cent of the demand in 1993, and this balance is

projected to decline at the rate of 1.88 per cent per annum. In the case of the demand policy, about 82 per cent of the fuelwood demand is expected to be met in 1993, although the balance under this policy deteriorates over time in the same manner as in the baseline situation (Table 4.52). It is interesting to note that the demand policy also enhances the fuelwood supply, mainly due to the net decline in the magnitude of per capita need which results in less deforestation. A decline in deforestation implies that accessible forests are deforested to a lesser extent, thereby increasing the fuelwood supply. This is the reason why the total supply of fuelwood under the demand policy decreases at a lower rate than in the baseline situation.

The supply policy, focussing on improved management, involves significant increment in wood yield beyond 1998, which is not within the limited time frame (5 years) considered in the model. Stated differently, the incremental biomass yield from improved management extends beyond 1998, which is beyond the time frame of the present exercise. Besides, the limited contribution of forests to the total fuelwood supply (20%) is another reason why the effect of this policy is not as apparent as in the case of the demand policy. As is evident from Table 4.52, the fuelwood balance does not change much as a result of this policy. The joint effect of the policy on fuelwood balance is also given in Table 4.52. The joint effect on fuelwood balance is similar to that of the demand policy. This also implies that benefits from improved forest management, especially in the initial five-year period, are not significant enough to improve the supply situation (Chart 4.8). Table 4.53 presents the impact on fuelwood when only forests are considered to be the source of fuelwood.

Chart 4.8

Impact on Fodder

Currently about 23 per cent of the total fodder supply in the district is estimated to come from forests and the remaining from shrub and grazing lands, adjacent NCI, and private lands. When all the accessible forests in the mid-mountains are brought under improved management, the total fodder supply from forests increases by over two and a half-fold in 1993. In other words, the contribution of forests to the total fodder supply is estimated to reach 44 per cent as a result of the improved management policy, compared to 23 per cent under the baseline scenario. The total fodder supply from all sources at present exceeds the demand by a little over four per cent (i.e., 104.2%), and this situation is projected to remain fairly constant under the baseline scenario (Table 4.52). Under the improved management policy, the fodder availability in the district is expected to improve further as a result of the incremental fodder yield. For example, the fodder supply as a percentage of demand increases from 104 per cent under the baseline scenario to 144 under the supply policy. Despite the improvement in fodder supply as a result of this policy, the excess supply declines over time at the rate of 2.2 per cent, and, by the year 1998, the fodder supply as a percentage of fodder demand is projected to reach 129 per cent.

The demand curtailment policy also increases the fodder supply due to the protection of accessible forests which would otherwise have been over-harvested to meet the fuelwood deficit. But the result indicates that the effect of the demand policy on fodder balance is not very different from the baseline scenario. As a result, the overall fodder balance situation does not improve much under the supply policy, even when both policies are introduced jointly (Chart 4.9). The impacts of the policy options on fodder, when only forests are considered as the sole supplier, are highlighted in Table 4.53.

Impact on Timber

Timber deficit in Sindhupalchok is more pronounced than either fuelwood and fodder deficits. Currently, about 55 per cent of the demand is estimated to be met from the total timber supply in the district under the baseline scenario, and this worsens over time with the decline in accessible forests. Under the demand curtailment policy, the timber balance situation improves slightly as less accessible forest areas need to be deforested to meet the deficit (Table 4.52). The supply policy also affects timber supply, but the effect is apparent only after 15 years or so, and it cannot be considered in the present exercise given the limited time frame considered in the model. The joint demand and supply policies would have a much stronger combined impact on the timber balance, if the increment timber yield over the full gestation period of forests under improved management was taken into account (Chart 4.10).

Environment and Carrying Capacity

As mentioned earlier, the environmental quality depends, to a great extent, upon the nature and magnitude of the relationship between population and land resources in a given geographical area. The direction and magnitude of inter-class land transfers that have taken place in the district along with the deforestation rate have grave environmental implications. This section attempts to examine the

effects of different policies on the environment in terms of the carrying capacity of land resources and associated demand pressure on these resources. The impacts of different policies on some selected indicators of sustainability, such as changing pressure on the natural resource base, forest-cultivated land ratio, and deforestation can be judged from the results presented in Table 4.53.

Pressure on the Resource Base

Under the current trend of population growth, the pressure on the natural resource base, as well as the environment, results primarily in the natural resource deficit which, in turn, leads to deforestation and land use changes. Since the population increases at a faster rate than the cultivated area, the population density per cultivated land gradually increases over the period and the pressure on cultivated land does not decrease significantly even after the policy intervention.

Similarly, the pressure on accessible forest lands will continue to grow over the projected period under all policy scenarios, because the accessible forests decrease at a faster rate than the population growth. In comparison to the baseline scenario, the population density per hectare of forest land under the demand policy is projected to grow at a relatively lower rate (2.3%) than under the supply policy (2.6%). The livestock density per hectare of forest area increases, while the livestock pressure on cultivated and grazing lands decreases under all policy scenarios (Table 4.54).

The forest-cultivated land ratio in Sindhupalchok shows a declining trend over time and is fairly below the optimum level as described in the previous chapter. But, the rate of declining in this ratio is much lower (1.79%) under the demand policy than under the supply policy (-2.08%). This implies that the demand reduction policy results in lesser deforestation of accessible forests than the supply policy.

The ratio between shrubland and forest land is often used as an indicator of forest degradation, particularly since deforestation in most hill regions of Nepal has resulted in forests being converted to shrublands. The ratio between shrubland and forest land increases over time under all policy interventions, but this ratio is expected to grow at a slightly lower rate (2.91%) under the demand policy than under the supply policy (3.44%).

The manner in which deforestation takes place annually and its estimation on the basis of the model have already been described in the previous section. Table 4.55 shows the magnitude and trend of the deforested area estimated by means of a simulation exercise under different policy scenarios. Under the baseline scenario, the deforested area in the district as a whole is projected to increase from 687 hectares in 1993 to 855 hectares in 1998, at the rate of 4.63 per cent per annum. In the mid-mountain region, it is projected to increase from 861 hectares in 1993 to

1,005 hectares in 1998 at the rate of 3.2 per cent per annum (Chart 4.11). Deforestation takes place mainly in the mid-mountain region of the district, given the current state of fuelwood deficit in this belt. The results indicate that the magnitude of deforestation under the demand policy is relatively lower than under the supply policy. It should, however, be noted that the rate of deforestation under the demand policy increases at a much faster rate (4.9%) than under the supply policy (3.4%).

Carrying Capacity

Food The impacts of different policies on the carrying capacity of crop lands to meet the calorie requirements are given in Table 4.56. The results indicate that the irrigation policy has a stronger impact on improving the carrying capacity of crop land than the fertiliser policy. While the demand pressure on a hectare of crop land remains unchanged under all policy interventions, the crop land capacity to sustain the population in terms of calorie requirements is estimated to be 6.16 persons per hectare of crop land under the irrigation policy compared to 5.6 persons per hectare under the fertiliser policy in 1998. It is, however, interesting to note that, although the impact of the irrigation policy on the calorie requirement is much stronger than the fertiliser policy, the per hectare supply of calories under the former policy increases at a slower rate (0.4%) than under the latter policy (1.02%).

When both these policies, along with the potato promotion policy, are simultaneously introduced, the carrying capacity of cropland in terms of sustaining the population is expected to increase to 7.15 persons per hectare compared to 5.43 persons per hectare under the baseline scenario. The demand pressure per

hectare of crop land also decreases as a result of this policy, due to the increased area under crops (i.e., potatoes). Consequently, the crop land capacity to meet the calorie requirements of the population increases to 93 per cent due to this combined policy, compared to 51 per cent under the baseline scenario (as already pointed out above). The results further indicate that the carrying capacity of crop land increases at a faster rate (1.02%) under this combined policy than the per hectare demand pressure (0.64%). Table 4.56 also shows the effect of the price policy on the carrying capacity of crop land to meet the calorie requirements. The results indicate that the 10 per cent change in the maize price will have a marginal effect on the carrying capacity compared to the baseline scenario.

Fuelwood Table 4.57 presents the impacts of different policies on the carrying capacity of land in terms of fuelwood. The carrying capacity of aggregate land in terms of fuelwood is estimated to be 2.21 persons per hectare of land, whereas the current demand pressure (i.e., load) is 1.78 persons per hectare under the baseline scenario. The per hectare supply of fuelwood is declining at the rate of 1.31 per cent per annum while the load factor is increasing at the rate of 0.58 per cent per annum.

The impact of the supply policy on the carrying capacity is, however, not very pronounced due to the reason stated earlier. Even if the accessible forests in the mid-mountain region are brought under improved management, the flow of benefits are visible only in later years and are not captured by the model. This could be the reason why the impact of the combined policy does not differ much from the results of the demand policy.

To gain a better understanding of the relative influence of policies, the carrying capacity of forest land was also estimated. The extent to which the natural resource policy affects biomass supply depends considerably upon the relative contribution of forests to the total fuelwood and fodder supply under the baseline scenario. If the district's fuelwood demand was met from forests only, the fuelwood supply from forests should meet about 70 per cent of the district's fuelwood demand, and this would deteriorate over time at a rate of 1.94 per cent per annum in the baseline situation. Under the demand management policy, the estimated carrying capacity of forest land to meet the fuelwood demand increases by 10 per cent (i.e., 77% compared to 69% under the baseline scenario). The estimated carrying capacity of forest land under the demand reduction policy is 12.5 persons per hectare for 1993, whereas the demand pressure (i.e., load) is 16.2 persons per hectare, the load being about 30 per cent higher than the carrying capacity. Although the impact of the supply management policy on the carrying capacity of forest land is not very different to the baseline situation, the long-term trend in per hectare supply of fuelwood from forests is more sustainable. This is because, compared to other policies, the carrying capacity of forests under this policy improves over time. The details are given in Table 4.58.

Fodder The extent to which the carrying capacity of land resources in terms of fodder is influenced by both demand and supply policies also depends on the relative share of forests in the total fodder supply in the district. As a result, the carrying capacities of both aggregate land and forests were estimated, and the impacts of policy alternatives were assessed. The results are given in Table 4.59. As can be observed from the Table, under the baseline scenario the capacity of all land resources to support the existing livestock population in the district is 1.27 LSU per hectare in 1993, whereas the current pressure is only 1.22 LSU per hectare. This implies that the carrying capacity of land is about four per cent higher than the load, indicating that the carrying capacity of aggregate land in terms of fodder is reasonable. When all the accessible forests in the mid-mountain region of the district are brought under improved management, the carrying capacity of land increases to 1.76 LSU per hectare compared to 1.27 LSU per hectare under the baseline scenario in 1993. The carrying capacity of land under this policy is, therefore, about 44 per cent higher than the fodder demand pressure on per hectare of land. The demand policy also affects the fodder supply through changes in accessible forest area, as described earlier, but the effect of this policy on the carrying capacity of land is marginal, given the limited contribution of forests to the total fodder supply.

Considering that the total fodder requirement of the district is to be met from forests alone, forests can meet only 24 per cent of the fodder demand under the baseline scenario. Under an improved forest management policy, the capacity of forest land to support the livestock population is estimated to be about 2.16 LSU per hectare, which is about 64 per cent of the demand (Table 4.60). But as the load per hectare increases at a faster rate (3.85%) than the carrying capacity (1.77%), the capacity of forest land to meet the fodder requirement declines over time at the rate of 6.24 per cent under this policy. Table 4.60 also shows the impacts of the combined policy on the carrying capacity of forest land, and these are not very different from these of the supply policy, mainly because of the marginal impact of the demand management policy on fodder supply.

Timber The impacts of different policies on the carrying capacity of forest land in terms of timber are given in Table 4.61. The results indicate that the carrying capacity of forest land to meet the timber demand remains more or less unchanged under the policy interventions. This is primarily because of the fact that the marginal increase in per hectare timber supply under the policy intervention results primarily from an increase in the accessible forest area, rather than from an improvement in the timber yield. While timber yield also increases as a result of improved forest management, this is not reflected within the timeframe covered by the model.

Conclusion

The economic and environmental conditions of Sindhupalchok district are already serious and are deteriorating rapidly.The results discussed indicate that the population reduction policy does not appear to have a significant impact on the food, natural resource, and environmental sectors of Sindhu district within the time frame of the model (6 years). It is precisely because the timeframe is short that all the impacts could be captured by the model. Population reduction policies, even as instantaneous as those in the model, do not manifest all the impacts within a short period of six years. Over a much longer period, the size and composition of the population will change, and the impacts will become more and more pronounced. What should be noted is that, if the population can be reduced to fifty per cent from the current level of growth within five to six years as envisaged in the Eighth Five Year Plan, this will have a cumulative impact over time. Over several decades, this policy will most likely have very positive impacts on the food and natural resource sectors as well as on the environment.

Examination of some policies related to the crop sector reveals that limited scope exists, within the present state of technology, to improve the economic situation of the district. The strongest positive impact was exerted by the combined policy action of irrigation development, greater application of chemical fertiliser, and increased cropping intensity. When the above policies were examined separately, the impacts were smaller than under the combined policy action. The food situation in the district also improved considerably under the combined policy action, thus making this policy more favourable. The impacts of this policy on employment and income were also more positive.

Under the existing natural resource harvest regime system in the district, which is already under severe stress, the situation is observed to deteriorate rapidly over time. Policy options regarding supply as well as demand and the two combined were examined. The demand policy, which aims at curtailing fuelwood demand by 10 per cent, had strong positive impacts on the carrying capacity as the load factor was reduced, but, over time, the impacts were observed to weaken. Population growth results in increased demand while supply remains unchanged. When the supply management policy was introduced, the initial impacts were seen to be less pronounced, but longer-term impacts were observed to be much greater. The combined policy impact was even more pronounced as it curtailed demand and increased supply.

Finally, all the policy scenarios examined do not suggest that the environmental condition of the district is sustainable, based on the carrying capacity of land to meet calorie, fuelwood, timber, and fodder needs. The exercise conducted clearly reveals that, in order to improve the economic and environmental conditions of Sindhu, combined policy measures regarding both demand and supply are urgently required in the crop and natural resource sectors.

Table 4.1: Trends in Area Under Different Crops

Year	Paddy	Maize	Millet	Wheat	Oilseeds	Potatoes	Total
1975	3900	9500	2500	1202	90	1725	18917
1976	3900	9500	2450	1382	99	1897	19228
1977	3900	9500	2450	1380	90	1850	19170
1978	4170	10320	2930	1400	100	2470	21390
1979	4170	10320	2930	1400	90	2480	21390
1980	3900	8600	2700	2200	50	1750	19200
1981	3900	9600	2700	2200	50	1600	20050
1982	4250	8600	2450	2200	100	2700	20300
1983	4400	10000	2450	4000	250	2500	23600
1984	4400	9500	2830	4300	250	2590	23870
1985	4300	9500	2850	4770	240	2500	24160
1986	4350	9700	2500	4500	260	2510	23820
1987	5100	10000	2550	4400	480	2500	25030
1988	5170	10040	2600	4300	650	2580	25340
Average	4272	9620	2635	2831	199	2260	21818
Std. Dev.	400	507	179	1384	170	379	2305
Coeff. Var	9.37	5.27	6.79	48.90	84.82	16.7	10.56

Source: DFAMS, 1990.

Table 4.2: Regression Results on Crop Area

Paddy Area=	3597.968+374.67*ln(time) (309.74) (110.9)	R2 = 0.48
Maize Area=	9516.69+57.41*ln(time) (546.13) (195.67)	R2 = 0.007
Millet Area=	2560.45+ 41.43*ln(time) (190.43) (68.23)	R2 = 0.03
Wheat Area=	37.71 + 1552.37*ln(time) (819.8) (293.73)	R2 = 0.69
Oilseeds Area=	3.846 + 0.1524*ln(time)	
Potatoes Area=	1664.36+331.49 in (time) (310.7) (111.32)	R2 = 0.43

Note: Figures in parenthesis are standard errors of estimate

Table 4.3: Trends in Crop Yield (kg/ha)

Year	Paddy	Maize	Millet	Wheat	Oilseeds	Potatoes
1976	2113	1942	1120	1190	433	5586
1977	2300	1942	1118	1071	434	5306
1978	1726	1747	894	1116	444	5497
1979	2002	1600	1072	1200	700	5498
1980	1719	1200	966	1164	667	5500
1981	1821	1600	1000	1200	600	6497
1982	1821	1600	1000	1100	600	7000
1983	1716	1408	1000	1500	800	7000
1984	1734	1152	1000	1000	640	8000
1985	1727	1500	901	1000	640	7000
1986	1619	1400	1000	849	667	5500
1987	1632	1474	1088	911	654	6000
1988	1963	1200	1000	1323	562	7500
1989	2052	1500	1100	1400	646	7500
Avg. Yield	1976	1519	1018	1144	661	7180
Avg. Growth	-0.22	-1.96	-0.14	1.25	3.12	2.29

Source: DFAMS 1990

Table 4.4: Fertiliser Sale and Average Sale Per Cropped Area

Year	Fertiliser sale (MT)	Sale (kg/ha)
1982	1624	80
1983	2080	88
1984	1952	82
1985	1607	11
1986	1912	80
1987	2197	88
1988	1613	64
1989	1613	-
1990	1622	-
1991	1889	

Source: Agricultural Inputs Corporation

Table 4.5: Livestock Population and Livestock Products

	1984	1985	1986	1987	1988
Population					
Goats	111831	116092	120515	119360	118763
Cattle	105389	106864	108360	107535	106728
Buffaloes (female)	55114	56530	57983	57580	57350
Buffaloes (male)	9992	10249	10512	11054	10956
Milch Cows	8747	8869	8994	8274	8200
Pigs	6704	7031	7374	7460	7535
Sheep	20971	21533	22110	21930	21754
Pork	96	101	106	107	108
Chicken	103550	109680	116173	113629	111242
Products (MT)					
Mutton	80	82	84	83	82
Buffalo Milk	8873	9101	9440	10328	10236
Cow's Milk	3787	3840	3957	3817	3783
Chicken	164	174	184	180	176
Buffalo Meat	1778	1824	1871	1858	1851
Goat Meat	279	290	301	298	297

Table 4.6: Land Use Changes in Sindhupalchok by Ecological Region

Land use (ha)	1978	1979	1980	1985	1986	1987	1988	1989	1990
Mid-mountains	81524	81524	81524	81524	81524	81524	81524	81524	81524
Natural Forests	17585	17409	17235	16390	16226	16064	15904	15745	15587
Accessible Forests	17585	17409	17235	16390	16226	16064	15904	15745	15587
Change in Forests		-176	-174	-166	-164	-162	-161	-159	-157
Shrublands	16347	16435	16522	16944	17026	17107	17188	17267	17346
Grasslands	1966	1992	2018	2145	2170	2194	2218	2242	2266
Mapped Cultivation	44842	44895	44947	45200	45250	45298	45346	45394	45441
Adjacent NCI	15120	15138	15155	15239	15256	15272	15288	15304	15320
Gross Cultivated	29722	29757	29792	29961	29994	30026	30058	30090	30122
NCI Within	5722	5722	5722	5722	5722	5722	5722	5722	5722
Net Cultivated	24000	24035	24070	24239	24272	24304	24336	24368	24400
MM Calculated	80740	80731	80723	80680	80672	80664	80656	80648	80640
High Mountains	102569	102569	102569	102569	102569	102569	102569	102569	102569
Natural Forests	50055	49734	49417	47875	47576	47280	46987	46697	46410
Accessible Forests	32085	31764	31447	29906	29606	29310	29017	28727	28440
Change in Forests		-321	-318	-302	-299	-296	-293	-290	-287
Inaccessible Forests	17970	17970	17970	17970	17970	17970	17970	17970	17970
Shrublands	16791	16951	17110	17881	18030	18178	18325	18470	18614
Grasslands	8090	8138	8186	8417	8462	8506	8550	8594	8637
Mapped Cultivation	18792	18888	18984	19446	19536	19624	19712	19799	19886
Adjacent NCI	7199	7231	7263	7417	7447	7476	7506	7535	7564
Gross Cultivated	11593	11657	11721	12029	12089	12148	12207	12265	12322
NCI within	2046	2046	2046	2046	2046	2046	2046	2046	2046
Net Cultivated	9547	9611	9675	9983	10043	10102	10161	10219	10276
HM Calculated	93728	93712	93696	93619	93604	93589	93575	93560	93546
Residual	9701	9717	9733	9810	9825	9840	9854	9869	9883
Total									
Forests	86780	86283	85792	83406	82943	82484	82031	81581	81137
Accessible Forests	49670	49174	48682	46296	45833	45375	44921	44472	44027
Shrublands	34568	34816	35062	36255	36487	36716	36943	37167	37390
Grasslands	11756	11831	11904	12262	12332	12400	12468	12536	12602
Adjacent NCI	22319	22369	22418	22656	22703	22749	22794	22839	22883
NCIG	7768	7768	7768	7768	7768	7768	7768	7768	7768
Net Cultivated	33817	33916	34015	34492	34584	34676	34767	34857	34946
Residual (including)	51088	51113	51137	51257	51280	51303	51325	51348	51370
Sindhu Total	248096	248096	248096	248096	248096	248096	248096	248096	248096

Table 4.7: Summary of Plantation Activities in Sindhupalchok

Year	HMG	PF	PPF	Total
1975	80	-	-	80
1976	166	-	-	166
1977	400	-	-	400
1978	220	-	-	220
1979	76	-	-	76
1980	100	-	-	100
1981	83	-	-	83
1982	201.2	190.9	-	392.1
1983	327.5	146.9	19.5	493.9
1984	390.6	223.2	22.7	636.5
1985	436.59	334.37	25.4	796.36
1986	459.07	382.01	0.7	841.85
1987	534.78	533.9	1.6	1070.28
1988	546.0	558.7	41.38	1046.15
1989	872.77	81.14	13.68	967.59
1990	487.0	395.1	-	882.1
Total	5380.51	2946.29	125.03	8451.83

Source: Sindhupalchok District Resource Information and Forest Management Scheme: DFO Sindhupalchok

Table 4.8: Forecasted Product and Factor Prices (Rs/kg)

Products & Factors	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Products									
Paddy	6.76	7.36	8.03	8.75	9.54	10.39	11.33	12.35	8.99
Wheat	6.89	7.35	7.84	8.35	8.91	9.50	10.13	10.80	6.62
Maize	6.58	7.05	7.56	8.11	8.70	9.33	10.01	10.73	7.24
Millet	6.95	7.59	8.30	9.07	9.91	10.82	11.83	12.92	9.26
Mustard Seeds	17.08	18.97	21.06	23.38	25.95	28.81	31.98	35.51	11.02
Potatoes	5.28	5.70	6.14	6.62	7.14	7.70	8.30	8.95	7.82
Mutton	56.87	63.28	70.41	78.34	87.17	97.00	107.93	120.10	11.27
Chicken	60.05	65.92	72.37	79.45	87.22	95.75	105.11	115.39	9.78
Buffaloes	26.37	29.40	32.77	36.54	40.73	45.41	50.62	56.44	11.48
Pork	31.26	34.27	37.57	41.19	45.16	49.51	54.28	59.51	9.64
Milk (Rs/Lit.)	8.99	9.78	10.65	11.60	12.63	13.76	14.98	16.31	8.89
Mustard Oil (Rs/Lit)	59.91	66.37	73.53	81.45	90.23	99.96	110.74	122.68	10.78
Ghee (Rs/Lit.)	108.26	118.87	130.52	143.31	157.35	172.78	189.71	208.30	9.80
Wool	80.25	85.87	91.88	98.31	105.19	112.55	120.43	128.86	7.00
Cereal Grain Price	6.71	7.22	7.78	8.38	9.03	9.73	10.48	11.29	7.72
Oils and Fats Price	78.79	85.39	92.64	100.56	109.21	118.70	129.14	140.65	8.63
Aggregate Meat Price	34.88	38.82	43.20	48.08	53.50	59.53	66.24	73.70	11.28
Factors									
Fertiliser price (Rs/kg)	4.28	4.58	4.90	5.24	5.61	6.00	6.42	6.87	7.00
Wage Rate (Rs/day)	33.52	35.87	38.38	41.06	43.94	47.01	50.31	53.83	7.00
Bullocks (Rs/pair days)	26.82	28.69	30.70	32.85	35.15	37.61	40.24	43.06	7.00

Table 4.9: Forecasted Area under Different Crops (hectares)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	5194	5216	5238	5258	5277	5296	5313	5330	0.37
Maize	10044	10047	10051	10054	10057	10059	10062	10065	0.03
Millet	2602	2605	2607	2609	2612	2614	2616	2617	0.08
Wheat	4400	4494	4583	4667	4746	4822	4894	4963	1.74
Oilseeds	726	815	918	1038	1177	1340	1530	1751	13.40
Potatoes	2601	2622	2641	2658	2675	2692	2707	2722	0.65
Total Cropped Area	25567	25799	26037	26284	26545	26823	27122	27447	1.02
Total Cultivated Land	15238	15264	15289	15312	15334	15355	15375	15394	0.15
Area Under Irrigation	4409	4498	4588	4679	4773	4868	4966	5065	2.00
Total Fertiliser Sale in District	1953	1986	2020	2054	2088	2124	2160	2196	1.69

Table 4.10: Forecasted Yield Rates of Different Crops (kg/ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	2075	2067	2067	2067	2067	2067	2066	2066	-0.06
Maize	1478	1473	1473	1473	1473	1473	1473	1473	-0.04
Wheat	1263	1225	1225	1225	1225	1225	1225	1225	-0.44.
Millet	1007	1005	1005	1005	1005	1005	1005	1005	-0.02
Oilseeds	661	665	665	665	665	665	665	665	0.09
Potatoes	7182	7174	7174	7173	7173	7173	7173	7173	-0.02

Table 4.11: Forecasted Changes in Crop Production (MT)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	10780	10782	10826	10867	10906	10944	10978	11012	0.31
Maize	14840	14804	14808	14812	14816	14820	14823	14826	-0.01
Wheat	5559	5506	5614	5717	5814	5907	5995	6079	1.29
Millet	2621	2619	2621	2623	2625	2627	2629	2631	0.06
Oilseeds	480	542	610	690	783	891	1017	1164	13.50
Potatoes	18685	18807	18942	19070	19192	19307	19417	19522	0.63

Table 4.12: Forecasted Revenue, Costs, and Gross Margins Per Hectare of Cultivated Land under Different Crops (Rs/ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Revenue									
Paddy	14.68	15.88	17.25	18.74	20.36	22.13	24.06	26.16	8.61
Maize	10.27	10.95	11.70	12.51	13.37	14.30	15.29	16.36	6.87
Wheat	9.11	9.41	10.00	10.64	11.32	12.04	12.81	13.63	5.92
Millet	7.40	8.04	8.75	9.52	10.36	11.29	12.29	13.39	8.84
Oilseeds	11.29	12.61	14.00	15.54	17.26	19.16	21.27	23.61	11.11
Potatoes	37.95	40.87	44.06	47.51	51.22	55.23	59.54	64.20	7.80
Cost									
Paddy	9.79	10.47	11.21	12.00	12.85	13.75	14.72	15.76	7.05
Maize	7.16	7.66	8.20	8.77	9.39	10.04	10.74	11.49	6.99
Wheat	6.88	7.35	7.86	8.40	8.98	9.60	10.27	10.98	6.91
Millet	6.15	6.58	7.04	7.54	8.07	8.64	9.25	9.91	7.06
Oilseeds	4.33	4.65	4.99	5.35	5.74	6.16	6.61	7.09	7.29
Potatoes	14.84	15.92	17.07	18.32	19.65	21.09	22.62	24.27	7.29
Per Hectare Gross Margin									
Paddy	4896	5405	6035	6736	7515	8381	9337	10402	11.37
Maize	3111	3285	3502	3735	3987	4259	4551	4867	6.60
Wheat	2235	2056	2145	2237	2334	2436	2542	2653	2.48
Millet	1257	1460	1703	1978	2290	2642	3040	3487	15.69
Oilseeds	6956	7964	9015	10194	11516	12997	14656	16514	13.15
Potatoes	23113	24951	26988	29189	31569	34141	36921	39926	8.12

Table 4.13: Forecasted Livestock Population

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cattle	106836	106942	107044	107142	107233	107318	107395	107462	0.08
Milch Cows	44444	44488	44530	44571	44609	44644	44676	44704	0.08
Bullocks	62392	62454	62514	62571	62624	62674	62719	62758	0.08
Buffalo-total	57418	57485	57549	57611	57669	57722	57770	57813	0.10
Milch Buffaloes	11254	11267	11280	11292	11303	11314	11323	11331	0.10
Sheep	21918	21938	21958	21976	21994	22010	22025	22037	0.08
Goats	119951	120071	120187	120298	120402	120498	120585	120661	0.08
Pigs	7828	8063	8305	8554	8810	9075	9347	9627	3.00
Chicken	114579	118017	121557	125204	128960	132829	136814	140918	3.00
Total LSU	136490	136634	136773	136905	137030	137145	137248	137339	0.09

Table 4.14: Forecasted Annual Production and Growth in Livestock Products (MT)

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cow's Milk	4329	4333	4337	4341	4345	4348	4351	4354	0.08
Buff Milk	2145	2147	2150	2152	2154	2156	2158	2160	0.10
Ghee	84	84	84	84	84	85	85	85	0.09
Net Milk Supply	4532	4536	4541	4545	4550	4553	4557	4560	0.09
Buffalo Meat	1523.41	1525.19	1526.90	1528.53	1530.07	1531.49	1532.77	1533.88	0.10
Goat meat & Mutton	428.83	429.26	429.67	430.06	430.43	430.77	431.08	431.34	0.08
Chicken Meat	151.24	155.78	160.46	165.27	170.23	175.33	180.59	186.01	3.00
Pork	73.58	75.79	78.06	80.41	82.82	85.30	87.86	90.50	3.00
Aggregate Meat Available	2177.07	2186.02	2195.09	2204.27	2213.54	2222.89	2232.30	2241.74	0.42
Wool Production (kg)	9647.59	9656.48	9665.06	9673.24	9680.93	9688.04	9694.45	9700.04	0.08

Table 4.15: Forecasted Cost and Returns from Livestock (Rs/animal)

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998
Buffaloes	280	300	321	343	368	393	421	450
Sheep and Goats	95	102	109	117	125	134	143	153
Pigs	143	153	164	175	187	201	215	230
Chicken	14	15	16	17	18	20	21	23
Milch Cows	421	450	482	515	551	590	631	675
Milch Buffaloes	668	715	765	819	876	937	1003	1073
Cattle excluding Milch Cows	336	360	385	412	441	472	505	540
Total Cost (Rs'000)	85456	91619	98225	105305	112892	121022	129730	139056
Total Gross Margin From Livestock	79526	89978	101702	114847	129577	146076	164547	185215

Table 4.16: Forecasted Per Capita Food Supply (kg/adult)

Food (edible form)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
CerealGrains	77.62	76.59	76.20	75.81	75.41	75.01	74.60	74.19	-0.64
Meat	7	7	7	7	7	7	7	7	-0.51
Milk	14	14	14	14	14	14	14	13	-0.84
Oils and Fats	1	1	1	1	1	1	1	1	8.35
Vegetables	46	46	46	46	46	46	46	45	-0.31

Table 4.17: Forecasted Per Capita Food Demand (kg/adult)

Food (ediable form)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal Grains	128.66	128.16	128.49	128.56	128.64	128.73	128.81	128.90	0.03
Vegetables	22.44	21.01	21.32	21.40	21.48	21.56	21.63	21.72	-0.46
Meat	3.31	3.03	3.10	3.12	3.13	3.15	3.17	3.19	-0.53
Milk	20.51	19.32	19.53	19.58	19.64	19.70	19.76	19.82	-0.49
Oils and Fats	2.17	2.07	2.09	2.09	2.10	2.10	2.11	2.11	-0.41

Table 4.18: Forecasted Per Capita Food Balance Situation (kg/adult)

Food (edible form)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal Grains	-51.05	-51.57	-52.28	-52.75	-53.23	-53.72	-54.21	-54.71	0.99
Vegetables	23.91	25.18	24.75	24.55	24.34	24.11	23.88	23.63	-0.16
Meat	3.55	3.79	3.68	3.63	3.58	3.53	3.48	3.43	-0.50
Milk	-6.23	-5.16	-5.50	-5.67	-5.84	-6.01	-6.18	-6.36	0.29
Oils and Fats	-1.49	-1.35	-1.31	-1.26	-1.19	-1.12	-1.03	-0.92	-6.69

Table 4.19: Forecasted Change in Land Use (%)

Land Use	1991	1992	1995	1998
Forests	24	24	23	22
Shrublands	15	15	15	16
Grasslands	4	4	5	5
Adjacent NCI	9	9	9	10
Net Cultivated	14	14	14	15
Residual	34	34	34	32
Total %	100	100	100	100
Total (ha)	248,096	248,096	248,096	248,096

Table 4.20: Fuelwood Share of Different Sources and Total Annual Supply (%)

Sources	1991	1992	1995	1998
Forests	58	57	55	53
Adjacent NCI	14	14	14	15
Farmland	1	1	1	1
Shrub & Grasslands	22	23	24	26
Others	5	5	6	6
Total %	100	100	100	100
Total (adt)	116,461	115,483	112,344	108,888

Table 4.21: Forecasted Fuelwood Supply from Different Sources (air dry tonnes (adt))

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Sindhu Total									
Forests: Hardwood	46732	45433	44091	42704	41272	39794	38270	36699	-3.39
Coniferous	3983	3976	3968	3959	3951	3942	3933	3924	-0.22
Mixed	16732	16721	16710	16698	16686	16673	16660	16646	-0.07
Shrublands	24999	25238	25486	25744	26011	26288	26575	26873	1.04
Grazinglands	1102	1114	1126	1139	1153	1166	1181	1195	1.17
Adjacent NCI	15843	15898	15956	16015	16076	16140	16205	16272	0.38
Cultivated Area	1219	1225	1231	1237	1243	1249	1256	1263	0.50
Total Supply	116461	115483	114471	113425	112344	111227	110075	108888	-0.96
Per Capita Supply (adkg)	446	438	430	422	414	407	399	391	-1.88
Per Capita Deficit (adkg)	-142	-150	-158	-166	-174	-181	-189	-197	4.83
Total Deficit	-36991	-39467	-41973	-44507	-47069	-49659	-52278	-54925	5.81
Mid-Mountains									
Per Capita Supply (adkg)	253	245	237	229	221	213	205	197	-3.52
Per Capita Deficit (adkg)	-335	-343	-351	-359	-367	-375	-383	-391	2.24
High Mountains									
Per Capita Supply (adkg)	807	799	792	784	777	770	763	756	-0.93
Per Capita Deficit (adkg)	219	211	204	196	189	182	175	168	-3.72

Table 4.22: Forecasted Timber Supply and Demand (cubic metre)

	1991	1992	1993	1994	1995	1996	1997	1988	Growth
Total Supply	12124	11891	11649	11399	11141	10875	10601	10318	-2.28
Total Demand	20617	20818	21019	21219	21418	21616	21813	22009	0.94
Timber Balance (SS-DD)	-8492	-8928	-9370	-9819	-10276	-10740	-11212	-11691	4.67

Table 4.23: Forecasted Shares of Fodder Timber Supply by Source (%)

Sources	1991	1992	1995	1998
Forests	24	23	22	21
Shrublands	31	32	33	34
Grasslands	8	8	8	8
Adjacent NCI	6	6	6	6
Farmland	5	5	5	5
Others	26	26	26	26
Total %	100	100	100	100
Total (tdn MT)	88,700	88,800	89,084	89,357

Table 4.24: Forecasted Fodder Supply by Source (MTt-total digestible nutrient [TDN])

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Forest lands	21106	20759	20401	20031	19648	19254	18847	18428	-1.92
Shrublands	27897	28164	28441	28729	29027	29336	29657	29988	1.04
Grazinglansd	7231	7265	7300	7336	7373	7412	7451	7492	0.51
Adjacent NCI	5510	5530	5550	5570	5592	5614	5637	5660	0.38
Risers & Bunds	2438	2449	2461	2473	2486	2498	2512	2525	0.50
Fallow Grazings	2090	2099	2109	2120	2130	2141	2153	2165	0.50
Tree Fodder	4876	4899	4922	4946	4971	4997	5023	5051	0.50

Table 4.25: Labour Use by Sector

Labour Use & Activities	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Labour Days Available	44741	45217	45692	46167	46641	47114	47560	48005	1.01
Labour Use on Crops	4318	4349	4379	4410	4442	4474	4509	4545	0.73
Livestock	13649	13663	13677	13691	13703	13714	13725	13734	0.09
Professionals	687	695	702	709	716	724	731	737	1.01
Office Workers	773	781	790	798	806	814	822	830	1.01
Sales and Services	1632	1650	1667	1684	1701	1719	1735	1751	1.01
Production Workers	1804	1823	1842	1861	1881	1900	1918	1936	1.01
Construction etc	430	434	439	443	448	452	457	461	1.01
General Labourers	3737	3776	3816	3856	3895	3935	3972	4009	1.01
Total Labour Use	27030	27171	27312	27452	27592	27732	27867	28003	0.51
Labour Use as % of Available	60	60	60	59	59	59	59	58	-0.50

Table 4.26: Forecasted Values of Food and Non-food Imports (Rs'000)

Labour Use and Activity	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Growth Rate of Non-food Imports	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-7.96
Total Food Imports	-69380	-65196	-73348	-79778	-86521	-93510	-100582	-107732	6.49
Total N-food Imports	-257771	-260706	-263697	-266701	-269719	-272751	-275797	-278857	1.13
Value of Imports	-327151	-325902	-337044	-346479	-356241	-366262	-376379	-386589	2.41
Value: Per Capita Food (Rs)	-258	-247	-276	-297	-319	-342	-364	-387	5.96
Value: Per Capita N-food (Rs)	-988	-989	-991	-993	-995	-997	-999	-1001	0.19

Table 4.27: Forecasted Nominal Income by Source (Rs '000')

Sources of Income	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	123140	134264	146679	164775	182815	203117	226055	252143	10.78
Livestock	79526	89978	101702	114847	129577	146076	164547	185215	12.84
Professionals	7679	7760	7842	7924	8005	8166	8163	8239	1.01
Office Workers	8024	8109	8195	8280	8365	8450	8530	8610	1.01
Sales and Service Workers	18771	18971	19170	19369	19568	19767	19954	20141	1.01
Production Workers	13241	13382	13523	13663	13803	13943	14075	14207	1.01
Construction, etc	3775	3815	3855	3895	3935	3975	4013	4051	1.01
General Labourers	24982	25248	25513	25778	26043	26307	26556	26805	1.01
Total Sindhu Income	279138	301528	328480	358532	392112	429721	471893	519410	9.28
Per Household Income (Rs)	6418	6865	7408	8009	8678	9423	10254	11186	8.26
Per Capita Income (Rs)	1070	1144	1235	1335	1446	1571	1709	1011	8.26

Table 4.28: Forecasted Real Income by Source (Rs'000)

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	112392	113784	116971	120341	123940	127822	132043	136701	2.84
Livestock	72585	76253	80012	83876	87847	91926	96115	100416	4.75
Professionals	7009	6577	6170	5787	5427	5089	4768	4467	-6.23
Office Workers	7324	6872	6447	6047	5671	5317	4982	4668	-6.23
Sales and Service Workers	17133	16077	15082	14146	13266	12439	11656	10919	-6.23
Production Workers	12085	11341	10639	9979	9358	8775	8222	7702	-6.23
Construction, etc	3446	3233	3033	2845	2668	2502	2344	2196	-6.23
General Labourers	22802	21396	20072	18827	17656	16555	15512	14532	-6.23
Total Sindhu Income	254774	255533	258425	261847	265833	270425	275643	281602	1.44
Per Household Income (Rs)	6418	6865	7408	8009	8678	9423	10254	11186	8.26
Per Capita Income (Rs)	976	970	971	975	981	988	998	1011	0.50

Table 4.29: Forecasted Income Shares by Source (%)

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	44.11	44.53	45.26	45.96	46.62	47.27	47.90	48.54	1.38
Livestock	28.49	29.84	30.96	32.03	33.05	33.99	34.87	35.66	3.26
Professionals	2.75	2.57	2.39	2.21	2.04	1.88	1.73	1.59	-7.56
Office Workers	2.87	2.69	2.49	2.31	2.13	1.97	1.81	1.66	-7.56
Sales and Service Workers	6.72	6.29	5.84	5.40	4.99	4.60	4.23	3.88	-7.56
Production Workers	4.74	4.44	4.12	3.81	3.52	3.24	2.98	2.74	-7.56
Construction, etc.	1.35	1.27	1.17	1.09	1.00	0.93	0.85	0.78	-7.56
General Labourers	8.95	8.37	7.77	7.19	6.64	6.12	5.63	5.16	-7.56
Total	100	100	100	100	100	100	100	100	0.00

Table 4.30: Performance and Sustainability Indicators

Indicators (ha/person)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Per Capita Cultivated Land (ha/person)	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	-0.43
Per Capita Accessible Forest Land	0.16	0.22	0.22	0.21	0.21	0.20	0.20	0.19	2.64
Forest-Cultivated Area Ratio	1.72	1.69	1.65	1.62	1.59	1.55	1.52	1.48	-2.05
Shrub-Forest Area Ratio	0.87	0.89	0.92	0.95	0.98	1.02	1.05	1.09	3.39
Population Density Per Cultivated Land	7.49	7.53	7.57	7.60	7.64	7.67	7.70	7.72	0.43
Population Per Accessible Forests	6.24	4.47	4.58	4.69	4.81	4.93	5.06	5.20	-2.57
LSU Per Cultivated Area	3.92	3.90	3.89	3.88	3.86	3.84	3.83	3.81	-0.41
LSU Per Forest Area	3.26	2.32	2.35	2.39	2.43	2.47	2.52	2.56	-3.39
LSU Per Grazing Area	12.39	12.27	12.14	12.02	11.89	11.76	11.63	11.49	-1.07
Population Per Accessible Forests	6.24	4.47	4.58	4.69	4.81	4.93	5.06	5.20	-2.57

Table 4.31: Forecasted Population and Changes in the Size of the Active Population

Composition	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Active Males	94606	95723	96841	97962	99084	100206	101232	102255	1.12
Active Females	84357	85144	85927	86706	87480	88248	89009	89765	0.89
Total Active Population	178963	180867	182769	184668	186563	188455	190241	192020	1.01
Total: Males	138537	140010	141482	142951	144419	145884	147299	148710	1.02
Total: Females	122435	123511	124579	125640	126691	127733	128813	129883	0.85
Total Population	260972	263521	266061	268591	271110	273617	276112	278593	0.94
Mid-Mts Total Population	180593	182357	184114	185865	187608	189343	191070	192786	0.94
High Mts Total Population	80379	81164	81947	82726	83502	84274	85042	85807	0.94

Note: While deriving the active population, the participation rate was not accounted for, and, as a result, the active population is on the higher side

Table 4.32: Carrying Capacity of Agricultural Land in Terms of Calories

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Calories ('000)									
Per ha Calorie ss	3958.49	3927.40	3925.71	3924.11	3922.60	3921.16	3919.67	3918.35	-0.15
Per ha Calorie DD	7599.08	7629.41	7661.62	7695.43	7730.58	7766.85	7804.09	7842.10	0.45
SS as % of DD	52.09	51.48	51.24	50.99	50.74	50.49	50.23	49.97	-0.59
Carrying Capacity per ha.	5.47	5.43	5.43	5.43	5.42	5.42	5.42	5.42	-0.15
Current Load	10.51	10.55	10.59	10.64	10.69	10.74	10.79	10.84	0.45

Table 4.33: Carrying Capacity of Land in Terms of Fuelwood

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Fuelwood Supply Per ha	1.33	1.31	1.30	1.28	1.27	1.25	1.23	1.21	-1.31
Per ha Demand	1.75	1.76	1.78	1.79	1.80	1.81	1.82	1.83	0.58
SS as % of DD	75.89	74.53	73.17	71.82	70.47	69.13	67.80	66.47	-1.88
Carrying Capacity Per ha	2.26	2.24	2.21	2.18	2.15	2.12	2.09	2.06	-1.31
Current Load	2.98	3.00	3.02	3.04	3.06	3.07	3.09	3.10	0.58

Table 4.34: Carrying Capacity of Forest Land in Terms of Fuelwood

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Fuelwood Supply Per ha	6.51	6.55	6.60	6.65	6.71	6.76	6.83	6.90	0.83
Per ha Demand	9.03	9.26	9.51	9.77	10.05	10.34	10.65	10.98	2.84
SS as % of DD	72.08	70.74	69.40	68.06	66.74	65.42	64.11	62.80	-1.95
Carrying Capacity per ha	11.07	11.14	11.23	11.31	11.41	11.50	11.61	11.73	0.83
Current Load	15.36	15.75	16.18	16.62	17.09	17.59	18.11	18.68	2.84

Table 4.35: Carrying Capacity of Forest Land in Terms of Timber

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1988	Growth
Timber									
Timber Supply Per Ha	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.00
Per Ha Demand	0.49	0.51	0.52	0.54	0.56	0.58	0.60	0.62	3.29
SS as % of DD	58.81	57.12	55.42	53.72	52.02	50.31	48.60	46.88	-3.19
Carrying Capacity Per Ha	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	0.00
Current Load (persons/ha)	6.24	6.43	6.62	6.83	7.06	7.30	7.55	7.83	3.29

Table 4.36: Carrying Capacity of Land in Terms of Fodder

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Per ha Fodder SS	0.79	0.79	0.79	0.80	0.80	0.80	0.81	0.81	0.36
Per ha Fodder Demand	0.76	0.76	0.76	0.77	0.77	0.77	0.77	0.78	0.34
SS as % of DD	104.19	104.20	104.21	104.21	104.23	104.25	104.28	104.32	0.02
Carrying Capacity Per ha	1.27	1.27	1.27	1.28	1.28	1.29	1.29	1.30	0.36
Current Load	1.21	1.22	1.22	1.23	1.23	1.24	1.24	1.24	0.34

Table 4.37: Carrying Capacity of Forest Land in Terms of Fodder

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Per ha Fodder SS	0.50	0.51	0.51	0.51	0.51	0.51	0.52	0.52	0.37
Per ha Fodder Demand	2.04	2.08	2.12	2.17	2.22	2.28	2.34	2.41	2.42
SS as % of DD	24.79	24.36	23.92	23.46	22.99	22.51	22.02	21.51	-2.01
Carrying Capacity Per ha	0.81	0.81	0.81	0.82	0.82	0.82	0.83	0.83	0.37
Current Load	3.26	3.33	3.40	3.48	3.57s	3.66	3.75	3.86	2.42

Table 4.38: Population Reduction Growth Assumption

	1993	1994	1995	1996	1997	1998
Growth Rates (%)	0.998	0.898	0.798	0.698	0.598	0.498
Total Active Population	182830	184816	186825	188856	190809	192783
Total Population	266151	268807	271490	274199	276936	279700
Reduction due to Policy	90	216	380	582	824	1107

Table 4.39: Impacsts of Population Reduction on Calorie Balance

	1993	1994	1995	1996	1997	1998
Per ha Calorie Supply	3925.71	3924.11	3922.60	3921.16	3919.67	3918.35
Per ha Calorie Demand	7664.21	7701.62	7741.41	7783.38	7827.37	7873.25
Supply as % of Demand	51.22	50.95	50.67	50.38	50.08	49.77

Table 4.40: Impacts of Population Reduction Policy on Fuelwood

	1993	1994	1995	1996	1997	1998
Supply Per ha	1.30	1.28	1.27	1.25	1.23	1.21
Demand Per ha	1.75	1.76	1.80	1.81	1.82	1.83
Supply as % of Demand	73.15	71.76	70.37	68.99	67.60	66.21

Table 4.41: Impacts of Population Reduction Policy on Fuelwood Originating from Forests Only

	1993	1994	1995	1996	1997	1998
Supply Per ha	6.60	6.65	6.71	6.76	6.83	6.90
Demand Per ha	9.51	9.78	10.06	10.36	10.68	11.02
Supply as % of Demand	69.37	68.01	66.65	65.28	63.92	62.55

Table 4.42: Impacts of Population Reduction Policy on Timber Supply and Demand

	1993	1994	1995	1996	1997	1998
Supply Per ha	0.29	0.29	0.29	0.29	0.29	0.29
Demand Per ha	0.52	0.54	0.56	0.58	0.60	0.62
Supply as % of Demand	55.40	53.68	51.95	50.21	48.45	46.70

Table 4.43: Impact of Population Reduction Policy on Carrying Capacity and Load

	1993	1994	1995	1996	1997	1998
Agricultural Land						
Carrying Capacity Per ha	5.43	5.43	5.42	5.42	5.42	5.42
Current Load Per ha	10.60	10.65	10.70	10.76	10.82	10.88
All Land: Fuelwood						
Carrying Capacity Per ha	2.21	2.18	2.15	2.12	2.09	2.06
Current Load	3.02	3.04	3.06	3.08	3.10	3.12
Forests Only: Fuelwood						
Carrying Capacity Per ha	11.23	11.31	11.41	11.50	11.61	11.73
Current Load	16.18	16.63	17.11	17.62	18.17	18.75
Timber:						
Carrying Capacity Per ha	3.67	3.67	3.67	3.67	3.67	3.67
Current Load (persons/ha)	6.63	6.84	7.07	7.31	7.58	7.86

Table 4.44: Impacts of Alternative Policies on Crop Yield (kg/ha)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Paddy	2067	2067	2067	2067	2066	2066	-0.06
Maize	1473	1473	1473	1473	1473	1473	-0.04
Wheat	1225	1225	1225	1225	1225	1225	-0.44
Millet	1005	1005	1005	1005	1005	1005	-0.02
Oilseeds	665	665	665	665	665	665	0.09
Potatoes	7174	7173	7173	7173	7173	7173	-0.02
Irrigation							
Paddy	2349	2421	2421	2421	2421	2420	0.60
Maize	1546	1569	1569	1569	1569	1569	0.30
Wheat	1664	1688	1688	1688	1688	1688	0.29
Millet	1005	1005	1005	1005	1005	1005	0.00
Oilseeds	872	887	887	887	887	887	0.35
Potatoes	8315	8496	8496	8495	8495	8495	0.43
Fertiliser							
Paddy	2185	2387	2387	2387	2387	2387	1.78
Maize	1489	1529	1529	1529	1529	1529	0.53
Wheat	1295	1398	1398	1398	1398	1398	1.53
Millet	1005	1005	1005	1005	1005	1005	0.00
Oilseeds	669	689	689	689	689	689	0.58
Potatoes	7373	7766	7766	7766	7765	7765	1.04
Joint							
Paddy	2484	2707	2707	2707	2707	2706	1.73
Maize	1563	1604	1604	1604	1603	1603	0.51
Wheat	1759	1887	1887	1887	1887	1887	1.41
Millet	1005	1005	1005	1005	1005	1005	0.00
Oilseeds	878	899	899	899	899	899	0.49
Potatoes	8546	8975	8975	8974	8974	8974	0.98
Maize Price Increased (10%)							
Maize	1499	1523	1523	1523	1523	1523	0.32
Maize Price Reduced (10%)							
Maize	1446	1469	1469	1469	1469	1469	0.32

Table 4.45: Impacts of Alternative Policies on Food Availability

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Cereal Grains (edible form)	76.20	75.81	75.41	75.01	74.60	74.19	-0.64
Meat	7	7	7	7	7	7	-0.51
Milk	14	14	14	14	14	13	-0.84
Oils and Fats	1	1	1	1	1	1	8.35
Vegetables	46	46	46	46	46	45	-0.31
Irrigation							
Cereal Grains (edible form)	85.89	87.04	86.64	86.24	85.82	85.41	-0.11
Meat	7	7	7	7	7	7	-0.50
Milk	14	14	14	14	14	13	-0.83
Oils and Fats	1	1	1	1	1	2	9.95
Vegetables	54	56	55	55	55	55	0.17
Fertiliser							
Cereal Grains (edible form)	78.49	82.12	81.70	81.29	80.86	80.44	0.49
Meat	7	7	7	7	7	7	-0.50
Milk	14	14	14	14	14	13	-0.83
Oils and Fats	1	1	1	1	1	1	9.44
Vegetables	48	50	50	50	50	50	0.86
Joint							
Cereal Grains (edible form)	88.64	92.80	92.40	91.99	91.56	91.14	0.56
Meat	7	7	7	7	7	7	-0.50
Milk	14	14	14	14	14	13	-0.83
Oils and Fats	1	1	1	1	1	2	10.09
Vegetables	261	273	271	268	266	263	0.17
Maize Price Increased (10%)							
Cereal Grains (edible form)	76.89	77.46	77.05	76.64	76.22	75.80	-0.29
Meat	7	7	7	7	7	7	-0.50
Milk	14	14	14	14	14	13	-0.83
Oils and Fats	1	1	1	1	1	1	8.91
Vegetables	46	46	46	46	46	45	-0.32
Maize Price Reduced 10%							
Cereal Grains (edible form)	75.46	75.70	75.30	74.90	74.49	74.09	-0.37
Meat	7	7	7	7	7	7	-0.50
Milk	14	14	14	14	14	13	-0.83
Oils and Fats	1	1	1	1	1	1	8.91
Vegetables	46	46	46	46	46	45	-0.32

Table 4.46: Impacts of Alternative Policies on Per Capita Food Demand (kg/person)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Cereal Grains	128.49	128.56	128.64	128.73	128.81	128.90	0.03
Vegetables	21.32	21.40	21.48	21.56	21.63	21.72	-0.46
Meat	3.10	3.12	3.13	3.15	3.17	3.19	-0.53
Milk	19.53	19.58	19.64	19.70	19.76	19.82	-0.49
Oils and Fats	2.09	2.09	2.10	2.10	2.11	2.11	-0.41
Irrigation							
Cereal Grains	134.87	129.54	128.70	128.78	128.86	128.96	-0.89
Vegetables	28.27	22.33	21.51	21.58	21.66	21.75	-5.11
Meat	4.51	3.31	3.14	3.16	3.18	3.20	-6.62
Milk	23.36	20.16	19.67	19.73	19.79	19.86	-3.19
Oils and Fats	2.57	2.15	2.10	2.10	2.10	2.11	-3.85
Fertiliser							
Cereal Grains	129.83	131.04	128.63	128.70	128.78	128.86	-0.15
Vegetables	22.66	23.90	21.46	21.53	21.60	21.69	-0.87
Meat	3.37	3.63	3.13	3.15	3.16	3.18	-1.16
Milk	20.37	21.12	19.63	19.69	19.74	19.81	-0.56
Oils and Fats	2.18	2.26	2.10	2.10	2.10	2.11	-0.63
Joint							
Cereal Grains		130.97	128.43	128.47	128.52	128.57	-4.86
Vegetables		23.80	21.25	21.29	21.33	21.38	-24.92
Meat		3.62	3.09	3.10	3.11	3.12	-32.81
Milk		21.07	19.51	19.54	19.58	19.62	-17.75
Oils and Fats		2.25	2.08	2.08	2.08	2.09	-17.50
Maize Price Increased (10%)							
Cereal Grains	126.10	128.92	128.65	128.73	128.81	128.89	0.44
Vegetables	21.70	21.71	21.46	21.53	21.61	21.69	-0.01
Meat	3.13	3.18	3.13	3.15	3.16	3.18	0.31
Milk	20.64	19.77	19.62	19.67	19.73	19.80	-0.84
Oils and Fats	2.14	2.11	2.10	2.10	2.10	2.11	-0.29
Maize Price Reduced 10%							
Cereal Grains	131.01	128.81	128.64	128.72	128.80	128.90	-0.32
Vegetables	20.96	21.62	21.49	21.57	21.65	21.74	0.73
Meat	3.07	3.16	3.14	3.15	3.17	3.19	0.81
Milk	18.45	19.72	19.66	19.72	19.78	19.84	1.46
Oils and Fats	2.04	2.11	2.10	2.10	2.11	2.11	0.68

Table 4.47: Impacts of Alternative Policies on Per Capita Food Balance (kg/ha)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Cereal Grains	-52.28	-52.75	-53.23	-53.72	-54.21	-54.71	0.99
Vegetables	24.75	24.55	24.34	24.11	23.88	23.63	-0.16
Meat	3.68	3.63	3.58	3.53	3.48	3.43	-0.50
Milk	-5.50	-5.67	-5.84	-6.01	-6.18	-6.36	0.29
Oils and Fats	-1.31	-1.26	-1.19	-1.12	-1.03	-0.92	-6.69
Irrigation							
Cereal Grains	-48.98	-42.50	-42.06	-42.54	-43.04	-43.55	-2.32
Vegetables	26.19	33.31	33.97	33.71	33.45	33.16	-4.83
Meat	2.28	3.44	3.57	3.52	3.47	3.42	8.46
Milk	-9.32	-6.25	-5.87	-6.05	-6.22	-6.40	-7.25
Oils and Fats	-1.63	-1.12	-0.97	-0.86	-0.74	-0.60	-18.14
Fertiliser							
Cereal Grains	-51.35	-48.92	-46.92	-47.42	-47.92	-48.43	-1.16
Vegetables	24.69	26.39	28.68	28.45	28.21	27.95	2.35
Meat	3.41	3.12	3.58	3.53	3.48	3.43	0.14
Milk	-6.34	-7.20	-5.83	-6.00	-6.17	-6.35	0.04
Oils and Fats	-1.40	-1.40	-1.17	-1.09	-0.99	-0.88	-8.75
Joint							
Cereal Grains	-76.31	-38.17	-36.03	-36.48	-36.95	-37.43	-13.28
Vegetables	171.46	249.33	249.34	246.81	244.34	241.91	7.13
Meat	-16.03	3.13	3.62	3.58	3.54	3.49	
Milk	-38.08	-7.16	-5.71	-5.86	-6.01	-6.16	-30.52
Oils and Fats	-4.51	-1.20	-0.94	-0.83	-0.70	-0.56	-34.20
Maize Price Increased (10%)							
Cereal Grains	-49.21	-51.46	-51.60	-52.10	-52.59	-53.10	1.53
Vegetables	24.38	24.24	24.36	24.14	23.91	23.66	-0.60
Meat	3.65	3.57	3.58	3.53	3.48	3.43	-1.22
Milk	-6.61	-5.85	-5.82	-5.99	-6.16	-6.34	-0.84
Oils and Fats	-1.36	-1.28	-1.19	-1.11	-1.02	-0.92	-7.58
Maize Price Reduced 10%							
Cereal Grains	-55.56	-53.11	-53.33	-53.82	-54.31	-54.81	-0.27
Vegetables	25.12	24.33	24.32	24.10	23.86	23.61	-1.23
Meat	3.72	3.59	3.58	3.53	3.48	3.42	-1.63
Milk	-4.42	-5.80	-5.86	-6.03	-6.21	-6.39	7.64
Oils and Fats	-1.26	-1.27	-1.19	-1.12	-1.03	-0.92	-6.13

Table 4.48: Impacts of Alternative Policies on Calorie Supply and Demand (Calorie '000 cal)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Per ha Calorie Supply	3925.71	3924.11	3922.60	3921.16	3919.67	3918.35	-0.15
Per ha Calorie Demand	7661.62	7695.43	7730.58	7766.85	7804.09	7842.10	0.45
Supply as Percent of Demand	51.24	50.99	50.74	50.49	50.23	49.97	-0.59
Carrying Capacity Per ha	5.43	5.43	5.42	5.42	5.42	5.42	-0.15
Current Load	10.59	10.64	10.69	10.74	10.79	10.84	0.45
Irrigation							
Per ha Calorie Supply	4457.39	4542.97	4544.04	4545.03	4545.82	4546.68	0.40
Per ha Calorie Demand	7661.62	7695.43	7730.58	7766.85	7804.09	7842.10	0.47
Supply as Percent of Demand	58.18	59.03	58.78	58.52	58.25	57.98	-0.07
Carrying Capacity Per ha	6.16	6.28	6.28	6.28	6.28	6.29	0.40
Current Load	10.59	10.64	10.69	10.74	10.79	10.84	0.47
Fertiliser							
Per ha Calorie Supply	4044.88	4258.35	4257.62	4256.93	4256.12	4255.47	1.02
Per ha Calorie Demand	7661.62	7695.43	7730.58	7766.85	7804.09	7842.10	0.47
Supply as Percent of Demand	52.79	55.34	55.08	54.81	54.54	54.26	0.55
Carrying Capacity Per ha	5.59	5.89	5.89	5.89	5.88	5.88	1.02
Current Load	10.59	10.64	10.69	10.74	10.79	10.84	0.47
Joint:							
Per ha Calorie Supply	5175.31	5451.13	5449.75	5448.43	5447.04	5445.81	1.02
Per ha Calorie Demand	5537.48	5572.57	5608.12	5644.02	5680.22	5716.62	0.64
Supply as Percent of Demand	93.46	97.82	97.18	96.53	95.89	95.26	0.38
Carrying Capacity Per ha	7.15	7.54	7.53	7.53	7.53	7.53	1.02
Current Load	7.66	7.70	7.75	7.80	7.85	7.90	0.64
Maize Price Increased (10%)							
Per ha Calorie Supply	3956.06	3996.94	3995.33	3993.79	3992.22	3990.82	0.18
Per ha Calorie Demand	7661.62	7695.43	7730.58	7766.85	7804.09	7842.10	0.47
Supply as Percent of Demand	51.63	51.94	51.68	51.42	51.16	50.89	-0.29
Carrying Capacity Per ha	5.47	5.53	5.52	5.52	5.52	5.52	0.18
Current Load	10.59	10.64	10.69	10.74	10.79	10.84	0.47
Maize Price Reduced 10%							
Per ha Calorie Supply	3892.76	3919.29	3917.80	3916.38	3914.91	3913.61	0.11
Per ha Calorie Demand	7661.62	7695.43	7730.58	7766.85	7804.09	7842.10	0.47
Supply as Percent of Demand	50.81	50.93	50.68	50.42	50.16	49.91	-0.36
Carrying Capacity Per ha	5.38	5.42	5.42	5.41	5.41	5.41	0.11
Current Load	10.59	10.64	10.69	10.74	10.79	10.84	0.47

Table 4.49: Impacts of Alternative Policies on Food and Non-food Trade (Rs/person)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Per Capita Food	-276	-297	-319	-342	-364	-387	5.96
Per Capita Non-food	-991	-993	-995	-997	-999	-1001	0.19
Irrigation							
Per Capita Food	-367	-151	-122	-127	-129	-129	-18.91
Per Capita Non-food	-995	-998	-1000	-1002	-1004	-1006	0.21
Fertiliser							
Per Capita Food	-296	-309	-228	-243	-258	-271	-1.74
Per Capita Non-food	-992	-995	-997	-999	-1001	-1003	0.23
Joint							
Per Capita Food	-1042	1282	1478	1582	1697	-1824	
Per Capita Non-food	-1022	-1025	-1027	-1029	-1031	-1033	0.21
Maize Price Increased (10%)							
Per Capita Food	-291	-317	-326	-350	-373	-396	6.32
Per Capita Non-food	-992	-994	-996	-998	-1000	-1002	0.20
Maize Price Reduced 10%							
Per Capita Food	-260	-285	-297	-318	-339	-359	6.66
Per Capita Non-food	-990	-992	-994	-996	-998	-1000	0.20

Table 4.50: Impacts of Alternative Policies on Real Income (Rs '000)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Crops	116971	120341	123940	127822	132043	136701	2.84
Livestock	80012	83876	87847	91926	96115	100416	4.75
Professionals	6170	5787	5427	5089	4768	4467	-6.23
Office Workers	6447	6047	5671	5317	4982	4668	-6.23
Sales & Service Workers	15082	14146	13266	12439	11656	10919	-6.23
Production Workers	10639	9979	9358	8775	8222	7702	-6.23
Construction, etc.	3033	2845	2668	2502	2344	2196	-6.23
General Labourers	20072	18827	17656	16555	15512	14532	-6.23
Total Sindhu Income	258425	261847	265833	270425	275643	281602	1.44
Per Capita Income (Rs)	971	975	981	988	998	1011	0.50
Irrigation							
Crops	160644	172035	176737	181837	187416	193609	3.80
Livestock	79956	83846	87849	91965	96195	100540	4.69
Professionals	6165	5785	5427	5091	4772	4472	-6.22
Office Workers	6443	6045	5671	5320	4987	4674	-6.22
Sales & Service Workers	15071	14141	13267	12445	11665	10933	-6.22
Production Workers	10631	9975	9358	8778	8229	7712	-6.22
Construction, etc.	3031	2844	2668	2503	2346	2199	-6.22
General Labourers	20058	18820	17656	16562	15525	14550	-6.22
Total Sindhu Income	301999	313491	318634	324500	331135	338689	2.32
Per Capita Income (Rs)	1135	1167	1175	1186	1199	1216	1.38
Fertiliser							
Crops	126004	146900	150798	154985	159519	164502	5.48
Livestock	79985	83811	87774	91845	96025	100317	4.63
Professionals	6168	5782	5422	5084	4764	4462	-6.27
Office Workers	6445	6042	5666	5313	4978	4663	-6.27
Sales & Service Workers	15077	14135	13255	12428	11645	10909	-6.27
Production Workers	10635	9971	9350	8767	8214	7695	-6.27
Construction, etc.	3032	2843	2666	2499	2342	2194	-6.27
General Labourers	20065	18812	17641	16540	15498	14518	-6.27
Total Sindhu Income	267411	288296	292573	297462	302984	309260	2.95
Per Capita Income (Rs)	1005	1073	1079	1087	1097	1110	2.01
Joint:							
Crops	439460	483554	488990	494831	501154	508098	2.95
Livestock	79929	83786	87784	91895	96120	100460	4.68
Professionals	6163	5781	5423	5087	4768	4469	-6.23
Office Workers	6440	6041	5667	5316	4983	4670	-6.23
Sales & Service Workers	15066	14131	13257	12435	11656	10924	-6.23
Production Workers	10628	9968	9351	8772	8222	7706	-6.23
Construction, etc.	3030	2842	2666	2501	2344	2197	-6.23
General Labourers	20051	18806	17643	16549	15513	14539	-6.23
Total Sindhu Income	580766	624908	630782	637385	644760	653062	2.37
Per Capita Income (Rs)	2183	2327	2327	2329	2335	2344	1.44
Maize Price Increased (10%)							
Crops	121223	126664	130115	133838	137884	142349	3.27
Livestock	80012	83877	87852	91935	96129	100435	4.65
Professionals	6170	5787	5427	5089	4769	4468	-6.25
Office Workers	6447	6047	5671	5318	4983	4669	-6.25
Sales & Service Workers	15082	14146	13267	12440	11657	10921	-6.25
Production Workers	10639	9979	9359	8775	8223	7704	-6.25
Construction, etc.	3033	2845	2668	2502	2344	2196	-6.25
General Labourers	20072	18827	17657	16557	15514	14535	-6.25
Total Sindhu Income	258425	262577	266579	271187	276421	282396	1.79
Per Capita Income (Rs)	971	978	983	991	1001	1014	0.86
Maize Price Reduced 10%							
Crops	112358	117304	121077	125147	129570	134450	3.66
Livestock	80012	83876	87847	91926	96115	100416	4.65
Professionals	6170	5787	5427	5089	4768	4467	-6.25
Office Workers	6447	6047	5671	5317	4982	4668	-6.25
Sales & Service Workers	15082	14146	13266	12439	11656	10919	-6.25
Production Workers	10639	9979	9358	8775	8222	7702	-6.25
Construction, etc.	3033	2845	2668	2502	2344	2196	-6.25
General Labourers	20072	18827	17656	16555	15512	14532	-6.25
Total Sindhu Income	253813	258811	262970	267749	273169	279351	1.94
Per Capita Income (Rs)	954	964	970	979	989	1003	1.00

Table 4.51: Impacts of Alternative Policies on Share Distribution of Income (%)

Alternative Policies	1993	1994	1995	1996	1997	1998
Baseline						
Crops	45.26	45.96	46.62	47.27	47.90	48.54
Livestock	30.96	32.03	33.05	33.99	34.87	35.66
Professionals	2.39	2.21	2.04	1.88	1.73	1.59
Office Workers	2.49	2.31	2.13	1.97	1.81	1.66
Sales & Service Workers	5.84	5.40	4.99	4.60	4.23	3.88
Production Workers	4.12	3.81	3.52	3.24	2.98	2.74
Construction, etc.	1.17	1.09	1.00	0.93	0.85	0.78
General Labourers	7.77	7.19	6.64	6.12	5.63	5.16
Total	100.00	100.00	100.00	100.00	100.00	100.00
Irrigation						
Crops	53.19	54.88	55.47	56.04	56.60	57.16
Livestock	26.48	26.75	27.57	28.34	29.05	29.69
Professionals	2.04	1.85	1.70	1.57	1.44	1.32
Office Workers	2.13	1.93	1.78	1.64	1.51	1.38
Sales & Service Workers	4.99	4.51	4.16	3.83	3.52	3.23
Production Workers	3.52	3.18	2.94	2.71	2.48	2.28
Construction, etc.	1.00	0.91	0.84	0.77	0.71	0.65
General Labourers	6.64	6.00	5.54	5.10	4.69	4.30
Total	100.00	100.00	100.00	100.00	100.00	100.00
Fertiliser						
Crops	47.12	50.95	51.54	52.10	52.65	53.19
Livestock	29.91	29.07	30.00	30.88	31.69	32.44
Professionals	2.31	2.01	1.85	1.71	1.57	1.44
Office Workers	2.41	2.10	1.94	1.79	1.64	1.51
Sales & Service Workers	5.64	4.90	4.53	4.18	3.84	3.53
Production Workers	3.98	3.46	3.20	2.95	2.71	2.49
Construction, etc.	1.13	0.99	0.91	0.84	0.77	0.71
General Labourers	7.50	6.53	6.03	5.56	5.12	4.69
Total	100.00	100.00	100.00	100.00	100.00	100.00
Joint						
Crops	75.67	77.38	77.52	77.63	77.73	77.80
Livestock	13.76	13.41	13.92	14.42	14.91	15.38
Professionals	1.06	0.93	0.86	0.80	0.74	0.68
Office Workers	1.11	0.97	0.90	0.83	0.77	0.72
Sales & Service Workers	2.59	2.26	2.10	1.95	1.81	1.67
Production Workers	1.83	1.60	1.48	1.38	1.28	1.18
Construction, etc.	0.52	0.45	0.42	0.39	0.36	0.34
General Labourers	3.45	3.01	2.80	2.60	2.41	2.23
Total	100.00	100.00	100.00	100.00	100.00	100.00
Maize Price Increased (10%)						
Crops	47.37	48.44	49.03	49.60	50.16	50.72
Livestock	29.77	30.56	31.55	32.49	33.36	34.15
Professionals	2.30	2.11	1.95	1.80	1.65	1.52
Office Workers	2.40	2.20	2.04	1.88	1.73	1.59
Sales & Service Workers	5.61	5.15	4.77	4.40	4.05	3.71
Production Workers	3.96	3.64	3.36	3.10	2.85	2.62
Construction, etc.	1.13	1.04	0.96	0.88	0.81	0.75
General Labourers	7.47	6.86	6.34	5.85	5.38	4.94
Total	100.00	100.00	100.00	100.00	100.00	100.00
Maize Price Reduced 10%						
Crops	43.03	44.07	44.80	45.50	46.20	46.91
Livestock	32.23	33.15	34.18	35.13	36.01	36.79
Professionals	2.48	2.29	2.11	1.94	1.79	1.64
Office Workers	2.60	2.39	2.21	2.03	1.87	1.71
Sales & Service Workers	6.07	5.59	5.16	4.75	4.37	4.00
Production Workers	4.28	3.94	3.64	3.35	3.08	2.82
Construction, etc.	1.22	1.12	1.04	0.96	0.88	0.80
General Labourers	8.08	7.44	6.87	6.33	5.81	5.32
Total	100.00	100.00	100.00	100.00	100.00	100.00

Table 4.52: Impacts of Different Policies on Supply and Demand of Forest Products Originating from Various Sources

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fodder	104.21	104.22	104.23	104.25	104.28	104.32	0.02
Fuelwood	73.17	71.82	70.47	69.13	67.80	66.47	-1.88
Timber	55.42	53.72	52.02	50.31	48.60	46.88	-3.19
Demand Reduction							
Fodder	104.21	104.22	104.24	104.26	104.28	104.31	0.02
Fuelwood	81.30	79.92	78.55	77.18	75.82	74.47	-1.74
Timber	55.42	53.92	52.42	50.91	49.40	47.88	-2.88
Management							
Fodder	143.81	140.89	137.94	134.94	131.87	128.75	-2.19
Fuelwood	73.17	71.82	70.49	69.17	67.86	66.56	-1.88
Timber	55.42	53.93	52.45	50.98	49.51	48.06	-2.81
Combined							
Fodder	143.81	141.39	138.95	136.46	133.91	131.32	-1.80
Fuelwood	81.30	79.93	78.57	77.23	75.90	74.58	-1.71
Timber	55.42	53.73	52.05	50.38	48.71	47.05	-3.22

Table 4.53: Impacts of Different Policies on Supply and Demand of Forest Products Originating from Forests Only

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fodder	23.92	23.46	22.99	22.51	22.02	21.51	-2.01
Fuelwood	69.40	68.06	66.74	65.42	64.11	62.80	-1.95
Demand Reduction							
Fodder	23.92	23.53	23.14	22.74	22.33	21.91	-1.74
Fuelwood	77.11	75.75	74.40	73.06	71.72	70.39	-1.81
Management							
Fodder	63.51	60.13	56.71	53.22	49.65	46.01	-6.24
Fuelwood	69.65	68.99	68.01	66.97	66.02	65.00	-1.37
Combined							
Fodder	63.51	60.70	57.86	54.97	52.01	48.99	-5.06
Fuelwood	77.39	76.79	75.86	74.86	74.00	73.09	-1.14

Table 4.54: Changing Pressure on Land Under Baseline and Policy Scenarios

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Per Capita Cultivated Land (ha/ person)	0.13	0.13	0.13	0.13	0.13	0.13	-0.43
Per Capita Accessible Forest Land	0.22	0.21	0.21	0.20	0.20	0.19	2.64
Forest-Cultivated Area Ratio	1.65	1.62	1.59	1.55	1.52	1.48	-2.05
Shrub-Forest Area Ratio	0.92	0.95	0.98	1.02	1.05	1.09	3.39
Population Density Per Cultivated Land	7.57	7.60	7.64	7.67	7.70	7.72	0.43
Population Per Accessible Forests	4.58	4.69	4.81	4.93	5.06	5.20	-2.57
LSU Per Cultivated Area	3.89	3.88	3.86	3.84	3.83	3.81	-0.41
LSU Per Forest Area	2.35	2.39	2.43	2.47	2.52	2.56	-3.39
LSU Per Grazing Area	12.14	12.02	11.89	11.76	11.63	11.49	-1.07
Demand Reduction							
Per Capita Cultivated Land (ha/ person)	0.13	0.13	0.13	0.13	0.13	0.13	-0.49
Per Capita Accessible Forest Land	0.22	0.21	0.21	0.20	0.20	0.19	-2.26
Forest-Cultivated Area Ratio	1.65	1.63	1.60	1.57	1.54	1.51	-1.78
Shrub-Forest Area Ratio	0.92	0.94	0.97	1.00	1.03	1.06	2.91
Population Density Per Cultivated Land	7.57	7.61	7.65	7.69	7.72	7.76	0.49
Population Per Accessible Forests	4.58	4.68	4.78	4.89	5.01	5.13	2.31
LSU Per Cultivated Area	3.89	3.88	3.86	3.85	3.84	3.82	-0.36
LSU Per Forest Area	2.35	2.38	2.42	2.45	2.49	2.53	1.45
LSU Per Grazing Area	12.14	12.04	11.93	11.82	11.71	11.59	-0.92
Management							
Per Capita Cultivated Land (ha/ person)	0.13	0.13	0.13	0.13	0.13	0.13	-0.42
Per Capita Accessible Forest Land	0.22	0.21	0.21	0.20	0.20	0.19	-2.49
Forest-Cultivated Area Ratio	1.65	1.62	1.59	1.56	1.52	1.49	-2.08
Shrub-Forest Area Ratio	0.92	0.95	0.98	1.01	1.05	1.09	3.44
Population Density Per Cultivated Land	7.57	7.60	7.64	7.67	7.70	7.73	0.42
Population Per Accessible Forests	4.58	4.69	4.81	4.93	5.06	5.19	2.55
LSU Per Cultivated Area	3.82	3.88	3.86	3.84	3.83	3.81	-0.42
LSU Per Forest Area	2.35	2.39	2.43	2.47	2.51	2.56	1.69
LSU Per Grazing Area	12.14	12.02	11.89	11.77	11.64	11.51	-1.07
Combined							
Per Capita Cultivated Land (ha/person)	0.13	0.13	0.13	0.13	0.13	0.13	-0.50
Per Capita Accessible Forest Land	0.22	0.21	0.21	0.20	0.20	0.20	-2.21
Forest-Cultivated Area Ratio	1.65	1.63	1.60	1. 57	1.54	1.52	-1.72
Shrub-Forest Area Ratio	0.92	0.94	0.97	1.00	1.02	1.06	2.80
Population Density Per Cultivated Land	7.57	7.61	7.65	7.69	7.72	7.76	0.51
Population Per Accessible Forests	4.58	4.68	4.78	4.89	5.00	5.12	2.26
LSU Per Cultivated Area	3.89	3.88	3.86	3.85	3.84	3.82	-0.35
LSU Per Forest Area	2.35	2.38	2.42	2.45	2.48	2.52	1.39
LSU Per Grazing Area	12.14	12.04	11.93	11.83	11.72	11.61	-0.89

Table 4.55: Impacts of Different Policies on Deforestation (ha)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Deforested Area:Mid-mountains	-861	-889	-917	-946	-975	-1005	3.20
Deforested Area:District	-687	-720	-753	-787	-820	-855	4.63
Demand Reduction							
Deforested Area:Mid-mountains	-717	-741	-766	-791	-816	-842	3.27
Deforested Area:District	-543	-572	-601	-631	-661	-691	4.96
Management							
Deforested Area:Mid-mountains	-856	-870	-890	-913	-934	-957	2.26
Deforested Area:District	-682	-700	-726	-753	-779	-807	3.42
Combined							
Deforested Area:Mid-mountains	-711	-721	-738	-756	-772	-789	2.08
Deforested Area:District	-538	-552	-573	-596	-617	-638	3.50

Note: negative sign indicates deforestation

Table 4.56: Impacts of Alternative Policies on Environment in Terms of Agricultural Land (Adult per ha)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Carrying Capacity	5.43	5.43	5.42	5.42	5.42	5.42	-0.15
Current Load	10.59	10.64	10.69	10.74	10.79	10.84	0.45
Irrigation							
Carrying Capacity	6.16	6.28	6.28	6.28	6.28	6.29	0.40
Current Load	10.59	10.64	10.69	10.74	10.79	10.84	0.47
Fertiliser							
Carrying Capacity	5.59	5.89	5.89	5.89	5.88	5.88	1.02
Current Load	10.59	10.64	10.69	10.74	10.79	10.84	0.47
Joint							
Carrying Capacity	7.15	7.54	7.53	7.53	7.53	7.53	1.02
Current Load	7.66	7.70	7.75	7.80	7.85	7.90	0.64
Maize Price Increased (10%)							
Carrying Capacity per ha	5.47	5.53	5.52	5.52	5.52	5.52	0.18
Current Load	10.59	10.64	10.69	10.74	10.79	10.84	0.47
Maize Price Reduced (10%)							
Carrying Capacity per ha	5.38	5.42	5.42	5.41	5.41	5.41	0.11
Current Load	10.59	10.64	10.69	10.74	10.79	10.84	0.47

Table 4.57: Impacts of Different Policies on Carrying Capacity and Demand Pressure: Fuelwood

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fuelwood Supply Per ha	1.30	1.28	1.27	1.25	1.23	1.21	-1.31
Per ha Demand	1.78	1.79	1.80	1.81	1.82	1.83	0.58
Carrying Capacity Per ha	2.21	2.18	2.15	2.12	2.09	2.06	-1.31
Current Load	3.02	3.04	3.06	3.07	3.09	3.10	0.58
Demand Reduction							
Fuelwood Supply Per ha	1.30	1.29	1.27	1.26	1.24	1.23	-1.12
Per ha Demand	1.60	1.61	1.62	1.63	1.64	1.65	0.63
Carrying Capacity Per ha	2.45	2.43	2.40	2.38	2.35	2.32	-1.12
Current Load	3.02	3.04	3.06	3.08	3.10	3.11	0.63
Management							
Fuelwood Supply Per ha	1.30	1.28	1.27	1.25	1.23	1.22	-1.32
Per ha Demand	1.78	1.79	1.80	1.81	1.82	1.83	0.57
Carrying Capacity Per ha	2.21	2.18	2.15	2.13	2.10	2.07	-1.32
Current Load	3.02	3.04	3.06	3.07	3.09	3.11	0.57
Combined							
Fuelwood Supply Per ha	1.30	1.29	1.27	1.26	1.24	1.23	-1.08
Per ha Demand	1.60	1.61	1.62	1.63	1.64	1.65	0.64
Carrying Capacity Per ha	2.45	2.43	2.40	2.38	2.35	2.32	-1.08
Current Load	3.02	3.04	3.06	3.08	3.10	3.12	0.64

Table 4.58: Impacts of Different Policies on Carrying Capacity and Demand Pressure:Fuelwood from Forests Only

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fuelwood Supply Per ha	6.60	6.65	6.71	6.76	6.83	6.90	0.83
Per ha Demand	9.51	9.77	10.05	10.34	10.65	10.98	2.84
Carrying Capacity Per ha	11.23	11.31	11.41	11.50	11.61	11.73	0.83
Current Load	16.18	16.62	17.09	17.59	18.11	18.68	2.84
Demand Reduction							
Fuelwood Supply Per ha	6.60	6.64	6.69	6.74	6.79	6.84	0.72
Per ha Demand	8.56	8.77	8.99	9.22	9.46	9.72	2.57
Carrying Capacity Per ha	12.47	12.55	12.64	12.73	12.82	12.93	0.72
Current Load	16.18	16.57	16.98	17.42	17.88	18.36	2.57
Management							
Fuelwood Supply Per ha	6.62	6.74	6.83	6.92	7.02	7.12	1.45
Per ha Demand	9.51	9.77	10.04	10.33	10.63	10.95	2.86
Carrying Capacity Per ha	11.27	11.46	11.62	11.76	11.94	12.10	1.45
Current Load	16.18	16.62	17.08	17.57	18.08	18.62	2.86
Combined							
Fuelwood Supply Per ha	6.62	6.73	6.81	6.89	6.99	7.08	1.35
Per ha Demand	8.56	8.77	8.98	9.21	9.44	9.69	2.51
Carrying Capacity Per ha	12.52	12.72	12.88	13.03	13.21	13.38	1.35
Current Load	16.18	16.57	16.98	17.40	17.85	18.31	2.51

Table 4.59: Impacts of Different Policies on Carryig Capacity and Demand Pressure: Fodder

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Per ha Fodder Supply	0.79	0.80	0.80	0.80	0.81	0.81	0.36
Per ha Fodder Demand	0.76	0.77	0.77	0.77	0.77	0.78	0.34
Carrying Capacity Per ha	1.27	1.28	1.28	1.29	1.29	1.30	0.36
Current Load	1.22	1.23	1.23	1.24	1.24	1.24	0.34
Demand Reduction							
Per ha Fodder Supply	0.79	0.80	0.80	0.80	0.80	0.81	0.31
Per ha Fodder Demand	0.76	0.76	0.77	0.77	0.77	0.77	0.29
Carrying Capacity Per ha	1.27	1.28	1.28	1.29	1.29	1.29	0.31
Current Load	1.22	1.23	1.23	1.23	1.24	1.24	0.29
Management							
Per ha Fodder Supply	1.10	1.08	1.06	1.04	1.02	1.00	-1.86
Per ha Fodder Demand	0.76	0.77	0.77	0.77	0.77	0.78	0.33
Carrying Capacity Per ha	1.76	1.73	1.70	1.67	1.63	1.60	-1.86
Current Load	1.22	1.23	1.23	1.24	1.24	1.24	0.33
Combined							
Per ha Fodder Supply	1.10	1.08	1.07	1.05	1.03	1.02	1.52
Per ha Fodder Demand	0.76	0.76	0.77	0.77	0.77	0.77	0.29
Carrying Capacity Per ha	1.76	1.73	1.71	1.68	1.66	1.63	-1.52
Current Load	1.22	1.23	1.23	1.23	1.24	1.24	0.29

Table 4.60: Impacts of Different Policies on Carrying Capacity and Demand Pressure: Fodder from Forests

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Per ha Fodder Supply	0.51	0.51	0.51	0.51	0.52	0.52	0.37
Per ha Fodder Demand	2.12	2.17	2.22	2.28	2.34	2.41	2.42
Carrying Capacity Per ha	0.81	0.82	0.82	0.82	0.83	0.83	0.37
Current Load	3.40	3.48	3.57	3.66	3.75	3.86	2.42
Demand Reduction							
Per ha Fodder Supply	0.51	0.51	0.51	0.51	0.51	0.52	0.32
Per ha Fodder Demand	2.12	2.16	2.21	2.25	2.30	2.36	2.10
Carrying Capacity Per ha	0.81	0.82	0.82	0.82	0.82	0.83	0.32
Current Load	3.40	3.47	3.54	3.61	3.69	3.78	2.10
Management							
Per ha Fodder Supply	1.35	1.31	1.26	1.21	1.16	1.10	-3.93
Per ha Fodder Demand	2.12	2.17	2.22	2.28	2.34	2.40	2.47
Carrying Capacity Per ha	2.16	2.09	2.02	1.94	1.86	1.77	-3.93
Current Load	3.40	3.48	3.56	3.65	3.75	3.85	2.47
Combined							
Per ha Fodder Supply	1.35	1.31	1.28	1.24	1.19	1.15	-3.14
Per ha Fodder Demand	2.12	2.16	2.21	2.25	2.30	2.35	2.02
Carrying Capacity Per ha	2.16	2.11	2.05	1.98	1.92	1.84	-3.14
Current Load	3.40	3.47	3.54	3.61	3.68	3.76	2.02

Table 4.61: Impacts of Different Policies on Carrying Capacity and Demand Pressure: Timber

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Timber Supply Per ha	0.29	0.29	0.29	0.29	0.29	0.29	0.00
Per ha Demand	0.52	0.54	0.56	0.58	0.60	0.62	3.29
Carrying Capacity Per ha	3.67	3.67	3.67	3.67	3.67	3.67	0.00
Current Load (persons/ha)	6.62	6.83	7.06	7.30	7.55	7.83	3.29
Demand reduction							
Timber Supply Per ha	0.29	0.29	0.29	0.29	0.29	0.29	0.00
Per ha Demand	0.52	0.54	0.55	0.57	0.59	0.61	2.97
Carrying Capacity Per ha	3.67	3.67	3.67	3.67	3.67	3.67	0.00
Current Load (persons/ha)	6.62	6.81	7.00	7.21	7.43	7.67	2.97
Management							
Timber Supply Per ha	0.29	0.29	0.29	0.29	0.29	0.29	0.00
Per ha Demand	0.52	0.54	0.56	0.58	0.60	0.62	3.33
Carrying Capacity Per ha	3.67	3.67	3.67	3.67	3.67	3.67	0.00
Current Load (persons/ha)	6.62	6.83	7.05	7.29	7.54	7.80	3.33
Combined							
Timber Supply Per ha	0.29	0.29	0.29	0.29	0.29	0.29	0.00
Per ha Demand	0.52	0.54	0.55	0.57	0.59	0.60	2.89
Carrying Capacity Per ha	3.67	3.67	3.67	3.67	3.67	3.67	0.00
Current Load (persons/ha)	6.62	6.81	7.00	7.20	7.41	7.64	2.89

5

RASUWA DISTRICT

Economic Performance of Rasuwa District

Introduction

This section briefly describes the economic performance of Rasuwa, dealing mainly with the crop, livestock, tourism, horticulture, and forest sectors. The performances of these sectors were examined by using the historical data available from different sources. These data on the major economic activities presented in this section provide the basis for projecting the baseline trend to be described in the subsequent section. The overall performance of Rasuwa's economy has, until very recently, depended heavily on the performance of the crop sector. Given the limited agricultural area, as well as the area under irrigation, the performance of the crop sector depends to a large extent upon the vagaries of the monsoons. The historical data on cropped area, food yield, and cash crops, together with the fertiliser use rate, are described below.

Crop Area

Paddy, maize, millet, and wheat are the principal food crops grown in the district. Potatoes had traditionally been one of the principal cash crops in Rasuwa, presently accounting for about 30 per cent of the total cropped area. Table 5.1 presents the historical data on the area under these crops over the period from1975-1990. The overall picture shows an increasing trend in the area under all crops with the highest average annual rate of increase over this period being observed for paddy (13.2%), followed by potatoes (10.4%). The lowest growth rate is that of wheat (3.2%). Considerable variations in the cropped area are, however, discernible with the highest degree of variability being observed in the case of paddy and potatoes as indicated by their coefficient of variation. The drastic reduction in the area under all crops, particularly paddy and maize which are both monsoon crops, during the period from 1980-1983 can be attributed mainly to the bad monsoons in these years. The area under all crops increased considerably in 1984. For example, between the years 1983 and 1984, the area under paddy increased six fold potatoes three fold, and under other crops two foldtimes.

It should be noted that oilseed cultivation was completely stopped after 1982, according to the data collected by DFAMS. The crop composition also changed considerably, along with the expansion in cropped area, over the period. For example, the share of potatoes in the total cropped area increased from 19.5 per

cent in 1975 to about 30 per cent in 1990. A similar increase in the relative share of maize can also be observed. The relative shares of both maize and wheat, however, declined over this period.

It is important to note that there is considerable uncertainty regarding the statistics collected by DFAMS. These time-series' data should, therefore, be treated cautiously. The overall trend in cropped area based on the historical data suggests relatively higher annual growth rates for most crops which cannot be applied directly to project the future trend. Experiences and review of other information reveal that cropping intensity and expansion in the area under cultivation in most hill districts has crossed the limit of sustainability. Further expansion of cropped area in most hill and mountain districts, therefore, seemingly has to be limited in order to avoid a high degree of environmental degradation. A semilog regression model was fitted to the historical data in order to forecast the cropped area and the estimated results are given in Table 5.2. Most of the time trend coefficients are statistically significant at a five per cent level.

Crop Yield

Despite the expansion of Rasuwa's cropped area, the productivity of most crops, except potatoes, declined over the period from 1975-1990. Therefore, any increase in food production in the district in the past should be attributed mainly to expansion in cropped area rather than improvement in crop productivity. The historical data on crop yields and their average growth rate are given in Table 5.3. As can be observed, the negative trend in crop productivity is relatively more pronounced in the case of millet and maize than with other cereal crops. The yield of potatoes, the crop that expanded most rapidly over the period, however, increased by an average annual rate of 3.16 per cent. Considerable variations in per hectare yield of almost all crops are visible, with the highest degree of fluctuation being observed in potato yields, followed by maize, as indicated by the estimated coefficient of variation. Given the limited irrigation facilities, the vagaries of the cyclical monsoon are perhaps the principal reason for such fluctuating trends in crop productivity.

Fertiliser Use

Given the past expansion in cropped area, one of the principal constraints to increasing productivity in Rasuwa, as in most mountain districts of Nepal, is the unavailability of plant nutrients, particularly chemical fertilisers. Although the actual use of fertiliser by crop in the district is not known, the historical fertiliser sale data collected by the Agricultural Inputs' Corporation (AIC) can provide an indication of the extent of fertiliser availability per hectare of cropped area in Rasuwa. The time-series' data on fertiliser sales over the 1982-1991 period and the estimated sale rate per hectare of cropped area (5 crops) in the district are given in Table 5.4. The

available data indicate that fertiliser sales in the district increased from 78 MT in 1982 to 257 MT in 1991, an average annual growth rate of nine per cent. Since the cropped area also increased rapidly, the fertiliser sale per hectare of cropped area showed a marginal increment (less than one %) over the period. The average fertiliser sale per cropped area is estimated to be 30 kg, indicating the low level of fertiliser availability in the district. Our estimates, based on the crop specific fertiliser use rate reported in the Irrigation Master Plan, indicate a shortage of fertiliser supply in the district. In order to forecast the fertiliser supply in the district, a double log linear trend equation was fitted to the historical data on fertiliser sales. The results are presented below.

Log (Fertiliser Sale) = 4.32 + 0.56 Log(Time)
(sse=0.07)
R^2=0.86

Livestock

As in most hill and mountain districts of Nepal, livestock are an indispensable component of the farming system in Rasuwa. The historical data on the livestock population and livestock products (meat, milk, etc) collected by DFAMS over the period from 1984-1988 are given in Table 5.5. The overall picture shows an increasing trend in all types of livestock population, with the highest average annual growth rate (over 20%) being observed in the case of milch animals (cows and buffaloes). Although the shares of milch buffaloes (milch cows) in the total buffalo (cow) population increased along with the growth in the buffalo population, the relative share of milch cows (16%) and milch buffaloes (26%) in 1988 were still very low. The existence of a relatively large number of unproductive animals might suggest excessive pressure on forest and other land resources. The total cattle and buffalo populations in the district in 1988 were 23,795 and 11,042 respectively. Among the small animals, the goat population registered the highest growth rate (16%), while the sheep population increased by an average annual rate of six per cent. The time-series' data on livestock products over the same period are also given in Table 5.5.

Land Use Changes

Rasuwa district has a total land area of 1,51,179 hectares. The detailed breakdown of land use statistics for 1978 collected by the LRMP was updated and projected using simple assumptions regarding the magnitude and the direction of the inter-class land transfers. As indicated in the methodological framework of the study, the land use changes in most districts of Nepal are primarily the result of deforestation that was assumed to take place at the annual rate of one per cent in the mid-hill region over the past decade (Master Plan). It was further assumed that the

deforested area is first converted to shrubland, then to grassland, and eventually to agricultural land. Table 5.6 presents the projected land use changes in Rasuwa district over the period from 1978-1990 by region. It should be noted that the area under the Langtang National Park (LNP), which covers about 65 per cent of the district's total area, was excluded while projecting the land use changes in the district, considering that the area under the LNP will remain unchanged over time.

The overall land use distribution in the district shows that over 97 per cent of the total natural forests and 75 per cent of the total cultivated land in the district lie in the high mountains. The natural forests in the mid-mountains are immature with low crown densities and are covered by hardwood species. The natural forests in the high-mountain region are of predominantly of mixed species, with maturity class M and density class 2, while all the national forests in the mid-mountains are accessible, only 45 per cent and 14 per cent respectively of the natural forests in the high mountains and the high Himal are accessible, according to the estimate of the Forestry Sector Master Plan. As can be observed from Table 5.6, all the accessible areas are projected to decline at the rate of one per cent per annum over the period. Since 50 per cent of the deforested area is assumed to have been converted into shrubland, the area under shrubland in the district is more expansive than the other land categories such as grassland, non-cultivated inclusions, and agricultural land. The details are given in Table 5.6.

Tourism

Rasuwa district has potential for tourism development. Langtang National Park, the second biggest national park in the country, is one of the major tourist spots in Rasuwa district. A number of other places like Gosaikunda, Rasuwagadhi, Tatopani, and the beautiful Himalalyan peaks situated within this district are important from the tourism point of view. All these factors, together with its varied culture as well as its distinct religious and cultural heritage, have helped to promote tourism activities in the district. Tourism is, therefore, becoming one of the major sources of employment and income for a significant proportion of the local population. Portering in the Langtang National Park (LNP) is the most important source of off-farm employment, followed by agricultural labour and cottage industries.

Trekkers visiting the Langtang National Park (LNP) are of three types, i.e., agency-organised groups; individual trekkers with porters and other support staff; and individual trekkers without porters. Table 5.7 presents the historical data on the number of trekking tourists visiting the Langtang National Park by category over the period from 1983-1987

It can be observed from Table 5.7 that about two-thirds of the tourists fall under the agency-organised group category, 26 per cent under the 'individual trekkers with

guides-cum-porters' category, and the rest under the 'individuals without guides' category. The average annual growth rate of all types of tourist flow over the period is 22 per cent.

Available information (APROSC 1989) indicates that the first category, of 'agency-organised trekking group,' normally consists of 12 members. Each group consists of four employees (one *sardar*, two porters, two kitchen boys, and one cook), all hired outside the district. The APROSC study further indicates that about 25 per cent of the second category of trekkers normally hire porters in Rasuwa district, and it is only this type of trekker that has contributed to the generation of seasonal employment in the district. The details on the assumptions and methods used to forecast tourism flow, local employment, and income generation from tourism in Rasuwa are summarised in the subsequent section.

Horticulture

Rasuwa district is believed to have considerable potential for horticultural development. The district's land area, 98 per cent of which lies in the temperate to alpine zone, is quite suitable for growing fruits. Land in Rasuwa is predominantly marginal and vulnerable to erosion and landslides. Suitable fruit crops, if properly planted and managed, can have a positive effect on these marginal lands.

As a result of the favourable agroclimatic conditions and the district's close proximity to Kathmandu by motorable road, horticultural activities, particularly fruit cultivation, is gradually increasing over time. Apples, pears, walnuts, peaches, citrus fruits, guavas, mangoes, etc are grown in Rasuwa. The available data on the area where different kinds of fruit are cultivated, and which lies mostly in the high mountain region of the district, are given in Table 5.8.

Apples are the predominant fruit crop. In 1990, they accounted for over 40 per cent of the total fruit area in the district, with the remaining area being covered by pears (19.8%), peaches (13%), walnuts (9%), and other fruits (17%). Between 1990 and 1991, the area under apple cultivation increased by 4.3 per cent, which is relatively higher than other types of fruit (Table 5.8). Apple cultivation in the district began after the establishment of the horticultural station in 1971 in Dhunche. The predominant varieties of apples grown in Rasuwa are *Red Delicious and Golden Royal*, whereas the *Pharping Naspati* and *Shelled* varieties are the main varieties of pears and walnuts respectively.

Table 5.9 presents the average cost of fruit cultivation with special reference to apples. Similarly, the average yield and benefit (gross) of different types of fruit are given in Table 5.10. The estimated cost of cultivation is far below the gross return per hectare, indicating that apple cultivation can be a viable economic enterprise

in Rasuwa. Besides, apples grown in Rasuwa (which are marketed in Kathmandu) fetch a relatively high price compared to apples grown in Helumbu and Daman.

Despite the favourable climate and high returns, the nature of cultivation in Rasuwa remains subsistence-oriented. The few orchards in the district lack improved management practices (pruning and fertiliser application, etc). The mortality rate, as reported in the Horticultural Master Plan, is quite high (32.75) due to the lack of care and the need to grow cereals. Some of the institutions that are involved in horticultural development in the district are the Horticultural Farm at Dhunche (which covers about 25 hectares of orchard and one nursery), the Agricultural Development Office (ADB), and the Agricultural Inputs' Corporation (AIC). Some of the major constraints that have severely limited horticultural growth include the lack of storage and processing facilities, lack of transportation, lack of high quality saplings and seeds, and the damage caused by wild animals of Langtang National Park. Finally, in order to project the horticultural income, the area under major fruits, particularly apples, peaches, walnuts, and other fruits, was assumed to grow at an annual rate of one per cent.

Economic and Natural Resource Conditions: Baseline Scenario

Crop Area and Yield

The cultivated area of Rasuwa is far less than in the other districts of Bagmati Zone. Potatoes, as a principal crop, account for more that 80 per cent of the cultivated land in Rasuwa based on the data series used in the study. The area under paddy, wheat, and millet account for less than 1,000 ha each, whereas the area under maize is about 1,500 ha. Oilseeds are not grown in the district.

The results of the area forecasted for different crops, based on the semilog time trend fitted to the historical data series, are given in Table 5.11. Similarly, Table 5.12 provides the respective crop yield projections based on the assumption of non-constant crop prices and variable inputs.

The area forecasted for crops over time indicates almost negligible growth rates in Rasuwa. The highest positive growth rate is for paddy (2.2%), followed by potatoes (1.6%), and the lowest for wheat (0.80%). The total cropped area in the district also does not appear to change much over time (1.3%). Given the existence of marginal lands, vulnerable to landslides and soil erosion, further expansion in the cultivated area of the district seems to be limited. On the other hand, the prospect for increasing the cropping intensity of the district also seems to be limited, given the current state of technology and infrastructure (e.g., irrigation and fertiliser constraints).

Available data indicate that only 14 per cent of the district's cultivated land is under year-round (5%) and monsoon irrigation (9%), and the potential area that can be brought under irrigation is estimated to be 836 hectares. The year-round irrigated area is assumed to grow over time at two per cent per annum (Table 5.11).

Another main constraint in increasing both the cropping intensity and crop yield is the supply of chemical fertilisers. Fertiliser sales are expected to grow at about five per cent, based on the time trend equation fitted to the historical fertiliser sale figure in the district provided by the AIC. The projected sale of fertiliser in the district is far below the projected demand for fertiliser in the district, in contrast to other districts of Bagmati Zone where projected supply far exceeds demand.

Table 5.12 provides the forecasted yields of five crops in Rasuwa, based on the assumption that the crop technology will remain the same over time. The forecasted crop yields are not encouraging. All crops considered show marginally increasing or stagnant yield trends over time. The highest positive growth rate is for paddy (0.52%) and the lowest is for millet (0.1%).

Crop Production

Crop output is determined by the area and yield results discussed above. Table 5.13 indicates that the resulting production growths for all crops are positive, with the highest growth observed in the case of paddy (2.8%), followed by potatoes (1.6%), and the lowest for millet (0.8%). The higher (lower) positive growth observed in production is the result of rapid (marginal) increase in the area rather than yield changes.

Gross Margin

Table 5.14 presents the projected gross margins and cultivation cost per hectare of cultivated crops. It should be noted that the gross margins calculated for the five crops also include the value of crop residues. The results show positive gross margins for all crops, except for wheat and millet. Maize and paddy per hectare gross margins show a relatively higher growth trend (25% and 39%) despite their low per hectare returns. Potatoes appear to be the most profitable crop in terms of returns. The potato gross margin, which is currently estimated at Rs 25,000 per hectare, is expected to grow at the rate of eight per cent per annum. The results also indicate that while the wheat gross margin consistently decreases over time at the rate of 1.65 per cent, the millet per hectare gross margin will improve.

Livestock

The livestock sector gross margins were also projected on the basis of livestock population and product projections Table 5.15 indicates that the average annual

growth rate of LSU in the district is less than one per cent. It should be noted that the average growth rate generated by the model is lower than the historical growth trend reported in the previous section. This is simply because of the fact that the livestock population, particularly the grazing animals, is assumed to be driven by the land use changes in the district, as indicated in the methodology. The average LSU holding per households declines over time, because the number of households increases over time at a faster rate than the increase in LSU.

According to the results derived from the model, the availability of bullock pairdays in the district does not appear to be a constraining factor. But the manure demand exceeds the manure supply over time. This might suggest that the present dose of organic manure is likely to decline over time. This, in addition to the shortage of chemical fertilisers based on past trends, will have negative effects on crop productivity.

Milk, ghee, meat, and wool are the main livestock products. The average yield per head of animal, derived from the historical data on different types of livestock population and their respective products, was assumed to remain constant over time, and the average yield figures were applied to forecasted livestock products over time. Table 5.16 presents the projected trends for different types of livestock products in the district. It should be noted that the average annual growth rates of all livestock products, except for chicken meat, are less than one per cent.

The forecasted gross margin per LSU is given in Table 5.17, along with the raising cost per animal. The results indicate that the total gross margin from buffaloes is among the highest, followed by sheep and goats. The total gross margin from buffalo meat (milk+ghee) is expected to grow at the annual rate of 15.8 per cent (11%). The details are given in Table 5.17.

Food Availability and Demand

The total cereal availability (edible form) in the district was derived by subtracting different waste, loss, and seed allowances from the total production of the four cereal grains (rice, wheat, maize, and millet. Subsequently, the per capita availability was calculated. A similar exercise was carried out to obtain the per capita domestic supply of vegetables (potato only), meat (mutton, buffalo, pork, and chicken), oils and fats (oilseeds are not produced in Rasuwa), and milk. The forecasted per capita availability for each of these food items is given in Table 5.18. Similarly, the forecasted per capita demand for these food categories and the total food balance situation in the district over time are given in Tables 5.19 and 5.20.

The results indicate a declining trend in the per capita availability of all types of food except for vegetables (Table 5.18). This indicates that the population growth in the district exceeds the growth in net food production over the projected period. The

projected food balance situation given in Table 5.20 indicates that there is a net deficit in cereal grains, meat, and oils and fat over time in Rasuwa district, but this deficit is compensated by the large surplus of potatoes and milk.

Land Use

Land use types are agricultural land, forest land, grassland, non-cultivated inclusions, and others. The manner in which land use changes occur over time in the district has already been described earlier. Table 5.21 presents the changes in land use over time in Rasuwa.

The results show a declining trend in the area under natural forests, as well as a result of the net decline in accessible forests which are assumed to be deforested at the rate of one per cent per annum. The natural forests in the mid-mountains are accessible, while only 45 and 14 per cent respectively of the natural forests in the high mountains and high Himal are accessible. The deforested accessible forests are assumed to be converted to shrubland, grassland, and agricultural land, depending upon the direction and magnitude of inter-class and transfers. The results show that shrubland and cultivated areas increase marginally over time.

As in Kabhre and Sindhu districts, significant discrepancy exists between the cultivated area reported in the LRMP and the area estimated from DFAMS data. In the absence of time-series' data on the cultivated area, DFAMS' data on the cropped area was used and the net cultivated area in the district was derived as the sum of non-competing crops (paddy and maize).

Forest Products

Fuelwood, fodder, and timber are the main forest products for which the demand and supply projections were made on the basis of constant yield assumptions.

Fuelwood

Fuelwood is assumed to come from different sources, namely, accessible forests, shrubland, grassland, non-cultivated inclusions, and farmland. Forests under the Langtang National Park were not considered while estimating fuelwood or fodder supply, as these land resources vary as indicated earlier (Chapter 2). Under constant yield assumptions, the forecasted growth in the supply of fuelwood from these sources depends primarily on the projected changes in these land resources over time. Similarly, the projected demand for fuelwood under the constant per capita fuelwood consumption increases over time, along with population growth.

The forecasted changes, in the supply of fuelwood from different sources are given in Table 5.22, and it can be observed that currently about 70 per cent of the total

fuelwood supply in the district is estimated to come from accessible forests, 20 per cent from shrub and grasslands, and the rest from non-cultivated inclusions and farmland. This clearly indicates that forests are the major sources of fuelwood and the contribution of farmlands to the total fuelwood supply is negligible (less than 4%). Over time, the share of forests in the supply of fuelwood from the accessible forest area declines, whereas the share of shrubland increases slightly. On the whole, the projected supply of fuelwood in the district decreases at an annual rate of less than one per cent (0.44%) (Table 5.23).

Despite the declining trend in fuelwood supply, Rasuwa has considerable fuelwood surplus over the projected time period. Currently, fuelwood supply exceeds the demand by almost two-fold, but this excess supply, however, deteriorates marginally over time as a result of the positive growth in fuelwood demand caused by the positive population growth rate (1.86% per annum).

Fodder

Under the constant yield assumption, fodder supply in the district changes over time along with the changes in land use. Table 5.24 shows that only 17 per cent of the district fodder supply is estimated to come from farmland and the remaining from forests (26%), grassland (37%), and shrubland (20%). Over time the share of forests declines and the shares of shrubland, grassland, and farmland increase marginally due to changes in land use. On the whole, the projected supply of fodder in the district (Table 5.25) also continues to exceed the projected fodder requirement by a considerable amount. Put differently, although the fodder requirement of the district increases at a relatively higher rate than the fodder supply, the district fodder supply is found to be sufficient to meet the fodder requirement for the period considered.

The grasslands located inside the Langtang National Park are open for seasonal grazing and were included in the estimation of fodder supply. This source contributes nearly 30 per cent to the total fodder supply. Even if this class of land is assumed to be inaccessible, fodder supply would still exceed the requirement by about 32 per cent of the district.

Timber

Table 5.26 shows that Rasuwa district has surplus timber, as is the case for both fuelwood and fodder. Forests are the only source of timber and, at present, the timber supply exceeds the timber demand by two and a half fold.

Labour Supply and Use

Labour supply in the district is determined by the size of the active population and the normal duration of work. The normal duration of work as reported by NRB for the mountain region is 240 mandays available per active member of the household. This constant period of work was applied to the projected active population (Table 5.27) to forecast the total supply of labour (mandays) in the district. While the number of labour days utilised in the crop and livestock sectors was generated by the model, labour spent on other non-agricultural activities was projected by using the information collected by Nepal Rastra Bank.

The forecasted labour supply and labour use situation in the district is given in Table 5.28. In 1990-1991, over 82 per cent of the labour force in the district was gainfully employed. Since the projected labour supply in the district increased at a faster rate than the labour use, the employment rate declined marginally over time. About two-thirds of the labour force are depicted as being employed in the agricultural sector and the rest in the non-agricultural sector. It should also be noted that although the employment generated by tourism activities in the district is negligible, its future trend (growth) is quite encouraging and it is one area where policy intervention appears to be important.

Horticulture

Rasuwa district has considerable potential for horticultural development, given the favourable agroclimatic conditions and infrastructure. As described earlier horticultural activities, particularly fruit crops, were incorporated into the model to capture the income generated from this sector.

Based on the available information on the area under different fruits (apples, walnuts, peaches, and other fruits), their cultivation costs and yields, and gross margins for these fruits were projected over time. The areas under all fruits, adjusted to a mortality rate of 37.2 per cent, are projected to grow at the rate of one per cent per annum (Table 5.29). Table 5.30 shows fruit production by type. Similarly Table 5.31 shows the per hectare costs and gross margins for different fruits.

The results indicate positive gross margins for all fruits. The highest gross margin per hectare is for apples (Rs 57,680) and the lowest for peaches (Rs 12,208). On the whole, the estimated per hectare gross margins of fruit crops were found to be substantially higher than for cereal crops. The projected gross margins per hectare for all fruits show an increasing trend over time, with walnuts registering a relatively higher rate of growth (10.3%) than other types of fruit (7-8%).

Tourism

Rasuwa district has potential for mountain tourism, as mentioned earlier. The Langtang National Park (LNP), which covers a large part of Rasuwa, and a number of other important tourist spots in the district, have attracted many tourists. Tourism is a major off-farm source of employment and income in the district.

In order to project the number of tourists visiting the district, the total number of trekking tourists visiting Nepal were first projected by using the historical data reported in the Tourism Statistics of Nepal, and also the number of tourists visiting the LNP was assumed to be a fixed proportion (11%) of the total number of trekking tourists that visit Nepal. Table 5.32 shows that the forecasted flow of tourists visiting LNP will increase from 8,742 in 1991 to 18,580 by 1998, with an average annual rate of 11.4 per cent.

Assuming that one tourist hires on an average 1.04 porters and that only 60 per cent of the porters are hired locally, the total number of porters gainfully employed in tourism was also projected (Banskota and Upadhyay 1989). Further, assuming that the porter wage is thrice the agricultural wage, the total porter income was also forecasted. The results indicate that whereas local porter employment in the tourism sector will follow the same growth trend as tourist flow, porter income is expected to grow rapidly at the rate of 19.2 per cent per annum. Another important source of income from tourism in the district is tourists' expenses on local food and lodging which were also projected on the basis of estimates (Banskota and Upadhyay 1989). The results indicate that in 1990-91 about 95 per cent of the total income from tourism is accounted for by the local food and lodging expenses of tourists and the rest by porter income. On the whole, the total income from tourism is projected to reach Rs 92.92 million by the year 1998 from Rs 42.39 million in 1991, at an average growth rate of about 12 per cent per annum (Table 5.32).

Trade

Food

The extent to which many food items are exported (imported) in the district was determined by the magnitude of food surplus (deficit) generated by the model, based on the food demand estimate and supply forecasts, as indicated earlier. Rasuwa district has considerable surpluses of potatoes and milk and deficits in other food groups (cereals, meat, oils and fats). But since the potato and milk surplus is large enough to offset the magnitude of deficit in other food items, the district has net food exports in terms of value. Table 5.33 shows that the total value of food exports from Rasuwa will increase from Rs 4.95 million in 1991 to Rs 9.12 million in 1998, with an annual growth rate of about nine per cent. The per

capita value of aggregate food export in the district is forecasted to increase by seven per cent.

Non-Food

Import demand for non-food items is assumed to be influenced by population growth, income growth, and income elasticity for non-food demands as specified in Chapter 2. The average monthly expenditure on non-food items reported by NRB for the mountain regions was first adjusted to reflect the situation in the base year (1991). The projected growth rate of import demand was then applied to this base value of non-food import to project the total value of non-food imports in the district. Table 5.33 shows that non-food imports in Rasuwa are expected to increase from Rs 42.6 million in 1991 to Rs 49 million in 1998, at the rate of two per cent per annum. The per capita value of non-food imports, however, remains almost stagnant despite the growth in population.

Income

Income is determined endogenously by the model. Gross margins of the crop (including horticulture) and livestock sectors and income accruing from different employment activities were added to derive the aggregate income for Rasuwa. The forecasted nominal and real incomes of different sectors are given in Tables 5.34 and 5.35 and the income shares of different sources are given in Table 5.36.

The per capita nominal income for Rasuwa was Rs 4,102 in 1991, and it is expected to grow at an average annual rate of 10.6 over the projected period. The contribution of the crop sector to the total income is among the highest (39%), followed by tourism (28%), horticulture (18%), and livestock (10%). The income share of the crop sector remains more or less constant over time. The income shares of the livestock and tourism sectors, however, increase while those of horticulture and other off-farm activities decline over time. As a result, the real per capita income estimated by using the price index at 1991 constant prices shows a marginally declining trend over time.

Environment: Sustainability and Carrying Capacity

The performance of the district in terms of some selected sustainability indicators, such as population density, agriculture-forest land ratio, and so on can be judged from the results given in Table 5.37. The density of both the human and livestock populations per hectare of cultivated land in the district is much more pronounced than the density per hectare of accessible forest area, primarily because of the limited area under cultivation compared to the accessible forest area in the district. As indicated earlier, the cultivated land in the district, which was derived as the sum

of the area under non-competing crops using the DFAMS data, is 49 per cent lower than the figure obtained from the LRMP statistics.

The population density per hectare of cultivated land is currently 13 persons, and this pressure increases marginally over time due to the increase in population. Stated differently, the per capita cultivated land in the district, which is currently 0.079 of a hectare, is expected to decline marginally over time. Population pressure on accessible forests in Rasuwa is very low at 2.2 persons per hectare in 1991 and an estimated three persons in 1998. The density of livestock population per hectare of forest and grassland is also very low compared to the density per cultivated land.

The Wyatt-Smith estimate indicates that 3.5 hectares of accessible unmanaged forest are required to support one hectare of cultivated land in the present context of the hill farming system. The ratio between cultivated land and forest area in Rasuwa is currently 5.7, and this is fairly high compared to the 3.5 estimate. This clearly indicates that Rasuwa district is in a relatively better position compared to Kavre and Sindhu in terms of the natural resource base, despite the relative scarcity of cultivated area. The carrying capacity of land in terms of food, fuelwood, and fodder was separately calculated on a per hectare basis.

Implications for Food

Assuming that 2,410 calories are required by an adult, the carrying capacity of one hectare of cropland was calculated. Table 5.38 shows that the per hectare calorie supply in Rasuwa in 1990/1991 was 3,756,000 and this is about 97 per cent of the calorie demand per hectare. The carrying capacity of cropland decreases marginally over time because the per hectare of cropland can support about 5.2 adults, whereas the demand pressure (i.e., load per ha) is 5.3 adult persons, about three per cent greater. This indicates that a little over one hectare of cropped area is required to support the calorie requirements of one household, assuming that the average size is 6.5 persons per household.

Implications for Fuelwood

The carrying capacities of both aggregate land and forest land in terms of fuelwood were estimated and the results are given in Tables 5.39 and 5.40. The results indicate that, in Rasuwa, the carrying capacity of aggregate land from which fuelwood is supplied is about 77 per cent higher than the existing demand pressure. The 1991 figures show that, one hectare of land can support 1.4 persons' fuelwood need, whereas the demand pressure is only 0.47 persons' fuelwood need per hectare. This indicates that the present stock of fuelwood that can be sustainably harvested from different fuelwood sources in the district is 1.77 times greater than

the fuelwood requirement of the district. The carrying capacity of the district in terms of fuelwood declines over time at the rate of 2.27 per cent per annum because the per hectare demand increases at a higher rate than the projected demand pressure. The carrying capacity of forest in terms of fuelwood, as reported in Table 5.40 further, indicates that forests can support over 50 per cent of the total fuelwood requirements of the district, although this proportion declines over time at the rate of about two per cent per anum as a result of decline in the accessible forest area.

Implications for Fodder

The estimated carrying capacity of Rasuwa's land resources from which fodder originates is also far greater than the existing fodder demand pressure. Table 5.41 shows that the per hectare fodder supply is currently 1.91 times greater than the per hectare fodder demand. Although the carrying capacity declines marginally over time, Rasuwa district is expected to have a large fodder surplus over the projected period. More specifically, the base trend in 1991 shows one hectare of land from which fodder originates can support less than one LSU (i.e.,0.9), whereas the stocking rate is only 0.47 LSU per hectare.

Table 5.42 also shows the estimated carrying capacity of forest land in terms of fodder. The results indicate that the estimated carrying capacity of forest land is currently 0.86 per hectare, whereas the demand pressure (i.e., load) is 1.72 LSU per hectare. This indicates that about 50 per cent of the current fodder demand can be supported by forest land, although its capacity to meet the fodder demand shows a declining trend over time as a result of decline in the accessible forest area.

Policy Scenarios and Impact Analysis

Introduction

The policy scenario discussion on Rasuwa district will be confined to two sectors, namely, tourism and horticulture. Tourism provides income and employment to a large number of people in the district. Horticulture is a growing enterprise in the district with many households cultivating apples, walnuts, peaches, and other types of fruit. The role of the agricultural sector in the district is small compared to other districts of the Bagmati Zone, primarily due to the lack of suitable cultivable land. The potential to increase agricultural land or productivity of the existing crops (paddy, maize, and millet) are also fairly limited, given the harsh topography and climatic conditions of the district. Potatoes have potential for development and the impact of developing potato cultivation in the district will primarily be increased productivity, as the scope for increasing the land under potatoes is fairly limited.

In addition, the impact of the potato policy has already been examined in the context of other districts to provide an idea of the impact of the policy.

Policy Alternatives

Tourism

Langtang National Park is located in Rasuwa district. Even though the park covers parts of Nuwakot and Sindhupalchok districts, Rasuwa district encompasses a large area of the National Park. The main tourist destinations, namely, Langtang Valley and Gosaikunda are both located within Rasuwa. As a result, most of the tourism activities generated by the National Park are confined to Rasuwa district.

The tourism policy was evaluated in terms of two policy scenarios. First, it was assumed that the number of tourists visiting Langtang National Park will increase by 25 per cent. The second policy scenario examined assumes an increase in the number of days spent by visitors in the Park by one day from the current four days' assumption, and the number of trekkers was assumed to remain the same as under the baseline scenario.

Horticulture

The present role of the horticultural sector in Rasuwa has already been highlighted in the previous section. The horticultural sector has a relatively good potential for further progress, hence a simple horticultural policy was examined. The horticultural policy involves an increase in the area under apples by 25 per cent in 1993. This policy assumes that apple production will start immediately after the area under apples is increased by 25 per cent. Of course, apple production will not start immediately after the area is increased, but the purpose of the exercise is to demonstrate the impact of such a policy. Under this policy, the cost of apple production, mortality rates, and other costs are all deducted, as reported by Shrestha (1992).

Impact Analysis

The impacts of the three policy alternatives will be analysed in terms of employment, income, trade, and the food situation in Rasuwa.

Employment

According to the baseline scenario, employment in Rasuwa is approximately 81 per cent but, as the population grows and the size of the labour force increases, the employment situation will deteriorate marginally over time (Table 5.43). Under the

horticultural policy, which consists of increasing the area under apples by 25 per cent, labour use in the district improves marginally. The same situation can be observed under the two tourism policies examined in the section. Between the two tourism-related policies, increasing the number of tour days by one additional day appears to have a stronger impact than increasing the tourist number in the long run, as indicated by the larger growth rate. However, none of the three policies examined appears to have a significant impact on improving labour use in Rasuwa compared to the baseline scenario (Table 5.43).

Tourism

First, the impact of the tourism policy on income from tourism will be discussed. As defined in the model, income from tourism is in the form of porter income and other local income in the form of lodging, food expenses, and other local purchases. For details refer to the previous section.

The results of the two tourism-related policies, as well as the baseline scenario with regard to income accruing from tourism, are given in Table 5.44. The projections of tourist flow to Langtang National Park under the baseline and policy scenarios are also given in Table 5.44. The tourist flow to Langtang National Park under the baseline scenario and under the 'increased tourist day' policy are the same, since under the policy scenario the same number of tourists was considered as under the baseline scenario. However, their stay was increased by one additional day from the present duration of four days.

The impacts of the two tourism-related policies on income are different. Under the 'increased tourist day' policy, the porter income changes as porters are hired for one additional day, but other local expenses also change. This happens because tourists visiting the Langtang National Park usually spend one night in a lodge and then move on to another place. This assumption may not be very accurate for tourists spending more nights in local lodges. However, a large majority prefer camping. If more nights are spent in local lodges, more local income will obviously be generated.

The impacts of the two policies on porter income are not different since the number of porter days is the same under both scenarios. However, the impacts on other types of local income are different, with the increased tourist number policy having a significant positive impact on local income than the increased tourist day policy. Besides the overall increase in local income, the increased tourist number policy has a better impact since the income accruing from tourism is obtained by a wider section of the compared population to the increased tourist day policy.

Horticulture

The impacts of all the policies on income were also examined. The results are given in Table 5.45 and are compared across other major income sources. The income shares of major sources are given in Table 5.45 and real incomes are given in Table 5.46.

The three major sources of income in Rasuwa at present consist of crop, tourism, and horticulture, as these account for over 70 per cent under the baseline scenario. Under the baseline trend, crop income (paddy, wheat, maize, millet, and potato) accounts for about 37-39 per cent only, followed by tourism between 29-31 per cent, and horticulture (16-18%).

Under the horticultural and 'increased tourist day' policies, the income shares of the three sources do not vary much. A few percentage point changes in the shares are noticeable under the 'increased tourist day' policy, as can be seen in Table 5.46, along with real per capita incomes estimated on the basis of the model.

The real per capita incomes are also observed to be highest under the 'increased tourist number' policy, but it can be seen that the real per capita incomes are declining gradually over time under all scenarios. The growth rates provide an idea of the projected changes in income over time in Rasuwa. It should be noticed that income from tourism is also in the form of park entrance fees. This income was not taken into account in the model since all types of income that accrue from this source are government revenue and are not a part of Rasuwa's income.

Conclusion

Rasuwa is an extremely poor district without the tourism and horticultural inputs. Agriculture cannot be considered as a long-term development alternative in Rasuwa, because the scope of expanding agricultural land in the district is severely limited by its topography. Furthermore, given the very small area under cultivation, developing an irrigation system in the district may not be cost-effective. Scope, however, exists for potato development, but this may primarily be in terms of productivity increase rather than area increase.

Tourism has potential for further development. Currently the impact of tourism is significant since it provides additional seasonal employment and also income. Increasing the tourist flow to Rasuwa is not an unrealistic policy since LNP is the most accessible part from the capital. New routes and facilities, if developed, can increase the duration of tourist stay inside the Park and this will further generate employment and income. Horticulture also has potential for further development. The apple policy was focussed on only one fruit, namely, apples. However,

Rasuwa has already started cultivating other fruits such as walnuts and peaches. Scope exists for expanding the areas under these fruits as well. The simulation exercise revealed that when only one fruit was considered, benefits accruing were not negligible. Further, the yield assumption made in the current exercise is small, and there is scope for improving fruit yield rates far above the existing rates. Additionally, with appropriate extension, input, and marketing facilities, it is possible to intercrop vegetables with fruits, thus generating more employment and income in Rasuwa.

Table 5.1: Area under Different Crops in Rasuwa

Year	Paddy	Maize	Wheat	Millet	Oilseeds	Potatoes
1975	200	1120	510	610	40	600
1976	220	1125	480	640	30	630
1977	200	1120	480	650	20	640
1978	130	1000	480	620	20	600
1979	130	1000	480	620	20	600
1980	240	620	470	610	20	350
1981	160	700	470	610	20	350
1982	150	700	400	500	0	500
1983	150	790	400	500	0	700
1984	830	1500	840	800	0	2200
1985	850	1300	850	900	0	2200
1986	1060	2090	400	890	0	2300
1987	1050	2090	1000	1220	0	2500
1988	1140	2390	1300	870	0	2310
Mean	465	1253	611	717	12	1177
Std. Dev.	396	545	265	189	13	846
Coef. Var	85	43	43	26	108	71

Table 5.2: Estimated Regression Results for Cropped Area: Rasuwa

Crops	Semi-log Equation	
Paddy	= -162.27+ 348.61 ln (time) (115.8)	R2=0.43
Maize	= 668.11 +305.17 ln (time) (189.01)	R2=0.20
Millet	= 305.42 +170.06 ln (time) (90.32)	R2=0.23
Wheat	= 485.1 +128.96 ln (time) (63.33)	R2=0.25
Potatoes	= 147.417+736.12 ln (time) (249.24)	R2=0.42

Note: Figures in parenthesis indicate the standard error of the estimates

Table 5.3: Crop Yields Over Time (kg/ha)

Year	Paddy	Maize	Millet	Wheat	Potato
1975	1950	1714	1196	1089	5000
1976	1950	1707	1208	980	5000
1977	2000	1366	958	1092	5000
1978	1462	1350	958	1097	5500
1979	1462	1210	958	1113	5583
1980	1625	1355	894	1000	7000
1981	2000	1200	894	1098	7514
1982	2000	1014	900	1000	9000
1983	1800	1101	1000	1000	7543
1984	1807	1200	917	1000	8000
1985	2353	1400	918	889	6000
1986	2160	1670	1000	910	6000
1987	2010	1584	900	1197	7500
1988	1912	1498	992	1034	7497
Mean	1892	1383	978	1035	6581
Std Dev	238	218	98	80	1249
Coef Var	12	15	10	8	18

Table 5.4: Fertiliser Sales Over Time in Rasuwa

Year	Sales (MT)	Sales Per Cropped ha
1982	78	35
1983	107	42
1984	169	27
1985	163	27
1986	142	21
1987	170	22
1988	213	27
1989	263	32
1990	347	37

Source: AIC

Table 5.5: Livestock Population and Product in Rasuwa

Year	1984	1985	1986	1987	1988
Population					
Pigs	264	277	281	285	288
Goat	10065	10448	18529	18350	18166
Sheep	8740	8974	11360	11270	11180
Cattle	15163	15375	24158	23975	23795
Buffaloes	6996	7176	11198	11120	11042
Milch Buff	1280	1313	2916	3066	2860
Milch Cow	1724	1748	4313	3968	3787
Products					
Milk-Buff	850	872	1361	1458	1514
Milk-Cows	365	370	582	555	603
Goat Meat	36	37	66	65	64
Buffalo Meat	237	243	379	376	373
Mutton	33	34	43	43	43
Pork	4	4	4	4	4

Table 5.6: Land Use by Land Type in Rasuwa and Changes Over Time (ha)

	1978	1979	1980	1985	1986	1987	1988	1989	1990
Mid-mountains	4148	4148	4148	4148	4148	4148	4148	4148	4148
Natural Forests	217	215	213	202	200	198	196	194	192
Accessible	217	215	213	202	200	198	196	194	192
Forests	387	388	389	394	395	396	397	398	399
Shrublands	888	888	889	890	891	891	891	891	892
Grasslands	2644	2645	2645	2648	2649	2650	2650	2651	2651
Mapped Cultivated	983	983	983	984	985	985	985	985	985
Adjacent NCI									
Gross Cultivated	1661	1661	1662	1664	1664	1665	1665	1666	1666
NCI Within	327	327	327	327	327	327	327	327	327
Net Cultivated	1334	1334	1335	1337	1337	1338	1338	1339	1339
MM Calculated	4136	4136	4136	4135	4135	4135	4135	4135	4135
High Mountains	75161	75161	75161	75161	75161	75161	75161	75161	75161
Natural Forests	41343	41155	40968	40063	39887	39713	39541	39370	39201
Accessible Forests	18852	18664	18477	17572	17396	17222	17050	16879	16710
Shrublands	7163	7257	7351	7802	7891	7978	8064	8150	8234
Grasslands	9739	9767	9795	9931	9957	9984	10009	10035	10060
Mapped Cultivated	7738	7785	7841	8112	8165	8217	8269	8320	8371
Adjacent NCI	3066	3085	3104	3194	3212	3229	3246	3263	3280
Gross Cultivated	4671	4700	4737	4914	4953	4988	5023	5057	5090
NCI Within	801	801	801	801	801	801	801	801	801
Net Cultivated	3861	3899	3936	4117	4152	4187	4222	4256	4289
HM Calculated	65982	65964	65955	65909	65901	65892	65883	65875	65866
High Himal	71870	71870	71870	71870	71870	71870	71870	71870	71870
Natural Forests	1056	1045	1035	984	974	965	955	945	935
Accessible Forests	151	149	148	141	139	138	137	135	134
Shrublands	2124	2124	2124	2124	2124	2124	2124	2124	2124
Grasslands	13437	13437	13437	13437	13437	13437	13437	13437	13437
HH Calculated	16617	16606	16596	16545	16535	16526	16516	16506	16496
Rasuwa Total									
Forests	42616	42415	42216	41249	41062	40876	40692	40510	40329
Shrublands	9504	9596	9687	10130	10215	10300	10385	10468	10550
Grasslands	24064	24093	24121	24258	24285	24311	24338	24363	24389
Adjacent NCI	4049	4068	4087	4179	4196	4214	4231	4249	4266
NCIG	1128	1128	1128	1128	1128	1128	1128	1128	1128
Net Cultivated	5195	5233	5271	5454	5490	5525	5560	5594	5628
Rasuwa Calculated	86735	86706	86686	86590	86571	86553	86534	86516	86497
Residual	64444	64473	64493	64589	64608	64626	64645	64663	64682
Total Area	151179	151179	151179	151179	151179	151179	151179	151179	151179

Table 5.7: Number of Trekkers Who Visited Langtang National Park by Type

Year	Type I	Type II	Type III	Total
1983	1249	499	125	1873
1984	1475	590	147	2212
1985	2095	838	209	3142
1986	2371	948	237	3556
1987	2779	1111	278	4168

Note: Type I, Type II, and Type III refer to agency organised trekker, individual trekker with guide-cum-porter, and individual trekker without guide respectively.

Source: APROSC (1989), Master Plan for Tourism Development

Table 5.8: Area under Different Kinds of Fruits

Fruits	1989/90	1990/91	% Change
Apple	341	356 (224)	4.3
Peach	109	110 (69)	0.9
Walnut	71	72 (45)	1.4
Pear	167	169 (105)	1.2
Other Fruits	139	144 (90)	3.5
Total	827	851 (533)	2.9

Figures in Parenthesis indicate the adjusted area using the mortality rate of 37 per cent as reported in Horticulture Master Plan.

Note: Other fruits include plums, citrus, guavas, apricots, jack fruits, pineapples, papayas, and bananas
Source: Fruit Development Division, Department of Horticulture

Table 5.9: Average Cost of Fruit Cultivation with Special Reference to Apple

	Quantity	Rs/hectare
Labours	230 md/ha	7200
Fertiliser	950/kg/ha	5722
Other Variable Costs		
Tools and implements		5112
Maintenance		200
Total variable cost		18,234

Source: Shrestha, K.B. (1991)
Note: No chemical fertilisers are used for fruit except under mixed cropping (vegetable+apple).

Table 5.10: Per Hectare Yield and Benefit (Gross) of Different Fruit Crops in Rasuwa

	MT/ha	Total Income (Rs/ha)
Apple	7.46	74600
Pear	13.50	67500
Walnut	2.75	68750
Other Furits	10.35	n.a

Source: Shrestha, K.B. (1991)

Table 5.11: Forecasted Area under Different Crops (hectares)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	804	825	845	864	882	899	915	931	2.20
Maize	1570	1589	1608	1626	1642	1658	1673	1688	1.08
Millet	777	787	797	806	815	823	831	839	1.14
Wheat	843	850	858	865	871	878	884	889	0.80
Potatoes	2358	2402	2444	2484	2522	2558	2592	2625	1.61
Horticultural area	535	539	542	546	549	553	556	560	0.64
Total Cropped Area	6886	6993	7095	7190	7282	7369	7452	7531	1.34
Total Cultivated Land	2909	2954	2996	3035	3074	3110	3145	3178	1.32
Area Under Irrigation (2% gr)	247	252	257	262	267	273	278	284	2.00
Total Fertiliser Sale in District	259	274	289	304	318	331	344	357	4.99

Table 5.12: Forecasted Yield Rates of Different Crops (kg/ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	1993	1991	1987	1984	1981	1979	1977	1975	0.54
Maize	1419	1419	1418	1418	1417	1416	1416	1415	0.28
Wheat	1084	1083	1082	1080	1079	1078	1077	1076	0.48
Millet	986	986	986	986	986	986	986	985	0.09
Potatoes	6788	6786	6784	6780	6777	6775	6773	6771	0.36

Table 5.13: Forecasted Changes in Crop Production (MT)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	1603	1643	1680	1715	1748	1779	1809	1838	2.75
Maize	2227	2255	2281	2304	2327	2348	2368	2388	1.36
Wheat	914	921	928	934	940	946	952	957	1.28
Millet	766	776	786	795	803	811	819	826	1.24
Potatoes	16003	16302	16581	16842	17092	17329	17554	17772	1.97

Table 5.14: Forecasted Revenue, Cost, and Gross Margins Per Hectare of Cultivated Lands under Different Crops (Rs/ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Revenue (Rs.'000)									
Paddy	11.85	13.05	14.34	15.75	17.29	18.97	20.79	22.79	10.54
Maize	7.59	8.27	8.99	9.76	10.59	11.47	12.42	13.45	8.90
Wheat	6.60	7.04	7.51	8.01	8.54	9.11	9.71	10.36	7.24
Millet	5.66	6.29	6.99	7.75	8.57	9.48	10.46	11.54	10.92
Potatoes	39.12	41.92	44.92	48.16	51.65	55.41	59.47	63.85	7.65
Cost (Rs '000'):									
Paddy	9.72	10.41	11.15	11.94	12.79	13.69	14.66	15.70	7.08
Maize	7.12	7.62	8.16	8.73	9.34	10.00	10.70	11.45	7.02
Wheat	6.72	7.19	7.69	8.23	8.80	9.41	10.07	10.77	6.97
Millet	6.11	6.54	7.01	7.51	8.04	8.61	9.22	9.87	7.09
Potatoes	15.31	16.39	17.55	18.79	20.13	21.56	23.10	24.75	7.09
Per Hectare Gross Margin (Rs/ha)									
Paddy	2126	2637	3193	3813	4506	5277	6132	7086	25.62
Maize	470	645	830	1029	1244	1476	1724	1994	38.91
Wheat	-119	-148	-182	-220	-261	-307	-358	-413	1.65
Millet	-451	-249	-20	240	535	869	1245	1670	
Potatoes	23812	25527	27372	29364	31520	33854	36374	39106	8.02

Table 5.15: Forecasted Livestock Population

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cattle	24232	24439	24676	24915	25155	25398	25644	25891	0.95
Milch Cows	3877	3910	3948	3986	4025	4064	4103	4143	0.95
Bullocks	20355	20529	20728	20928	21131	21335	21541	21748	0.95
Buffalo-total	11057	11151	11259	11369	11479	11590	11702	11815	0.85
Milch Buffaloes	3173	3200	3231	3263	3294	3326	3358	3391	0.85
Sheep	11194	11282	11383	11485	11587	11691	11795	11900	0.78
Goats	18174	18324	18497	18670	18846	19023	19201	19381	0.81
Pigs	297	306	315	324	334	344	354	365	3.00
Chickens	12460	12834	13219	13615	14024	14444	14878	15324	3.00
Total LSU	28809	29053	29332	29614	29898	30185	30474	30766	0.89

Table 5.16: Forecasted Annual Production and Growth in Livestock Products (MT)

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Milch Cows	378	381	385	388	392	396	400	403	0.95
Milch Buffaloes	605	610	616	622	628	634	640	646	0.85
Ghee	14	14	14	14	14	14	14	15	0.88
Net milk supply	688	694	700	707	714	721	728	735	0.89
Aggregate oils and fats	13.60	13.72	13.85	13.99	14.12	14.26	14.40	14.54	0.88
Buffalo meat (MT)	304.32	306.92	309.90	312.91	315.94	319.00	322.08	325.20	0.85
Goat and sheep meat (MT)	84.82	85.51	86.30	87.10	87.90	88.71	89.53	90.36	0.80
Chicken meat (MT)	16.45	16.94	17.45	17.97	18.51	19.07	19.64	20.23	3.00
Pork meat (MT)	2.79	2.87	2.96	3.05	3.14	3.23	3.33	3.43	3.00
Aggregate meat available (MT)	408.38	412.24	416.61	421.02	425.49	430.01	434.58	439.21	0.95
Wool Production (kg)	4927.27	4966.07	5010.47	5055.22	5100.34	5145.82	5191.67	5237.89	0.78

Table 5.17: Forecasted Cost and Returns from Livestock (Rs/animal)

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998
Buffaloes	4267	4968	5776	6699	7755	8961	10337	11905
Sheep and Goats	3173	3577	4043	4573	5178	5867	6650	7541
Pigs	45	52	60	69	79	91	105	120
Poultry	813	924	1051	1194	1357	1542	1751	1989
Cow (milk+Ghee)	2246	2503	2791	3111	3467	3862	4300	4786
Buffalo (milk+ghee)	4282	4754	5282	5867	6515	7233	8028	8909
Total Gross Margin From Livestock	14826	16778	19001	21514	24351	27555	31171	35251

Table 5.18: Forecasted Per Capita Food Supply (kg/adult)

Food-edible form	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal grains-edible form	109.87	109.38	108.74	108.02	107.25	106.43	105.56	104.66	-0.23
Meat	11.11	11.00	10.91	10.83	10.74	10.66	10.58	10.50	-0.90
Milk	18.70	18.51	18.35	18.18	18.02	17.87	17.72	17.57	-0.95
Oils and Fats	0.37	0.37	0.36	0.36	0.36	0.35	0.35	0.35	-0.96
Vegetables	339.79	339.67	339.06	338.05	336.77	335.24	333.47	331.55	0.17

Table 5.19: Forecasted Per Capita Food Demand (kg/adult)

Food-edible form	1991	1992	1993	1994	1995	1996	1997	1998
Cereal Grains	113.90	113.18	113.31	113.43	113.55	113.65	113.75	113.84
Vegetables	317.86	317.74	317.74	317.33	316.63	315.65	314.40	313.01
Meat	3.37	3.18	3.18	3.19	3.19	3.20	3.20	3.21
Milk	22.40	21.92	21.87	21.83	21.80	21.77	21.75	21.73
Oils and Fats	2.25	2.15	2.15	2.15	2.15	2.15	2.15	2.16

Table 5.20: Forecasted Per Capita Food Balance Situation (kg/adult)

Food-edible form	1991	1992	1993	1994	1995	1996	1997	1998
Cereal Grains	-4.03	-3.81	-4.57	-5.41	-6.30	-7.23	-8.19	-9.18
Vegetable	21.93	21.93	21.31	20.72	20.14	19.59	19.07	18.54
Meat	7.74	7.82	7.73	7.64	7.55	7.46	7.38	7.29
Milk	-3.69	-3.41	-3.53	-3.65	-3.78	-3.90	-4.03	-4.16
Oils and Fats	-1.88	-1.78	-1.78	-1.79	-1.79	-1.80	-1.80	-1.81

Table 5.21: Forecasted Changes in Land Use (ha)

Land Type	1991	1992	1993	1994	1995	1996	1997	1998	Growth Rate
Forest s	40151	39630	39463	39298	39134	38972	38812	38653	-0.53
Shrublands	10842	10926	11010	11092	11174	11255	11335	11415	0.74
Grasslands	24414	24440	24466	24491	24516	24541	24565	24589	0.10
Adjacent NCI	4283	4299	4316	4332	4348	4365	4380	4396	0.38
NCIG	1128	1128	1128	1128	1128	1128	1128	1128	0.00
Net Cultivated	5662	5696	5729	5762	5794	5826	5858	5889	0.57
Residual	64699	65060	65068	65076	65084	65092	65100	65108	0.08
Rasuwa HH: Under Langtang									
Forests	17630	17630	17630	17630	17630	17630	17630	17630	
Shrublands	4950	4950	4950	4950	4950	4950	4950	4950	
Grasslands	15510	15510	15510	15510	15510	15510	15510	15510	
Other	59720	59720	59720	59720	59720	59720	59720	59720	
Total	97810	97810	97810	97810	97810	97810	97810	97810	
% Under Park	64.70	64.70	64.70	64.70	64.70	64.70	64.70	64.70	

Table 5.22: Forecasted Change in the Share of Fuelwood from Different Sources

Sources	1991	1992	1995	1998
Forests	69	68	67	66
Shrub and Grasslands	20	20	21	22
Adjacent NCI	8	8	8	9
Farm Land	3	4	4	3
Total Supply (air dried tonnes)	36,304	36,142	35,664	35,195

Table 5.23: Forecasted Fuelwood Supply from Different Sources (air dry tonne (ADT))

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Forest: Hardwood (5 adt/ha)	6861.25	6792.63	6724.71	6657.46	6590.89	6524.98	6459.73	6395.13	-1.00
Conifers	2083.40	2062.57	2041.94	2021.52	2001.31	1981.30	1961.48	1941.87	-1.00
Mixed	16075.86	15915.10	15755.95	15598.39	15442.41	15287.98	15135.10	14983.75	-1.00
Total Fuelwood from Forest	25020.51	24770.30	24522.60	24277.38	24034.60	23794.26	23556.31	23320.75	-1.00
Shrubs	6015.28	6073.01	6130.17	6186.75	6242.77	6298.22	6353.13	6407.48	0.92
Grazing land	1097.73	1100.24	1102.73	1105.19	1107.62	1110.04	1112.42	1114.79	0.22
Adjacent NCI	2954.97	2966.51	2977.94	2989.26	3000.46	3011.55	3022.54	3033.41	0.38
Cultivated Area	198.17	199.35	200.51	201.65	202.79	203.92	205.03	206.13	0.57
Plantation	176.95	172.88	168.92	165.08	161.35	157.73	154.21	150.78	
Crop Residue	1016.97	1032.88	1047.89	1062.08	1075.55	1088.35	1100.57	1112.24	1.34
Total Fuelwood Supply (ADT)	36303.63	36142.30	35981.83	35822.31	35663.79	35506.34	35350.00	35194.79	-0.44
Per Capita ss from forest (kg)	987.37	964.67	942.60	921.17	900.35	880.11	860.47	841.38	-2.26
Total Demand adt	20516.544	20906.028	21300.534	21699.504	22102.938	22511.394	22923.756	23341.14	1.86
Deficit (-)	15787.0884	15236.2741	14681.3003	14122.8058	13560.8562	12994.9473	12426.2391	11853.6514	-3.92
Per ha Supply	0.77	0.77	0.77	0.76	0.76	0.75	0.75	0.74	-0.55

Table 5.24: Forecasted Change in Fodder Supply

Sources	1991	1992	1995	1998
Forests	26	26	25	24
Shrublands	20	20	20	21
Grasslands	38	38	38	38
Adjacent NCI	3	3	3	3
Farm Land	13	14	14	13
Total Supply (tonnes/TDN)	33,356	34,411	34,558	34,686

Table 5.25: Forecasted Fodder Supply by Sources
(MT-total Digestible Nutrient (TDN))

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Forests	9015.31	8925.16	8835.90	8747.55	8660.07	8573.47	8487.73	8402.86	-1.00
Shrubs	6712.71	6777.13	6840.91	6904.06	6966.57	7028.45	7089.72	7150.38	0.92
Grazing lands	13020.68	13039.88	13058.88	13077.68	13096.31	13114.74	13132.99	13151.06	0.14
Adjacent NCI	1027.81	1031.83	1035.81	1039.74	1043.64	1047.50	1051.32	1055.10	0.38
Risers and Bunds	396.35	398.69	401.01	403.31	405.58	407.83	410.06	412.26	0.57
Fallow Grazing	339.73	341.74	343.72	345.69	347.64	349.57	351.48	353.37	0.57
Tree Fodder	792.70	797.38	802.02	806.61	811.16	815.66	820.12	824.53	0.57
Crop Residue	3050.90	3098.64	3143.66	3186.24	3226.64	3265.06	3301.70	3336.71	1.34
Total Fodder Supply (TDN)	34356.18	34410.45	34461.91	34510.88	34557.60	34602.29	34645.12	34686.26	0.14

Table 5.26: Forecasted Timber Supply and Demand (cubic metres)

	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Total Supply	4852.80	4804.28	4756.23	4708.67	4661.58	4614.97	4568.82	4523.13	-1.00
Timber Demand	1838.40	1873.30	1908.65	1944.40	1980.55	2017.15	2054.10	2091.50	1.86

Table 5.27: Forecasted Population and Changes in the Size of Active Population

	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Active males	13164	13468	13778	14094	14418	14748	15062	15382	2.17
Active females	11902	12126	12353	12581	12811	13043	13278	13516	1.79
Total active	25067	25594	26130	26675	27228	27790	28340	28898	1.99
Total males	19319	19713	20113	20519	20932	21352	21765	22185	2.00
Total females	17449	17753	18060	18369	18679	18991	19317	19645	1.70
Total population	36768	37466	38173	38888	39611	40343	41082	41830	1.86

Table 5.28: Labour Use by Sector

Labour Use & Activity	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Labour Days Available	6267	6399	6533	6669	6807	6948	7085	7224	1.99
Labour Use on Crops	1158	1178	1197	1215	1231	1248	1263	1277	1.47
Livestock	2881	2905	2933	2961	2990	3018	3047	3077	0.89
Professionals	108	111	113	115	118	120	122	125	1.99
Office Workers	66	68	69	70	72	73	75	76	1.99
Sales and Services	162	166	169	173	176	180	184	187	1.99
Production Workers	120	123	125	128	131	133	136	139	1.99
Construction, etc	24	25	25	26	26	27	27	28	1.99
Tourism Labour	22	24	27	30	34	37	42	46	11.37
Horticultural Labour	166	167	168	169	170	171	173	174	0.64
General Labourers	451	461	470	480	490	500	510	520	1.99
Total Labour Use	5159	5227	5297	5368	5438	5509	5579	5649	1.27
Labour Use as % of Available	82.33	81.69	81.09	80.49	79.89	79.29	78.74	78.19	-0.70

Table 5.29: Forecasted Area under Horticulture (ha)

	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Area under Fruits (ha)	535	539	542	546	549	553	556	560	0.64
Area under Apples (ha)(net)	226	229	231	233	235	238	240	243	1.00
Area under Walnuts	45	46	46	47	47	48	48	49	1.00
Peaches	70	70	71	72	73	73	74	75	1.00
Other Fruits	194	194	194	194	194	194	194	194	0.00

Table 5.30: Forecasted Fruit Production by Type of Fruit (MT)

	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Apples	1471	1485	1500	1515	1530	1546	1561	1577	1.00
Walnuts	82	83	83	84	85	86	87	88	1.00
Peaches	332	335	338	342	345	349	352	356	1.00
Others	1358	1358	1358	1358	1358	1358	1358	1358	0.00

Table 5.31: Forecasted Gross Margin and Gross Margin Per Hectare by Type of Fruit

	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Total Gross Margin (Rs '000)									
Apples	13050	14223	15492	16864	18349	19955	21691	23569	8.72
Walnuts	1470	1614	1769	1938	2120	2317	2530	2761	9.25
Peaches	851	958	1074	1200	1336	1484	1644	1817	
Others	12217	13178	14206	15306	16484	17743	19091	20533	7.61
Total Horticultural Income (Rs '000)	27587	29972	32541	35308	38288	41498	44956	48680	8.34
Gross Margin Per ha (Rs)									
Apples	57680	62243	67125	72349	77939	83920	90320	97167	7.64
Walnuts	32348	35157	38164	41380	44822	48505	52445	56662	8.17
Peaches	12208	13608	15106	16708	18423	20258	22221	24322	
Others	62974	67927	73227	78898	84967	91459	98407	105840	7.61

Table 5.32: Forecasted Tourist Flow, Employment and Income

	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Projected Tourists (#)	8742	9736	10844	12077	13450	14979	16683	18580	11.37
Porters Hired (mandays)	21821	24302	27065	30143	33571	37388	41640	46375	11.37
Porter's Income ('000)	2194	2615	3116	3713	4425	5273	6284	7489	19.17
Other Local Purchases ('000)	40198	44769	49860	55530	61844	68877	76709	85432	11.37
Local Income	42392	47384	52976	59243	66269	74150	82993	92920	11.85

Table 5.33: Forecasted Values of Food and Non-food Imports (Rs'000)

	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Growth Rate of Non-Food Imports	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	
Total Food Exports	5221	6588	6786	6949	7066	7141	7167	7113	4.52
Total N-Food Imports	42598	43488	44392	45309	46238	47182	48137	49107	2.06
Value of Total Imports	37377	36903	37606	38360	39172	40041	40970	41994	
Value: per capita food	142	176	178	179	178	177	174	170	2.61
Value: per capita non-food	1159	1161	1163	1165	1167	1170	1172	1174	0.20

Table 5.34: Forecasted Nominal Income by Source (Rs'000)

Source of Income	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	58135	64200	70768	77913	85713	94227	103496	113635	11.07
Livestock	14826	16778	19001	21514	24351	27555	31171	35251	13.09
Professionals	1210	1235	1261	1288	1314	1341	1368	1395	1.99
Office Workers	687	701	716	731	746	761	777	792	1.99
Sales and Service Workers	1868	1907	1947	1988	2029	2071	2112	2154	1.99
Production Workers	883	902	921	940	959	979	998	1018	1.99
Construction, etc.	212	216	220	225	230	234	239	244	1.99
General Labourers	3016	3080	3145	3210	3277	3344	3410	3478	1.99
Tourism Income	42392	47384	52976	59243	66269	74150	82993	92920	11.85
Horticultural Income	27587	29972	32541	35308	38288	41498	44956	48680	8.34
Total Rasuwa Income	150817	166376	183496	202359	223177	246162	271521	299567	10.63
Per Capita Income	4102	4441	4807	5204	5634	6102	6609	7162	8.61
Income growth rate	0.00	8.26	8.25	8.25	8.27	8.30	8.32	8.36	

Table 5.35: Forecasted Real Income by Source (Rs'000)

Source of Income	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Deflator	1.10	1.21	1.32	1.45	1.59	1.73	1.89	2.07	9.49
Crops	52858	53153	53428	53708	54009	54330	54656	55008	1.44
Livestock	13480	13891	14345	14830	15344	15888	16461	17064	3.29
Professionals	1100	1023	952	888	828	773	722	675	-6.85
Office Workers	624	581	541	504	470	439	410	383	-6.85
Sales and Service Workers	1699	1579	1470	1370	1279	1194	1115	1043	-6.85
Production Workers	803	747	695	648	604	565	527	493	-6.85
Construction, etc.	192	179	166	155	145	135	126	118	-6.85
General Labourers	2743	2550	2374	2213	2065	1928	1801	1683	-6.85
Tourism Income	38544	39230	39995	40838	41757	42754	43828	44981	2.15
Horticultural Income	25083	24815	24568	24339	24126	23927	23741	23565	-1.05
Total Rasuwa Income	137126	137746	138535	139492	140628	141933	143388	145014	1.03
Per Capita Income	3729	3677	3629	3587	3550	3518	3490	3467	-0.81
Income Growth Rate	0.80	-1.42	-1.29	-1.16	-1.03	-0.90	-0.79	-0.67	

Table 5.36: Forecasted Income Shares by Source (%)

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	38.55	38.59	38.57	38.50	38.41	38.28	38.12	37.93	0.40
Livestock	9.83	10.08	10.36	10.63	10.91	11.19	11.48	11.77	2.23
Professionals	0.80	0.74	0.69	0.64	0.59	0.54	0.50	0.47	-7.81
Office Workers	0.46	0.42	0.39	0.36	0.33	0.31	0.29	0.26	-7.81
Sales and Service Workers	1.24	1.15	1.06	0.98	0.91	0.84	0.78	0.72	-7.81
Production Workers	0.59	0.54	0.50	0.46	0.43	0.40	0.37	0.34	-7.81
Construction, etc.	0.14	0.13	0.12	0.11	0.10	0.10	0.09	0.08	-7.81
General Labourers	2.00	1.85	1.71	1.59	1.47	1.36	1.26	1.16	-7.81
Tourism	28.11	28.48	28.87	29.28	29.69	30.12	30.57	31.02	1.11
Horticulture	18.29	18.01	17.73	17.45	17.16	16.86	16.56	16.25	-2.06
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.00

Table 5.37: Performance and Sustainability Indicators

Indicators	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Per Capita Cultivated Land (ha/person)	0.079	0.079	0.078	0.078	0.078	0.077	0.077	0.076	-0.53
Per Capita Accessible Forest Land	0.455	0.442	0.430	0.418	0.406	0.394	0.383	0.373	-2.81
Cultivated Area-Forest Area Ratio	0.174	0.178	0.183	0.187	0.191	0.195	0.200	0.204	2.34
LSU per Cultivated Area	9.902	9.836	9.792	9.756	9.728	9.706	9.690	9.679	-0.42
LSU per Forest Area	1.722	1.754	1.788	1.824	1.860	1.897	1.934	1.973	1.91
LSU per Grazing Area	1.180	1.189	1.199	1.209	1.220	1.230	1.241	1.251	0.79

Table 5.38: Carrying Capacity of Agricultural Land in Terms of Calories

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998
Calories ('000)								
Per ha Calories Supply	3755.78	3759.07	3760.55	3761.46	3762.39	3763.33	3763.76	3764.59
Per ha Calories Demand	3862.02	3875.11	3891.96	3911.99	3934.83	3960.26	3987.84	4017.54
Supplies as % of Demand	97.25	97.01	96.62	96.15	95.62	95.03	94.38	93.70
Carrying Capita per ha.	5.19	5.20	5.20	5.20	5.20	5.20	5.20	5.20
Current Load	5.34	5.36	5.38	5.41	5.44	5.47	5.51	5.55

Table 5.39: Carrying Capacity of Land in Terms of Fuelwood

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998
Fuelwood supply per ha	0.77	0.77	0.77	0.76	0.76	0.75	0.75	0.74
Per ha Demand	0.44	0.45	0.45	0.46	0.47	0.48	0.49	0.49
SS as % of DD	176.90	172.83	168.87	165.03	161.30	157.68	154.16	150.74
Carrying Capacity per ha	1.39	1.38	1.37	1.36	1.36	1.35	1.34	1.33
Current Load	0.78	0.80	0.81	0.83	0.84	0.86	0.87	0.88

Table 5.40: Carrying Capacity of Forest Land in Terms of Fuelwood

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998
Per ha Demand	2.95	3.04	3.13	3.22	3.31	3.40	3.50	3.60
SS as % of Demand	115.73	112.44	109.25	106.17	103.19	100.31	97.52	94.82
Carrying Capacity per ha	5.81	5.81	5.81	5.81	5.81	5.81	5.81	5.81
Current Load	5.02	5.17	5.32	5.47	5.63	5.79	5.96	6.13

Table 5.41: Carrying Capacity of Land in Terms of Fodder

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998
Per ha Fodder Supply	0.56	0.56	0.57	0.57	0.57	0.57	0.57	0.57
Per ha Fodder Demand	0.29	0.30	0.30	0.30	0.31	0.31	0.31	0.32
SS as % Demand	191.21	189.90	188.37	186.85	185.32	183.80	182.28	180.77
Carrying Capacity per ha	0.90	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Current Load	0.47	0.48	0.48	0.49	0.49	0.50	0.50	0.51

Table 5.42: Carrying Capacity of Forest in Terms of Fodder

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998
Per ha Fodder Supply	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Per ha Fodder Demand	1.07	1.09	1.12	1.14	1.16	1.18	1.21	1.23
SS as % Demand	50.17	49.26	48.30	47.36	46.44	45.54	44.66	43.79
Carrying Capacity per ha	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Current Load	1.72	1.75	1.79	1.82	1.86	1.90	1.93	1.97

Table 5.43: Impacts of Policy Alternatives on the Labour Use Situation in Rasuwa ('000 Mandays)

	1993	1994	1995	1996	1997	1998	Growth Rate
Baseline							
Tourism	27	30	34	37	42	46	11.37
Horticultural	168	169	170	171	173	174	0.64
Labour Use as % of Available	81.09	80.49	79.89	79.29	78.74	78.19	-0.70
Apples							
Tourism	27	30	34	37	42	46	11.37
Horticultural	185	185	186	186	186	187	1.56
Labour Use as % of Available	81.35	80.73	80.11	79.50	78.94	78.38	-0.67
Days							
Tourism	34	38	42	47	52	58	14.52
Horticultural	168	169	170	171	173	174	0.64
Labour Use as % of Available	81.19	80.60	80.01	79.42	78.89	78.35	-0.68
Numbers							
Tourism	34	30	34	37	42	46	11.37
Horticultural	168	169	170	171	173	174	0.64
Labour Use as % of Available	81.19	80.49	79.89	79.29	78.74	78.19	-0.70

Table 5.44: Impact of Tourism Policy Alternatives on Incomes from Tourism

	1993	1994	1995	1996	1997	1998	Growth Rate
Baseline							
Projected Tourist Flow	10844	12077	13450	14979	16683	18580	11.37
Porter Hired (mandays)	27065	30143	33571	37388	41640	46375	11.37
Porter Income ('000)	3116	3713	4425	5273	6284	7489	19.17
Other Local Purchase ('000)	49860	55530	61844	68877	76709	85432	11.37
Local People Tourism Income	52976	59243	66269	74150	82993	92920	11.85
Days							
Projected Tourist Flow	10844	12077	13450	14979	16683	18580	11.37
Porter Hired	33832	37679	41964	46735	52050	57969	14.52
Porter Income ('000)	3895	4642	5532	6592	7855	9361	22.54
Other Local Purchase ('000)	49860	55530	61844	68877	76709	85432	11.37
Local People Tourism Income	53755	60171	67376	75468	84564	94792	12.13
Numbers							
Projected Tourist Flow	13554	15096	16812	18724	20853	23225	14.52
Porter Hired	33832	37679	41964	46735	52050	57969	14.52
Porter Income ('000)	3895	4642	5532	6592	7855	9361	22.54
Other Local Purchase ('000)	62325	69412	77305	86096	95886	106789	14.52
Local People Tourism Income	66220	74054	82837	92687	103741	116150	15.01

Table 5.45: Share of Income Originating from Major Sources

	1993	1994	1995	1996	1997	1998
Baseline						
Crops	38.57	38.50	38.41	38.28	38.12	37.93
Tourism	28.87	29.28	29.69	30.12	30.57	31.02
Horticulture	17.73	17.45	17.16	16.86	16.56	16.25
Apples						
Crops	37.80	37.79	37.74	37.66	37.54	37.41
Tourism	28.30	28.73	29.18	29.64	30.11	30.59
Horticulture	19.36	18.98	18.59	18.20	17.81	17.41
Days						
Crops	38.40	38.33	38.22	38.07	37.90	37.70
Tourism	29.17	29.60	30.04	30.49	30.97	31.45
Horticulture	17.66	17.37	17.07	16.77	16.46	16.15
Numbers						
Crops	35.97	35.88	35.75	35.60	35.41	35.20
Tourism	33.66	34.10	34.55	35.02	35.50	35.98
Horticulture	16.54	16.26	15.97	15.68	15.38	15.08

Table 5.46: Impacts of Policy Alternatives on Real Income (Rs'000)

	1993	1994	1995	1996	1997	1998	Growth Rate
Baseline							
Crops	53428	53708	54009	54330	54656	55008	1.44
Tourism Income	39995	40838	41757	42754	43828	44981	2.15
Horticultural Income	24568	24339	24126	23927	23741	23565	-1.05
Total Rasuwa Income	138535	139492	140628	141933	143388	145014	1.03
Per Capita Income	3629	3587	3550	3518	3490	3467	-0.81
Income Growth Rate		-1.16	-1.03	-0.90	-0.79	-0.67	
Apples							
Crops	53428	53708	54009	54330	54656	55008	1.44
Tourism Income	39995	40838	41757	42754	43828	44981	2.15
Horticultural Income	27366	26977	26610	26261	25927	25608	-0.02
Total Rasuwa Income	141333	142131	143111	144267	145574	147057	1.21
Per Capita Income	3702	3655	3613	3576	3544	3516	-0.64
Income Growth Rate		-1.28	-1.15	-1.02	-0.91	-0.79	
Days							
Crops	53428	53708	54009	54330	54656	55008	1.44
Tourism Income	40584	41478	42455	43514	44657	45887	2.41
Horticultural Income.	24568	24339	24126	23927	23741	23565	-1.05
Total Rasuwa Income	139123	140132	141325	142694	144217	145920	1.11
Per Capita Income	3645	3603	3568	3537	3510	3488	-0.73
Income Growth Rate		-1.13	-0.99	-0.86	-0.75	-0.63	
Numbers							
Crops	53428	53708	54009	54330	54656	55008	1.44
Tourism Income	49994	51048	52197	53442	54785	56226	5.04
Horticultural Income	24568	24339	24126	23927	23741	23565	-1.05
Total Rasuwa Income	148534	149702	151067	152622	154345	156259	1.98
Per Capita Income	3891	3850	3814	3783	3757	3736	0.12
Income Growth Rate		-1.07	-0.93	-0.80	-0.69	-0.57	

6

NUWAKOT DISTRICT

Performance of the District Economy

Introduction

This section summarises the historical performance of the economy of Nuwakot with the main focus being on the agricultural, livestock, and forestry sectors. The performances of these closely interrelated economic activities are analysed using the time series' data made available from different sources. The time series' data on the crops and livestock sector were obtained from the Department of Food and Agricultural Marketing Services (DFAMS). Information compiled by the Land Resources' Mapping Project (LRMP) on land use and forests has been used, and the land use changes are projected on the basis of assumptions described in detail in the methodology section.

Crop Area

The performance of crops depends heavily upon the monsoon cycle, because only 11 per cent of the cultivable land in the district is under irrigation. Given the limited irrigated area, a bad monsoon always results in sharp declines in crop production and the households' real income. Furthermore, the very low levels of modern inputs used by farm households severely limit productivity in this sector.

Paddy, maize, wheat, millet, oilseed, and potatoes are the major crops grown in the district, accounting for 33, 44, 12, 7, 1, and 3 per cent respectively of the total cropped area of the district. Food crops occupy over 95 per cent of the district's total cropped area and the remaining five per cent is under cash crops (oilseed 1% and potatoes 3%). The historical data on areas under different crops are reported in Table 6.1.

The total cropped area in the district increased from 20,470ha in 1975 to 45,190ha in 1989 at an annual growth rate of over five per cent. Within this period, wheat registered the highest growth rate (8.3%), followed respectively by maize (6.6%), potatoes (6.2%), and paddy (5.6%). The areas under wheat in terms of the percentage of total cropped area increased from 8.7 per cent to 12 per cent from 1975-1989. On the other hand, the area under millet declined by half (from about 14% in 1975 to 7% in 1989), indicating a great deal of substitution over millet. The area under paddy remained fairly constant at 7,000ha from 1975 to 1981, but it doubled in 1982. The reason for this is not clear. Since 1983, the area under paddy has remained more or less stagnant. In the case of maize, a sharp increase in crop area is also visible, especially from 1986 onwards. Similarly, the area under potatoes has also been expanding rapidly in recent years. The area under oilseed

shows the greatest variation over the period considered, and this is indicated by the highest value of the coefficient of variation. Chart 6.1 presents the fluctuations in cropped area. Finally, to project the area under different crops a semilog time trend equation was imposed on the historical data. The estimated regression results are presented in Table 6.2.

Crop Yield

Table 6.3 presents the productivity trends of different crops over the period from 1975 to 1989. As can be seen, the per hectare yield of all crops, apart from wheat, oilseed, and potatoes, has been declining over time. The yield in potatoes increased at the rate of 3.4 per cent per annum, while that of oilseed and wheat at 2.8 per cent and one per cent per annum respectively. The highest declining trend in yield is observed for millet (-1.1%), followed by maize (-0.6%) and paddy (-0.2%).

The overall picture shows a marginal increasing trend in wheat and potato yield rates over time (Chart 6.2). Despite increase in oilseed productivity, the area under this crop has not increased over time. Given the erratic trends in the yield rates of different crops, no functional form could be fitted to the date series for projection and hence an average yield over the 1975-1989 period has been used as the base yield.

Fertiliser Use

According to the Agricultural Inputs' Corporation (AIC), the sale of fertiliser in the district increased from 2,468 MT in 1982 to 5,440 MT in 1991 (Table 6.4). The average growth rate in fertiliser sale during this period has been estimated to be about seven per cent per annum.

The average sale of fertiliser per hectare of cropped are in Nuwakot increased from 67kg in 1982 to 94 kg in 1989, at an annual growth of about five per cent. There was a sudden rise in sales during 1990 and 1991. While information regarding the actual fertiliser consumption level in the district is not available, the Irrigation Master Plan assumes it to be 18 kg/ha in the hill regions, which is far below the sale rate reported in Table 6.4. Even if the current level of fertiliser use is assumed to be three times greater than this, the actual consumption of fertiliser in the district comes to be about 2,384 MT, which is still lower than the reported sale in the year 1991. A large gap between the reported sales' figure and the actual consumption level could be the result of fertiliser leakage from the district to other areas or faulty statistics on sales or areas under different crops.

In order to forecast the fertiliser sales in the district, a simple linear time trend equation was fitted to this historical data, and the result is presented below.

$$\text{Fertiliser Sale} = 1713.63 + 352.66\ \text{time}$$
$$(448.610)\ (49.39)\quad R^2 = 0.86$$

Livestock

Historical data on the livestock population by type of animal and its products in Nuwakot district, as reported by DFAMS, is presented in Table 6.5. A close examination of the trends in livestock population indicates positive growth in all type of animals with the exception of goats and pigs. During the same period, the goat

population annually decreased by nine per cent and pigs by 19 per cent. Consequently, their meat production also declined. Among the large animals, the cattle population registered the highest growth rate (5.6%), followed by buffaloes (5%), milch cows, and milch buffaloes (3%). The sheep population, however, increased (3.7% per annum). The downward trend in goat population, an important source of cash income for marginal and poor households, cannot be readily explained, especially since a large market (Kathmandu Valley) for goat meat is easily accessible from Nuwakot.

Many buffaloes are unproductive, as indicated by the low proportion of milch buffaloes in the total buffalo population which decreased over time from 22 per cent in 1984 to 20 per cent in 1988. On the other hand, the proportion of milch cows to cows remained almost stagnant at 10 per cent over the same period. Milk production from buffaloes increased at a faster rate (5% a year) than from cows (4.7%). While the buffalo milk yield increased at the rate of 1.6 per cent per year, the average annual growth in cow milk yield was less than one per cent. The average annual yield of buffalo milk is estimated to be 0.91 MT compared to 0.33 MT per milch cow. The declining proportion of milch buffalo population and their increasing milk yield suggest that households are becoming selective in their choice of animals.

Table 6.5 also shows that the meat production from goats and pigs has decreased by about nine per cent and 19 per cent per annum respectively, simply because of decline in their population, and there has been no improvement in the productivity (meat) of these animals over the period from 1984 to 1988. In order to project the livestock population, cross-sectional data on livestock population provided by the LRMP have been regressed with different land use categories as described in the methodology section.

Land Use Changes

Time series' data on land use statistics in the district are not available. The land use statistics reported by the LRMP pertain to the year 1978 and these data were projected, using the assumption regarding the interclass land transfer over the period. As described in the methodological framework (Chapter 2), the land use changes in most hill districts of Nepal result primarily from deforestion, which is assumed to have taken place at the rate of one per cent per annum in the mid-hill region over the decade (Master Plan). The deforested area was first converted to shrubland, grassland, and eventually to agricultural land. Table 6.6. presents the projected land use changes in Nuwakot over the period from 1978-1990.

Nuwakot district is comprised of three ecological belts, viz., mid-mountains, high mountains, and high Himal, covering 83 per cent, 10.6 per cent and 2.2 per cent respectively of the districts' total area. Over 97 per cent of the district's net cultivated area (and also population) lies in the mid-mountain belt and the rest in the high mountains. Over 57 per cent of the cultivated land in the district is unirrigated and the rest is monsoon irrigated (18.7%) with 24 per cent under year-round irrigation. The potential area that can be brought under irrigation in Nuwakot

is estimated to be 15,047 hectares. According to the LRMP estimate, a large portion (over 75%) of the mapped cultivated area (i.e., adjacent NCI plus gross cultivated area) in the district is comprised of level terraces and rest consists of sloping terraces (11.2%), lower foot slopes (100.5%), and valley floor (2.8%)/.

Although about two-thirds of the district's natural forest lie in the mid-mountain region, the share of natural forests in the total area in the mid-mountain region is less than 13 per cent compared to over 65 per cent in the high mountains. In other words, the ratio between forest and agricultural land in the mid mountains is less than 0.45 hectares, which is far below the suggested level required for sustainable agriculture under the current state of technology and prevailing practices in the hills. This implies there is excessive pressure on natural forests which are all accessible in the mid-mountains. Even if all the shrub and grasslands are afforested, the forest-cultivated land ratio would increase to only 1.15 which is still lower than the suggested level required to sustain hill agriculture.

The situation is quite the reverse in the high mountains with the forest-cultivated ratio being as high as 10. The high value of this ratio is due to the fact that about 40 per cent of the total area in the high mountains is under natural forests (accessible), whereas the cultivated area accounts for only four per cent.

The species' composition of the total forest area in the mid-mountains is predominantly hardwood (86%) with a larger proportion of the forest area under low crown density (10-25%) and low maturity classes (97%). Both the crown density and the maturity class of the forest improve as one moves from low to higher elevations in the district and as more forest areas become inaccessible. The overall land use changes in the district by ecological belt over the period from 1978-1990 are presented in Table 6.6. The total forest area in the mid-mountain region of the district is projected to decline at the rate of 1.44 per cent per year whereas, in the high mountains, natural forests have declined by one per cent per annum. Since a major portion of the deforested area is assumed to have been converted to shrub and grasslands, the area under these land classes has increased at a relatively higher rate per annum. The net cultivated area in the high mountains has increased at a faster rate than that in the mid-mountain region. In the district as a whole, natural forests have decreased at the rate of 1.3 per cent per year while the areas under shrubs and grass, and the cultivated area increased by 0.56 per cent, 0.96 per cent, and 0.15 per cent per annum respectively during the 1978-1990 period as reported in Table 6.6.

It should be noted that a significant portion of the district's total area falls within Shivapuri (6.4%) of the mid-mountain region and Langtang National Parks (35.3%) of the high mountain region. Since the park areas are not likely to change, they are excluded from the land use categories reported in Table 6.6. All of the high Himal area falls into this excluded category under the Langtang National Park. Limited seasonal grazing is, however, allowed in the Park, and this factor is taken into account later while evaluating livestock carrying capacity.

Economic and Natural Resource Conditions: Baseline Scenario

Prices

The national forecasted price was calibrated to reflect the price situation in Nuwakot district. Data on prices for Dhading, a neighbouring district, were used to calibrate the prices for Nuwakot and are presented in Table 6.7. The last column of Table 6.7 also presents the growth rate of prices calculated by using the end points' values.

Among the foodgrains considered, millet and oilseed prices have the highest growth rates while wheat prices have the lowest growth. The aggregate cereal grain price has a growth rate of about 9.64 per cent. The table also contains the forecasted prices of other food products and production factors.

Crop Area and Yield

Table 6.8 provides the results of the forested area under different crops and Table 6.9 provides the respective crop yield projections based on the assumption of non-constant crop prices and variable inputs. Area growth follows a time trend based on historic data series. The growth rates forecasted for crop area over time indicate almost negligible growth rates in the areas under different crops in Nuwakot, which average about one per cent per annum.

Fertiliser sale is expected to grow at about six per cent per annum based on fertiliser sales in the district over the past few years. The sale of fertilisers in Nuwakot, as reported by the AIC, exceeds the per hectare use rates on the crops as was reported for other districts in the Bagmati zone. Other more recent estimates that reflect current fertiliser use in the district are not available for confirmation of the sales' figures. However, field observations indicate that fertiliser use in the district is increasing over time and more and more farmers have begun to use fertiliser.

Table 6.9 provides the future yield trend of six crops in Nuwakot on the basis of past trends. Forecasting is based on the assumption that the crop technology will remain the same over time. Despite the positive trend in the crop yield rates in Nuwakot, the forecasted growth rates are well below the population growth, which is not encouraging. The results indicate that, over time, Nuwakot faces a declining trend in food sufficiency (from its own source base) under the existing state of technology in this sector. Although Nuwakot is self-sufficient in food at present, the declining trend in food sufficiency has implications over time for the land resources (these are examined later below).

Crop Production

According to the model, crop output or production is determined by the area and yield outcomes discussed above. The resulting growth in production (Table 6.10)

of the different crops is positive. The higher production growth rates observed are mainly due to the growth in area discussed above.

Gross Margin

Gross margins were calculated for each of the six crops, based on existing information provided in the Irrigation Master Plan (1989). Table 6.11 also presents the total gross margin and cost of cultivation per hectare of cultivated crops. All crops registered positive gross margins. Millet gross margin has the highest growth rate, despite the fact that its area and yield remain almost constant over time. The increase in the gross margins reported in Table 6.11 is primarily the result of the increase in nominal crop prices over time. Maize, however, has the highest per hectare gross margin in Nuwakot, followed by paddy and oilseeds.

Livestock

The manner in which livestock numbers were forecasted has already been explained in the methodology section. The livestock sector results indicate that the average annual growth in LSU in the district is negative (Table 6.12). Based on data collected by the Department of Food and Agricultural Marketing Services' Department (Agricultural Statistics of Nepal) (DFAMS 1990), livestock products (meat, milk, ghee, and wool) were derived and also applied to estimate the gross margins from livestock over time. Trend equations were fitted to the data series and the results linked with the forecasted livestock population to project livestock products for Nuwakot.

The average annual increases in the different types of livestock products are reported in Table 6.13. The reason why pork and chicken meat production register the same growth rate is because these two products are not linked to the land-use sector as already discussed in the methodology section. Simple time trends were fitted to the past data to forecast the future populations of chicken and pigs.

Gross margins were also calculated for livestock enterprises. Livestock raising costs were calculated after consultation with livestock experts. The average increase in LSU cost over time is about seven per cent. Gross margins from livestock were also derived (Table 6.14). The average annual increase in per LSU gross margin is about 11 per cent.

Food Availability and Demand

Assuming different waste, loss, and seed allowance factors, the total cereal availability in the district was derived from the production of the four cereal grains (rice, wheat, maize, and millet) reported above. The per capita availability was then derived. A similar exercise was carried out to obtain the per capita domestic (district) supplies of meat (mutton, buffalo, pork, and chicken), oils and fat (derived from oilseed production and ghee), vegetables (assumed to be potatoes only), and milk. Tables 6.15, 6.16, and 6.17 provide estimates of the forecasted food availability, demand, and food balance situation in the district.

Crop yield rates are important in determining food supplies, given that land is almost inelastic in terms of supply in Nuwakot. Despite the low growth in crop yield rates, Nuwakot appears to be self-sufficient in cereal grains. As a matter of fact, Nuwakot is surplus in cereal grains as can be observed from Table 6.17. Nuwakot has a surplus production of potatoes and meat but faces a deficit in milk and oils and fat supply.

Land Use Changes

Land use in the district includes agriculture, forests, grazing land, shrubland, non-cultivated inclusions, and other categories. Because of the interaction between competing land uses, land use is subject to change over time in the district. Table 6.18 provides details on the changes in land use over time in Nuwakot.

The results given in Table 6.18 indicate that land use changes, albeit small, have occurred in the district. The share of the forest area declines over time at a rate of one per cent annually and the forest area is forecasted to constitute only 11 per cent of the district's total area by 1998, from the share of 14 per cent in 1991. Marginal gains are forecasted for shrub and grass lands. Other land use categories tend to remain unchanged over time.

The cultivated areas given in Table 6.8 and in Table 6.18 appear to be different. This discrepancy in the two figures arises because they come from two different datasets, namely, DFAMS and LRMP. It was not possible to obtain the net cultivated area in the district from the data reported by DFAMS and the LRMP for the area under different crops is not provided. To derive the cultivated area reported in Table 6.8, it was assumed that the cultivated area is the sum of the areas under paddy and maize, i.e., non-competing crop areas. From the results reported in Table 6.8, the percentage of the cultivated area is about 30 per cent, compared to 26 per cent reported in Table 6.18. In other districts, the discrepancy is larger.

Forest Products

The section on methodology has elaborated on how the forestry sector has developed, based on LRMP and other data sources. Only the results will be discussed in this section. Forests are assumed to provide three primary products, namely, fuelwood, timber, and fodder. The supplies of these resources over time were derived and compared with the demand.

Fuelwood

The fuelwood demand perhaps exerts the most pressure on forests, especially when stocking forests is an uncommon practice in many parts of Nepal. Fuelwood is assumed to come from different sources, namely, accessible forests, farmland, non-cultivated inclusions, and plantations. The yield rates of these sources vary. Density and maturity classes are the two important factors that were taken into account while establishing the yield rates of different forests.

Table 6.19 provides an estimate of the fuelwood supply from different sources in Nuwakot. Non-cultivated inclusions (NCI) are the main source of fuelwood supply in Nuwakot. Accessible forest is the third important source of fuelwood in the district, following shrubland. The contributions of NCI and shrubland increase over time and those of forests decline over time. Crop residue is also an important source of fuelwood in Nuwakot. The contribution of fuelwood from farmlands is negligible. The corresponding estimates of fuelwood from different sources in terms of air dry tonnes (adt) are provided in Table 6.20. Nuwakot is already experiencing a fuelwood deficit which is seen to increase over time.

Fodder

Fodder is also an important forest product. Fodder is supplied by various sources as highlighted in Table 6.21. Forests are not the most important source of fodder supply in the district, as they contribute only about five per cent, and this share shows a decline over time. The main source of fodder is crop residue, followed by NCI land. Other sources reported in the Table contribute a small percentage of the district's total fodder supply.

Labour Supply and Use

Labour supply is determined by the size of the active population. Households devote labour to crop production, livestock raising, and other activities. An active person is assumed to have at his/her disposal 240 mandays. Each active member supplies labour for crop production, and livestock raising (100 mandays per LSU). Other, more specific, information on labour use patterns for Nuwakot is not directly available. The Multipurpose Household Budget Survey - Nepal Rastra Bank (M-NRB) report, however, provides information on the percentage of the population engaged in other activities in the hill region of Nepal. An assumption that 240 mandays of labour in a year are supplied by persons engaged in activities other than agriculture and livestock has been made. The number of persons engaged in other activities (Table 6.22), multiplied by the number of working days in a year, provides an estimate of employment in other sectors in Nuwakot district.

In terms of the labour use pattern in the district, labour use as a percentage of availability declines marginally over time as indicated by the "Labour Use" row in Table 6.22. Members of the households spend time collecting fuelwood and water and carrying out other crop production activities. These activities have not been taken into account in the present exercise. As a result, the percentage of unutilised labour in the district appears to be large. But, even if these activities are taken into account, it is unlikely that labour utilisation in the district will increase substantially to make Nuwakot a labour-deficit district. Currently, only about 70 per cent of the available labour in the district is gainfully employed. Another reason why the results indicate a high underemployment rate is because, while the active population is taken into account in the model, the participation rate is not considered, which, if accounted for, would reduce the size of the total active population, and, hence, the underemployment rate.

Trade

Many food and non-food items are imported into Nuwakot. The exact amount of imports into the district is not known. However, the Multipurpose Household Budget Survey provides information on the average monthly household expenditure on non-food items. The results are for 1984, i.e., the year the survey was conducted. The values of imports were aggregated and, allowing for inflation, these values were updated to 1991 (base year). The expenditure figures are given for food and non-food imports.

The method of estimating the non-food import demand growth rate has already been described in Chapter 2. It is important to emphasise that calculation of the import demand growth rate requires information on the income growth discussed in the following section. The growth in import demand is driven by the income and population growth. The results are presented in Table 6.23.

The average growth in non-food demand is about one per cent per year and is solely determined endogenously by the model. The per capita value of non-food import in 1992 was Rs 985, and this will increase to Rs 988 by 1998 at a rate of less than one per cent growth.

Also presented in Table 6.23 is the value of food exports, since, as has already been discussed above, Nuwakot is surplus in some food items. Food export was derived from the excess food demand determined from the model. More specifically, the demand for food imports is conditioned by the differences in domestic supply (district) and domestic demand. The difference between supply and demand is carried over to the trade section. The value of food surplus, including cereals, meat, milk, vegetables, and oils and fat, is multiplied by the aggregate price of cereals and the respective food prices. The value of per capita food exports increases over time by about nine per cent.

Income

Income is also determined endogenously by the model. The per year gross margins originating from the crop and livestock sectors and income accruing from the different employment activities were added to derive the aggregate income for Nuwakot district. Tables 6.24, 6.25, and 6.26 present the magnitude of nominal, real, and income shares originating from different sectors.

The per capita nominal income grows at about 11 per cent per annum, but, when real incomes are taken into account, the growth in real per capita income is only about one per cent, indicating a very rough time ahead for the district.

The share of income originating from the crop sector tends to increase marginally over time. The share of income from the livestock sector, however, deteriorates marginally, even though the real income from this sector registers positive growth. The share of income from other off-farm activities declines over time, and so does

the real income as employment in the other sectors is assumed to remain at a fixed percentage of the total population.

Environment: Sustainability and Carrying Capacity

The purpose of this section is to assess the performance of the district in terms of selected sustainability indicators and explore the carrying capacity of the district, given the human and livestock populations and the demand and supply of natural resource-based products in the district. In particular, the natural resource products considered are the land and the various products that can be produced from it to meet human and livestock needs.

The performance of the district in terms of some selected sustainability indicators can be judged from the results presented in Table 6.27. In the hill-farming system, forests are an important source of the fodder needed by livestock, which, in turn, provide nutrients (manure) to the fields. In addition, forests also provide fuelwood and timber to households. Besides these three resources, forests also provide leaf litter as a nutrient-supplement to the fields. As the area under accessible forests declines over time, the supply of fodder and leaf litter also declines, leaving negative implications for agricultural productivity. Therefore, the forest-cultivated land ratio in a district gives an idea of the amount of resources that can be harvested sustainably to meet the households' requirements for forest resources.

Wyatt-Smith (APROSC 1982) in his study estimates that 3.5 hectares of accessible unmanaged forests are required to support one hectare of agricultural land in the context of the hill-farming system. Wyatt-Smith provides a breakdown of the estimate of the three forest resources (fodder, fuelwood, and timber) needed to support one hectare of agricultural land. One hectare of agricultural land requires 2.8, 0.24 to 0.48, and 0.32 ha of unmanaged accessible forests in terms of fodder, fuelwood, and timber respectively.

Similar estimates have not been derived for this study, but some indication can be provided by the results derived from the model. For example, the accessible forest-cultivated land ratio in Nuwakot is currently 0.55 hectare, which is very low compared to the Wyatt-Smith estimate of 3.5 hectares. If it is assumed that 3.5 hectares of forest land are required to support one hectare of agricultural land to make the hill farming system sustainable, then the existing ratio estimated for Nuwakot is alarming. This ratio in Nuwakot shows a declining trend over time (Table 6.27).

The ratio of shrubland to accessible forest land is another indicator which explains partially the extent of forest degradation, since, as forests degrade, they are first converted into shrubland. The shrubland-forest ratio in Nuwakot is currently estimated to be 1.43, indicating that the area under shrubland far exceeds the area under forests, and this ratio increases over time. The dependency on forest is also seen to increase over time. Livestock also continue to exert increasing pressure on forests, but livestock pressure on cultivated land and grazing land decreases over time (Table 6.27).

Population

The population of the district continues to grow over the timeframe covered by the study. The size and growth of population in Nuwakot over time are given in Table 6.28. The increase in labour force and its appropriate use will have to be examined in terms of the employment situation as well as food supply among other considerations, under the current trend scenario. For many years to come, the district will have to rely on the existing natural resource base to use the labour force gainfully as well as to feed the total population. In addition, the fuelwood demand will also increase due to the increase in population.

During 1990-91, the bulk of the employment generated in the district was in the agricultural and livestock sectors. According to the results derived from the model, the agricultural area is not increasing to the extent needed to utilise the expanding labour force. If it is assumed that the new labour force will be employed in the agricultural sector, new areas will have to be brought under cultivation.

If new areas are brought under cultivation, the current land use situation in the district will have to change. For example, more forest areas will have to be converted into agricultural land. This option may not be viable or sustainable given the already constraining situation in the forestry sector in terms of meeting the fuelwood and fodder demands. It is possible, however, that the adjacent NCI, which occupies vast tracts of land in the district, could be used for agriculture. But the use of such land will not be sufficient to generate employment to absorb all the new entries into the labour force, and there is not enough land in the first place, even if the limitations in the form of financial and technical constraints did not exist.

It can be urged that employment can be generated in the livestock sector. Under the current trend scenario, this too does not appear to be a viable alternative. Even though the livestock carrying capacity appears to be relatively better compared to other districts in the Bagmati Zone, the livestock productivity is similar. What appears to be imperative in the livestock sector is the reduction of numbers and the increase in productivity per animal, and this is not likely to generate further employment. In this situation, labour is more likely to be displaced rather than to be employed in the livestock sector. If a district's sustainability is viewed in terms of the labour use situation, clearly Nuwakot does not qualify as sustainable because an increasing number of people remain either unemployed or underemployed.

Food

This section examines the implications of the expanding population in terms of the carrying capacity of land to meet the food requirements. Table 6.29 provides the calorie demand and availability situation over time for Nuwakot. Under current trends, the calorie supply will decrease marginally from 4,223,000 calories per ha in 1991 to 4,217,000 calories per ha in 1998, primarily due to decreasing crop yields, despite some growth in the cropped area. The calorie supply over time

meets the calorie demands, even though the growth in calorie demand (due to population growth) exceeds the growth in calorie supply.

The present supply of calories per hectare supported 5.84 adults in 1991, and this situation remains more or less the same until 1998. On the other hand, given an adult's calorie need (2,410), the load on one hectare of land in 1991 was about 5.30 adults, and this also remains fairly constant till 1998. The results indicate that Nuwakot will continue to be surplus in food (cereals and potato) over the 1991-1998 period.

It is worth noting that access to calories may, in fact be less than availability and needs indicate. Access to food is determined by income and relative prices, given base year consumption levels. Table 6.29 presents the results in terms of one's food need. The Table indicates that Nuwakot is surplus in cereals, potatoes, and meat but deficit in milk and oils and fats, even from the consumption point of view.

Fuelwood

The fuelwood situation is presented in Table 6.30. The supply per hectare decreases over time as the accessible forest area also decreases. The pressure on a hectare of forest land increases due to the population growth. It can be observed that the demand is already higher than the supply. This pattern continues to deteriorate over time. The supply position is currently 75 per cent of the demand and, by the year 1998, the supply will decrease to 67 per cent. The carrying capacity will also decline as the forest quality deteriorates, leading to an increase in the load factor. The load factor (which indicates the fuelwood requirements of the persons that a hectare of land can support given the per capita need of 0.588 adt) will increase from 4.66 persons per hectare in 1992 to 5.04 persons per hectare by 1998. On the other hand, the carrying capacity will decrease from 3.51 persons per hectare to 3.37 persons per hectare by 1998. Clearly, the fuelwood situation in Nuwakot is alarming.

Fodder

Under the existing trend, given the livestock growth and changing patterns of land use generated by the model, the capacity of forest, grazing, and agricultural lands and other fodder supply sources to support the livestock population appears to be sustainable in Nuwakot as indicated by the results given in Table 6.31. Under the current trend of land use change and livestock population growth, the capacity of land to support the livestock population appears to be satisfactory. Currently, the livestock population (expressed in terms of LSU) that can be supported by one hectare of land is about 1.09 LSU, whereas the current load factor is smaller (0.84 LSU/ha). The present situation indicates a surplus in fodder supply compared to the fodder demand in Nuwakot.

Conclusion

Under the current state of technology and infrastructure, the capacity of the district to sustain the increasing human and livestock populations in Nuwakot appears to be fairly satisfactory. One major advantage of the district is that it continues to produce surplus food. This factor is important since Nuwakot can diversify its crop sector by including more high-value crops to generate a higher level of income and employment. Enough scope exists within the crop sector to improve crop yields and cropping intensity so as to generate more income and employment. The natural resource scenario in the district indicates that the fuelwood situation should be given more attention. The quantity and quality of forests are deteriorating fairly rapidly in Nuwakot, and it is likely that greater pressure will be exerted on forests to meet the growing fuelwood demand. The fodder supply problem in the district is not serious currently, as indicated by the surplus, based on the results derived from the model.

The overall results suggest that the natural resource and environmental conditions in Nuwakot are not as alarming as those in the other two districts of Bagmati Zone, namely Kabhre and Sindhupalchok. The carrying capacity and load analyses indicate that pressure on agricultural land in Nuwakot is not likely to be serious over time since the current capacity exceeds the load factor in terms of calories. This implies that agriculture in Nuwakot may not pose a threat to forest lands since the district's food produce is in surplus. However, the threat to forests, from the fuelwood point of view, cannot be ruled out. Fuelwood demand already exceeds the current sustainable yield rates. But, since forest resources complement agricultural productivity, the deteriorating forest conditions will have a negative implication on agriculture.

Policy Scenario and Impact Analysis

Introduction

This section examines the impact of different policies on the food supply and natural resource base of Nuwakot district. A population policy is also examined.

Population Policy Scenario and Impact

Nuwakot's population growth according to the 1991 census is about 1.46 per cent compared to the national average of 2.3 per cent. Over time, even with the small increase in population, Nuwakot's economic situation is likely to deteriorate, although the economic situation in Nuwakot is relatively better compared to other districts in the Bagmati Zone. As a result, a 'population reduction policy' was examined within the simulation model developed for Nuwakot.

The population reduction policy is assumed to start in 1993 and continues till 1998. Initially only a small reduction (growth rate) is envisaged, and this is allowed to decrease each year till it reaches 0.9 per cent in 1998. The growth allowed in 1998

is about half the existing growth trend and it also matches with the overall target of 50 per cent reduction in the population growth envisaged in the Eighth Plan Period (1993-1997). The growth assumptions made for each year are given in Table 6.32.

The impact of the population policy, as defined by the growth rate assumptions noted in Table 6.32, indicates that population reduction gradually increases over time from 258 persons in 1993 to over 5,000 by 1998. This reduction implies that by the end of 1998 the population reduction policy will have reduced the total population of Nuwakot by over 13,600 persons. A reduction of 13,600 in a five-year period is not insignificant, and the impact of this reduction will affect other sectors. The annual impacts will occur primarily to the reduction in population which is an extremely small percentage of the total population (Table 6.32)

The impact of the population policy on the calorie balance situation does not change since the policy does not affect the calorie supply. On the demand side, the calorie situation does not change very much (although it decreases) since the reduction in population is still small compared to the total population. Likewise, the impacts of this policy on other variables of interest are also small and hence not reported.

Crop Sector Policy Scenarios and Impacts

The impacts of alternative policy scenarios dealing mainly with fertiliser, irrigation, and combined policy in the crop sector are examined in this section. The first policy scenario envisages the development of all the potential irrigable areas in the district (estimated to total 15,047 hectares). Under the fertiliser policy scenario, the present level of fertiliser use rate in the district is assumed to increase by 25 per cent. Finally, the combined policy scenario refers, in particular, to the combination of irrigation and fertiliser policies in addition to the cropping intensity effect resulting from the net increment in potato area equal to the additional irrigation area developed. All other cropping intensity effects that can be expected to occur during the non-potato season are held constant to simplify matters. The relative merits of these alternative policy scenarios are assessed in terms of the yield, food balance, trade, income, employment, etc and are discussed in the following sections.

Impacts on the Food Sector

Crop Yield: With the introduction of the irrigation policy, the existing irrigated area in the district almost doubles to 15,047 hectares by 1993, and this area is assumed to remain constant over the projected period. This change in irrigated area will affect the yield of all crops except millet, depending on the irrigation elasticities and parameters of crop yield response functions used in the model. The results presented in Table 6.33 (Chart 6.2) indicate that both the magnitude and trend in crop yields will improve significantly due to this policy. For example, the magnitude of increase in crop yields is more pronounced in the case of potatoes, followed by wheat and paddy, whereas the average annual growth rate of crop yields, although less than one per cent, is among the highest for paddy (0.85%), followed by potatoes (0.5%), and wheat (0.4%).

The impact of the 25 per cent increase in the per hectare fertiliser use rate on yield improvement is lower than that of the irrigation policy, whereas the long-run growth trend under the fertiliser policy is relatively higher than under the irrigation policy. Other considerations remaining the same, a 25 per cent increase in the use rate of fertiliser increases the yield of paddy and wheat by over five per cent and that of potatoes and maize by less than three per cent, given the fertiliser elasticities assumed in the model. Since no fertiliser is assumed to be applied to millet, its yield remains unchanged under this policy as in the case of the irrigation policy.

When both irrigation and fertiliser policies are introduced jointly together with the expansion in the area under potatoes, as indicated above, the wheat yield is expected to increase the most (by 28%), followed by oilseeds (20%), paddy (15%), and potatoes (13%), whereas the maize yield is expected to increase by less than five per cent compared to the hectare yield in 1993 under the baseline scenario. Despite the improvement in crop yields due to this combined policy, it is interesting to note that the projected growth rate of crop yields under this policy is lower than under the fertiliser policy.

Food Supply: The impacts of different policies on the food availability situtation in Nuwakot are given in Table 6.34 (Chart 6.3). The results indicate that the magnitude and trend of the per capita food availability by food types under the different policy scenarios are similar. That is, while the irrigation policy increases the level of per capita food availability more than the fertiliser policy, the long-run growth trend of the per capita food availability under the former policy is, however, relatively higher than under the later policy.

Food Demand: The rural households' demand for food is assumed to be influenced by the changes in the income and price of different food items. The food policy scenarios considered in the present exercise, however, affect household incomes (through increased crop production), and, hence, the per capita food demand increases depending upon the growth in income and the magnitude of income elasticity of the food demand. The changes in the per capita demand for different food groups generated by the model under each policy scenario are given in Table 6.35.

The results indicate that the per capita demand for most food items under both the irrigation and fertiliser policies, in general, do not increase much compared to the baseline situation. Since food is a necessity, its income elasticity is generally inelastic, indicating that the rural demand for food does not change proportionately with the change in income. The results further indicate that the per capita demand under each policy, especially under the irrigation policy, declines at a faster rate than under the baseline scenario. This trend is in line with Engel's Law which states that the share of the food basket gradually declines as household incomes rise. When both the irrigation and fertiliser policies are introduced jointly with increased cropping intensity, the per capita demand for all food, however, increases considerably in the initial years and then begins to decline over time.

Food Balance: The per capita food balance situation, with and without food policy interventions, in the district over the 1993-1998 period is presented in Table 6.36 (Chart 6.4). Even under the baseline situation, the district continues to experience a net surplus in food despite the declining trend in food surplus. Under the irrigation and fertiliser policy interventions, the district's food balance situation improves and shows a positive trend in the per capita food surplus over time. It should, however, be noted that the per capita oil and fat balance situation in the district does not improve under these policy interventions, because of the little or no effect of such policies on the supply of this food group, including not only oilseeds but livestock products such as ghee.

When both the irrigation and fertiliser policies are introduced jointly along with expansion in one existing area under potatoes, the net surplus in the food balance situation declines drastically in 1993, mainly due to a sudden rise in income which induces food demand more than the policy impact on supply. From 1994 onwards, the surplus in food balance, however, improves considerably due to the decline in per capita demand resulting from the gradual decline in income growth.

Calorie Balance: Table 6.37 provides the forecasted calorie demand and supply situation in the district under each policy scenario (Chart 6.5). Under the current state of technology, the estimated calorie supply (from cereal and potato only) is over 1.10 times greater than the total calorie requirement, and this calorie surplus declines marginally over time. Both the irrigation and fertiliser policies enhance the calorie supply compared to the baseline situation, but the impact of the irrigation policy is relatively more pronounced than that of the fertiliser policy. For example, in 1993, the calorie supply under the former policy would be about 1.19 times higher than the calorie demand, compared to 1.14 times higher under the latter policy. When both these policies are introduced jointly, along with expansion in the

cropping intensity, the calorie supply is expected to exceed the calorie demand considerably, the per hectare calories being 1.62 times greater than the per hectare calorie demand. It should be noted that all the policies scenarios, except the joint policy, enhance the calorie supply rather than the calorie demand.

Impact on Trade

The manner in which both food and non-food exports/imports in the district are forecasted has already been described. The impact of alternative policy options on food and non-food export/import is examined in this section and the results generated by the model under each policy scenario are presented in Table 6.38 (Chart 6.6).

Food:: Currently, the district is a net exporter of food with the value of exports increasing at the rate of about seven per cent per annum under the baseline scenario trend. The value of food exports, under both irrigation and fertiliser policies, increases at a much faster rate than under the baseline scenario, but the annual growth of the value of food export under the former policy is relatively higher (17%) than under the latter (11%). However, the value of exports under all policy scenarios declined drastically in 1993 due to the sudden rise in income which induces higher food consumption. Under the joint policy, the value of aggregate food exports is expected to increase considerably from Rs 109 million in 1993 to Rs 972,4 million in 1988 at the average growth rate of about 55 per cent, primarily as a result of the large surplus in potato production. The value of per capita food exports under each policy scenario is given in Table 6.38.

Non-Food: The extent to which the demand for non-food imports is influenced by policy interventions depends very much upon the magnitude of income growth resulting from policy action, together with the strength of income elasticity for non-food demand, other considerations remaining the same. The results presented in Table 6.38 indicate that the value of non-food imports under the joint policy is more

pronounced than under the single policy, taken separately. The value of non-food imports under the single policy does not change from the baseline scenario. This is perhaps because the annual growth in income (which is declining) resulting from the policy interventions is not strong enough to induce import demand growth over time. The joint policy has a greater impact on non-food imports than the other two policies.

Impact on Labour Use

Before examining the employment impacts of the different policy interventions, it is important to emphasise that any increase in total labour utilisation results primarily from the crop sector rather than from the livestock and non-agricultural sectors. Therefore, it is only under the joint policy that the additional labour force can be used in the crop sector, due to the increased cropping intensity effect. While development of irrigation facilities would also help to generate considerable employment opportunities, at least in the short run, this effect has not been taken into account in the present exercise. As a result, the total labour utilisation rate under both irrigation and fertiliser policies remains unchanged from the baseline situation, whereas the joint policy improves the labour use rate significantly. The results presented in Table 6.39 indicate that an additional seven per cent of the total labour force would be used in the crop sector if all the potential irrigated area in the district is brought under potato cultivation. It is also possible to grow other crops during the non-potato season, hence increasing labour utilisation, but this has not been considered in the present exercise to simplify matters. It is further evident from the Table that, although the labour use rate is expected to increase from 69 per cent under the baseline condition to 77 per cent under the joint policy, the labour use situation under both scenarios declines over time as the population grows.

Impact on Income

All the policies examined above affect the income through their impacts on the crop sector. Income originating from the livestock and other non-agricultural sectors, is not directly affected by these policies. The estimated nominal income originating from all these sources was converted to real incomes, using the weighted cereal grain price index at 1991 constant prices as mentioned in the baseline results described above. The results presented in Table 6.40 indicate that the real per capita income, which is estimated to be Rs 1,174 in 1993 under the baseline situation, is expected to reach Rs 1,322 under the irrigation policy, Rs 1,241 under the fertiliser policy, and Rs 2,563 under the joint policy. Irrigation development is seen to have a larger impact on the income level than the fertiliser policy. Yet the long-run (1993-1998) growth rate of the real per capita income under the fertiliser policy is slightly higher than under the irrigation policy (Table 6.40, Chart 6.7) because the growth in crop yields under the former policy is found to be relatively higher than under the latter policy.

The relative shares of income from different sources in the total income, with and without policy interventions, are provided in Table 6.41. The contribution of the

crop sector to the total income, which was about 50 per cent under the baseline scenario in 1993, is expected to reach 56 per cent, 53 per cent, and as high as 78 per cent respectively under the irrigation, fertiliser, and under joint policy interventions. The results further indicate that the projected share of crop income under the fertiliser policy grows at a slightly higher rate than under the irrigation and joint policy interventions. The declining share of livestock and non-agricultural income over time is also discernible from Table 6.41.

Natural Resource Base: Policy Scenarios and Impacts

The impacts of different policies on the natural resource sector are examined in this section. Two sets of policy interventions, dealing with both the demand and supply sides of the natural resource sector (forest), have been considered. While the demand side policy refers in particular to a 10 per cent reduction in the per capita consumption of fuelwood, the supply side policy involves improved management of all the existing accessible forests in the district. The effects of these two policies on demand and supply reduces the rate of deforestation, thereby more fuelwood will be available to meet the fuelwood demand. The results presented in Table 6.42 are, therefore, the results of these simultaneous effects. This also explains why the total supply of fuelwood under the demand policy decreases at a slower rate (1.54%) than under the baseline situation (1.68%).

The results of the supply side policy are also presented in Table 6.42. As is evident from the Table, the fuelwood balance situation improves in comparison to the baseline situation, but the situation is less pronounced compared to the demand

side policy. What is more interesting, however, is that the long-run growth (1993-1998) also reported in the Table indicates that the supply side policy has a better impact in terms of reducing the fuelwood deficit (in the long-run) than the demand side policy. The supply side policy induces better growth of forests over time adding to the biomass stock. The total effect of the supply side policy will become visible after 15 years or so, and cannot be covered by the model. Thus, each year, a larger biomass stock is added to the existing forest area, and this explains the relatively lower negative long-run growth under the supply side policy (indicating relatively larger supplies in the long run).

When the demand reduction and supply management policies are simultaneously examined (joint policy), the fuelwood situation in the districts does not change very much compared to the demand side policy in the initial years. The effect of this policy on fuelwood is visible in the following years when compared to the fuelwood balance situation under the above two policies.

Impact on Fodder

Compared to the fuelwood situation, the fodder situation in Nuwakot is relatively better. Currently, there appears to be an excess supply in Nuwakot. Crop residue is the most important source of fodder in Nuwakot and it continues thus under the different policy scenarios as highlighted in Table 6.42.

The fodder situation in Nuwakot under the baseline scenario improves over time and this trend continues under all the policy options. The different policies do not have much impact on the fodder balance situation in the district (Table 6.42). The long run growth observed in the fodder balance situation is also positive under all scenarios.

Environment and Carrying Capacity

The quality of environment depends substantially upon the nature and extent of the relationship existing between the population and land resources in a given area. The direction and magnitude of inter-class land transfers that have taken place in the district,along with the deforestation rate, have grave environmental implications. The impacts of different policies on some selected indicators of sustainability, such as the changing pressure on the natural resource base, the forest-cultivated land ratio, and deforestation, were assessed against the capacity of land resources. The associated demand pressure on these resources was also determined.

Pressure on the Resource Base

Per Capita Cultivated Land: Under the current population growth trend, the pressure on the natural resource base and environment results primarily from natural resource deficit, leading to deforestation and land use changes. In the case of Nuwakot, the population growth rate of about 1.46 per cent per annum (Table

6.43) exceeds the growth in agricultural land, and, as a result, the per capita cultivated land declines steadily over time at about 1.73 per cent per annum, indicating the increasing pressure on agricultural land. The different policy options do not have any visible impact on agricultural land in terms of reducing the human pressure over time.

Per Capita Accessible Forest: The pressure on accessible forests (land) will continue to grow over the projected period under all policy scenarios simply because the accessible forest area under all policies decreases at a faster rate than the population growth, but the pressure on forest lands is not reduced by the policy interventions. Compared to the baseline scenario, the population density per hectare of forest land under the demand side and joint policy options is projected to grow at a relatively lower rate (3.58%) than under the supply side policy (7.79%).

Cultivated-Forest Area Ratio: Forests are an important source of fodder for livestock, which, in turn, provide nutrients (manure) to farmers' fields. In addition, forests also provide litter as a nutrient supplement to farmers' fields. As the accessible forest area declines over time, the supply of fodder and leaf litter will decline also and this will have negative implications for agricultural productivity. Therefore, the cultivated-forest land ratio in a district provides an idea of the amount of resources that can be harvested sustainably to meet the households' needs.

Wyatt-Smith (APROSC 1982) in his study estimates that 3.5 hectares of accessible unmanaged forest are required to support one hectare of agricultural land in the context of the hill farming system in Nuwakot. This ratio is very small and is seen to decline over time. The different policy options do not have appreciable impacts on this ratio.

The forest-cultivated land ratio in Nuwakot declines over time and is fairly below the optimum level as described earlier (Table 6.43). But the rate of decline in this ratio is much lower (2.37%) under the demand policy than under the supply side policy (3.65%). This implies that the demand reduction policy leads to less accessible forests being deforested than the supply side policy. Stated differently, the accessible forest area under the demand policy decreases at a lower rate than under the supply side policy. The impact of the joint policy is more pronounced as the growth rate is even lower.

Shrub-Forest Land Ratio: The ratio between shrub and forest lands is often used as an indicator of forest degradation, particularly since deforestation in most hilly areas of Nepal leads to the conversion of forest into shrubland. The ratio between shrub and forest lands increases over time under all policy intervention, but this ratio is expected to grow at a slightly lower rate (2.91%) under the demand policy than under the supply policy (3.44%), and at a lower rate still under the joint policy (2.64%).

Deforestation: Table 6.44 shows the estimated magnitude and trend of deforestation under the different policy scenarios. Under the baseline scenario, the deforested area in the district as a whole increases from 406 hectares in 1993 to 565 hectares in 1998, at the rate of 6.83 per cent per annum. The results indicate that the magnitude of deforestation under the demand policy is relatively lower than under the supply policy. It should, however, be noted that the rate of deforestation under the demand policy increases at a much faster rate (10.16%) than under the supply policy (3.56%) (Chart 6.8). However, the demand reduction policy reduces the total deforested area substantially compared to the baseline scenario (from 406 ha under the baseline scenario to 217ha under the demand reduction policy), indicating the strong positive impact of the policy. The supply policy's impact is not readily felt in the few years covered by the model, but the low long-run growth in deforestation indicates a positive impact over an extended period.

Carrying Capacity

Food: The impacts of different policies on the carrying capacity of crop land to meet the calorie needs are presented in Table 6.45. The load or demand pressure is driven by the size of the population as well as by the total cultivated area. The carrying capacity, on the other hand, is a positive function of crop yield rates and the area under different crops. The natural resource policies do not affect any of the variables (neither the carrying capacity nor the demand side of the crop sector), and hence they are not reported. Thus, only the crop sector policies affecting the carrying capacity of agricultural land are examined.

The results indicate that the irrigation policy has a stronger impact in terms of improving the carrying capacity of crop land than the fertiliser policy. While the demand pressure per hectare of crop land or the current load remains unchanged under the irrigation and fertiliser policies, these interventions have positive impacts. The ability of cropland to sustain the population in terms of the calorie requirements is estimated to be 6.30 persons per hectare of crop land under the irrigation policy compared to 6.06 persons per hectare under the fertiliser policy (in 1993), and, under both policies, this capacity increases over time. It is, however, interesting to note that, although the impact of the irrigation policy is seen to be much stronger than that of the fertiliser policy, the carrying capacity under the fertiliser policy exhibits a higher long-run growth. Since the population remains constant, and these two policies do not affect the cultivable area, the demand pressure or the load factor remains the same under these two policy scenarios.

When both these policies are jointly introduced with the potato promotion policy, the carrying capacity of cropland to sustain the population is expected to increase to 6.72 persons per hectare compared to 5.85 persons per hectare under the baseline scenario. The demand pressure per hectare of cropland also decreases due to this policy, because of the increased area under crops (i.e., potatoes) thereby reducing the load factor to 4.13 persons per hectare in 1993. Consequently,the capacity of crop land to meet the calorie requirements of the population increases substantially due to this combined policy as indicated above under the crop sector analysis.

Fuelwood: Table 6.46 presents the impacts of different policies on the carrying capacity of land in terms of fuelwood (Charts 6.9 and 6.10). The carrying capacity of land in terms of fuelwood is estimated to be 3.76 persons per hectare of land (in 1993), whereas the current demand pressure (i.e., load) is 5.04 persons per hectare under the baseline scenario. The per hectare supply of fuelwood is declining at the rate of 0.68 per cent per annum, while the demand is increasing at the rate of 1.11 per cent per annum.

Chart 6.8

The impact of the supply policy on the carrying capacity is, however, not very pronounced so as to ease the demand pressure, although the long-run growth is reversed from negative to positive due to the policy. The demand policy helps to ease some of the pressure exerted on forests in the short run, but not in the long run. The effect of the joint policy is similar to that of the supply policy, since the demand is also reduced under this policy scenario. Table 6.47 presents the results in terms of the fuelwood situation (forests are considered to be the sole source of fuelwood). Finally, Table 6.48 shows the changing share of fuelwood originating from different sources under different policy scenarios.

Fodder: The extent to which the carrying capacity of land resources, in terms of fodder, is influenced by both the demand and supply policies also depends on the relative share of forests in the total supply of fodder in the district. As a result, the carrying capacity of both aggregate land and forest land were estimated and the impacts of policy alternatives assessed. As can be seen from Table 6.49, the baseline scenario capacity of land to support the existing livestock population in the district is 1.78 LSU per hectare (in 1993), whereas the current pressure is only 1.35 LSU per hectare. This implies that the carrying capacity of land is about 31 per cent higher than the load. Table 6.50 shows the fodder situation (only forests are

considered) and Table 6.51 shows the changes in fodder sources under different policy scenarios.

The different policy options do not have any impact on the fodder supply situation in Nuwakot, and, as a result, the carrying capacity of the district to meet fodder needs as well as the load factor do not change. Changes that may occur due to the supply policy cannot be captured within the five-year time frame of the study.

Conclusion

One major conclusion that emerges from the above analysis of the crop sector policy scenarios is that pursuing a combination of policy actions will have far-reaching effects on the food sector than the introduction of a single policy such as irrigation development and increased use of fertilisers. With the introduction of a joint or combined policy consisting of the above options, the present level of per capita income would double as the per hectare gross margin from crops improves substantially, and the district's current food export capacity would also improve considerably. Secondly, if a single policy is pursued, the planner has to choose between long-run growth and equity based on the results. While the fertiliser policy was seen to be more effective in enhancing the long-run growth, the irrigation policy was found to bring about a larger magnitude of change. If short-term employment generation is taken into account through this policy, the impacts in terms of employment could be stronger, and this is likely to benefit the poor. Clearly, generating employment appears to be more difficult than improving income. The combined policy scores better on both fronts. Population reduction was also seen to have negligible impacts, since the reduction was less than one per cent of the total population. The population reduction policy should, however, not be

undermined and should be examined over a longer period (which could not be covered by the model).

In the context of natural resource and environmental degradation, the results for Nuwakot are fairly mixed. Agricultural land continues to generate food surplus in the district over time, even though the growth in surplus declines marginally over time. Although no immediate threat to forest land from agriculture is evident, the declining food surplus on one hand and the population growth, on the other, are likely to exert greater pressure on forests. Furthermore, if forests are viewed as a complementary to agricultural productivity, then the dwindling area under forests as well as the decline in biomass will obviously cause a reduction in the food supply, exerting additional pressure on forests. Small reductions in the population are not likely to affect this trend, at least not in the five-year period covered by the study. This, however, does not mean that the population reduction policy should be underestimated, since, over an extended period, population reduction will lead to less pressure in terms of food supply and, hence, on forests.

The existing forests are already in a poor state. The area under forests in Nuwakot is already decreasing and so is the quality of forests. Since the present fuelwood demand cannot be met by the current yield rates, deforestation is increasing fairly rapidly in the district. The population growth adds incremental pressure on deforestation annually. Livestock do not appear to threaten forests from the fodder demand point of view since the existing fodder demand is met from other sources besides forests.

The policy options examined in the natural resource sector indicate the need for immediate action in the forestry sector to control deforestation as well as increase the forest yield rates. The supply policy was seen to have a pressure impact on yield rates, and, hence, deforestation over an extended period (not within the model's framework). The demand policy has an immediate effect on deforestation as the fuelwood demand was curtailed by 10 per cent, but the demand policy is not sustainable from a long term perspective. The joint policy aimed at controlling the demand and improving the supply of forest products, primarily fuelwood, was found to have more desirable impacts.

Table 6.1: Areas under Different Crops: Nuwakot (ha)

Year	Paddy	Maize	Wheat	Millet	Oilseeds	Potato
1975	7000	8000	2820	1800	250	600
1976	7000	8000	1820	1836	245	600
1977	7000	8000	1820	1850	230	610
1978	7000	8000	1800	1900	220	600
1979	7000	7600	1800	1950	220	600
1980	7010	8000	1790	4000	220	1200
1981	9750	8000	1790	4000	220	1200
1982	18970	8200	2420	6000	900	570
1983	16920	8510	2420	4810	780	1060
1984	16950	10200	2370	5190	1050	750
1985	15190	11900	2400	5140	780	900
1986	16240	16570	2440	5220	800	1130
1987	16260	16210	2670	5580	780	1310
1988	16380	19040	2700	5550	430	1320
1989	15090	19780	3000	5500	420	1400
Average	12250	11067	2270	4021	503	923
St. Dev.	4664	4327	415	1607	295	307
Coef. Var.	38	39	18	39	58	33

Table 6.2: Estimated Regression Results for Areas under Different Crops: Nuwakot

Crops	Semilog function	
Paddy Area =	3236.17 + 4846.63 ln (time) (3104.01) (1060.88)	R2 = 0.62
Maize Area =	3870.71 + 3869.25 ln (time) (3427.45) (1171.43)	R2 = 0.47
Millet Area =	1897.71 + 200.52 ln (time) (415.51) (142.01)	R2 = 0.13
Wheat Area =	551.95 + 1865.52 ln (time) (830.53) (283.85)	R2 = 0.77
Oilseeds Area =	67.45 + 234.17 ln (time) (257.71) (87.05)	R2 = 0.36
Potato Area =	390.90 + 286.26 ln (time) (235.14) (80.36)	R2 = 0.50

Note: Figures in parentheses indicate standard errors in estimate

Table 6.3: Crop Yield Trend: Nuwakot (kg/ha)

Year	Paddy	Maize	Millet	Wheat	Oilseeds	Potato
1975	2501	1615	1177	1180	404	5000
1976	2500	1700	1824	1100	404	5000
1977	2624	1360	1440	1178	609	6197
1978	2629	1400	1444	1200	500	5500
1989	2420	1429	1083	1262	500	6000
1980	2425	1500	1000	1235	500	6067
1981	2501	1600	1000	1630	545	7500
1982	2332	1122	1000	1200	600	6000
1983	2489	1610	798	1071	692	7000
1984	2319	1514	899	1098	495	4773
1985	2250	1496	900	1128	603	5000
1986	2435	1260	889	1199	600	5000
1987	2331	1467	1000	1330	654	7603
1988	2432	1480	1019	1350	605	8000
Mean	2442.00	1468.07	1105.21	1225.79	550.79	6045.71
Std.	106.22	145.87	270.80	137.11	83.87	1055.23
Co. Var.	2298.96	1006.45	408.13	894.04	656.75	572.93

Table 6.4: Sale of Chemical Fertilisers in Nuwakot District

Year	Quantity Supplied (MT)	Sale Per Cropped Area (kg/ha)
1982	2468	67
1983	2547	74
1984	2975	82
1985	2998	83
1986	2887	68
1987	3431	80
1988	3844	85
1989	4255	94
1990	5689	120
1991	5440	134

Source: Agricultural Inputs Corporation

Table 6.5: Livestock Population and Livestock Products

	1984	1985	1986	1987	1988
Population					
Buffaloes	52205	53881	56720	63148	63224
Milch Buffaloes	11224	11584	12200	12176	12712
Cattle	80664	81519	83590	101520	100505
Milch Cows	8679	8771	9600	10161	9958
Goats	75235	76491	75725	50750	51765
Sheep	15165	15744	16020	16810	17533
Pigs	2915	3070	2980	1180	1216
Products					
Meat: Buffalo (MT)	1535	1584	1668	2043	2045
Goat (MT)	224	228	225	151	154
Mutton (MT)	33	34	35	37	39
Pork (MT)	42	44	43	17	18
Chicken (MT)	94	99	99	92	97
Milk: Buffalo (lit)	10023	10345	10895	11550	12058
Cows (lit)	2839	2869	3141	3531	3460

Source: DFAMS 1989

Table 6.6: Land Use Changes in Nuwakot Over Time (ha)

	1978	1979	1980	1985	1986	1987	1988	1989	1990
Total Area	119649	119649	119649	119649	119649	119649	119649	119649	119649
Mid-mountains	93291	93291	93291	93291	93291	93291	93291	93291	93291
Natural Forests	12498	12373	12249	11649	11532	11417	11303	11190	11078
Accessible Forests	12498	12373	12249	11649	11532	11417	11303	11190	11078
Shrublands	19317	19379	19441	19742	19800	19857	19915	19971	20027
Grasslands	2166	2185	2203	2293	2311	2328	2345	2362	2379
Mapped Cultivation	56755	56792	56830	57010	57045	57079	57114	57147	57181
Adjacent NCI	20368	20380	20393	20453	20465	20476	20488	20499	20510
Gross Cultivation	36387	36412	36437	36557	36580	36603	36626	36649	36671
NCI Within	6808	6808	6808	6808	6808	6808	6808	6808	6808
Net Cultivation	29579	29604	29629	29749	29772	29795	29818	29841	29863
MM Calculated	90736	90730	90724	90694	90688	90682	90676	90671	90665
High Mountains	11181	11181	11181	11181	11181	11181	11181	11181	11181
Natural Forests	6755	6706	6658	6425	6380	6335	6291	6247	6203
Accessible Forests	4857	4808	4760	4527	4482	4437	4392	4349	4305
Shrubland	999	1023	1047	1164	1187	1209	1231	1253	1275
Grasslands	1299	1306	1313	1348	1355	1362	1369	1375	1382
Mapped Cultivation	1609	1624	1638	1708	1722	1735	1748	1761	1775
Adjacent NCI	789	794	799	822	827	831	835	840	844
Gross Cultivation	820	830	839	886	895	904	913	922	930
NCI within	183	183	183	183	183	183	183	183	183
Net Cultivation	637	647	656	703	712	721	730	739	747
HM Calculated	10662	10660	10657	10646	10643	10641	10639	10637	10634
Nuwakot (Total)									
Forests	19253	19079	18908	18074	17912	17752	17594	17437	17281
Accessible Forests	17355	17181	17009	16176	16014	15854	15695	15538	15383
Shrublands	20316	20403	20489	20905	20986	21066	21146	21224	21302
Grasslands	3465	3491	3517	3642	3666	3690	3714	3737	3761
Adjacent NCI	21157	21174	21192	21275	21291	21307	21323	21339	21354
NCIG	6991	6991	6991	6991	6991	6991	6991	6991	6991
Net Cultivated	30216	30251	30285	30452	30484	30516	30548	30579	30610
Nuwakot (Calculated)	101398	101389	101381	101339	101331	101323	101315	101307	101299
Residual (including)	18251	18260	18268	18310	18318	18326	18334	18342	18350
Conservation Area	5731	5740	5748	5790	5798	5806	5814	5822	5830

Table 6.7: Forecasted Product and Factor Prices

Products & Factors	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Products									
Units (Rs/kg)									
Paddy	5.62	6.22	6.89	7.61	8.40	9.25	10.19	11.21	10.45
Wheat	5.72	6.13	6.57	7.04	7.54	8.07	8.64	9.25	7.13
Maize	4.96	5.43	5.94	6.49	7.08	7.71	8.39	9.11	9.17
Millet	5.33	5.97	6.68	7.45	8.29	9.20	10.21	11.30	11.47
Oilseeds	17.08	18.97	21.06	23.38	25.95	28.81	31.98	35.51	11.02
Potatoes	5.76	6.18	6.62	7.10	7.62	8.18	8.78	9.43	7.27
Mutton	65.76	72.17	79.30	87.23	96.06	105.89	116.82	128.99	10.04
Chicken meat	60.05	65.92	72.37	79.45	87.22	95.75	105.11	115.39	9.78
Buffalo meat	26.37	29.40	32.77	36.54	40.73	45.41	50.62	56.44	11.48
Pork	31.26	34.27	37.57	41.19	45.16	49.51	54.28	59.51	9.64
Wool	80.25	85.87	91.88	98.31	105.19	112.55	120.43	128.86	7.00
Cereal grains	5.31	5.84	6.42	7.04	7.71	8.43	9.22	10.06	9.64
Aggregate Oils and Fat	83.50	91.52	100.38	110.13	120.84	132.62	145.56	159.79	9.65
Aggregate Meat	34.53	38.30	42.51	47.20	52.42	58.23	64.71	71.92	11.03
Milk (Rs/lit)	8.99	9.78	10.65	11.60	12.63	13.76	14.98	16.31	8.89
Mustard Oil (Rs/lit)	49.13	54.43	60.30	66.80	74.00	81.98	90.82	100.61	10.78
Ghee (Rs/lit)	108.26	118.87	130.52	143.31	157.35	172.78	189.71	208.30	9.80
Factors									
Wage Rate (Rs/day)	33.52	35.87	38.38	41.06	43.94	47.01	50.31	53.83	7.00
Bullocks (Rs/pair day)	26.82	28.69	30.70	32.85	35.15	37.61	40.24	43.06	7.00
Fertiliser price (Rs/kg)	4.28	4.58	4.90	5.24	5.61	6.00	6.42	6.87	7.00

Table 6.8: Forecasted Area under Different Crops (hectares)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	16674	16968	17245	17507	17755	17992	18217	18433	1.50
Maize	19599	19833	20054	20263	20462	20651	20831	21003	1.03
Millet	2954	2966	2977	2988	2998	3008	3018	3026	0.36
Wheat	5724	5837	5944	6045	6140	6232	6318	6401	1.68
Oilseeds	717	731	744	757	769	780	791	802	1.68
Potatoes	1435	1451	1466	1481	1495	1508	1520	1532	0.98
Total Cropped Area	47102	47786	48431	49041	49620	50170	50695	51197	1.24
Total Cultivated Land	36272	36801	37299	37770	38217	38643	39048	39435	1.25
Area under Irrigation	7646	7799	7955	8114	8276	8442	8611	8783	2.00
Total Fertiliser Sale	4888	5240	5593	5946	6298	6651	7004	7356	6.23

Table 6.9: Forecasted Yield Rates of Different Crops (kg/ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	2563	2573	2569	2565	2562	2559	2556	2554	0.56
Maize	1498	1503	1502	1501	1500	1500	1499	1498	0.26
Wheat	1269	1271	1270	1268	1267	1266	1265	1264	0.38
Millet	1111	1113	1113	1113	1113	1112	1112	1112	0.08
Oilseeds	563	565	564	564	564	564	564	564	0.29
Potatoes	6217	6231	6228	6225	6223	6221	6218	6216	0.35

Table 6.10: Forecasted Changes in Crop production (MT)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	42739	43659	44301	44910	45490	46044	46569	47075	2.07
Maize	29366	29806	30120	30417	30700	30969	31223	31468	1.29
Wheat	7264	7422	7548	7667	7780	7888	7990	8089	2.06
Millet	3281	3301	3313	3325	3336	3346	3356	3366	0.44
Oilseeds	404	413	420	427	434	440	446	452	1.98
Potatoes	8919	9041	9132	9218	9300	9378	9452	9523	1.33

Table 6.11: Forecasted Revenue, Cost, and Gross Margins Per Hectare of Cultivated Land under Different Crops (Rs/ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Revenue									
Paddy	15.05	16.67	18.35	20.17	22.17	24.34	26.70	29.27	10.67
Maize	7.98	8.72	9.48	10.30	11.18	12.12	13.12	14.20	8.91
Wheat	7.66	8.20	8.75	9.33	9.96	10.62	11.33	12.09	7.20
Millet	6.33	7.05	7.84	8.69	9.62	10.64	11.76	12.97	10.98
Oilseeds	9.63	10.71	11.89	13.19	14.64	16.26	18.04	20.03	11.34
Potatoes	35.83	38.49	41.24	44.22	47.42	50.88	54.60	58.62	7.64
Cost:									
Paddy	9.72	10.41	11.15	11.94	12.79	13.69	14.66	15.70	7.08
Maize	7.12	7.62	8.16	8.73	9.34	10.00	10.70	11.45	7.02
Wheat	6.72	7.19	7.69	8.23	8.80	9.41	10.07	10.77	6.97
Millet	6.11	6.54	7.01	7.51	8.04	8.61	9.22	9.87	7.09
Oilseeds	4.33	4.65	4.99	5.35	5.74	6.16	6.61	7.09	7.29
Potatoes	15.31	16.39	17.55	18.79	20.13	21.56	23.10	24.74	7.09
Per Hectare Gross Margin									
Paddy	5331	6261	7199	8235	9380	10644	12036	13573	16.78
Maize	863	1101	1327	1572	1835	2119	2423	2752	23.07
Wheat	937	1007	1055	1105	1156	1210	1264	1320	9.26
Millet	215	510	827	1184	1585	2035	2538	3102	
Oilseeds	5292	6059	6899	7843	8905	10097	11434	12935	14.31
Potatoes	20520	22097	23694	25422	27293	29318	31505	33874	8.06

Table 6.12: Forecasted Livestock Population

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cattle	100374	100233	100071	99884	99668	99418	99130	98797	-0.21
Milch Cow	41756	41697	41629	41552	41462	41358	41238	41099	-0.21
Bullock	58618	58536	58441	58332	58206	58060	57892	57687	-0.21
Buffalo-total	63140	63051	62948	62830	62694	62537	62355	62145	-0.21
Milch Buffalo	36368	36317	36258	36190	36112	36021	35917	35796	-0.21
Sheep	17507	17480	17449	17413	17372	17324	17268	17204	-0.24
Goat	51739	51712	51681	51645	51604	51556	51500	51436	-0.08
Pig	1252	1290	1329	1369	1410	1452	1496	1540	3.00
Chicken	61674	63525	65430	67393	69415	71497	73642	75852	3.00
Total LSU	125163	124995	124801	124577	124318	124020	123675	123276	-0.21

Table 6.13: Forecasted Annual Production and Growth in Livestock Products (MT)

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cow's Milk	4067	4061	4055	4047	4038	4028	4017	4003	-0.21
Buff's Milk	6932	6922	6911	6898	6883	6866	6846	6823	-0.21
Ghee	153	153	152	152	152	151	151	150	-0.21
Net Milk Supply	7699	7688	7676	7662	7645	7626	7604	7578	-0.21
Oils and Fat	262.84	265.04	266.83	268.48	269.98	271.34	272.56	273.63	0.72
Buffalo Meat	1033.45	1032.00	1030.32	1028.39	1026.16	1023.59	1020.61	1017.17	-0.21
Goat and Sheep Meat	204.61	204.46	204.28	204.08	203.84	203.57	203.26	202.90	-0.11
Chicken Meat	81.41	83.85	86.37	88.96	91.63	94.38	97.21	100.12	3.00
Pork	11.77	12.13	12.49	12.86	13.25	13.65	14.06	14.48	3.00
Aggregate Meat Available	1331.24	1332.43	1333.46	1334.29	1334.88	1335.18	1335.14	1334.67	0.04
Wool Production (kg)	7706.16	7694.25	7680.52	7664.69	7646.43	7625.33	7600.94	7572.68	-0.24

Table 6.14: Forecasted Cost and Returns from Livestock (Rs '000)

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998
Buffaloes	14491	16704	19202	22018	25189	28754	32755	37237
Sheep and Goats	7472	8358	9360	10491	11767	13205	14822	16640
Pigs	189	218	252	290	334	384	442	508
Poultry	4024	4575	5200	5910	6716	7630	8668	9846
Cows (Milk+Ghee)	24266	26767	29508	32508	35790	39376	43290	47555
Buffaloes (Milk+Ghee)	49239	54104	59423	65233	71575	78490	86020	94210
Total Gross Margin From LV	99681	110726	122944	136451	151372	167839	185997	205996

Table 6.15: Forecasted Per Capita Food Supply (kg/adult)

Food (Edible Form)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal Grains	225.00	225.60	225.04	224.32	223.49	222.54	221.49	220.38	-0.30
Meat	5.42	5.34	5.27	5.19	5.12	5.05	4.98	4.90	-1.42
Milk	31.34	30.83	30.33	29.82	29.33	28.83	28.34	27.84	-1.68
Oils and Fat	1.07	1.06	1.05	1.05	1.04	1.03	1.02	1.01	-0.89
Vegetables	27.95	27.92	27.78	27.63	27.46	27.29	27.11	26.93	-0.53

Table 6.16: Forecasted Per Capita Food Demand (kg/adult)

Food (Edible Form)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal Grains	218.25	218.42	217.56	217.01	216.32	215.51	214.56	213.57	-0.31
Vegetables	26.73	26.54	25.09	25.94	25.78	25.62	25.43	25.25	-0.81
Meat	5.24	5.12	4.96	4.89	4.82	4.75	4.68	4.61	-1.79
Milk	35.58	35.17	34.25	33.65	33.05	32.45	31.85	31.27	-1.83
Oils and Fat	1.18	1.09	1.07	1.06	1.05	1.04	1.03	1.02	-2.08

Table 6.17: Forecasted Per Capita Food Balance Situation (kg/adult)

Food (Edible Form)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal Grains	6.74	7.18	7.47	7.31	7.17	7.04	6.93	6.81	0.15
Vegetables	1.22	1.37	1.69	1.69	1.68	1.68	1.68	1.68	4.61
Meat	0.18	0.22	0.31	0.30	0.30	0.29	0.29	0.29	6.72
Milk	-4.23	-4.34	-3.93	-3.82	-3.72	-3.62	-3.52	-3.43	-2.98
Oils and Fat	-0.11	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-23.79

Table 6.18: Forecasted Changes in Land Use (%)

Land Use	1991	1992	1993	1994	1995	1996	1997	1998
Forests	14	14	13	13	13	12	12	11
Shrublands	18	18	18	18	19	19	19	19
Grasslands	3	3	3	3	3	3	4	4
Adjacent NCI	18	18	18	18	18	18	18	18
Net Cultivated	26	26	26	26	26	26	26	26
Residual (including)	15	15	15	15	15	16	16	16
Shivapuri, Langtang Net	5	5	5	5	5	5	5	5
Total	100	100	100	100	100	100	100	100
Total (ha)	119649	119649	119649	119649	119649	119649	119649	119649

Table 6.19: Supply Fuelwood from Different Sources and the Total Annual Supply (%)

Sources	1991	1992	1993	1994	1995	1996	1997	1998
Forests	23	22	22	21	20	20	19	18
Shrub Lands	24	24	25	25	25	26	26	27
Grazing Lands	0	0	0	0	0	0	0	0
Adjacent NCI	40	40	41	41	41	41	41	41
Cultivated Area	1	1	1	1	1	1	1	1
Crop Residue	11	11	12	12	12	12	12	12
Total	100	100	100	100	100	100	100	100
Total Supply (adt)	110948	110812	110641	110438	110201	109932	109630	109296

Table 6.20: Forecasted Fuelwood Supply from Different Sources (air dry tonne (ADT))

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Forest: Hardwood	20838	20258	19634	18964	18246	17481	16667	15803	-3.73
Conifer	477	465	453	440	426	411	395	378	-3.14
Mixed	4115	4050	3983	3913	3840	3765	3686	3605	-1.83
Shrublands	26871	27115	27378	27659	27959	28278	28618	28977	1.06
Grazing Lands	382	388	394	401	408	416	424	432	1.76
Adjacent NCI	44647	44729	44817	44911	45011	45117	45231	45351	0.22
Cultivated Area	1074	1077	1080	1083	1086	1090	1094	1098	0.30
Crop Residue	12544	12729	12904	13069	13225	13374	13516	13652	1.26
Total Fuelwood Supply (adt)	110948	110812	110641	110438	110201	109932	109630	109296	-0.20
Per Capita ss: Fuelwood (adkg)	452	444	437	430	423	416	409	402	-1.47
Per Capita Deficit (adkg)	-106	-114	-121	-128	-135	-142	-149	-156	
Total Deficit	-26122	-28337	-30599	-32907	-35262	-37661	-40104	-42591	

Table 6.21: Forecasted Fodder Supply by Source (MT-total digestible nutrient (TDN))

Source	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Forests	6916	6743	6558	6360	6149	5925	5687	5435	-3.26
Shrublands	16552	16703	16865	17038	17223	17419	17628	17850	1.06
Grazing Lands	1736	1755	1776	1798	1821	1845	1871	1898	1.27
Adjacent NCI	29950	30005	30064	30127	30194	30266	30342	30422	0.22
Risers and Bunds	2148	2154	2160	2166	2173	2180	2187	2195	0.30
Fallow Grazing	1841	1846	1851	1856	1862	1868	1875	1882	0.30
Tree Fodder	4296	4307	4319	4332	4345	4359	4375	4391	0.30
Crop Residue	37633	38188	38711	39206	39676	40123	40549	40956	1.26
Total Fodder Supply (tdn)	101073	101701	102303	102883	103443	103985	104513	105029	0.56

Table 6.22: Labour Use by Sector

Labour Use & Activity	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Labour Days Available	41442	42182	42931	43690	44458	45236	46006	46784	1.47
Labour Use in the Crop Sector	8360	8484	8601	8711	8816	8915	9010	9101	1.27
Livestock	12516	12499	12458	12458	12432	12402	12368	12328	-0.21
Professional Workers	637	648	650	671	683	695	707	719	1.47
Office Workers	716	729	742	755	768	782	795	808	1.47
Sales and Service Workers	1512	1539	1586	1594	1622	1650	1678	1707	1.47
Production Workers	1671	1701	1731	1762	1793	1824	1855	1886	1.47
Construction, etc.	398	405	412	419	427	434	442	449	1.47
General Labourers	3461	3523	3566	3649	3713	3778	3842	3907	1.47
Total Labour Use	29271	29528	29777	30018	30253	30480	30697	30905	0.71
Labour Use as % of Available Labour	71	70	69	69	68	67	67	66	-0.74

Table 6.23: Forecasted Values of Food and Non-food Imports (Rs '000)

Import/Export	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Growth Rate of Non-food Imports		0.018	0.017	0.017	0.017	0.017	0.017	0.017	
Total Food Imports	-34065	-38919	-38734	-42437	-46507	-50981	-55765	-61247	8.74
Total Non-food Imports	-241960	-242966	-247257	-251541	-255862	-260219	-264611	-269037	1.53
Value of Total Imports	-276025	-281885	-285991	-293978	-302369	-311200	-320376	-330284	2.60
Value: Per Capita Food (Rs)	-139	-156	-153	-165	-178	-193	-208	-225	7.16
Value: Per Capita N-food (Rs)	-985	-974	-977	-979	-981	-984	-986	-988	0.05

Table 6.24: Forecasted Nominal Income by Source (Rs '000)

Source of Income	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	145042	171946	199373	229821	263585	300990	342323	388102	17.51
Livestock	99681	110726	122944	136451	151372	167839	185997	205996	10.95
Professional Workers	7113	7240	7368	7498	7630	7764	7896	8029	1.47
Office Workers	7432	7565	7700	7836	7973	8113	8251	8391	1.47
Sales and Service Workers	17387	17698	18012	18330	18653	18979	19302	19629	1.47
Production Workers	12265	12484	12706	12930	13157	13387	13615	13846	1.47
Construction, etc	3497	3559	3622	3686	3751	3817	3882	3948	1.47
General Labourers	23140	23553	23972	24395	24824	25258	25688	26123	1.47
Total Income	315556	354770	395696	440948	490946	546147	606955	674063	12.24
Per Capita Income	1285	1423	1563	1716	1883	2065	2262	2476	10.81

Table 6.25: Forecasted Real Income by Source (Rs '000)

Source	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	131569	141808	149736	157401	164830	172046	179036	185887	7.18
Livestock	90422	91319	92335	93453	94658	95937	97277	98665	1.19
Professional Workers	6452	5971	5534	5136	4771	4438	4130	3846	-7.46
Office Workers	6742	6239	5783	5367	4986	4637	4315	4019	-7.46
Sales and Service Workers	15772	14596	13528	12554	11664	10848	10095	9401	-7.46
Production Workers	11125	10296	9542	8856	8228	7652	7121	6632	-7.46
Construction, etc	3172	2935	2721	2525	2346	2182	2030	1891	-7.46
General Labourers	20990	19425	18004	16708	15524	14438	13435	12512	-7.46
Total	286244	292588	297182	301999	307007	312178	317439	322852	2.37
Per Capita Real Income	1165	1173	1174	1176	1178	1180	1183	1186	1.06

Table 6.26: Forecasted Income Shares by Source (%)

Source	1991	1992	1993	1994	1995	1996	1997	1998
Crops	45.96	48.47	50.39	52.12	53.69	55.11	56.40	57.58
Livestock	31.59	31.21	31.07	30.94	30.83	30.73	30.64	30.56
Professional Workers	2.25	2.04	1.86	1.70	1.55	1.42	1.30	1.19
Office Workers	2.36	2.13	1.95	1.78	1.62	1.49	1.36	1.24
Sales and Service Workers	5.51	4.99	4.55	4.16	3.80	3.48	3.18	2.91
Production Workers	3.89	3.52	3.21	2.93	2.68	2.45	2.24	2.05
Construction, etc	1.11	1.00	0.92	0.84	0.76	0.70	0.64	0.59
General Labourers	7.33	6.64	6.06	5.53	5.06	4.62	4.23	3.88
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 6.27: Performance and Sustainability Indicators

Indicators	1991	1992	1993	1994	1995	1996	1997	1998
Per Capita Cultivated Land (ha/person)	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Per Capita Accessible Forest Land	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.04
Cultivated Area-Forest Area Ratio	0.55	0.54	0.52	0.50	0.49	0.47	0.45	0.43
Shrub-Forest Area Ratio	1.43	1.49	1.54	1.61	1.69	1.78	1.88	1.99
Population Density Per Cultivated Land	8.00	8.11	8.20	8.30	8.40	8.49	8.59	8.68
Population Per Accessible Forest Land	7.41	7.58	7.78	8.00	8.25	8.53	8.84	9.20
LSU Per Cultivated Area	4.08	4.06	4.05	4.03	4.01	3.98	3.96	3.93
LSU Per Forest Area	8.35	8.56	8.80	9.07	9.38	9.73	10.14	10.61
LSU Per Grazing Area	0.12	0.12	0.11	0.11	0.11	0.10	0.10	0.09
Per Capita Nominal Income	1285	1423	1563	1716	1883	2065	2262	2467
Per Capita Real Income	1165.27	1173.31	1174.08	1175.59	1177.69	1180.24	1182.97	1186.09

Table 6.28: Forecasted Population and Changes in the Size of the Active Population

Composition	1991	1992	1993	1994	1995	1996	1997	1998
Active Male Population	85761	87429	89128	90857	92617	94410	96118	97853
Active Female Population	80005	81298	82598	83904	85216	86532	87905	89284
Total Active Population	165767	168728	171726	174761	177833	180943	184024	187137
Total: Male Population	127669	129744	131843	133966	136114	138285	140399	142532
Total: Female Population	117976	119626	121276	122925	124572	126218	127942	129667
Total Population	245645	249370	253119	256891	260686	264503	268341	272199

Note: While deriving the active population, the participation was not accounted for, and, as a result, the active population was on the higher side

Table 6.29: Carrying Capacity of Agricultural Land in Terms of Calorie

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998
Calories ('000)								
Per ha Calorie Supply	4223	4237	4233	4229	4226	4223	4220	4217
Per ha Calorie Demand	3831	3833	3839	3848	3860	3874	3889	3907
Supply as % of Demand	110.25	110.54	110.26	109.90	109.49	109.02	108.50	107.95
Carrying Capacity Per ha	5.84	5.86	5.85	5.85	5.84	5.84	5.83	5.83
Current Load	5.30	5.30	5.31	5.32	5.34	5.36	5.38	5.40

Table 6.30: Carrying Capacity of Land in Terms of Fuelwood

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998
Fuelwood Supply Per ha	2.11	2.10	2.09	2.08	2.07	2.05	2.04	2.02
Per ha Demand	2.80	2.83	2.87	2.90	2.93	2.96	3.00	3.03
Supply as % of Demand	75	74	73	72	70	69	68	67
Carrying Capacity Per ha	3.51	3.50	3.48	3.46	3.44	3.42	3.40	3.37
Current Load	4.66	4.72	4.78	4.83	4.89	4.94	4.99	5.04

Table 6.31: Carrying Capacity of Land in Terms of Fodder

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998
Total Fodder SS/ha	1.09	1.10	1.11	1.11	1.12	1.13	1.13	1.14
Total Demand/ha	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.83
Supply as % of Demand	129.47	130.45	131.43	132.41	133.41	134.43	135.49	136.60
Carrying Capacity	1.75	1.77	1.78	1.79	1.80	1.81	1.82	1.83
Current Load	1.35	1.35	1.35	1.35	1.35	1.34	1.34	1.34

Table 6.32: Population Reduction Growth Assumption

Year	1993	1994	1995	1996	1997	1998
Growth Rates (%)	1.40	1.30	1.20	1.11	1.01	0.90
Total Population	252861	256148	259222	262074	264694	267077
Reduction due to Policy	258	743	1464	2429	3647	5122
Reduction as % of Total	0.1	0.3	0.6	0.9	1.4	1.9

Table 6.33: Impacts of Alternative Policies on Crop Yield (kg/ha)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Paddy	2569	2565	2562	2559	2556	2554	-0.12
Maize	1502	1501	1500	1500	1499	1498	-0.05
Wheat	1270	1268	1267	1266	1265	1264	-0.10
Millet	1113	1113	1113	1112	1112	1112	-0.01
Oilseeds	564	564	564	564	564	564	-0.01
Potatoes	6228	6225	6223	6221	6218	6216	-0.04
Irrigation							
Paddy	2791	2924	2921	2917	2914	2911	0.85
Maize	1550	1583	1583	1582	1581	1580	0.40
Wheat	1548	1592	1590	1588	1587	1586	0.48
Millet	1113	1113	1113	1112	1112	1112	-0.01
Oilseeds	673	686	686	685	685	685	0.37
Potatoes	6853	7035	7033	7030	7027	7025	0.50
Fertiliser							
Paddy	2716	2853	2850	2846	2843	2840	0.90
Maize	1518	1552	1551	1551	1550	1549	0.41
Wheat	1343	1389	1388	1387	1385	1384	0.61
Millet	1113	1113	1113	1112	1112	1112	-0.01
Oilseeds	568	582	582	582	582	581	0.46
Potatoes	6401	6591	6588	6586	6583	6581	0.56
Combined							
Paddy	2951	3092	3088	3085	3081	3078	0.85
Maize	1566	1600	1599	1598	1597	1597	0.39
Wheat	1637	1683	1681	1680	1678	1677	0.48
Millet	1113	1113	1113	1112	1112	1112	-0.01
Oilseeds	677	690	690	690	689	689	0.36
Potatoes	7044	7231	7229	7226	7223	7221	0.50

Table 6.34: Impacts of Alternative Policies on Food Availability (kg/person)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Cereal Grains-(Edible Form)	225.04	224.33	223.49	222.55	221.50	220.38	-0.42
Meat	5.27	5.20	5.13	5.05	4.98	4.91	-1.42
Milk	30.35	29.85	29.36	28.86	28.37	27.88	-1.69
Oils and Fat	1.05	1.05	1.04	1.03	1.02	1.01	-0.94
Vegetables	27.78	27.63	27.47	27.29	27.11	26.93	-0.62
Irrigation							
Cereal Grains-(Edible Form)	241.81	249.24	248.35	247.34	246.21	245.00	0.26
Meat	5.27	5.20	5.13	5.05	4.98	4.91	-1.42
Milk	30.35	29.85	29.36	28.86	28.37	27.88	-1.69
Oils and Fat	1.14	1.15	1.14	1.13	1.12	1.11	-0.67
Vegetables	31.04	31.83	31.64	31.45	31.24	31.03	-0.01
Fertiliser							
Cereal Grains-(Edible Form)	232.84	240.48	239.61	238.62	237.51	236.34	0.30
Meat	5.27	5.20	5.13	5.05	4.98	4.91	-1.42
Milk	30.35	29.85	29.36	28.86	28.37	27.88	-1.69
Oils and Fat	1.06	1.06	1.05	1.04	1.03	1.02	-0.72
Vegetables	28.68	29.52	29.35	29.17	28.98	28.78	0.07
Combined							
Cereal Grains-(Edible Form)	250.42	258.16	257.25	256.22	255.05	253.82	0.27
Meat	5.27	5.20	5.13	5.05	4.98	4.91	-1.42
Milk	30.35	29.85	29.36	28.86	28.37	27.88	-1.69
Oils and Fat	1.15	1.15	1.14	1.13	1.12	1.11	-0.67
Vegetables	328.69	333.77	328.76	323.88	319.11	314.48	-0.88

Table 6.35: Impacts of Alternative Policies on the Per Capita Food Demand (kg/person)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Cereal Grains	127.61	127.70	127.77	127.83	127.87	127.92	0.05
Vegetables	21.60	21.60	21.59	21.59	21.57	21.57	-0.02
Meat	3.16	3.17	3.17	3.16	3.16	3.16	-0.02
Milk	20.16	20.14	20.11	20.09	20.07	20.05	-0.11
Oils and Fat	2.10	2.10	2.10	2.10	2.10	2.09	-0.04
Irrigation							
Cereal Grains	132.36	129.73	127.75	127.80	127.85	127.89	-0.68
Vegetables	26.81	23.68	21.56	21.55	21.54	21.53	-4.29
Meat	4.21	3.60	3.16	3.16	3.16	3.15	-5.60
Milk	23.11	21.44	20.09	20.07	20.04	20.02	-2.83
Oils and Fat	2.46	2.23	2.10	2.09	2.09	2.09	-3.21
Fertiliser							
Cereal Grains	129.74	129.92	127.75	127.81	127.85	127.89	-0.29
Vegetables	23.83	23.90	21.58	21.57	21.56	21.55	-1.99
Meat	3.63	3.64	3.16	3.16	3.16	3.16	-2.75
Milk	21.61	21.58	20.11	20.08	20.06	20.04	-1.50
Oils and Fat	2.24	2.25	2.10	2.10	2.09	2.09	-1.35
Combined							
Cereal Grains	162.23	128.85	127.11	127.20	127.28	127.35	-4.73
Vegetables	86.28	22.27	20.96	20.98	21.00	21.02	-24.60
Meat	21.74	3.40	3.04	3.04	3.04	3.05	-32.48
Milk	52.16	20.87	19.70	19.70	19.69	19.69	-17.70
Oils and Fat	5.29	2.18	2.06	2.06	2.06	2.06	-17.19

Table 6.36: Impacts of Alternative Policies on the Per Capita Food Balance (kg/person)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Cereal Grains	97.42	96.63	95.72	94.72	93.63	92.46	-1.04
Vegetables	6.18	6.03	5.87	5.71	5.54	5.36	-2.82
Meat	2.11	2.03	1.96	1.89	1.82	1.75	-3.67
Milk	10.19	9.71	9.24	8.77	8.31	7.83	-5.13
Oils and Fat	-1.04	-1.05	-1.06	-1.07	-1.08	-1.09	0.84
Irrigation							
Cereal Grains	109.45	119.51	120.60	119.54	118.36	117.11	1.36
Vegetables	4.23	8.15	10.08	9.89	9.70	9.50	17.55
Meat	1.07	1.60	1.97	1.89	1.83	1.75	10.50
Milk	7.24	8.41	9.26	8.80	8.33	7.86	1.66
Oils and Fat	-1.32	-1.09	-0.96	-0.97	-0.98	-0.99	-5.64
Fertiliser							
Cereal Grains	103.10	110.56	111.86	110.81	109.67	108.44	1.02
Vegetables	4.85	5.62	7.77	7.59	7.42	7.23	8.30
Meat	1.64	1.56	1.96	1.89	1.82	1.75	1.31
Milk	8.75	8.27	9.25	8.78	8.31	7.84	-2.16
Oils and Fat	-1.18	-1.19	-1.05	-1.05	-1.06	-1.07	-1.92
Combined							
Cereal Grains	88.20	129.31	130.14	129.01	127.78	126.46	7.47
Vegetables	242.41	311.00	307.80	302.90	298.11	293.45	3.90
Meat	-16.47	1.80	2.09	2.01	1.94	1.86	ERR
Milk	-21.80	8.99	9.66	9.17	8.68	8.19	ERR
Oils and Fat	-4.14	-1.03	-0.92	-0.93	-0.94	-0.95	-25.50

Table 6.37: Impacts of Alternative Policies on Calorie Supply and Demand ('000 calorie)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Per ha Calorie Supply	4233	4230	4226	4223	4220	4218	-0.07
Per ha Calorie Demand	3839	3848	3860	3874	3889	3907	0.35
Supply as % of Demand	110	110	109	109	109	108	-0.42
Irrigation							
Per ha Calorie Supply	4555	4706	4703	4701	4698	4695	0.61
Per ha Calorie Demand	3839	3848	3860	3874	3889	3907	0.35
Supply as % of Demand	119	122	122	121	121	120	0.26
Fertiliser							
Per ha Calorie Supply	4380	4535	4532	4529	4526	4523	0.64
Per ha Calorie Demand	3839	3848	3860	3874	3889	3907	0.35
Supply as % of Demand	114	118	117	117	116	116	0.29
Combined							
Per ha Calorie Supply	4861	5018	5014	5010	5006	5003	0.58
Per ha Calorie Demand	2988	3004	3022	3040	3060	3081	0.61
Supply as % of Demand	163	167	166	165	164	163	-0.03

Table 6.38: Impacts of Alternative Policies on the Food and Non-food Trade (Rs/person)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Value: Per Capita Food	488	517	546	576	606	635	5.40
Value: Per Capita N-food	-965	-967	-970	-972	-974	-976	0.24
Irrigation							
Value: Per Capita Food	337	465	581	614	647	680	15.05
Value: Per Capita N-food	-965	-970	-974	-976	-979	-981	0.32
Fertiliser							
Value: Per Capita Food	413	440	562	593	624	655	9.69
Value: Per Capita N-food	-965	-969	-972	-975	-977	979	0.29
Combined							
Value: Per Capita Food	431	2635	2907	3117	3339	3572	52.63
Value: Per Capita N-food	-965	-996	-999	-1001	-1003	-1005	0.82

Table 6.39: Impacts of Alternative Policies on Labour Use

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline, Irrigation, and Fertiliser							
Labour Use as % of Available Labour	69	69	68	67	67	66	-0.97
Combined							
Labour Use as % of Available Labour	76	75	75	74	73	72	-1.04

Table 6.40: Impacts of Alternative Policies on Real Income (Rs '000)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Crops	149739	157405	164834	172051	179042	185894	4.42
Livestock	92410	93535	94749	96038	97390	98792	1.34
Professional Workers	5534	5136	4771	4438	4130	3846	-7.02
Office Workers	5783	5367	4986	4637	4315	4019	-7.02
Sales and Service Workers	13528	12554	11664	10848	10095	9401	-7.02
Production Workers	9542	8856	8228	7652	7121	6632	-7.02
Construction, etc	2721	2525	2346	2182	2030	1891	-7.02
General Labourers	18004	16708	15524	14438	13435	12512	-7.02
Total	297260	302085	307102	312285	317559	322986	1.67
Per Capita Real Income	1174	1176	1178	1181	1183	1187	0.21
Irrigation							
Crops	187436	213794	221870	229721	237330	244793	5.48
Livestock	92232	93312	94546	95854	97223	98639	1.35
Professional Workers	5523	5123	4761	4429	4122	3840	-7.01
Office Workers	5772	5354	4975	4628	4308	4013	-7.01
Sales and Service Workers	13502	12524	11639	10828	10078	9387	-7.01
Production Workers	9524	8834	8210	7638	7109	6621	-7.01
Construction, etc	2715	2519	2341	2178	2027	1888	-7.01
General Labourers	17969	16668	15490	14410	13412	12493	-7.01
Total	334672	358129	363834	369685	375608	381674	2.66
Per Capita Real Income	1322	1394	1396	1398	1400	1402	1.18
Fertiliser							
Crops	166801	193465	201379	209067	216513	223812	6.06
Livestock	92277	93319	94524	95803	97143	98532	1.32
Professional Workers	5526	5124	4760	4427	4119	3836	-7.04
Office Workers	5774	5354	4974	4626	4304	4008	-7.04
Sales and Service Workers	13508	12525	11636	10822	10069	9377	-7.04
Production Workers	9529	8835	8208	7634	7103	6614	-7.04
Construction, etc	2717	2519	2340	2176	2025	1886	-7.04
General Labourers	17978	16669	15487	14402	13401	12479	-7.04
Total	314110	337811	343309	348957	354679	360544	2.80
Per Capita Real Income	1241	1315	1317	1319	1322	1325	1.31
Combined							
Crops	501785	534851	536958	539434	542163	545222	1.67
Livestock	92101	93177	94408	95711	97074	98484	1.35
Professional Workers	5515	5116	4754	4423	4116	3834	-7.01
Office Workers	5763	5346	4968	4622	4301	4006	-7.01
Sales and Service Workers	13483	12506	11622	10811	10062	9372	-7.01
Production Workers	9510	8822	8198	7626	7098	6611	-7.01
Construction, etc	2712	2515	2337	2174	2024	1885	-7.01
General Labourers	17944	16644	15468	14388	13391	12473	-7.01
Total	648813	678977	678714	679189	680230	681888	1.00
Per Capita Real Income	2563	2643	2604	2568	2535	2505	-0.46

Table 6.41: Impacts of Alternative Policies on the Share Distribution of Income (%)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Crops	50.37	52.11	53.67	55.09	56.38	57.55	2.70
Livestock	31.09	30.96	30.85	30.75	30.67	30.59	-0.32
Professional Workers	1.86	1.70	1.55	1.42	1.30	1.19	-8.55
Office Workers	1.95	1.78	1.62	1.48	1.36	1.24	-8.55
Sales and Service Workers	4.55	4.16	3.80	3.47	3.18	2.91	-8.55
Production Workers	3.21	2.93	2.68	2.45	2.24	2.05	-8.55
Construction, etc	0.92	0.84	0.76	0.70	0.64	0.59	-8.55
General Labourers	6.06	5.53	5.05	4.62	4.23	3.87	-8.55
Total	100.00	100.00	100.00	100.00	100.00	100.00	0.00
Irrigation							
Crops	56.01	59.70	60.98	62.14	63.19	64.14	2.75
Livestock	27.56	26.06	25.99	25.93	25.88	25.84	-1.28
Professional Workers	1.65	1.43	1.31	1.20	1.10	1.01	-9.42
Office Workers	1.72	1.49	1.37	1.25	1.15	1.05	-9.42
Sales and Service Workers	4.03	3.50	3.20	2.93	2.68	2.46	-9.42
Production Workers	2.85	2.47	2.26	2.07	1.89	1.73	-9.42
Construction, etc	0.81	0.70	0.64	0.59	0.54	0.49	-9.42
General Labourers	5.37	4.65	4.26	3.90	3.57	3.27	-9.42
Total	100.00	100.00	100.00	100.00	100.00	100.00	0.00
Fertiliser							
Crops	53.10	57.27	58.66	59.91	61.04	62.08	3.17
Livestock	29.38	27.62	27.53	27.45	27.39	27.33	-1.44
Professional Workers	1.76	1.52	1.39	1.27	1.16	1.06	-9.57
Office Workers	1.84	1.58	1.45	1.33	1.21	1.11	-9.57
Sales and Service Workers	4.30	3.71	3.39	3.10	2.84	2.60	-9.57
Production Workers	3.03	2.62	2.39	2.19	2.00	1.83	-9.57
Construction, etc	0.86	0.75	0.68	0.62	0.57	0.52	-9.57
General Labourers	5.72	4.93	4.51	4.13	3.78	3.46	-9.47
Total	100.00	100.00	100.00	100.00	100.00	100.00	0.00
Combined							
Crops	77.34	78.77	79.11	79.42	79.70	79.96	0.67
Livestock	14.20	13.72	13.91	14.09	14.27	14.44	0.35
Professional Workers	0.85	0.75	0.70	0.65	0.61	0.56	-7.94
Office Workers	0.89	0.79	0.73	0.68	0.63	0.59	-7.94
Sales and Service Workers	2.08	1.84	1.71	1.59	1.48	1.37	-7.94
Production Workers	1.47	1.30	1.21	1.12	1.04	0.97	-7.94
Construction, etc	0.42	0.37	0.34	0.32	0.30	0.28	-7.94
General Labourers	2.77	2.45	2.28	2.12	1.97	1.83	-7.94
Total	100.00	100.00	100.00	100.00	100.00	100.00	0.00

Table 6.42 Impacts of Different Policies on Supply and Demand of Forest Products

(Supply as % of Demand)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fodder	131	132	133	134	135	136	0.752
Fuelwood	74	73	72	71	70	68	-1.677
Demand Reduction							
Fodder	131	132	133	134	135	135	0.623
Fuelwood	83	81	80	79	78	77	-1.54
Management							
Fodder	131	132	133	134	135	136	0.734
Fuelwood	75	75	74	73	73	73	-0.539
Joint							
Fodder	131	132	133	134	134	135	0.595
Fuelwood	83	83	83	82	82	82	-0.35

Table 6.43: Changing Pressure on Land under Baseline and Policy Scenarios

Year	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Per Capita Cultivated Land (ha/person)	0.12	0.12	0.12	0.12	0.12	0.12	0.000
Per Capita Accessible Forest Land	0.06	0.05	0.05	0.05	0.05	0.04	-7.789
Cultivated Area-Forest Area Ratio	0.53	0.51	0.49	0.48	0.46	0.44	-3.654
Shrub-Forest Area Ratio	1.51	1.58	1.65	1.74	1.83	1.95	5.247
Population Density Per Cultivated Land	8.22	8.31	8.41	8.51	8.6	8.69	1.118
Population Per Accessible Forest Land	7.68	7.89	8.13	8.4	8.71	9.06	3.360
LSU Per Cultivated Area	4.05	4.04	4.02	3.99	3.97	3.94	-0.549
LSU Per Forest Area	8.67	8.93	9.23	9.57	9.96	10.41	3.726
LSU Per Grazing Area	0.12	0.11	0.11	0.1	0.1	0.1	-3.581
Demand Reduction							
Per Capita Cultivated Land (ha/person)	0.12	0.12	0.12	0.12	0.12	0.11	-1.725
Per Capita Accessible Forest Land	0.06	0.06	0.05	0.05	0.05	0.05	-3.581
Cultivated Area-Forest Area Ratio	0.53	0.52	0.51	0.5	0.48	0.47	-2.374
Shrub-Forest Area Ratio	1.51	1.55	1.59	1.64	1.69	1.76	3.112
Population Density Per Cultivated Land	8.22	8.32	8.43	8.54	8.64	8.75	1.258
Population Per Accessible Forest Land	7.68	7.81	7.95	8.11	8.29	8.49	2.026
LSU Per Cultivated Area	4.05	4.04	4.03	4.02	4	3.99	-0.298
LSU Per Forest Area	8.67	8.82	8.99	9.19	9.41	9.66	2.186
LSU Per Grazing Area	0.12	0.11	0.11	0.11	0.11	0.1	-3.581
Management							
Per Capita Cultivated Land (ha/person)	0.12	0.12	0.12	0.12	0.12	0.11	-1.725
Per Capita Accessible Forest Land	0.06	0.05	0.05	0.05	0.05	0.04	-7.789
Cultivated Area-Forest Area Ratio	0.53	0.51	0.5	0.48	0.46	0.44	-3.654
Shrub-Forest Area Ratio	1.51	1.58	1.65	1.72	1.81	1.9	4.702
Population Density Per Cultivated Land	8.22	8.32	8.41	8.51	8.61	8.7	1.142
Population Per Accessible Forest Land	7.68	7.89	8.11	8.36	8.64	8.94	3.085
LSU Per Cultivated Area	4.05	4.04	4.02	4	3.97	3.95	-0.499
LSU Per Forest Area	8.67	8.93	9.21	9.52	9.87	10.25	3.405
LSU Per Grazing Area	0.12	0.11	0.11	0.11	0.1	0.1	-3.581
Joint							
Per Capita Cultivated Land (ha/person)	0.12	0.12	0.12	0.12	0.12	0.11	-1.725
Per Capita Accessible Forest Land	0.06	0.06	0.05	0.05	0.05	0.05	-3.581
Cultivated Area-Forest Area Ratio	0.53	0.52	0.51	0.5	0.49	0.48	-1.962
Shrub-Forest Area Ratio	1.51	1.55	1.59	1.63	1.67	1.72	2.639
Population Density Per Cultivated Land	8.22	8.33	8.43	8.54	8.65	8.76	1.281
Population Per Accessible Forest Land	7.68	7.8	7.93	8.07	8.22	8.38	1.760
LSU Per Cultivated Area	4.05	4.04	4.03	4.02	4.01	4	-0.248
LSU Per Forest Area	8.67	8.82	8.97	9.14	9.32	9.51	1.867
LSU Per Grazing Area	0.12	0.11	0.11	0.11	0.11	0.11	-1.725

Table 6.44: Impacts of Different Policies on Deforestation (Hectares)

	1993	1994	1995	1996	1997	1998	Growth %
Baseline							
Deforested Area	-406	-436	-468	-500	-532	-565	6.833
Demand Reduction							
Deforested Area	-217	-243	270	-297	-324	-352	10.158
Management							
Deforested Area	-398	-408	426	-446	-461	-474	3.557
Joint							
Deforested Area	-210	-215	227	-241	-249	-253	3.796

Table 6.45: Impacts of Different Policies on Agricultural Land (Adults per hectare)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Carrying Capacity Per ha	5.85	5.85	5.84	5.84	5.83	5.83	-0.07
Current load	5.31	5.32	5.34	5.36	5.38	5.40	0.35
Irrigation							
Carrying Capacity Per ha	6.30	6.51	6.50	6.50	6.49	6.49	0.61
Current load	5.31	5.32	5.34	5.36	5.38	5.40	0.35
Fertiliser							
Carrying Capacity Per ha	6.06	6.27	6.26	6.26	6.26	6.25	0.64
Current load	5.31	5.32	5.34	5.36	5.38	5.40	0.35
Combined							
Carrying Capacity Per ha	6.72	6.94	6.93	6.93	6.92	6.92	0.58
Current load	4.13	4.15	4.18	4.20	4.23	4.26	0.61

Table 6.46: Impacts of Different Policies on the Carrying Capacity and Demand Pressure (Fuelwood per hectare)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fuelwood Supply	2.1	2.08	2.07	2.06	2.05	2.03	-0.676
Fuelwood Demand	2.81	2.85	2.88	2.91	2.94	2.97	1.114
Supply as % of Demand	74	73	72	71	70	68	-1.677
Carrying Capacity	3.76	3.74	3.71	3.69	3.67	3.64	-0.647
Current Load	5.04	5.1	5.16	5.21	5.27	5.32	1.087
Demand Reduction							
Fuelwood Supply	2.10	2.09	2.08	2.08	2.07	2.06	-0.32
Fuelwood Demand	2.53	2.57	2.60	2.63	2.66	2.69	1.24
Supply as % of Demand	83	81	80	79	78	77	-1.54
Carrying Capacity	3.38	3.37	3.36	3.35	3.34	3.33	-0.32
Current Load	4.08	4.14	4.19	4.24	4.29	4.34	1.24
Management							
Fuelwood Supply	2.11	2.12	2.13	2.14	2.15	2.16	0.470
Fuelwood Demand	2.81	2.85	2.88	2.91	2.94	2.97	1.114
Supply as % of Demand	75	75	74	73	73	73	-0.539
Carrying Capacity	3.77	3.81	3.82	3.83	3.85	3.88	0.577
Current Load	5.04	5.1	5.16	5.22	5.27	5.33	1.125
Joint							
Fuelwood Supply	2.11	2.13	2.15	2.16	2.18	2.20	0.92
Fuelwood Demand	2.53	2.57	2.60	2.63	2.66	2.70	1.27
Supply as % of Demand	83	83	83	82	82	82	-0.35
Carrying Capacity	3.40	3.44	3.46	3.48	3.51	3.55	0.92
Current Load	4.08	4.14	4.19	4.24	4.30	4.35	1.27

Table 6.47: Impacts of Different Policies on the Carrying Capacity and Demand Pressure

(Fuelwood from Forests Only)

(Person need per hectare)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fuelwood Supply	21.16	21.73	22.36	23.07	23.87	24.78	3.209
Fuelwood Demand	27.41	28.68	30.09	31.67	33.47	35.5	5.309
Supply as % of Demand	77.22	75.77	74.31	72.83	71.33	69.8	-2.000
Carrying Capacity	37.93	38.94	40.07	41.34	42.78	44.41	3.205
Current Load	49.12	51.39	53.92	56.76	59.97	63.63	5.313
Demand Reduction							
Fuelwood Supply	21.16	21.49	21.86	22.27	22.73	23.24	1.89
Fuelwood Demand	24.67	25.48	26.38	27.36	28.44	29.63	3.74
Supply as % of Demand	85.80	84.35	82.89	81.42	79.93	78.43	-1.78
Carrying Capacity	34.14	34.67	35.26	35.92	36.66	37.49	1.89
Current Load	39.79	41.10	42.54	44.12	45.87	47.80	3.74
Management							
Fuelwood Supply	21.27	22.13	22.93	23.78	24.8	25.95	4.058
Fuelwood Demand	27.41	28.66	30.01	31.5	33.14	34.95	4.980
Supply as % of Demand	77.6	77.22	76.4	75.5	74.83	74.25	-0.879
Carrying Capacity	38.12	39.66	41.09	42.62	44.44	46.51	4.059
Current Load	49.12	51.36	53.79	56.45	59.39	62.63	4.980
Joint							
Fuelwood Supply	21.27	21.90	22.44	22.99	23.68	24.45	2.83
Fuelwood Demand	24.67	25.47	26.31	27.21	28.17	29.19	3.42
Supply as % of Demand	86.22	85.98	85.27	84.51	84.06	83.77	-0.57
Carrying Capacity	34.30	35.32	36.19	37.09	38.19	39.43	2.83
Current Load	39.79	41.08	42.44	43.88	45.43	47.07	3.42

Table 6.48: Impacts of Different Policies on Fuelwood Supply from Different Sources (%)

	1993	1994	1995	1996	1997	1998
Baseline						
Forests	22	21	21	20	19	18
Shrublands	25	25	25	26	26	26
Grazinglands	0	0	0	0	0	0
Adjacent NCI	40	41	41	41	41	41
Cultivated Area	1	1	1	1	1	1
Crop Residue	12	12	12	12	12	12
Total	100	100	100	100	100	100
Total Supply (adt)	110821	110619	110384	110117	109817	109485
Demand Reduction						
Forests						
Shrublands	22	22	21	21	20	20
Grazinglands	25	25	25	25	25	26
Adjacent NCI	0	0	0	0	0	0
Cultivated Area	40	40	41	41	41	41
Crop Residue	1	1	1	1	1	1
Total	12	12	12	12	12	12
Total Supply (adt)	100	100	100	100	100	100
Management	110821	110771	110693	110586	110451	110287
Forests						
Shrublands	22	22	21	21	20	20
Grazinglands	25	25	25	25	25	26
Adjacent NCI	0	0	0	0	0	0
Cultivated Area	40	40	41	41	41	41
Crop Residue	1	1	1	1	1	1
Total	12	12	12	12	12	12
Total Supply (adt)	100	100	100	100	100	100
Joint	110821	110771	110693	110586	110451	110287
Forests						
Shrublands	22	23	23	24	24	25
Grazinglands	24	24	24	24	24	24
Adjacent NCI	0	0	0	0	0	0
Cultivated Area	40	40	39	39	39	38
Crop Residue	1	1	1	1	1	1
Total	12	12	12	12	12	12
Total Supply (adt)	100	100	100	100	100	102
	111364	112912	113868	114765	116105	117702

Table 6.49: Impacts of Different Policies on the Livestock Carrying Capacity and Fodder Load (LSU per hectare)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fodder Supply	1.11	1.11	1.12	1.13	1.13	1.14	0.535
Fodder Demand	0.84	0.84	0.84	0.84	0.84	0.83	-0.239
Supply as % of Demand	131	132	133	134	135	136	0.764
Carrying Capacity	1.78	1.79	1.8	1.81	1.82	1.82	0.445
Current Load	1.35	1.35	1.35	1.35	1.34	1.34	-0.149
Demand Reduction							
Fodder Supply	1.11	1.11	1.12	1.12	1.13	1.14	0.535
Fodder Demand	0.84	0.84	0.84	0.84	0.84	0.84	-0.239
Supply as % of Demand	131	132	133	134	135	136	0.764
Carrying Capacity	1.78	1.78	1.79	1.80	1.81	1.82	0.445
Current Load	1.35	1.35	1.35	1.35	1.35	1.34	-0.149
Management							
Fodder Supply	1.11	1.11	1.12	1.13	1.13	1.14	0.535
Fodder Demand	0.84	0.84	0.84	0.84	0.84	0.84	0.000
Supply as % of Demand	131	132	133	134	135	136	0.734
Carrying Capacity	1.78	1.79	1.8	1.81	1.81	1.82	0.445
Current Load	1.35	1.35	1.35	1.35	1.34	1.34	-0.149
Joint							
Fodder Supply	1.11	1.11	1.12	1.12	1.13	1.14	0.535
Fodder Demand	0.84	0.84	0.84	0.84	0.84	0.84	0.000
Supply as % of Demand	131	132	133	134	134	135	0.595
Carrying Capacity	1.78	1.78	1.79	1.8	1.81	1.82	0.445
Current Load	1.35	1.35	1.35	1.35	1.35	1.35	0.000

Table 6.50: Impacts of Different Policies on the Livestock Carrying Capacity and Load (Fodder from Forests only)

(per hectare)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fodder Supply	7.1	7.37	7.67	8.01	8.4	8.85	4.505
Fodder Demand	5.41	5.57	5.76	5.97	6.21	6.49	3.707
Supply as % of Demand	131	132	133	134	135	136	0.764
Carrying Capacity	11.38	11.81	12.3	12.85	13.48	14.2	4.527
Current Load	8.67	8.93	9.23	9.57	9.96	10.41	3.726
Demand Reduction							
Fodder Supply	7.1	7.27	7.45	7.66	7.9	8.16	2.822
Fodder Demand	5.41	5.5	5.61	5.73	5.87	6.02	2.160
Supply as % of Demand	131	132	133	134	135	135	0.623
Carrying Capacity	11.38	11.65	11.95	12.29	12.66	13.08	2.824
Current Load	8.67	8.82	8.99	9.19	9.41	9.66	2.186
Management							
Fodder Supply	7.1	7.36	7.65	7.97	8.32	8.7	4.148
Fodder Demand	5.41	5.57	5.74	5.94	6.15	6.39	3.386
Supply as % of Demand	131	132	133	134	135	136	0.734
Carrying Capacity	11.38	11.81	12.27	12.77	13.33	13.95	4.157
Current Load	8.67	8.93	9.21	9.52	9.87	10.25	3.405
Joint							
Fodder Supply	7.1	7.26	7.44	7.62	7.81	8.02	2.467
Fodder Demand	5.41	5.5	5.6	5.7	5.81	5.93	1.852
Supply as % of Demand	131	132	133	134	134	135	0.595
Carrying Capacity	11.38	11.65	11.92	12.21	12.53	12.86	2.475
Current Load	8.67	8.82	8.97	9.14	9.32	9.51	1.867

Table 6.51: Impacts of Different Policies on Fodder Supply from Different Sources

(in per cent)

	1993	1994	1995	1996	1997	1998
Baseline	7	6	6	6	6	5
Forests	16	16	17	17	17	17
Shrublands	2	2	2	2	2	2
Grazinglands	29	29	29	29	29	29
Adjacent NCI	2	2	2	2	2	2
Risers and Bunds	2	2	2	2	2	2
Fallow Grazing	4	4	4	4	4	4
Tree Fodder	38	38	38	39	39	39
Crop Residue	100	100	100	100	100	100
Total	102261	102840	103399	103942	104469	104984
Total Supply (tdn)						
Demand Reduction	7	6	6	6	6	6
Forests	16	16	16	16	17	17
Shrublands	2	2	2	2	2	2
Grazinglands	29	29	29	29	29	29
Adjacent NCI	2	2	2	2	2	2
Risers and Bunds	2	2	2	2	2	2
Fallow Grazing	4	4	4	4	4	4
Tree Fodder	38	38	38	39	39	39
Crop Residue	100	100	100	100	100	100
Total	102261	102804	103326	103831	104320	104795
Total Supply (tdn)						
Management	7	6	6	6	6	5
Forests	16	16	17	17	17	17
Shrublands	2	2	2	2	2	2
Grazinglands	29	29	29	29	29	29
Adjacent NCI	2	2	2	2	2	2
Risers and Bunds	2	2	2	2	2	2
Fallow Grazing	4	4	4	4	4	4
Tree Fodder	38	38	38	39	39	39
Crop Residue	100	100	100	100	100	100
Total	102261	102839	103393	103927	104444	104946
Total Supply (tdn)						
Joint	7	6	6	6	6	6
Forests	16	16	16	16	16	17
Shrublands	2	2	2	2	2	2
Grazinglands	29	29	29	29	29	29
Adjacent NCI	2	2	2	2	2	2
Risers and Bunds	2	2	2	2	2	2
Fallow Grazing	4	4	4	4	4	4
Tree Fodder	38	38	38	39	39	39
Crop Residue	100	100	100	100	100	100
Total	102261	102803	103320	103816	104294	104755
Total Supply (tdn)						

7

DHADING DISTRICT

Performance of the District Economy

Introduction

The economic performances for the crops, livestock, and forest sectors of Dhading district are discussed in this section. These performances were examined by applying the historical data available from different sources. The historical data presented in this section provide a basis for projecting the baseline trend to be described in the subsequent sections. The overall performance of Dhading's economy has, until very recently, depended heavily on its agricultural production. The growth in productivity of the agricultural sector, however, has remained fairly stagnant and largely subsistence-oriented for various reasons. Given the limited irrigation facilities, the performance of the crop sector depends to a large extent on the vagaries of the monsoon. The low use of modern inputs very weak extension services, and other infrastructures have also severely constrained the growth in this sector. The historical data on the cropped area and the yields of food and cash crops, together with the fertiliser supply and use rate in the district, are described in the following section.

Crop Area

Paddy, maize, millet, and wheat are the principal food crops grown in the district, accounting altogether for over 95 per cent of the total cropped area in 1989. The share of cash crops in the total cropped area is less than five per cent, with potatoes covering about four per cent of the cropped area in 1989. Table 7.1 presents the historical data on the area under these crops over the 1975-1990 period. The overall picture in general shows an increasing trend in the area under different crops, despite the varying degree of annual fluctuations that can be observed in most cropped areas. While estimating the average annual growth rate of the cropped area for the 1975-1989 period, the highest annual growth rate is observed to be 13 per cent in the case of wheat followed by potatoes (12%), paddy (10%), and maize (2.4%). The total cropped area shows an increase at the rate of about six per cent per annum during this period. A considerable degree of variation in the cropped area is discernible, with the highest degree of variability being observed in the case of wheat, followed by potatoes and paddy as indicated by their respective coefficient of variation. The drastic reduction in the area under

some crops in some years cannot be explained readily, but, in the case of monsoon crops, such as paddy and maize, adverse monsoonal weather could be a plausible reason. Another pattern that can be noticed is the declining trend in the area under paddy and maize, especially after 1985.

The crop composition also changed considerably along with the expansion in the cropped area over the period. For example, the share of maize decreased considerably from 60 per cent in 1975 to 40 per cent in 1989, while the share of paddy and potatoes increased. The share of wheat and millet, on the other hand, remained more or less constant over the same period.

It is important to emphasise that there is considerable uncertainty regarding these statistics reported by DFAMS. These time-series' data should therefore be treated cautiously. The overall trend in the cropped area, based on the historical data, suggests the relatively higher annual growth rate for most crops which cannot be directly applied to plan future trends. Experience and review of available information reveal that cropping intensity and expansion in the area under cultivation in most hill districts have already exceeded the limit of sustainability under the current state of technology. Further expansion in the cropped area in the district, therefore, seems to be limited, unless at the cost of environmental degradation. The cropped area has to be projected, nevertheless, for the policy exercise discussed below. Hence, a semi-log regression model was fitted to the historical data in order to forecast the cropped area.

Crop Yield

Despite expansion in the cropped area, the productivity of most crops in general has remained fairly stagnant over the past decade. The historical data on crop yields and their average growth rates over the 1975-1989 period are given in Table 7.2. The yields of both paddy and maize, which account for 83 per cent of the total cropped area, declined at the rate of one per cent over 1975-1989. The yields of potatoes and wheat however, increased by an annual rate of 2.3 per cent and 1.3 per cent respectively. The paddy yield declined, consistently, especially after 1982, and it started to pick up marginally from 1988 onwards. The maize yield shows considerable fluctuation and declined drastically in 1983. A considerable degree of variation in yield can be observed as indicated by the coefficient of variation given in Table 7.2. No satisfactory explanation exists for such extreme variability in crop yields, although adverse monsoonal weather may be the reason.

Fertiliser Use

Although the actual use rate of fertiliser by crop in the district is not known, the historical fertiliser sale data reported by the Agricultural Inputs' Corporation (AIC) can give some indication about the extent of fertiliser availability per hectare of

cropped area in Dhading. In Table 7.3, time-series' data on fertiliser sales over the 1983-1990 period and the estimated sales per hectare of cropped area are given. Fertiliser sales in the district increased from 153 metric tonnes in 1983 to 528 MT in 1990. This level of fertiliser sales seems to be quite low compared to Sindhu, Kabhre, and Nuwakot, and it also indicates a low level of sales per cropped area. For instance, the sales' rate in the district ranged from six kg per hectare in 1983 to 17 kg/ha in 1988. The modest increase in the fertiliser sales' rate over time implies that the growth rate of fertiliser supply in the district is higher than the growth in the total cropped area, excluding millet,for which fertiliser is not assumed to be used.

Our estimate, based on the crop specific fertiliser use rate as reported in the Irrigation Master Plan, indicates a shortage of fertiliser only in 1990, and thereafter the district shows no shortage, given the low level of use rate which is driven solely by the growth in cropped area under the constant dose assumption.

In order to forecast the fertiliser supply in the district, a double log linear trend equation was fitted to the historical data on fertiliser sales. The estimated result is presented below.

Log (Fertiliser Sale) =5.07 + 0.53 Log (Time) R2=0.92
SE (0.06)

Livestock

The historical data in the livestock population and livestock products (meat, milk, etc) reported by DFAMS over the 1984-1988 period are presented in Table 7.4. The overall picture shows an increasing trend in all types of livestock population with the exception of milch cows and cattle (their population declined at the rate of 2.7 % and 1.03 % annually). The annual rate of increases in livestock population is amongst the highest for sheep (29%) and the lowest for buffaloes (1.1%). The share of milch buffaloes (22%) and cows (14%) in the total buffalo and cattle population remained constant over the period. This constant share over time raises doubts about the reliability of DFAMS data on the number of milch animals. Table 7.4 provides time-series' data in livestock products over the same period.

Land Use Changes

The detailed breakdown of land use statistics reported by the LRMP pertaining to the year 1978 was updated and projected by using simplified assumptions regarding the magnitude and direction of inter-class land transfers. As indicated in the methodological framework of the study, land use changes in most hill districts result from deforestation assumed to take place at the annual rate of one per cent

over the past few decades (Master Plan). Table 7.5 presents the projected land use changes in Dhading district by ecological region over the 1978-1990 period.

The overall land use distribution in the district shows that over two-thirds of natural forests and 92 per cent of the cultivated land lie in the mid-mountain region where over 91 per cent of the district's population is concentrated. All the natural forests in the mid-mountains are accessible and are of immature type (72%), predominantly hardwood (66%). Only 84 per cent of the natural forest in the high mountains is accessible with a relatively large proportion falling under crown density class 2 and maturity class type-matured. All the accessible forests in the district are projected to decline at the rate of one per cent as stated earlier. Since a major portion of the deforested areas is assumed to be converted into shrubland, the area under shrubland will expand more than other categories of land use such as grass, non-cultivated inclusions, and net cultivated land.

As is evident from Table 7.5, the share of accessible forests in the mid-mountains(high mountains) declined from 32 per cent (47%) to 28 per cent (41%). The share of accessible forests in the district as a whole declined from 35 per cent in 1978 to 31 per cent in 1990, whereas the per cent of cultivated and increased from one per cent to 20 per cent during the same period. It should also be noted that over 52 per cent of the net cultivated land in the mid-mountains, which covers over 90 per cent of the district's cultivated land, is under level terraces, 37 per cent under sloping terraces, and the rest under lower foot slopes.

Economic and Natural Resource Conditions: Baseline Scenario

This section deals with the baseline results generated by the multi-market model in order to examine the economic and environmental status of Dhading district over time under the current state of technology and infrastructure in the district. The baseline results are important, because it is against these results that verification of the extension economic and environmental situation of Dhading can be made. Moreover, the baseline results are important for valuating the changes over time when shocks are given to the model. The first section provides an idea of the past economic performance of the district. The capacities of land in terms of food, fuelwood, and fodder.

Crop Area and Yield

The historical trends in the area under different crops and crops yields in Dhading over the 1975-1990 period have already been described in the preceding section. The forecasted baseline results regarding the crop area and crop yields over the 1989-1991 period are examined in this section. Data on the forecasted area for different crops, based on the semi-log time trend fitted to historical data, are

presented in Table 7.6. Similarly, Table 7.7 provides the respective crop yield projections, based on the assumption of non-constant crop prices and variable inputs.

The forecasted crop area indicates almost negligible growth rates in Dhading. The highest positive growth rate is for oilseeds (3.5%), followed by wheat (1.9%), and the lowest for maize (0.50%). The total cropped area in the district also does not appear to change much over time (1.2%). Expansion of the total cultivated land in the district seems to be limited, unless more forests are brought under cultivation, which is possible only at a high cost, i.e, environmental degradation. Increasing the cropping intensity is possible, but more investment will be required.

The available data indicate that about 26 per cent of the district's cultivated land is under year round (10%) and monsoon irrigation (16%), and the potential area that can be brought under irrigation is estimated to be 10,839 hectares. The year-round irrigated area is assumed to grow over time at two per cent per annum (Table 7.6), and in 1991 it covered 7,593 ha or about 73 per cent of the potential irrigable area. Given that a large part of the potential irrigable area in Dhading is already under irrigation, agricultural development will have to focus more on productivity and increasing the cropping intensity, as well as efficient use of irrigation water.

The availability of chemical fertilisers is another principal constraint to increasing both the cropping intensity and crop yields in the district. Fertiliser sales are expected to flow at a rate of 4.4 per cent, based on the time trend equation fitted to the historical fertiliser sale, data reported by the AIC. The projected fertiliser sales in the district, according to estimates, met 90 per cent of the fertiliser demand in 1991. However, the fertiliser deficit in the district is expected to decline over time, especially after 1994, because the projected sale, of fertiliser increases at a faster rate than the fertiliser demand (1.25%), based on the results(Table 7.6).

Data on the forecasted crop yields in Dhading are given in Table 7.7. This is based on the assumption that crop technologies will remain the same over time. The forecasted crop yields are not encouraging. All crops considered show fairly stagnant or negative yield trends over time, with the annual rate of decline ranging from 0.03 per cent for millet to 0.18 per cent for paddy. Given the fairly low crop yield growth rates, any increase in the food grain total in the district in future is expected to exert additional pressure on forest lands, if the productivity and cropping intensity are not increased.

Crop Production

Crop output or production is determined by the area and yield outcomes discussed in the methodology section. Table 7.8 indicates that the resulting growth in production of all crops is positive with the highest growth observed for oilseeds

(3.45%), followed by wheat (1.7%), and the lowest for maize (0.43%). The positive growth observed in production is due to an increase, although small, in the cultivation area rather than an increase in yield.

Gross Margin

Table 7.9 presents the projected gross margins and cost of cultivation per hectare of cultivated crops. It should be noted that the gross margins were derived by subtracting the projected variable cost of cultivation from the projected value of crops, including the value of crop residue.

The results indicate positive gross margins for all crops, except for millet, as crop prices are assumed to grow at about seven per cent per annum. As in the other districts of Bagmati zone, potatoes appear to be the most profitable crop in terms of returns (currently estimated to be over Rs 27,000 per hectare). Oilseeds rank second, followed by paddy and wheat in terms of per hectare gross margins. Since the per hectare gross margin of paddy reflects a possible increase at a faster rate (18.5%) than that of potatoes (7.3%) over time, the relative contribution of potatoes to the total crop income, however, declines (from 44% in 1991 to 28% in 1998), while that of paddy increases (32% in 1991 to 43 % in 1998). The maize gross margin also increases at a relatively higher rate despite lower returns. According to the results, the millet gross margin, estimated to be negative in 1991, has shown an improved trend, especially after 1993.

Livestock

The gross margin from the livestock sector was estimated, based on projection of the livestock population and products. Table 7.10 indicates that the estimated livestock population in terms of LSU is expected to remain more or less stagnant from 1990- 1998. Any changes in the livestock population, particularly grazing animals, are assumed to be driven by the land use and cattle population changes as described in the methodology section. The average LSU holding per household declines over time because the number of households increases at a faster rate than the LSU population.

Milk, ghee, meat, and wool are the main livestock products. The average yield per head of animal, derived from the historical data on different types of livestock population and their respective produce, was assumed to remain constant over time. These average yield figures were applied to the forecasted livestock population to project the livestock products in the district. Table 7.11 presents the projected trends for different livestock products in the district. The average annual growth rate of all livestock products, except buffalo milk, goat meat, and mutton show a positive trend with the highest positive growth rate being observed for pork and wool (over 6%) followed by chicken (5.9%), and the lowest for ghee and milk

(less than 1%). Given the fairly stagnant trend in meat supply from buffaloes, which constitute a large proportion of the livestock population in the district, the aggregate meat supply in the district is expected to grow at less than one per cent per annum.

The forecasted gross margin from livestock, which was estimated by subtracting the livestock-raising cost from livestock revenue, is given in Table 7.12. The results indicate that of the total gross margin from livestock,that from buffaloes is among the highest followed by sheep and goats. The total gross margin from livestock in the district was estimated to be Rs 101.3 million in 1991 out of which over 62 per cent is accounted for by meat (36%) and milk production (26%) from buffaloes alone, and the rest by sheep and goats (18%), cows (9%), and pigs and poultry (11%). It can be estimated from the results given in Table 7.12 that the gross margin per head of milch buffalo is presently 2.3 times greater than the gross margin per milch cow (Rs 580), because of the higher milk yield of the former compared to the latter, despite the higher cost of raising buffaloes. On the whole, the total gross margin from livestock in the district is expected to grow at an annual rate of 13.2 per cent per annum.

Food Availability and Demand

The total cereal availability (edible form) in the district is derived by subtracting different waste, loss, and seed allowances from the total production of four cereal grains (rice,wheat,maize,and millet). Further, the per capita availability was derived. Similar exercises were carried our to obtain the per capita domestic supply of vegetables (assumed to be potatoes only), meat (mutton,buffalo, pork, and chicken), oils and fats (derived from oilseed and ghee production), and milk. Per capita availability of the forecasted food items is presented in Table 7.13. Similarly, the forecasted per capita demand for these food categories and the total food balance situation in the district over time are given in Tables 7.14 and 7.15.

The results given in Table 7.13 indicate a declining trend in the per capita availability of types of food, except for oils and fats. The average annual rate of decline in the per capita availability is the highest for milk (1.5%) and the lowest for vegetables (0.19%). This indicates that the population growth in the district exceeds the growth in net food production over the projected period.

The per capita demand for all forecasted food items, by using the demand response function (determined by relative food prices and per capita income), also shows a declining trend over the 1991-1998 period. The highest negative growth is observed in the case of meat (2%) and the lowest for cereals (0.2%/). The projected food balance (Table 7.15) indicates that the district has a net surplus in all food items, except for milk and oils and fat. The results, however, show a declining trend in the per capita food items, with the exception of vegetables, which shows a positive growth of 6.6 per cent over time. The vegetable demand declines at a faster rate

than supply, whereas it is vice-versa in the case of cereals. Since the magnitude of balance in cereals, vegetables, and meat is large enough to compensate for the resulting deficit in other food items, the district has a net surplus in food balance from an aggregate point of view. But this does not necessarily mean that the district is self sufficient in terms of calories, because a district could be producing enough food in terms of the calorie requirements but people may be denied access to food items due to price and income constraints. This issue will be discussed later.

Land Use Changes

Land use in the district is comprised of agriculture, forests, shrubs, grassland, non-cultivated inclusions (NCI), and others. The manner in which land use changes in the district are projected over time has already been described in the methodology section. It is, however, important to note that the land use statistics reported by the LRMP for the year 1978 were updated to reflect the situation prevailing in 1991. While projecting the land-use changes over the 1978-1990 period, the accessible forests in different regions of the district were assumed to be deforested at an annual rate of one per cent (Forestry Master Plan), and the deforested area was assumed to be converted to shrubs and agricultural lands depending upon the assumption of the magnitude and the direction of inter-class land transfer (described in the methodology section). For 1991 onwards, the deforested areas in different regions of the district were determined endogenously by the model on the basis of projected fuelwood deficit (which has to be met largely through deforestation).

The simulation results indicate that deforestation takes place only in the mid-mountain region of the district where over 90 per cent of the district's population is concentrated. The high mountain region contains less than eight per cent of the district's population, but it contains about 33 per cent of the district's total forest area and hence no deforestation is assumed to take place in this region. As a result, the area under all land categories in the high mountain region will remain constant over the projected period (1991-1998). Table 7.16 presents the changes in land use over time in Dhading.

The results show a declining trend in the area under natural forests (annual decline of 0.2%) because of a net decline in the accessible forest area in the district (especially in the mid-mountain region). While natural forests in the mid-mountains are all accessible, only 84 per cent in the high mountains fall in that catagory. The accessible forest area in the mid-mountains is expected to decline at the rate of 0.3 per cent per annum, hence, land-use changes occur in this region also. As can be observed from the Table, shrubland is expected to grow at the rate of 0.5 per cent, while the average annual growth rate of other lands is even lower.

As in the case of Kabhre, Nuwakot, and Sindhu districts, significant discrepancy exists between the cultivated area reported by the LRMP and the area estimated on the basis of DFAMS data. In the absence of time series' data on the cultivated area, DFAMS data on the cropped area were used and the near cultivated area in the district was derived as the sum of non-competing major crops(paddy and maize).

Forest Products

Fuelwood, fodder, and timber are the main forest products for which the demand and supply projections were made under the constant yield assumptions as stated in the methodology section.

Fuelwood .

Fuelwood is assumed to come from different sources, mainly accessible forests, shrubland, grassland, non-cultivated inclusions (NCI), and farmland. The fuelwood yields from these land resources vary, as indicated earlier and, under the constant yield assumptions. The forecasted growth in the supply of fuelwood from these sources depends primarily on the projected changes in area under these categories over time. Similarly, the projected demand for fuelwoood (constant per capita consumption of fuelwood) increases over time with the growth in population.

The supply of fuelwood from different sources (Table 7.17) indicates that currently about 68 per cent of the total fuelwood supply in the district is estimated to come from accessible forests,12 per cent from shrubs and grasslands, and the rest from non-cultivated inclusions (13%) and farmlands (6%). This clearly indicates that forests are the major source of fuelwood. Farmlands contribute a negligible proportion (less than 7 %) of the supply. Over time the share of forests in the supply of fuelwood declines at the an annual rate of 0.2 per cent due to the decline in the accessible forest area, whereas the share of shrublands increase slightly. On the whole, the projected fuelwood supply in the district decreases at an annual rate of less than one per cent.

The total supply of fuelwood in Dhading already falls short of the demand (Table 7.18). Currently, the total supply of fuelwood in the district is estimated to meet 99 per cent of the total requirement, but this balance erodes over time at the rate of 1.5 per cent per annum.

Timber.

Table 7.19 shows a surplus in timber in Dhading district. Forests are the only source of timber and currently its supply is estimated to be 1.16 times greater than the timber demand. Under the constant yield assumption, the timber supply in the

district decreases marginally over time due to the decline in forest area, while the timber demand increases along with the growth in population.

Fodder.

Under the constant yield assumption, the supply of fodder in the district changes in land use as in the case of fuelwood. Table 7.20 shows that during 1991 only 26 per cent of the fodder supply in the district was estimated to come from forests, 41 per cent from farmlands and the rest from NCI (7%), shrubs-grasslands (26%). Over time the share's of forests and shrub-grasslands also decline and that of farmlands increase marginally due to some gains in land made by the latter category. On the whole, the projected supply of fodder in the district meets only 96 per cent of the total fodder requirement and the gap between supply and requirement narrows marginally over time. The quantities available from different sources are given in Table 7.21.

Labour Supply and Use

Labour supply in the district is determined by the size of the active population and the normal duration of work. The normal duration of work in the mountain region as reported by the NRB is 240 mandays available per active member of the household. This constant duration of work was directly applied to the projected active population (Table 7.22) to forecast the total supply of labour (mandays) in the district. While the number of labour days used in the crop and livestock sectors were generated by the model, the labour engaged in other non-agricultural activities was projected by using the information reported by Nepal Rastra Bank.

Table 7.23 provides data on the forecasted labour supply and use situation in the district. During 1991 over 85 per cent of the labour force in the district were gainfully employed, with about two-thirds of them employed in the agricultural sector and the rest in the non-agricultural sectors. Since the projected labour force supply in the district increases at a faster rate than labour use rate, the labour use rate declines marginally over time.

Trade Sector

Food.

The extent of food items exported (imported) in the district is determined by the magnitude of food surplus (deficit) generated by the model based on the estimated food demand and supply forecast. As indicated earlier, Dhading district has a considerable surplus in cereals, meat, and vegetables, but faces a deficit in other food groups such as milk and oils and fats. But since the surplus position in cereals, meat, and vegetables is large enough to compensate for the magnitude of

deficit in other food items, the district is a net exporter of food in an aggregate sense. Table 7.24 shows that the total value (nominal) of the food exported from Dhading will increase from Rs 52.8 million in 1991 to Rs 134 million in 1998, at an annual growth rate of about 9.8 per cent. The per capita value of food exported from the district is forecasted to increase by 12.5 per cent.

Non-food.

All non-food items are imported by the district. The import demand for non-food items is assumed to be influenced by the population growth, income growth, and income elasticity of the non-food demand specified in the methodology section. The average monthly expenditure on non-foods reported by the NRB for the mountain region were first adjusted to reflect the base year situation (1991). The projected growth rate of the import demand was then applied to the base value of non-food imports in order to project the total value of non-food imports in the district. Table 7.24 indicates that non-food imports in Dhading are expected to increase from Rs 261.49 million in 1991 to Rs 296.03 million in 1998, at the rate of 1.7 per cent per annum. The per capita value of non-food imports, however, remains almost stagnant because of the population growth, indicating that the import demand increases to match the population increase.

Income

Income is determined endogenously by the model. Gross margins originating from the crop and livestock sectors and income accruing from different employment activities were added to derive the aggregate income for Dhading. Tables 7.25 and 7.26 present the forecasted nominal and real income originating from different sectors and Table 7.27 provides data on the share of income originating from different sources.

The per capita nominal income for Dhading in 1991 was Rs 930 which is fairly low compared to other rural districts of Bagmati Zone. The sources of income identified in the study do not cover all the sources, and this partially explains the low per capita income generated. There is no authentic source to verify the levels of income in Nepal and the NRB Multi-Purpose Household Budget Survey was used as a guideline.

The per capita nominal income in Dhading is expected to grow at an annual rate of over 11.2 per cent, which is relatively high compared to other districts of Bagmati Zone. The per capita real income estimated by using the weighted cereal grain price index (deflator) at 1990 constant price is expected to grow at an annual rate of 1.6 per cent over the period.

As is evident from Table 7.27, currently the contribution of the livestock sector to the total income in Dhading is higher (39%) than that of the crop sector (33.5%). The share of income originating from both crop and livestock sectors increases while that accruing from off-farm employment activities decreases over time. It can also be noticed from the Table that the relative share of crop income increases at a faster rate (2.4%) than that of livestock income(2.0%).

Environment: Sustainability and Carrying Capacity

This section examines the performance of the sustainability indicators dealing mainly with the pressure on the natural resource base in order to assess the carrying capacity of the district in terms of calories and natural resource products. Other simpler indicators are also examined.

Pressure on the Resource Base.

The performance of the district in terms of some selected sustainability indicators, such as population density, agriculture-forest land ratio, and others can be judged from the results given in Table 7.28. It should be noted that the net cultivated land derived from the LRMP data was used to estimate the density of population on agricultural land. As the cultivated land area derived from the LRMP source is higher than the cultivated area derived from the DFAMS data, the density figure reported in the Table is underestimated in terms of magnitude, while at the same time it is overestimated in terms of growth, given the lower growth rate of cultivated land obtained from the LRMP data (0.06%) than that from the DFAMS data (1.03%). For example, the population density estimated from the DFAMS data in 1991 is about 1.33 times greater (9.81 persons) than that from the LRMP data, whereas the annual growth rate of population density per area of cultivated land according to DFAMS data is 0.48 per cent compared to 1.46 per cent according to LRMP data.

The density of both the human and livestock (LSU) populations per hectare of cultivated land in the district is more pronounced than the density per hectare of accessible forest area. Over time, the population pressure on accessible forests is expected to increase at a faster rate than the pressure on cultivated land, primarily because of the declining (increasing) trend in the accessible forest area (cultivated land) in the district. Similarly, the human population pressure on forests is more alarming than the livestock pressure on forests in terms of both magnitude and growth. Although the livestock density is more pronounced in the case of grazing areas than forests, pressure on grasslands is expected to decline due to its gradual increase as a result of deforestation.

The population density per hectare of cultivated land is currently 7.4 per cent, and this pressure is expected to increase at the rate of 1.5 per cent along with the

population growth, whereas the population pressure on accessible forests is at present estimated to be five persons per hectare and it is projected to grow by about 1.8 per cent a year over this period due to the decline (increase) in forests (population). This indicates that the per capita forest land in the district declines at a faster rate than the per capita cultivated land over time. The livestock pressure on cultivated land, on the other hand, remains more or less stagnant (or negative) over time due to the fairly stagnant growth in the livestock population. However,the density of the livestock population per grazing hectare is fairly high at about 10 LSU per ha compared to three LSU per ha of accessible forest.

One important function of forests in most hill districts is to provide forest litter for compost. On an average, 3.5 hectares of accessible unmanaged forests are needed to sustain the fertility level of one hectare of agricultural field according to an estimate made by Wyatt-Smith. This ratio in Dhading is below(only 1.48) the recommended level of 3.5. Furthermore, this ratio does not improve but deteriorates marginally over time, indicating a declining trend in agricultural productivity. This ratio, however, does not reflect productivity improvements made possible through the use of modern technology such as irrigation facilities and fertiliser application, in which case the pressure on forest lands can be reduced. This implies that adoption of improved agricultural technologies has a direct negative pressure on forests, besides increasing productivity.

The ratio between shrub and forest lands is another indicator explaining partially the extent of forest degradation, since, as forests degrade, they are first converted to shrublands. The estimated shrub-forest land ratio in Dhading is currently not very large but its positive trend over time suggests gradual degradation of forests, primarily as a result of over-exploitation of accessible forests to meet the fuelwood demands.

Carrying Capacity

The carrying capacity of land in terms of food, fuelwood, and fodder was calculated separately on a per hectare basis.

Calories : Assuming that 2,410 calories are required by an adult, the carrying capacity of one hectare of cropland was calculated. Table 7.29 shows that the per hectare calorie supply in Dhading is presently 3,851,000 which is about 74 per cent of the district's calorie demand. The carrying capacity of cropland decreases marginally over time because of the negative trend in calorie supply as a result of the declining trend in crop productivity. More specifically, at present, one hectare of cropland can support about 5.32 adults, whereas the demand pressure (i.e., load per ha) is 7.2 adults, and it is 1.35 times greater than the carrying capacity. This indicates that a little over one hectare of cropped area is required to support the calorie requirement of one household, assuming an average size of 6.5 persons per

household. The load on agricultural land will continue to increase as the population increases, and this situation will deteriorate rapidly since more land cannot be brought under agriculture. The carrying capacity is influenced by the total area under agriculture as well as productivity. Since the area is unlikely to increase to match the population growth, productivity enhancement can significantly improve the carrying capacity and appears to be a viable method for improving the resource base and environmental situation in the district.

Fuelwood. The carrying capacity of both aggregate and forest lands in terms of fuelwood was estimated, and the results are presented in Tables 7.30 and 7.31. The results indicate that the carrying capacity of aggregate land (from which fuelwood originates in Dhading) presently meets 99 per cent of the total fuelwood requirement, but the district's carrying capacity in terms of fuelwood is expected to decline over time at an annual rate of 0.15 per cent. More specifically, at present, one hectare of land can support 2.87 persons, whereas the demand pressure is about three persons per hectare. The projected carrying capacity of land by the year 1998 is expected to meet about 89 per cent of the fuelwood demand.

The carrying capacity of forest in terms of fuelwood (as reported in Table 7.31) further indicates that one hectare of accessible forest can support seven persons, whereas the demand pressure is about 10 persons per hectare. This indicates that the capacity of forests to support the fuelwood requirement of the population is about 70 per cent, but this ability declines over time at the rate of 1.78 per cent due to the decline in accessible forests. Since about 92 per cent of the population in the district is concentrated in the mid-mountain region, the forests in this region will experience a greater amount of pressure over time as the population grows.

Timber. The carrying capacity of the district in terms of timber is slightly better than that of fuelwood and fodder. The results presented in Table 7.32 show that the carrying capacity of forests from which timber originates is now 1.16 times greater than the estimated demand pressure (i.e., load). The capacity of forests to meet the growing demand for timber in the district, however, it continues to decrease over time along with the growth in demand pressure at an annual rate of 1.77 per cent, given the fairly constant trend in timber production.

Fodder. The carrying capacity of the land resources of Dhading from which fodder originates has already exceeded the limit of sustainability. It should be noted that grasslands in the Himal have also been included in the estimation of carrying capacity. Table 7.33 shows that the carrying capacity of the district in terms of fodder is now 1.28 LSU per hectare, whereas demand pressure is 1.33 LSU. This indicates that the fodder demand in the district is in excess (4% higher) of the carrying capacity and over time the carrying capacity improves marginally due to the marginal increase in shrub and grassland as deforestation continues.

Table 7.34 indicates the estimated carrying capacity of forests only. The results indicate that the estimated carrying capacity of forests is currently 0.74 LSU per hectare whereas the demand pressure (i.e.,load) is three LSU per hectare. The capacity of forests to meet the total fodder requirement in the district is, therefore, only 25 per cent, and this will remain almost constant over time. The estimated carrying capacity of forests in the mid-mountains is even lower, given the heavy concentration of population in this region (Table 7.34).

Conclusion

Under the current state of technology and infrastructure, the performance of the agricultural sector, upon which the economy of the district depends, continues to remain fairly stagnant or show signs of negative growth over the period considered. The yield rates of most crops and livestock productivity are low and in a state of decline, while the population is growing at an annual rate of 1.5 per cent, adding pressure to the resource base of the district. The population growth exerts unsustainable pressure on the natural resource base and leads to deforestation and environmental degradation. The possibility of further expansion of the cultivated land area to meet the growing food demand seems to be limited in future unless at a high cost, i.e., environmental degradation.

Given the negative trend in productivity growth and continuous deforestation in addition to the population growth, the carrying capacity of the district in terms of food and natural resource products, particularly fuelwood, fodder, and timber, shows a declining trend over time. The estimated real per capita income of the district is low compared to the other districts of Bagmati Zone and is expected to grow by less than two per cent annually over time. The declining share of income originating from the non-agricultural sector, on the other hand, implies that future plans and programmes for promoting off-farm employment opportunities in the rural areas would have far- reaching effects on raising the income level and growth in the district. On the whole, the future of the district depends upon how the food and natural resource policies are coordinated with the population policy.

Policy Scenarios and Impact Analysis

Introduction

In this section, the adaptive simulation model is used to analyse the impacts of different policy scenarios against the baseline results discussed earlier. The population of Dhading district continues to grow at about 1.5 per cent per annum on the basis of the recent population census results. The population of the district is already high in relation to the economic base, and it is believed that more and more people are falling below the poverty line. The growth in population is also

eroding the resource base of the district. The agricultural productivity is declining and the increasing demand for fuelwood has resulted in forest degradation. The livestock pressure has further compounded the problem. This section, therefore, attempts to evaluate some of these issues. Since some of the policies examined have impacts that spread over a longer time period than 1998, the timeframe was extended to the year 2005.

Population Scenario and Impact

Dhading's population growth, according to the 1991 census, is about 1.51 per cent compared to the national average of 2.3 per cent. Despite this relatively lower population growth recorded between the inter-census period from 1981-1991, the economy of Dhading is fairly unsustainable, based on the results discussed under the baseline scenario. Thus, a population reduction policy was examined within the simulation model development for Dhading.

The population reduction policy is assumed to start in 1993 and continue untill 1998. Initially,only a small reduction (growth rate) was envisaged and this was allowed to decrease each year till it reached 0.605 per cent (in 1998). This was made possible by reducing the annual growth by ten per cent each year (beginning in 1993), so that in 1998 the population growth rate would be 60 per cent that of the inter-census growth rate of 1.51 per cent. Beyond 1998, the average growth between 1993-1998 is assumed to drive the population of Dhading. The results are given in Table 7.35.

The population growth under the baseline scenario was derived from the results of population projection provided by the NPC (1992). The 1.514 growth rate was assumed to project population beyond 2001 under the baseline scenario. Under the policy scenario, the annual growth rate corresponding to the baseline scenario was assumed to decrease by ten per cent annually. The resulting growth rates are provided in Table 7.35. The average growth rate of 0.908 per cent was then assumed to be the population growth in Dhading after 1998. The average growth of population beyond 1998 is higher than the growth rate in 1998. This is because, after 1998, the population policy intervention stops and the growth rate is likely to increase but perhaps not to the original level of 1.51 per cent. Hence an average growth rate (1993-1998) was selected to project population beyond 1998.

Table 7.35 also provides the net annual reduction in population due to the policy relative to the baseline scenario. Each year the reduction increases. The last line of Table 7.35 provides the cumulative reduction in population of Dhading as a result of the policy. By the year 2005, there will be 46,014 people less in Dhading as a result of policy alternatives. Charts 7.1 and 7.2 depict the results. The implications of this reduction are reflected in both the food and natural resource sectors simultaneously with the other policy interventions made and are examined below.

Crop Sector: Policy Scenarios and Impacts

For many years to come, the agricultural sector will continue to play a predominant role in Dhading as almost the entire population of the district depend upon this sector either directly or indirectly for a living. Four different policy alternatives are examined in the food sector. The first policy alternative consists of irrigation development, whereby all potential irrigable area in the district is assumed to be fully developed. The second policy assures a 25 per cent increment in the application of chemical fertilisers. The third policy examines the irrigation development and fertiliser policies jointly including the population reduction policy. Since irrigation also makes it possible to increase the cropping intensity, the additional area irrigated is assumed to be brought under potato cultivation. The last policy in the food sector assumes a reduction in unproductive cattle by the per cent. The milk yield rates of these animals under the baseline scenario have been fixed at 0.4 and 0.9 litres per cow and buffalo respectively. Along with the increased milk yield rate assumption, it is also assumed that fodder consumption per LSU increases by 25 per cent.

Impact on the Food Sector

Crop Yield. Under the current state of agricultural technology and infrastructure, the productivity trends of both food and cash crops in Dhading reveal a bleak picture. Not only is the level of productivity low, but the growth trend is fairly stagnant or declines marginally over the projected 1993-2005 period. The lack of year-round irrigation facilities and the low level of fertiliser use are principal constraints to

improving both the cropping intensity and crops yields in the district. Consequently, both irrigation and fertiliser policies are examined and Table 7.36 shows the forecasted change in crop yields, with and without policy interventions.

Chart 7.2

The estimated irrigated area under the baseline trend in 1993 was 7,900 hectares with a potential area that can be brought under irrigation in the district at 10,839 hectares. Bringing all the potential area under irrigation through the irrigation development policy, therefore, implies an increase in the irrigated area by 37 per cent. Expansion in irrigation facilities will improve the yields of different crops, depending upon the irrigation elasticity parameters of crop response functions used in the model. The results presented in Table 7.36 indicate that both the magnitude and trend of crop yields improve significantly as a result of these policies, but the increase varies. For example, the magnitude of increase in crop yields due to irrigation is the highest for wheat (10% increase over baseline yield) and the lowest for maize (only 2%), whereas the long-run average growth rate of crop yield, although less than one per cent, is among the highest for paddy (0.275%) followed by potatoes (0.18%). The millet yield remains unaffected by this policy and thus its negative yield trend persists even after introducing the irrigation policy.

The impact of the 25 per cent increase in the per hectare application of fertiliser on crop yields is lower than that of the irrigation policy, whereas the long-run growth trend in yields of crops under the fetliliser policy scenario is relatively higher than under the irrigation policy. All considerations remaining the same, a 25 per cent increase in the use rate of fertiliser increases the yields of paddy and wheat by six per cent and that of potatoes and maize by less than three per cent, given the fertiliser elasticities assumed in the model. Since no fertiliser is assumed to be applied on millet, its yield trend is the same as under the baseline scenario.

When both the irrigation and fertiliser policies are introduced jointly together with an increase in the area [1] under potatoes, the wheat yield increases the most (17%), followed by paddy (10%), and the maize yield increases by less than five per cent compared to the per hectare yield in 1993 under the baseline scenario. Despite improvements in crop yield rates, it is interesting to note that the growth rates under this policy are more or less the same or even lower than under the fertiliser policy. This might suggest the relative merit of the fertiliser policy over the irrigation policy in terms of the long-run growth of crop yields. The population reduction policy has no obvious impact on crop yields.

Food Availability. Since the population growth surpasses the growth in net food production, the per capita availability of all food items, except oils and fat, in Dhading shows a declining trend over time under the baseline scenario. It is, therefore, equally important to reduce the existing growth rate of population in order to realise the meaningful and sustained impacts of the supply side policy interventions, such as fertiliser and irrigation, and that of the livestock policy. The forecasted trends in the per capita food availability, with and without policy interceptions, are presented in Table 7.37.

The results indicate that, while the level of per capita availability improves modestly, as a result of the population reduction policy relative to the baseline situation, the long-run growth in the supply of most food items, especially cereals, milk and meat continues to show a declining trend. This indicates that the long run growth rate of the per capita supply of cereals, milk, and meat in the district is even lower than the reduction in population growth rate assumed under the population policy (0.9%). The impact of raising the livestock productivity (yield rate of milch animals and reduced number of unproductive cattle) on the milk supply is more visible for obvious reasons. For example, the per capita milk supply would increase by over two-folds and oils and fat by one and a half-fold if the livestock policy is introduced. Similarly, the introduction of the irrigation and fertiliser policies has a stronger effect on increasing the level of per capita food availability, particularly cereals and vegetables, compared to the population policy. But it is interesting to note that the population policy indicates a relatively better picture than other policies in long-term growth. This might also suggest that mere adoption of a single policy is not adequate for improving both the level and growth rate of food availability in the district. When irrigation and fertiliser policies are introduced jointly along with the population policy, the level of food availability improves considerably. However, the long-run growth rates of food items, particularly vegetables, milk, and meat are still lower than the population growth.

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1. Note that this last set of policy alternatives also includes the population reduction policy, which is not expected to have an impact on the yield rates of crops.

Food Demand. The rural households' demand for food is assumed to be influenced by any changes in the income and price of different food items. The food policy scenario considered in the present exercise, however, increases household income (through increased crop production), and hence the per capita food demand increases depending upon the growth in income and the magnitude of income elasticity of the demand. The changes in the per capita demand of different food groups forecasted under the five different sets of policy interventions are given in Table 7.38. Price effects are also built in the demand framework and food prices increase at different growth rates.

The per capita demand for all food items under the baseline scenario shows a marginally declining trend over time. The impact of the population policy on the per capita demand, which results primarily from the change in the per capita income, is not much compared to the baseline situation, since the per capita income increases marginally when the population growth decreases over time, other considerations remaining the same. The case is similar under the livestock, irrigation, and fertiliser policy scenarios. Since food is a necessity, its income elasticity is generally inelastic, indicating that demand for food does not change proportionately with the change in income.

When both the irrigation and fertiliser policies are introduced jointly with an increase in the cropping intensity (increased area under potatoes) and the population policy, the per capita demand for all food items, however, increases considerably in the initial years and then begins to decline over time.

Food Balance. The per capita food balance situation, with and without food policy interventions, in the district over the 1993-2005 period is presented in Table 7.39. Under the baseline situation, the district experiences a net surplus in cereals, vegetables, and meat, although the net surplus, especially in cereals and meat, declines over time. With the population reduction policy, the rate of decline in the per capita food balance improves considerably,despite the magnitude of surplus under this policy more or less in keeping with the baseline situation. The livestock policy improves the per capita milk balance considerably for obvious reasons. Similarly, the irrigation and fertiliser policies have positive impacts on the per capita food balance. When the population policy, combined with the irrigation and fertiliser policies, are introduced jointly along with the expansion in the area under potato in newly irrigated areas, the net surplus in the food balance is expected to decline drastically. This takes place mainly due to a sudden rise in income which induces increased food demand. From 1994 onwards, the surplus in food balance, however, improves considerably, due to the decline in the per capita demand, as a result of the gradual decline in income growth.

Calorie Balance. Table 7.40 (Chart 7.3) provides the forecasted calorie requirement and supply situation in the district under each policy scenario. Under the calorie

need and supply scenario, only cereals and potatoes are considered (see methodology section for details). Furthermore, calorie requirement and supply are independent of income and prices, and thus calorie requirement and supply are different from demand and supply, as the latter depend on income and prices. The estimated calorie supply meets 74 per cent of the total calorie requirement in the district, and this situation declines marginally over time. With the introduction of the population policy, the rate of decline in the calorie deficit improves because of the modest decline in the per hectare calorie requirement, as the load on a hectare of land declines. Although the livestock policy increases the supply of milk and meat, these food items are not considered in the estimation of calorie supply, and hence the livestock policy is not seen to have any impact on the calorie supply and requirement situation.

With the introduction of the irrigation and fertiliser policies, the magnitude of the calorie balance in the district improves, but the calorie balance situation under both policies declines over time because the calorie requirement increases at a faster rate than supply. This clearly indicates that implementation of the supply side food policy alone is not sufficient to improve the calorie balance situation in Dhading over the long-run, unless the population growth is also curbed. In other words, a combination of demand and supply policies is required to bring about a sustainable food situation in the district. For example, over 88 per cent of the district's calorie requirement can be expected to be met from the supply, when both the irrigation and fertiliser policies are introduced jointly along with the population reduction policy. Under each policy alternative, the percentage of calories met from the district's supply is much lower. Under the last policy alternative, the calorie balance situation, although not positive, nevertheless does not deteriorate as much as under other policy options.

Impact of Trade

The manner in which both food and non-food trade in the district were forecasted has already been described earlier. The impacts of policy alternatives on food and non-food trade are examined in this section and the results generated by the model under each policy scenario are presented in Table 7.41.

Food. Currently, the district is a net exporter of food in an aggregate sense, with the export increasing at a rate of about seven per cent per annum under the baseline scenario. It may sound puzzling at this stage to say that Dhading exports food,when, in fact, the calorie requirement is not being met. Income and relative prices, which determine the per capita food demand, are subtracted from the per capita food availability discussed above. The balance is assumed to be traded.

Among the different food policy alternatives considered independently, the long-run growth rate of the per capita value of food exports is found to be the highest under the livestock policy (16.5%), followed by the population reduction policy (10.7%). The former policy results in a net increase in the milk supply and hence exports, whereas the latter policy results in reduced demand growth over time and also contributes to exports. The per capita value of food export under the irrigation and fertiliser policies also increases at the rate of over 10 per cent annually compared to 6.7 per cent under the baseline scenario. Again, as the results indicate, the impact is much more pronounced when both demand and supply policies are jointly introduced.Under such combined policy alternatives, the per capita value (nominal) of food export in Dhading is expected to reach Rs 2,210 by 2005 at an annual rate of about 23 per cent, which is relatively much higher than under the other policy options considered (Chart 7.4).

Non-Food.

The extent to which the demand for non-food import is influenced by policy interventions depends to a large extent upon the magnitude of growth in income, resulting from the policy interventions together with the strength of income elasticity of non-food demand, other considerations remaining the same. The results provided in Table 7.41 indicate that the value of non-food import under the joint policy is much more pronounced than under a single policy, such as the irrigation and fertilser policies. The per capita value of non-food import under all policy scenarios is, however, forecasted to grow by less than one per cent over the period. The value of non-food import under the single policy intervention does not

change from the baseline scenario. This is perhaps because the annual growth in income, resulting from the policy intervention, which reduces over time, is not strong enough to induce import demand growth over time, given that the income elasticity of demand for non-food in rural areas, is also not highly elastic.

Impact on Labour Use

Before examining the impacts of the policy interventions on employment, it is important to emphasis that any increase in the total labour utilisation as a result of a policy action, results primarily from the agricultural sector rather than from the non-agricultural sector. It is, therefore, only under the joint policy that the additional labour force (in terms of mandays) can be utilised in the crop sector due to increased cropping intensity effects. While development of irrigation facilities would also help to generate considerable employment opportunities, at least in the short run, this effect has not been taken into account in the present exercise. As a result, the total labour utilisation rate, under both irrigation and fertiliser policies, remains more or less similar to the baseline situation. When the irrigation and fertiliser policies, combined with the population reduction policy, are introduced jointly, the labour use rate improves marginally to 85 per cent compared to 83 per cent under the baseline scenario in 1993 (Table 7.42)

The labour use rate under all policy scenarios shows a declining trend over time. But the rate of decline in the labour use rate under the combined policy, as well as under the population policy, is, however, relatively lower than under the baseline scenario. The additional labour that is utilised under the combined policy is the result of the cropping intensity effect of the potato season, but this has not been included in the present exercise to simplify matters.

Impact on Income

All the policies examined above affect the per capita income. The estimated nominal incomes originating from all these sources were converted to real income, using the weighted cereal grain price index at 1991 constant price as mentioned in the baseline results described above. The results presented in Table 7.43 indicate that the real per capita income, which is estimated to be Rs 1,030 by the year 2005 under the baseline situation, would reach Rs 1,096 under the population policy, Rs 1,180 under the livestock policy, and Rs 1,422 when both the irrigation and fertiliser policies are introduced jointly along with the population policy. Among the single policy interventions, the livestock policy is seen be most effective in increasing income in the short run, while the population policy shows positive results over a longer period.

Data on the relative share of different sources of income in the total income, with and without policy interventions, are provided in Table 7.44 (Chart 7.5). The contribution of the crop sector to the total income, about 36 per cent under the baseline scenario in 1993, is expected to reach 55 per cent when the combined-irrigation,fertiliser, and population-policy is introduced. The projected share of the crop and livestock sectors' income increases while non-agricultural income decreases under each policy scenario. The declining share of non-agricultural income implies that the nominal money wage in the non-agricultural sector grows at a rate lower than the annual growth rate of inflation(price index) and, at the same time, it was not possible to predict whether the non-agricultural sector's employment would grow over time. It is further evident from the policy analysis that the share of the livestock sector in the total income would increase significantly from 39 per cent under the baseline scenario in 1993 to about 50 per cent under the livestock management policy. However, the forecasted share of the livestock sector in the total over time is expected to decline, given the marginally declining trend in productive livestock, especially milch buffaloes, sheep, and goats.

Natural Resource Sector: Policy Scenarios and Impacts

Forests provide fuelwood, timber, and fodder. To meet these growing demands, forests have either been degraded or deforested. As a result, three different policy alternatives are examined in the natural resource sector. The first policy examines a reduction in the per capita consumption of fuelwood by 10 per cent. Introduction of smokeless *chulo* (stoves) has been found to reduce fuelwood consumption by about ten per cent based on studies on this issue. Secondly, a policy whereby all forests in Dhading are assumed to be brought under management is examined.

Proper management results in fuelwood and fodder yield improvement. Thirdly, the two polices are then examined jointly along with the population reduction policy.

Impact on Land Use

As the population increases, greater and greater pressure will be exerted on the land resources to meet the food, fuelwood, and fodder demands. The fertility of existing agricultural lands is declining annually, resulting in a declining fertility trend over time. Forests provide nutrients to farmers' fields and meet fuelwood and fodder demands. Each year, as the population increases, the land use dynamics also change along with reduction in forest covers degradation of forests, increasing areas under shrubland, and possibly agriculture. Thus, changes in population and productivity result in land-use changes.

Table 7.45 provides data on the land use changes under different policy scenarios. Since the livestock population also has implications on land use in terms of fodder demand, the livestock policy results are also presented in Table 7.45. Under the baseline scenario, the area under forests is seen to decline with gains made by all other land uses. The results do not change much under the population, livestock, and demand reduction policies as a negative growth trend in forest areas continue. However, when all forests in Dhading are assumed to have been brought under management, the negative growth trend is reduced by almost one-fourths compared to the baseline scenario. The natural resource and population policies, implemented jointly will result in a stationary situation whereby the forest area will remain almost the same throughout the entire period. The natural resource policy includes both the supply management and demand reduction polices besides the population policy.[2] Clearly, the results indicate that increasing the area under forests is a difficult task.

Impact on Fuelwood

Table 7.46 provides data on the different sources of fuelwood and their shares. Under the baseline scenario, forests provide between 65-68 per cent of the fuelwood supply, followed by adjacent NCI and shrubland. Other land category shares are relatively smaller. The population reduction and livestock policies do not have any appreciable impact on the relative contribution of different land uses to the fuelwood supply. The Natural Resource Policy (NRP) has the most profound impact since the forest area as well as its contribution to the total fuelwood supply increase.

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2. This last policy will be referred to as the natural resource policy (NRP) hereafter.

Impact on Fodder

Table 7.47 provides similar results regarding the supply of fodder from different sources. The cultivated area's contribution to the total fodder supply is seen to be the largest under all policy alternatives and its share continues to grow over time under all the policy scenarios. Under the management and NRP alternatives, the share of forests is seen to increase, although the negative growth trend continues.

Environment and Carrying Capacity

Pressure on the Resource Base

Some indicators relating to the resource base were also developed. The different policies affect these indicators in different ways, and they are highlighted in Table 7.48. The values of these indicators under the baseline scenario are also provided.

Per Capita Cultivated Land. The per capita cultivated land (ha/person) in Dhading is already low (0.13 ha/person), and, as the population grows, the list will decline to 0.11 ha/person by the year 2005. The different policy alternatives do not have any significant impact on improving this indicator. The different reduction policy will increase the value from 0.11 ha/person to 0.12 ha/person by 2005. The NRP will field the same results. The person/ha indicator (which is opposite this indicator) should be examined also over time. As is clear, the population density on

agricultural land increases under all scenarios. It should be noted that the population density on the cultivated areas is the highest under the fuelwood demand reduction and management polices. This is so because according to the model, deforestation leads to an increment in agricultural land and, since no deforestation occurs as in the case of these two policies, the population density on the cultivated area increases. The NRP policy also reduces the density compared to the baseline scenario.

Per Capita Accessible Forest. The per capita accessible forests in Dhading will decline from 0.19 ha/person in 1993 to 0.15 ha/person by 2005 under the baseline scenario. No changes in the forest area occur in comparison to the baseline scenario under the population policy, but, since the population growth decreases, an improvement in the per hectare availability of accessible forests occurs. The livestock policy has no impact on this ratio as is to be expected. The demand reduction policy has a positive impact. Both the population reduction and demand reduction policies work on the demand side by curtailing the overall demand and do not influence the supply side. The management policy has an impact that is similar to the demand reduction policy. Finally, the NRP policy alternatives influence both the demand and supply, and it can be seen from the results in Table 7.48 that the impact of this policy is the strongest (see growth rate). The population density per accessible forest, which is also presented in the table, indicates the growing pressure exerted by the human population on the forest area.

Forest-Cultivated Area. The forest-cultivated area ratio is also an important indicator. Forests provide leaf litter for eventual use as compost to supplement the field nutrients. Thus, as the forest area declines, the supply of leaf litter will also be reduced, and this has an impact on the soil fertility. A study (Wyatt-Smith) has indicated that about 3.5 hectares of forests are required to sustain one ha of agricultural land. In the case of Dhading, this ratio is only about half and under the baseline scenario it gradually gets smaller. None of the policies examined are strong enough to improve this ratio to 3.5 hectares.

Shrub-Forest Area Ratio. The shrub-forest area ratio is an indicator of forest degradation because, as forests degrade, they are first converted to shrublands. The model allows for this interaction described in detail in the methodology section. Under the baseline scenario, this ratio increases. The NRP policy has the strongest impact relatively in terms of retarding this ratio.

Livestock Density. Livestock also exert pressure on cultivated land, forest, and grazing lands. These three indicators of livestock density are also given in Table7.48. As expected, the livestock policy reduces the density compared to other policies. The livestock density on grazing area increases to about 10 LSU under the

NRP policy, despite this policy's overall positive impact. The reason why density increases is that, as deforestation is controlled (under this policy), the land use changes that occur do not contribute enough additional area to grazing lands to lower the density. Despite the higher density of LSU under this policy alternative, it has already been shown that the fodder supply will exceed the fodder demand in Dhading, hence the high density under this policy scenario should not be a critical issue.

Carrying Capacity. The impact of the different policy options analysed under the natural resource sector has implications for the carrying capacity of land to meet food,fuelwood, timber, and fodder needs. This section examines these impacts.

Food. The food sector analysis has already indicated that Dhading is unable to supply enough calories to meet the population's needs under the prevailing state of technology. Only about 74 per cent of the calorie requirement is being met, and this supply dwindles by nearly 0.7 per cent per annum to reach about 68 per cent by 2005. To explain the calorie situation in a different way, currently about 7.22 persons(adults) depend on a hectare of agricultural land to fulfill their calorie requirements. As the population increases over time, this load on a hectare increases at about 0.6 per cent per annum, reaching 7.76 persons by 2005 under the baseline scenario (Table 7.49). One hectare of cultivated area (paddy,maize, wheat, millet and potatoes) can support only 5.32 adults and, since productivity is declining, the carrying capacity also declines to 5.25 persons by 2005 under the baseline scenario.

The population reduction policy does not have any impact on the carrying capacity of agricultural land but affects the load factor positively , as the total calorie requirement declines in proportion to population reduction. The reduction in population is just sufficient to maintain a constant calorie supply of about 73 per cent throughout the period, as can be noticed in Table 7.49. Since the livestock, fuelwood reduction, and forest management policies do not involve direct interaction with the food sector, the results in respect to agricultural land are similar to those of the baseline. The more obvious impacts of these policies are discussed below.

The changes that can be observed under the NRP are primarily the result of the population policy since the other combined policies (fuelwood reduction and forest management) have no impact on agricultural land use. Under all policy alternatives, the pressure on agricultural land is obvious and exceeds the level that the land can bear. A more detailed discussion of the impacts of other policy alternatives on the agricultural sector has already been given above (food sector).

Fuelwood. The impacts of the alternative polices on fuelwood demand and supply are given in Table 7.50. The carrying capacity indicates how many person's

fuelwood requirements one hectare of forest land can meet, given that one adult's fuelwood requirement is 588 kg per year. Under the baseline scenario, the carrying capacity is seen to decline rapidly at about 1.7 per cent per annum. One hectare of forest land can support 2.87 persons' fuelwood requirements per year, and this capacity declines to 2.76 persons by the year 2005 from the figure of 2.99 persons in 1993 at an annual rate of 1.42 per cent. Each year the unfulfilled fuelwood demand is met by deforestation, which reduces the forest area. This is a cumulative effect and each year more and more forest areas vanish, reducing the forest stock as well as the overall supply of fuelwood, timber, and fodder, consequently resulting in lower annual supplies.

The impact of the population policy reduces the incremental fuelwood demand and improves Dhading's fuelwood situation. As shown, 85 per cent of the fuelwood requirement will be met by 2005, compared to 78 per cent under the baseline scenario. However, despite this reduction, forests in Dhading will be unable to meet the fuelwood demand and thus a continuous state of deforestation at about one per cent per annum is predicted. Under the demand reduction policy, the fuelwood situation improves in 1993 as a surplus of fuelwood occurs in Dhading. But this situation does not last long and as the population continues to grow at 1.51 per cent, a fuelwood deficit is predicted to occur by 1999, resulting in deforestation once again (Chart 7.6).

The forest management policy assumed that all accessible forests in Dhading were under proper management in 1993. The results were remarkable. According to this assumption, fuelwood deficits occured in 1993, but as yield rates began to increase with the management policies introduced, fuelwood surplus began to occur from 1994. This situation continued throughout the forecasted period. Finally,the NRP policy shows the combined effects of the population and fuelwood demand reduction policies, as well as, the management policy. The growth in fuelwood supply is also seen to be a healthy 1.71 per cent and is just the opposite of the negative growth of 1.72 observed under the baseline scenario.

Forests are the main source of fuelwood. However, forests are not the main source of fodder as has already been pointed out earlier. Since forests are an important source of natural resource products,this section examines the carrying capacity and load on forest land in Dhading.

For the district as a whole, the alternative policies are given in Table 7.51. When forests only are considered, only 69 per cent of the fuelwood demand can be met and this situation deteriorates rapidly. By 2005 only 54 per cent of the demand will be met by Dhading's forests.The carrying capacity of forest land to meet the fuelwood demand is about seven persons per hectare, whereas the load is 10 persons and this load will increase over time to reach 13 persons by 2005. The population policy does relieve the burden to some extent as, 59 per cent of demand

compared to 54 per cent under the baseline scenario will be met by 2005. Under the demand reduction policy, the situation improves further as 63 per cent of the demand will be met by 2005. The load reduces marginally. The impacts of the forest management and NRP policies are noteworthy. In the second year of the policy intervention, about 75 per cent of fuelwood demand is met by forests compared to 68 per cent under the baseline scenario. The situation improves over

time and by 2005 an estimated 91 per cent of the demand is to be met under the management policy option and about 97 per cent under the NRP option (Chart 7.8).

Deforestation. The fuelwood situation in Dhading under the different policy scenarios has serious implications in terms of deforestation. Under the population policy, deforestation occurs at a rate lower than that under the baseline scenario. The demand reduction policy halts deforestation during the first few years, but, eventually, deforestation increases since the stocking rate remains unchanged as under the baseline scenario. The forest management and NRP polices are strong enough to completely stop deforestation. Table 7.52 provides the results regarding the per capita fuelwood supply, deficits/surplus, and the deforested area under the different policy options (Chart 7.7).

Chart 7.8

Under the baseline scenario, the deforested area continues to grow rapidly at 1.72 per cent per annum. According to the results, about 85ha will be deforested by 1993 and, by 2005, this area will have increased to nearly 600ha. The population reduction policy retards this area to 377ha. The fuelwood demand reduction policy retards deforestation until 1997, but in 1998, 13ha would have been deforested to meet the fuelwood deficit, and, by 2005 almost 262ha of forests will be deforested and thereafter the forest areas in Dhading will be sustainable.

Timber. Forests provide timber also. The timber situation in Dhading appears to be fairly good untill 1999 under the baseline scenario, but deteriorates thereafter, resulting in annual deficits. The results are given in Table 7.53. The strongest impacts result from the forest management and NRP policies.

Fodder. Under the baseline scenario, the predicted growth in the livestock population expressed in terms of LSU is almost stagnant. Table 7.54 provides the policy impacts on the fodder situation in Dhading and the baseline scenario. Under the baseline scenario, one hectare of land in Dhading supplies 0.8MT-TDN and a modest improvement in this supply occurs over time. The fodder supply per ha is seen to be the highest under the forest management and NRP policies.

The impact of the livestock policy on the fodder situation is also presented in Table 7.54. This policy assumes a ten per cent reduction in the number of unproductive animals, and, since the milk yield is allowed to increase by almost 100 per cent, fodder requirements of cows and buffaloes increase by 25 per cent. This policy has no impact on the fodder supply as expected by the fodder demand (load) per hectare increases to one MT-TDN. Greater pressure is exerted on land by the fodder demand. As a result, fodder supply as a percentage of demand declines compared to the baseline scenario, although the reduction in the livestock population does not make the growth rate negative. Over time, the fodder situation is seen to remain almost constant under this policy scenario compared to the baseline.

The fuelwood demand reduction policy has no significant impact on the fodder situation. The forest management and NRP policies have strong impacts (as shown in Table 7.54), although the impacts of these two policies are very similar. The fodder situation in the district improves over time marginally under the latter policy alternatives. The results regarding the fodder supply, when only forests are considered as the source, are highlighted in Table 7.55.

Conclusion

The period over which the policy analysis is conducted is important. In the case of Dhading, the timeframe was extended to the year 2005 to judge the impacts of the different policy alternatives. The population reduction policy was seen to retard the negative growth trend of all important variables,but was not strong enough to reverse the trend, given that the pressure on the resource base already exceeds the limit.

In the food and natural resource sectors, the policy impacts were seen to be the strongest when a combination of demand and supply side policies were introduced jointly along with the population reduction policy. The results indicate that the population pressure in Dhading is already very great, and, despite the positive effects of the jointly conducted irrigation, fertiliser, and population reduction policies, Dhading is not likely to meet the calorie requirements of its population by 2005. This is not to indicate that the possibility does not exist, since other agricultural technologies can still be introduced to raise the productivity level. Under the policy

examined, Dhading can produce food to meet about 91 per cent of the calorie requirement compared to the baseline projection of about 80 per cent. Scope, therefore, exists to introduce other agricultural technologies that can boost productivity to make Dhading self-sufficient in food production. For example,the option of introducing improved seeds has not been explored.

The natural resource base in Dhading was also seen to be fairly overloaded. The fuelwood and fodder demands continue to increase as the population rises unabated. Deforestation continues to exert greater pressure on the resource base. The population reduction policy alone was not sufficient to reverse deforestation, although it was effective enough to retard it significantly. The fuelwood demand reduction policy was seen to be effective as a short-run policy, since deforestation is reduced to zero, but, as the population continues to grow, deforestation is likely to occur once after 1998. The forest management policy,which assumed that all accessible forests were brought under management,was seen to halt deforestation completely. The fuelwood demand reduction policy and supply management policy, combined with the population reduction policy,was seen to be the most effective. Under this policy scenario, deforestation comes to a halt and the pressure on forests to meet the fuelwood and fodder demand continues to be sustainable.

Table 7.1: Area Under Different Crops (ha)

Year	Paddy	Maize	Millet	Wheat	Oilseeds	Potatoes
1975	3650	11000	2010	1015	190	310
1976	3650	11000	2010	1015	190	310
1977	5650	10450	1910	1050	170	310
1978	5600	11000	2010	1010	160	300
1979	5600	9900	2020	1050	180	330
1980	6490	7350	2000	1100	150	250
1981	10060	7350	2000	1100	150	250
1982	12660	7760	1480	4840	300	370
1983	11140	8800	3540	4000	270	560
1984	10270	14840	3200	4050	300	1200
1985	13000	15000	3300	4500	300	1350
1986	12990	14960	3200	4550	310	1360
1987	12740	15010	3500	4960	390	1370
1988	12700	15000	3600	4970	320	1370
Mean	9014	11387	2556	2801	241	689
Std.	3568	2927	742	1772	76	485
Coef.Var.%	40	26	29	63	32	70

Table 7.2: Yield Rates of Different Crops (kg/ha)

	Paddy	Maize	Millet	Wheat	Oilseeds	Potatoes
1975	2608	1615	1045	1160	489	5700
1976	2608	1700	1045	1160	511	5984
1977	2303	1360	1042	1162	529	6000
1978	2321	1759	1025	1198	500	5500
1979	2105	1369	1000	1000	389	6000
1980	2079	1650	900	1145	533	6000
1981	2070	1600	1000	1200	533	6000
1982	2000	1242	1000	1500	533	6000
1983	1803	914	1000	1600	593	6000
1984	1832	1300	900	1358	600	6500
1985	1750	1500	1000	1251	633	5496
1986	1782	1472	1000	1319	645	6000
1987	1952	1400	889	1369	487	7701
1988	2184	1539	1200	1368	656	7701
Mean	2100	1459	1003	1271	545	6184
Std.	271	212	75	153	71	663
Coef.Var %	13	15	7	12	13	11

Table 7.3: Fertiliser Sale

	Sale (MT)	Sale per Cropped ha
1983	153	6
1984	277	9
1985	291	13
1986	314	14
1987	318	14
1988	385	17
1989	410	
1990	528	

Source: AIC

Table 7.4: Livestock Population and Products

	1984	1985	1986	1987	1988	Growth
Population						
Cattle	130818	132205	133606	132710	125490	-1.03
Buffaloes	83427	86105	88869	88975	87170	1.10
Milch Cows	18799	18998	19200	18460	16830	-2.73
Milch Buffaloes	18229	18814	19418	20330	19190	1.29
Goats	138263	140572	142919	143460	166590	4.77
Sheep	1686	16782	17321	19531	18436	28.90
Pigs	7671	8079	8509	8620	11990	11.81
Products						
Buff.Meat	1796	1854	1913	1915	1876	1.10
Cow Milk	6341	6408	6476	6705	6192	-0.60
Goat Meat	273	278	382	283	329	4.77
Buff Milk	16260	16782	17321	19531	18436	3.18
Mutton	4	4	4	4	10	25.74
Pork	109	115	121	123	171	12.00

Source: DFAMS 1990

Table 7.5: Land Use Changes

Dhading Land Use	1978	1979	1980	1985	1986	1987	1988	1989	1990
Mid-mountains	138773	138773	138773	138773	138773	138773	138773	138773	138773
Natural Forests	44792	44344	43901	41749	41332	40918	40509	40104	39703
Acc. Forests	44792	44344	43901	41749	41332	40918	40509	40104	39703
Change in Forest Area		-448	-443	-422	-417	-413	-409	-405	-401
Shrublands	18915	19139	19361	20436	20645	20852	21056	21259	21460
Grasslands	5242	5309	5376	5698	5761	5823	5884	5945	6005
Mapped Cultivated	68373	68507	68640	69286	69411	69535	69658	69779	69900
Adj.NCI	27428	27473	27517	27732	27774	27815	27856	27897	27937
Gross Cultivated	40945	41035	41123	41554	41637	41720	41802	41883	41963
NCI Within	7466	7466	7466	7466	7466	7466	7466	7466	7466
Net Cultivated	33479	33569	33657	34088	34171	34254	34336	34417	34497
MM Calculated	137322	137300	137277	137170	137149	137128	137108	137088	137068
High Mountains	38042	38042	38042	38042	38042	38042	38042	38042	38042
Natural Forests	21375	21195	21017	20154	19986	19820	19656	19494	19333
Accessible Forests	17976	17797	17619	16755	16588	16422	16258	16095	15934
Inaccessible Forests	3399	3399	3399	3399	3399	3399	3399	3399	3399
Shrublands	4834	4924	5013	5445	5528	5611	5693	5775	5855
Grasslands	5807	5834	5861	5990	6015	6040	6065	6089	6113
Mapped Cultiavated	4973	5017	5061	5277	5319	5361	5402	5442	5483
Adjacent NCI	1534	1552	1570	1656	1673	1689	1706	1722	1738
Gross Cultivated	3438	3465	3492	3621	3646	3671	3696	3720	3744
NCI Within	602	602	602	602	602	602	602	602	602
Net Cultivated	2836	2863	2890	3019	3044	3069	3094	3118	3142
HM Calculated	36988	36970	36952	36866	36849	36833	36816	36800	36784
High *Himal*	15672	15672	15672	15672	15672	15672	15672	15672	15672
Natural Forests	1284	1284	1284	1284	1284	1284	1284	1284	1284
Inaccessible Forests	1284	1284	1284	1284	1284	1284	1284	1284	1284
Shrublands	1656	1656	1656	1656	1656	1656	1656	1656	1656
Grasslands	4892	4892	4892	4892	4892	4892	4892	4892	4892
HH Calculated	7832	7832	7832	7832	7832	7832	7832	7832	7832
Total									
Forests	67451	66823	66202	63187	62602	62023	61449	60882	60320
Shrublands	25405	25719	26030	27537	27830	28119	28406	28690	28971
Grasslands	15941	16035	16128	16581	16668	16755	16841	16926	17011
Adjacent NCI	28962	29025	29087	29388	29447	29505	29562	29619	29675
NCIG	8068	8068	8068	8068	8068	8068	8068	8068	8068
Net Cultivated	36315	36432	36547	37107	37215	37323	37429	37535	37639
Dhading Calculated	182142	182102	182062	181868	181830	181793	181756	181719	181683
Residual	10345	10385	10425	10619	10657	10694	10731	10768	10804
Dhading (Given)	192487	192487	192487	192487	192487	192487	192487	192487	192487

Table 7.6: Forecasted Area Under Different Crops (hectares)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	13029	13292	13539	13774	13996	14207	14408	14601	1.521
Maize	15347	15439	15525	15607	15684	15758	15828	15896	0.473
Millet	4043	4083	4122	4158	4192	4224	4255	4285	0.780
Wheat	4922	5036	5143	5245	5341	5433	5520	5604	1.731
Oilseeds	329	342	355	367	380	393	406	419	3.403
Potatoes	1389	1409	1428	1448	1469	1489	1510	1531	1.400
Total Cropped Area	39059	39600	40112	40598	41062	41505	41929	42335	1.085
Total Cultivated Land	28377	28731	29065	29380	29680	29965	30237	30497	0.966
Area Under Irrigation	7593	7745	7900	8058	8219	8383	8551	8722	2.000
Total Fertiliser	560	592	623	652	680	707	734	759	4.031

Table 7.7: Forecasted Yield Rates of Different Crops (kg/ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	1998	1995	1998	1993	1983	1975	1982	1973	-0.250
Maize	1493	1493	1495	1494	1489	1486	1489	1486	-0.128
Wheat	1346	1344	1344	1342	1338	1334	1337	1333	-0.170
Millet	1010	1010	1011	1011	1010	1008	1010	1008	-0.060
Oilseeds	661	661	662	661	660	659	660	660	-0.060
Potatoes	7412	7409	7417	7411	7394	7381	7395	7380	-0.099

Table 7.8: Forecasted Changes in Crop Production (MT)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	26034	26520	27052	27454	27760	28060	28555	28810	1.267
Maize	22919	23050	23212	23309	23360	23413	23575	23614	0.344
Wheat	6623	6767	6914	7039	7146	7249	7379	7470	1.558
Millet	4085	4126	4169	4203	4232	4259	4297	4321	0.720
Oilseeds	217	226	235	243	251	259	268	276	3.341
Potatoes	10297	10437	10594	10733	10860	10991	11167	11301	1.299

Table 7.9: Forecasted Revenue, Cost, Gross Margins Per Hectare of Cultivated Land Under Different Crops (Rs/ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Revenue									
Paddy	12	13	14	16	17	19	21	23	9.569
Maize	8	9	9	10	11	12	13	14	8.329
Wheat	8	9	9	10	10	11	12	13	6.630
Millet	6	6	7	8	9	10	11	12	10.517
Oilseeds	11	13	14	15	17	19	21	23	10.949
Potatoes	43	46	49	53	56	60	65	70	7.219
Cost									
Paddy	10	10	11	12	13	14	15	16	7.086
Maize	7	8	8	9	9	10	11	11	7.022
Wheat	7	7	8	8	9	9	10	11	6.966
Millet	6	7	7	8	8	9	9	10	7.093
Oilseeds	4	5	5	5	6	6	7	7	7.300
Potatoes	15	16	18	19	20	22	23	25	7.115
Per Hectare Gross Margin (Rs/ha)									
Paddy	2157	2664	3267	3883	4523	5239	6184	7066	16.683
Maize	839	1047	1287	1522	1757	2012	2344	2637	15.422
Wheat	1375	1451	1545	1624	1691	1762	1887	1962	4.892
Millet	-321	-103	150	427	732	1077	1493	1930	66.642
Oilseeds	6954	7884	8942	10106	11393	12837	14515	16324	12.793
Potatoes	27408	29375	31568	33841	36222	38806	41839	44853	7.277

Table 7.10: Forecasted Livestock Population

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cattle	106154	106157	106166	106180	106201	106227	106259	106298	0.025
Milch Cow	14862	14862	14863	14865	14868	14872	14876	14882	0.025
Bullocks	91292	91295	91303	91315	91333	91355	91383	91416	0.025
Buffalo-Total	87170	87171	87172	87175	87178	87182	87188	87194	0.005
Milch Buffaloes	19190	19190	19189	19188	19187	19185	19183	19180	-0.009
Sheep	4660	4659	4656	4650	4643	4633	4621	4607	-0.211
Goats	166590	166579	166552	166506	166442	166360	166258	166137	-0.050
Pigs	12962	13934	14906	15878	16850	17822	18794	19766	5.806
Chickens	147580	158023	168466	178909	189352	199795	210238	220681	5.548
Total LSU	166369	166369	166370	166372	166375	166379	166383	166388	0.002

Table 7.11: Forecasted Annual Production and Growth in Livestock Products (MT)

Livestock Product	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cow Milk	1448	1448	1448	1448	1448	1449	1449	1449	0.025
Buff Milk	3658	3658	3657	3657	3657	3657	3656	3656	-0.009
Ghee Supply	72	72	72	72	72	72	72	72	-0.001
Net Milk Supply	3574	3574	3574	3574	3574	3574	3574	3574	0.001
Buffalo Meat	2624	2624	2624	2624	2625	2625	2625	2626	0.009
Goat and Sheep Meat	526	526	526	526	526	525	525	525	-0.054
Chicken Meat	195	209	222	236	250	264	278	291	5.548
Pork Meat	122	131	140	149	158	168	177	186	5.806
Aggregate Meat	3467	3490	3513	3536	3559	3581	3604	3627	0.643
Wool Production (kg)	2051	2051	2049	2047	2044	2039	2034	2028	-0.211

Table 7.12: Forecasted Cost and Returns from Livestock (Rs/animal)

Livestock Cost and Returns	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Raising Cost/Animal									
Buffaloes	32402	34670	37098	39697	42479	45457	48644	52056	7.010
Sheep and Goat	16325	17466	18686	19988	21378	22862	24446	26137	6.942
Pigs	1853	2132	2440	2781	3158	3574	4033	4538	13.212
Chickens	2069	2370	2704	3072	3479	3928	4423	4968	12.936
Milch Cow	6250	6688	7157	7659	8196	8772	9389	10050	7.027
Milch Buffalo	12823	13721	14681	15707	16806	17981	19237	20581	6.990
Cattle (excluding M)	30715	32866	35170	37637	40279	43109	46141	49389	7.027
Total	102438	109914	117935	126542	135776	145683	156313	167718	7.297
Gross Margin/Animal									
Buffaloes	36798	42476	48909	56191	64427	73736	84250	96118	14.468
Sheep and Goats	18431	20671	23208	26079	29324	32989	37123	41782	12.479
Pigs	1954	2356	2823	3366	3994	4719	5556	6518	18.214
Poultry	9629	11381	13390	15690	18320	21323	24746	28645	16.427
Cow (Milk+Ghee)	8610	9513	10508	11603	12807	14132	15589	17192	10.347
Buffalo (Milk+Ghee)	25895	28502	31363	34501	37943	41718	45857	50395	9.950
Total Gross Margin	101318	114899	130201	147429	166816	188617	213121	240649	13.072

Table 7.13: Forecasted Per Capita Food Supply (kg/adult)

Food (Edible Form)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal Grains	148.43	147.92	147.61	146.78	145.58	144.40	143.99	142.68	-0.676
Meat	12.45	12.34	12.23	12.12	12.02	11.91	11.81	11.71	-0.858
Milk	12.83	12.63	12.44	12.25	12.07	11.89	11.71	11.54	-1.491
Oils and Fats	0.47	0.47	0.47	0.48	0.48	0.48	0.48	0.48	0.110
Vegetables	29.24	29.18	29.17	29.10	28.99	28.89	28.93	28.84	-0.225

Table 7.14: Forecasted Per Capita Food Demand (kg/adult)

Food (Edible Form)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal Grains	130.39	128.30	128.57	128.40	128.19	128.14	128.61	128.22	-0.055
Vegetables	24.85	22.50	22.68	22.41	22.12	22.00	22.41	21.95	-0.645
Meat	3.77	3.29	3.33	3.28	3.22	3.20	3.28	3.20	-0.822
Milk	21.99	20.52	20.61	20.43	20.23	20.14	20.14	20.09	-0.515
Oils and Fats	2.30	2.15	2.16	2.14	2.12	2.12	2.14	2.11	-0.444

Table 7.15: Forecasted Per Capita Food Balance Situation (kg/adult)

Food (Edible Form)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal Grains	18.04	19.62	19.04	18.37	17.39	16.27	15.38	14.47	-5.344
Vegetables	4.38	6.68	6.49	6.68	6.87	6.90	6.52	6.89	1.187
Meat	8.68	9.05	8.90	8.84	8.80	8.71	8.53	8.52	-0.872
Milk	-9.16	-7.89	-8.17	-8.18	-8.16	-8.25	-8.67	-8.55	0.902
Oils and Fats	-1.83	-1.68	-1.69	-1.67	-1.65	-1.64	-1.66	-1.63	-0.603

Table 7.16: Forecasted Changes in Land Use (%)

Land Use	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Forests	33.10	33.09	33.07	33.02	32.96	32.88	32.78	32.66	-0.248
Shrublands	15.05	15.06	15.07	15.09	15.12	15.16	15.21	15.27	0.269
Grasslands	8.84	8.84	8.84	8.85	8.86	8.87	8.89	8.90	0.138
Adjacent NCI	15.42	15.42	15.42	15.42	15.43	15.44	15.45	15.46	0.053
Net Cultivated	19.55	19.56	19.56	19.57	19.58	19.60	19.62	19.64	0.083
Others	8.04	8.04	8.04	8.04	8.05	8.05	8.05	8.06	0.051
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000

Table 7.17: Supply of Fuelwood from Different Sources (%)

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Forests	67.91	67.84	67.75	67.65	67.53	67.39	67.23	67.05	-0.209
Shrublands	11.61	11.60	11.61	11.63	11.66	11.71	11.76	11.83	0.373
Grasslands	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.76	0.281
Adjacent NCI	12.61	12.60	12.60	12.61	12.62	12.64	12.66	12.69	0.140
Net Cultivated	6.31	6.39	6.47	6.55	6.63	6.71	6.78	6.86	1.152
Total	99.19	99.19	99.19	99.19	99.19	99.19	99.18	99.18	-0.001

Table 7.18: Forecasted Fuelwood Supply from Different Sources (ADT)

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Forest: Hardwood	74867	74838	74760	74629	74445	74206	73910	73556	-0.324
Conifer	4315	4314	4312	4309	4305	4300	4294	4286	-0.121
Mixed	31071	31062	31037	30994	30934	30857	30761	30646	-0.253
Shrublands	18847	18854	18871	18901	18942	18996	19062	19142	0.285
Grazinglands	1212	1212	1213	1214	1216	1218	1221	1225	0.193
Adjacent NCI	20476	20477	20481	20487	20495	20506	20519	20535	0.053
Cultivated Area	1317	1318	1318	1318	1319	1320	1322	1323	0.083
Crop Residue	10248	10389	10523	10649	10768	10882	10991	11094	1.064
Total Fuelwood Supply	162353	162464	162514	162501	162425	162285	162080	161807	-0.087

Table 7.19: Forecasted Timber Supply and Demand (cubic metre)

	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Timber Supply	16135	16129	16114	16090	16055	16010	15954	15887	-0.284
Timber Demand	13924	14143	14362	14583	14806	15030	15256	15483	1.514

Table 7.20: Forecasted Share of Fodder Supply by Sources (%)

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Forests	25.81	25.69	25.56	25.43	25.28	25.13	24.97	24.79	-0.614
Shrublands	21.14	21.06	20.99	20.94	20.91	20.90	20.90	20.92	-0.065
Grasslands	4.79	4.77	4.75	4.74	4.72	4.71	4.71	4.70	-0.212
Adjacent NCI	7.16	7.13	7.10	7.08	7.05	7.03	7.01	7.00	-0.297
Net Cultivated	41.11	41.36	41.60	41.82	42.03	42.23	42.42	42.60	0.476

Table 7.21: Forecasted Fodder Supply by Sources (MT-TDN)

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Forests	25677	25669	25647	25610	25558	25491	25408	25309	-0.265
Shrublands	21032	21040	21059	21092	21138	21198	21273	21362	0.285
Grazinglands	4763	4764	4766	4770	4775	4781	4789	4799	0.138
Adjacent NCI	7122	7122	7124	7126	7129	7132	7137	7143	0.053
Risers and Bunds	2635	2635	2636	2637	2639	2641	2643	2647	0.083
Fallow Grazings	2258	2259	2259	2260	2262	2264	2266	2269	0.083
Tree Fodder	5269	5270	5271	5274	5277	5282	5287	5293	0.083
Crop Residue	30744	31168	31568	31946	32305	32646	32972	33283	1.064
Total Fodder Supply	99500	99926	100330	100714	101082	101435	101775	102104	0.351
Total Fodder Demand	103764	103764	103765	103766	103768	103770	103773	103776	0.002

Table 7.22: Forecasted Population and Changes in the Size of the Active Population

Composition	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Economically Active Males	87191	88841	91715	94324	95551	95543	97271	95932	0.903
Economically Active Females	57388	58363	60068	61607	62318	62290	63310	65143	1.635
Total Active Population	144579	147204	151783	155932	157869	157833	160581	161075	1.195
Total: Male	143685	146102	148533	150976	153431	155895	158370	160857	1.607
Total: Female	134803	136748	138711	140692	142692	144711	146748	148800	1.414
Total Population	278488	282850	287244	291668	296123	300606	305118	309657	1.514
Growth Rate	0.015	0.016	0.016	0.015	0.015	0.015	0.015	0.015	-0.863

Table 7.23: Labour Use by Sector ('000 mandays)

Labour Use & Activity	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Labour Days Available	36145	36801	37946	38983	39467	39458	40145	40269	1.195
Crops	6875	6974	7067	7156	7240	7321	7398	7472	1.121
Livestock	16637	16637	16637	16637	16638	16638	16638	16639	0.002
Professional Workers	555	565	583	599	606	606	617	619	1.195
Office Workers	625	636	656	674	682	682	694	696	1.195
Sales and Service Workers	1319	1343	1384	1422	1440	1439	1464	1469	1.195
Production Workers	1457	1484	1530	1572	1591	1591	1619	1624	1.195
Construction, etc	347	353	364	374	379	379	385	387	1.195
General Labourers	3019	3074	3169	3256	3296	3296	3353	3363	1.195
Total Labour Use	30834	31065	31391	31690	31872	31951	32168	32268	0.553
Labour Use (%)	85	84	83	81	81	81	80	80	-0.635

Table 7.24: Forecasted Values of Food and Non-food Imports (Rs'000)

Imports/Exports	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Growth Rate (%)	0.020	0.018	0.018	0.018	0.018	0.018	0.018	0.017	-1.327
Total Food Export	52807	78059	83963	93823	104270	113663	118384	133959	9.793
Total N-Food Import	261494	266319	271225	276134	281040	285969	291022	296037	1.766
Value of T-Imports	314300	344378	355188	369957	385310	399632	409406	429996	3.897
Per Capita Food Export	190	276	292	322	352	378	388	433	8.156
Per Capita Non-food Import	939	942	944	947	949	951	954	956	0.248

Table 7.25: Forecasted Nominal Income by Source (Rs'000)

Sources of Income	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	86801	102535	121042	140259	160485	183099	212042	239866	14.659
Livestock	101318	114899	130201	147429	166816	188617	213121	240649	13.072
Professional Workers	7105	7740	8539	9387	10169	10878	11842	12710	8.279
Office Workers	7424	8088	8923	9809	10626	11367	12375	13282	8.279
Sales and Service Workers	17368	18921	20875	22947	24858	26592	28949	31070	8.279
Production Workers	12251	13347	14725	16186	17535	18758	20420	21917	8.279
Construction, etc	3493	3805	4198	4615	4999	5348	5822	6249	8.279
General Labourers	23114	25181	27782	30539	33083	35390	38527	41351	8.279
Total Dhading Income	258873	294516	336285	381172	428570	480049	543099	607094	12.541
Per Capita Income (Rs)	930	1041	1171	1307	1447	1597	1780	1961	10.862

Table 7.26: Forecasted Real Income by Source (Rs'000)

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	78706	84569	90950	96148	100493	104849	111139	115187	4.839
Livestock	91870	94767	97831	101063	104458	108009	111705	115563	3.388
Professional Workers	6442	6384	6416	6435	6368	6229	6207	6104	-0.995
Office Workers	6732	6671	6705	6724	6654	6509	6486	6378	-0.995
Sales and Service Workers	15748	15605	15685	15730	15566	15227	15173	14921	-0.995
Production Workers	11108	11008	11064	11096	10980	10741	10703	10525	-0.995
Construction, etc	3167	3138	3154	3163	3130	3062	3052	3001	-0.995
General Labourers	20958	20769	20875	20935	20716	20266	20194	19857	-0.995
Total Dhading Income	234731	242911	252681	261294	268364	274893	284659	291536	2.902
Per Capita Income (Rs)	843	859	880	896	906	914	933	941	1.367

Table 7.27: Forecasted Income Shares by Source (%)

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	33.53	34.81	35.99	36.80	37.45	38.14	39.04	39.51	1.882
Livestock	39.14	39.01	38.72	38.68	38.92	39.29	39.24	39.64	0.472
Professional Workers	2.74	2.63	2.54	2.46	2.37	2.27	2.18	2.09	-3.787
Office Workers	2.87	2.75	2.65	2.57	2.48	2.37	2.28	2.19	-3.787
Sales and Service Workers	6.71	6.42	6.21	6.02	5.80	5.54	5.33	5.12	-3.787
Production Workers	4.73	4.53	4.38	4.25	4.09	3.91	3.76	3.61	-3.787
Construction, etc	1.35	1.29	1.25	1.21	1.17	1.11	1.07	1.03	-3.787
General Labourers	8.93	8.55	8.26	8.01	7.72	7.37	7.09	6.81	-3.787
Total	100	100	100	100	100	100	100	100	0.000

Table 7.28: Performance and Sustainability Indicators

Indicators	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Per Capita Cultivated Land	0.14	0.13	0.13	0.13	0.13	0.13	0.12	0.12	-1.409
Per Capita Accessible Forest	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	-1.771
Population Density Per Cultivated Land	7.40	7.51	7.63	7.74	7.86	7.97	8.08	8.19	1.430
Population Density Per Accessible Forest	5.01	5.09	5.17	5.26	5.35	5.45	5.55	5.65	1.803
Forest-Cultivated Land Ratio	1.48	1.48	1.48	1.47	1.47	1.46	1.46	1.45	-0.367
Shrub-Forest Area Ratio	0.52	0.52	0.52	0.52	0.53	0.53	0.53	0.54	0.555
LSU Per Cultivated Area	4.42	4.42	4.42	4.42	4.41	4.41	4.41	4.40	-0.081
LSU Per Forest Area	2.99	2.99	2.99	3.00	3.01	3.01	3.02	3.04	0.287
LSU Per Grazing Area	9.78	9.78	9.77	9.77	9.76	9.74	9.73	9.71	-0.136

Table 7.29: Carrying Capacity of Agricultural Land in Terms of Calorie ('000)

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Per ha Calorie Supply	3851	3846	3849	3841	3826	3813	3822	3809	-0.208
Per ha Calorie Demand	5201	5212	5226	5244	5265	5289	5315	5344	0.446
Supply as % of Demand	74	74	74	73	73	72	72	71	-0.651
Carrying Capacity Per ha	5.32	5.32	5.32	5.31	5.29	5.27	5.28	5.27	-0.208
Current Load	7.19	7.20	7.22	7.25	7.28	7.31	7.35	7.39	0.446

Table 7.30: Carrying Capacity of Land in Terms of Fuelwood (persons/ha)

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Fuelwood Supply	1.69	1.69	1.69	1.69	1.69	1.68	1.68	1.68	-0.134
Per ha Demand	1.70	1.73	1.76	1.78	1.81	1.84	1.86	1.89	1.467
Supply as % of Demand	99	98	96	95	93	92	90	89	-1.577
Carrying Capacity	2.87	2.87	2.87	2.87	2.87	2.87	2.86	2.85	-0.134
Current Load	2.90	2.94	2.99	3.03	3.08	3.12	3.17	3.21	1.467

Table 7.31: Carrying Capacity of Forest Land in Terms of Fuelwood (person/ha)

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Fuelwood Supply	4.13	4.13	4.13	4.13	4.13	4.13	4.12	4.12	-0.020
Per ha Demand	5.82	5.91	6.01	6.11	6.22	6.33	6.44	6.57	1.795
Supply as % of Demand	71	70	69	68	66	65	64	63	-1.783
Carrying Capacity	7.02	7.02	7.02	7.02	7.02	7.02	7.01	7.01	-0.020
Current Load	9.89	10.05	10.22	10.39	10.57	10.76	10.96	11.17	1.795

Table 7.32: Carrying Capacityof Forest in Terms of Timber

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Timber Supply Per ha	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.000
Per ha Demand	0.25	0.25	0.26	0.26	0.27	0.27	0.28	0.28	1.803
Supply as % of Demand	116	114	112	110	108	107	105	103	-1.77
Carrying Capacity	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	0.000
Current Load	5.01	5.09	5.17	5.26	5.35	5.45	5.55	5.65	1.803

Table 7.33: Carrying Capacity of Land in Terms of Fodder

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Total Fodder SS/ha	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.82	0.382
Fodder Demand Per	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.033
Supply as % of Demand	96	96	97	97	97	98	98	98	0.349
Carrying Capacity	1.28	1.28	1.29	1.29	1.30	1.30	1.31	1.31	0.382
Current Load	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	0.033

Table 7.34: Carrying Capacity of Forest Land in terms of Fodder

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Total Fodder Supply/ha	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.020
Fodder Demand	1.87	1.87	1.87	1.87	1.87	1.88	1.89	1.89	0.287
Supply as % of Demand	25	25	25	25	25	25	24	24	-0.267
Carrying Capacity	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.020
Current Load	2.99	2.99	2.99	3.00	3.01	3.01	3.02	3.04	0.287

Table 7.35: Impact of Population Policy on the Size of the Population and Growth Rate

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Baseline													
Total Population	287244	291668	296123	300606	305118	309657	314222	318813	323640	328539	333513	338562	343687
Growth Rate (%)	1.514	(1981-1991)											
Population													
Total Population	286704	290176	293251	295915	298155	299960	302684	305433	308207	311006	313830	316680	319555
Growth Rate (%)	1.363	1.211	1.060	0.908	0.757	0.605	0.908	0.908	0.908	0.908	0.908	0.908	0.908
Net Annual Reduction	540	1492	2872	4691	6963	9697	11538	13380	15433	17533	19683	21882	24132
Cumulative Reduction	540	2032	4364	7563	11654	16660	21235	24918	28813	32966	37216	41565	46014

Table 7.36: Impacts of Alternative Policies on Crop Yields

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Paddy	1998	1993	1983	1975	1982	1973	1978	1976	1972	1971	1970	1969	1969	-0.123
Maize	1495	1494	1489	1486	1489	1486	1488	1488	1486	1486	1485	1485	1485	-0.057
Wheat	1344	1342	1338	1334	1337	1333	1335	1334	1332	1332	1331	1331	1330	-0.088
Millet	1011	1011	1010	1008	1010	1008	1009	1009	1009	1009	1009	1009	1009	-0.023
Oilseeds	662	661	660	659	660	660	660	660	660	660	660	660	660	-0.021
Potatoes	7417	7411	7394	7381	7395	7380	7390	7389	7383	7382	7381	7381	7380	-0.042
Irrigation														
Paddy	2082	2179	2168	2159	2166	2157	2161	2160	2156	2154	2153	2153	2152	0.275
Maize	1518	1552	1548	1544	1548	1544	1547	1546	1545	1544	1544	1544	1543	0.136
Wheat	1483	1522	1517	1513	1515	1511	1513	1512	1510	1510	1509	1509	1508	0.138
Millet	1011	1011	1010	1008	1010	1008	1009	1009	1009	1009	1009	1009	1009	-0.023
Oilseeds	722	736	735	734	735	734	735	735	735	735	735	735	735	0.149
Potatoes	7778	7982	7964	7950	7965	7949	7960	7958	7952	7951	7950	7944	7949	0.182
Fertiliser														
Paddy	2113	2217	2206	2196	2204	2194	2199	2198	2193	2192	2191	2190	2189	0.298
Maize	1511	1547	1542	1539	1543	1539	1541	1541	1539	1539	1538	1538	1538	0.146
Wheat	1422	1468	1463	1459	1462	1458	1460	1459	1457	1457	1456	1456	1455	0.195
Millet	1011	1011	1010	1008	1010	1008	1009	1009	1009	1009	1009	1009	1009	-0.023
Oilseeds	666	683	682	681	682	681	682	682	681	681	681	681	681	0.190
Potatoes	7624	7628	7611	7597	7612	7597	7607	7605	7599	7598	7597	7597	7596	-0.030
Population+Irrigation+ Fertiliser														
Paddy	2200	2301	2289	2279	2286	2275	2282	2281	2277	2276	2275	2274	2273	0.271
Maize	1534	1569	1564	1560	1564	1559	1563	1562	1561	1561	1560	1560	1560	0.138
Wheat	1568	1609	1604	1599	1602	1597	1600	1599	1597	1596	1596	1595	1595	0.141
Millet	1011	1011	1009	1008	1009	1008	1009	1009	1009	1008	1008	1008	1008	-0.024
Oilseeds	726	740	739	738	739	738	739	739	738	738	738	738	738	0.137
Potatoes	7992	8200	8181	8164	8179	8161	8175	8174	8169	8168	8167	8167	8166	0.179

Table 7.37: Impacts of Alternative Policies on the Per Capita Food Availability

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Cereal Grains (Edible form)	147.61	146.78	145.58	144.40	143.99	142.68	142.05	141.06	139.82	138.70	137.54	136.36	135.16	-0.732
Meat	12.23	12.12	12.02	11.91	11.81	11.71	11.62	11.52	11.42	11.32	11.22	11.12	11.02	-0.865
Milk	12.44	12.25	12.07	11.89	11.71	11.54	11.37	11.21	11.04	10.88	10.72	10.56	10.40	-1.483
Oils and Fats	0.47	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.051
Vegetables	29.17	29.10	28.99	28.89	28.93	28.84	28.86	28.84	28.78	28.74	28.71	28.67	28.64	-0.152
Population														
Cereal Grains (Edible form)	147.83	147.44	146.88	146.52	147.15	147.05	147.30	147.09	146.72	146.41	146.07	145.68	145.26	-0.146
Meat	12.25	12.18	12.13	12.10	12.09	12.09	12.06	12.03	11.99	11.96	11.92	11.89	11.85	-0.277
Milk	12.46	12.32	12.19	12.08	11.99	11.91	11.81	11.70	11.60	11.49	11.39	11.29	11.18	-0.899
Oils and Fats	0.48	0.48	0.48	0.48	0.49	0.49	0.50	0.50	0.50	0.51	0.51	0.51	0.51	0.643
Vegetables	29.21	29.23	29.25	29.33	29.57	29.73	29.94	30.08	30.20	30.35	30.49	30.64	30.78	0.437
Livestock														
Cereal Grains (Edible form)	145.46	146.78	145.58	144.40	143.99	142.68	142.05	141.06	139.82	138.70	137.54	136.36	135.16	-0.610
Meat	12.23	12.12	12.02	11.91	11.81	11.71	11.62	11.52	11.42	11.32	11.22	11.12	11.02	-0.865
Milk	25.95	25.56	25.17	24.80	24.43	24.07	23.72	23.38	23.03	22.69	22.35	22.02	21.69	-1.483
Oils and Fats	0.74	0.74	0.74	0.74	0.73	0.73	0.73	0.73	0.72	0.72	0.71	0.71	0.71	-0.428
Vegetables	28.56	29.10	28.99	28.89	28.93	28.84	28.86	28.84	28.78	28.74	28.71	28.67	28.64	0.024
Irrigation														
Cereal Grains (Edible form)	152.90	156.84	155.60	154.36	153.95	152.57	151.91	150.88	149.58	148.39	147.17	145.92	144.65	-0.461
Meat	12.23	12.12	12.02	11.91	11.81	11.71	11.62	11.52	11.42	11.32	11.22	11.12	11.02	-0.865
Milk	12.44	12.25	12.07	11.89	11.71	11.54	11.37	11.21	11.04	10.88	10.72	10.56	10.40	-1.483
Oils and Fats	0.50	0.50	0.50	0.50	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.218
Vegetables	30.78	31.65	31.53	31.43	31.47	31.37	31.39	31.37	31.30	31.27	31.23	31.19	31.15	0.100
Fertiliser														
Cereal Grains (Edible form)	152.36	156.69	155.44	154.20	153.79	152.42	151.76	150.73	149.43	148.24	147.02	145.78	144.51	-0.440
Meat	12.23	12.12	12.02	11.91	11.81	11.71	11.62	11.52	11.42	11.32	11.22	11.12	11.02	-0.865
Milk	12.44	12.25	12.07	11.89	11.71	11.54	11.37	11.21	11.04	10.88	10.72	10.56	10.40	-1.483
Oils & Fats	0.48	0.48	0.48	0.48	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.178
Vegetables	30.09	30.07	29.96	29.86	29.89	29.80	29.82	29.80	29.74	29.70	29.67	29.63	29.59	-0.139
Population, Irrigation & Fertilisers														
Cereal-Grain (Edible form)	158.15	162.81	162.24	161.89	162.63	162.56	162.79	162.47	161.98	161.55	161.09	160.58	160.03	0.098
Meat	12.25	12.18	12.13	12.10	12.09	12.09	12.05	12.01	11.97	11.92	11.88	11.84	11.79	-0.318
Milk	12.46	12.32	12.19	12.08	11.99	11.91	11.80	11.68	11.57	11.46	11.35	11.24	11.13	-0.940
Oils & Fats	0.50	0.51	0.51	0.51	0.52	0.52	0.53	0.53	0.53	0.54	0.54	0.54	0.55	0.769
Vegetables	97.22	98.88	97.58	96.48	95.95	95.14	94.40	93.47	92.50	91.59	90.69	89.80	88.92	-0.741

Table 7.38: Impacts of Alternative Policies on the Per Capita Food Demand

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Cereal Grains	128.57	128.40	128.19	128.14	128.61	128.22	128.58	128.49	128.39	128.45	128.46	128.47	128.48	-0.006
Vegetables	22.68	22.41	22.12	22.00	22.41	21.95	22.26	22.12	21.98	22.00	21.98	21.95	21.93	-0.278
Meat	3.33	3.28	3.22	3.20	3.28	3.20	3.26	3.23	3.21	3.21	3.21	3.21	3.20	-0.321
Milk	20.61	20.43	20.23	20.14	20.38	20.09	20.27	20.18	20.08	20.09	20.07	20.05	20.03	-0.238
Oils and Fats	2.16	2.14	2.12	2.12	2.14	2.11	2.13	2.12	2.11	2.11	2.11	2.11	2.11	-0.197
Population														
Cereal Grains	128.61	128.49	128.32	128.31	128.83	128.49	128.80	128.67	128.63	128.68	128.69	128.70	128.71	0.006
Vegetables	22.71	22.50	22.25	22.17	22.63	22.22	22.48	22.31	22.22	22.22	22.20	22.18	22.15	-0.207
Meat	3.34	3.30	3.25	3.23	3.33	3.25	3.30	3.27	3.26	3.26	3.26	3.25	3.25	-0.222
Milk	20.64	20.48	20.31	20.25	20.52	20.26	20.41	20.29	20.23	20.23	20.21	20.19	20.17	-0.189
Oils and Fats	2.16	2.15	2.13	2.13	2.16	2.13	2.15	2.13	2.13	2.13	2.13	2.13	2.12	-0.150
Livestock														
Cereal Grains	135.19	128.80	127.99	127.97	128.38	128.07	128.39	128.33	128.25	128.32	128.33	128.35	128.36	-0.431
Vegetables	30.03	22.80	21.92	21.83	22.18	21.81	22.08	21.96	21.85	21.87	21.85	21.83	21.82	-2.626
Meat	5.30	3.35	3.18	3.17	3.24	3.17	3.22	3.20	3.18	3.19	3.18	3.18	3.18	-4.168
Milk	26.54	20.64	20.11	20.03	20.24	20.00	20.15	20.07	19.99	20.00	19.98	19.97	19.95	-2.350
Oils and Fats	2.43	2.17	2.11	2.11	2.13	2.10	2.12	2.11	2.11	2.11	2.11	2.10	2.10	-1.180
Irrigation														
Cereal Grains	130.68	130.08	128.14	128.09	128.55	128.17	128.52	128.43	128.34	128.40	128.42	128.43	128.43	-0.144
Vegetables	24.97	24.17	22.06	21.94	22.34	21.90	22.20	22.06	21.93	21.95	21.92	21.90	21.88	-1.095
Meat	3.78	3.64	3.21	3.19	3.27	3.18	3.25	3.22	3.20	3.20	3.20	3.20	3.19	-1.386
Milk	21.89	21.50	20.19	20.10	20.33	20.05	20.23	20.14	20.05	20.05	20.03	20.02	20.00	-0.750
Oils and Fats	2.32	2.26	2.12	2.11	2.14	2.11	2.13	2.12	2.11	2.11	2.11	2.11	2.11	-0.810
Fertiliser														
Cereal Grains	130.32	130.01	128.14	128.09	128.55	128.17	128.52	128.43	128.34	128.40	128.41	128.42	128.43	-0.122
Vegetables	24.58	24.12	22.07	21.96	22.35	21.91	22.21	22.07	21.93	21.96	21.93	21.91	21.89	-0.963
Meat	3.73	3.62	3.21	3.19	3.27	3.19	3.25	3.22	3.20	3.20	3.20	3.20	3.20	-1.273
Milk	21.82	21.46	20.20	20.11	20.35	20.06	20.24	20.14	20.05	20.06	20.04	20.02	20.01	-0.719
Oils and Fats	2.28	2.25	2.12	2.11	2.14	2.11	2.13	2.12	2.11	2.11	2.11	2.11	2.11	-0.654
Population+Irrigation+ Fertiliser														
Cereal Grains	142.95	129.59	127.82	127.88	128.37	128.10	128.36	128.27	128.24	128.31	128.34	128.36	128.38	-0.892
Vegetables	41.90	23.66	21.75	21.74	22.15	21.83	22.04	21.90	21.83	21.86	21.85	21.84	21.83	-5.288
Meat	7.81	3.53	3.15	3.15	3.23	3.17	3.22	3.19	3.18	3.18	3.18	3.18	3.18	-7.204
Milk	31.40	21.18	19.99	19.97	20.22	20.01	20.13	20.03	19.99	20.00	19.99	19.98	19.97	-3.700
Oils and Fats	3.26	2.22	2.10	2.10	2.13	2.10	2.12	2.11	2.10	2.11	2.10	2.10	2.10	-3.584

Table 7.39: Impacts of Alternative Policies on the Per Capita Food Balance

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Cereal Grains	19.04	18.37	17.39	16.27	15.38	14.47	13.47	12.57	11.43	10.24	9.08	7.89	6.68	-8.361
Vegetables	6.49	6.68	6.87	6.90	6.52	6.89	6.60	6.72	6.80	6.74	6.73	6.72	6.71	0.274
Meat	8.90	8.84	8.80	8.71	8.53	8.52	8.36	8.29	8.21	8.10	8.01	7.91	7.81	-1.078
Milk	-8.17	-8.18	-8.16	-8.25	-8.67	-8.55	-8.90	-8.97	-9.04	-9.21	-9.35	-9.49	-9.63	1.380
Oils and Fats	-1.69	-1.67	-1.65	-1.64	-1.66	-1.63	-1.65	-1.64	-1.63	-1.64	-1.63	-1.63	-1.63	-0.268
Population														
Cereal Grains	19.23	18.95	18.56	18.21	18.31	18.56	18.51	18.41	18.09	17.74	17.38	16.98	16.55	-1.240
Vegetables	6.50	6.74	7.01	7.16	6.94	7.51	7.46	7.77	7.99	8.12	8.29	8.46	8.63	2.387
Meat	8.91	8.89	8.89	8.87	8.76	8.84	8.75	8.75	8.74	8.70	8.67	8.63	8.60	-0.298
Milk	-8.17	-8.17	-8.12	-8.17	-8.54	-8.34	-8.60	-8.59	-8.64	-8.74	-8.82	-8.90	-8.99	0.798
Oils and Fats	-1.69	-1.67	-1.65	-1.64	-1.67	-1.64	-1.65	-1.63	-1.63	-1.62	-1.62	-1.61	-1.61	-0.387
Livestock														
Cereal Grains	10.26	17.98	17.59	16.43	15.61	14.61	13.66	12.73	11.57	10.38	9.21	8.01	6.79	-3.379
Vegetables	-1.47	6.30	7.06	7.07	6.75	7.03	6.79	6.87	6.93	6.87	6.86	6.84	6.82	0.000
Meat	6.93	8.77	8.83	8.75	8.57	8.55	8.39	8.32	8.24	8.13	8.03	7.94	7.84	1.032
Milk	-0.59	4.91	5.06	4.76	4.19	4.08	3.57	3.31	3.04	2.69	2.37	2.05	1.74	0.000
Oils and Fats	-1.68	-1.42	-1.37	-1.37	-1.39	-1.37	-1.39	-1.39	-1.38	-1.39	-1.39	-1.39	-1.40	-1.534
Irrigation														
Cereal Grains	22.23	26.77	27.46	26.27	25.40	24.40	23.39	22.45	21.23	19.90	18.76	17.50	16.22	-2.592
Vegetables	5.81	7.48	9.48	9.49	9.13	9.47	9.20	9.31	9.38	9.32	9.30	9.29	9.27	3.975
Meat	8.45	8.48	8.81	8.73	8.54	8.53	8.37	8.30	8.22	8.12	8.02	7.92	7.82	-0.642
Milk	-9.45	-9.25	-8.12	-8.21	-8.62	-8.51	-8.86	-8.93	-9.00	-9.18	-9.32	-9.46	-9.60	0.131
Oils and Fats	-1.83	-1.75	-1.62	-1.61	-1.63	-1.60	-1.62	-1.61	-1.60	-1.60	-1.60	-1.60	-1.60	-1.111
Fertiliser														
Cereal Grains	22.04	26.68	27.30	26.11	25.24	24.25	23.24	22.30	21.08	19.84	18.61	17.35	16.08	-2.597
Vegetables	5.51	5.95	7.89	7.90	7.54	7.89	7.61	7.73	7.81	7.75	7.73	7.72	7.71	2.839
Meat	8.50	8.50	8.81	8.72	8.54	8.53	8.37	8.30	8.22	8.11	8.02	7.92	7.82	-0.692
Milk	-9.37	-9.21	-8.13	-8.22	-8.63	-8.52	-8.87	-8.94	-9.01	-9.18	-9.32	-9.47	-9.61	0.203
Oils and Fats	-1.80	-1.77	-1.64	-1.63	-1.65	-1.62	-1.64	-1.63	-1.62	-1.62	-1.62	-1.62	-1.62	-0.887
Population+Irrigation+Fertiliser														
Cereal Grains	15.20	33.22	34.42	34.01	34.26	34.46	34.42	34.20	33.73	33.25	32.75	32.22	31.65	6.301
Vegetables	55.32	75.22	75.83	74.75	73.79	73.31	72.36	71.57	70.67	69.73	68.84	67.96	67.09	1.620
Meat	4.44	8.65	8.99	8.96	8.86	8.92	8.84	8.82	8.79	8.74	8.70	8.65	8.61	5.667
Milk	-18.93	-8.87	-7.80	-7.89	-8.23	-8.10	-8.33	-8.35	-8.42	-8.54	-8.64	-8.74	-8.84	-6.148
Oils and Fats	-2.76	-1.72	-1.59	-1.59	-1.61	-1.58	-1.59	-1.58	-1.57	-1.57	-1.56	-1.56	-1.56	-4.662

Table 7.40: Impacts of Alternative Policies on the Per Capita Calorie Supply and Demand

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Per ha Calorie Supply	3849	3841	3826	3813	3822	3809	3815	3812	3806	3804	3802	3801	3799	-0.108
Per ha Calorie Demand	5226	5244	5265	5289	5315	5344	5374	5406	5443	5482	5523	5567	5612	0.595
Supply as % of Demand	74	73	73	72	72	71	71	71	70	69	69	68	68	-0.699
Carrying Capacity Per ha	5.32	5.31	5.29	5.27	5.28	5.27	5.27	5.27	5.26	5.26	5.26	5.25	5.25	-0.108
Current Load	7.22	7.25	7.28	7.31	7.35	7.39	7.43	7.47	7.52	7.58	7.64	7.70	7.76	0.595
Population														
Per ha Calorie Supply	3857	3839	3823	3809	38.17	3803	3810	3808	3803	3801	3799	3798	3796	-0.111
Per ha Calorie Demand	5216	5217	5214	5207	5194	5176	5177	5179	5183	5190	5197	5207	5218	0.002
Supply as % of Demand	74	74	73	73	73	73	74	74	73	73	73	73	73	-0.113
Carrying Capacity Per ha	5.32	5.31	5.28	5.27	5.28	5.26	5.27	5.26	5.26	5.26	5.25	5.25	5.25	-0.111
Current Load	7.21	7.21	7.21	7.20	7.18	7.16	7.16	7.16	7.17	7.17	7.19	7.20	7.21	0.002
Livestock														
Per ha Calorie Supply	3791	3841	3826	3813	3822	3809	3815	3812	3806	3804	3802	3801	3799	0.017
Per ha Calorie Demand	5226	5244	5265	5289	5315	5344	5374	5406	5443	5482	5523	5567	5612	0.595
Supply as % of Demand	73	73	73	72	72	71	71	71	70	69	69	68	68	-0.574
Carrying Capacity Per ha	5.24	5.31	5.29	5.27	5.28	5.27	5.27	5.27	5.26	5.26	5.26	5.25	5.25	0.017
Current Load	7.22	7.25	7.28	7.31	7.35	7.39	7.43	7.47	7.52	7.58	7.64	7.70	7.76	0.595
Irrigation														
Per ha Calorie Supply	3991	4109	4094	4081	4091	4078	4084	4082	4076	4074	4073	4072	4071	0.165
Per ha Calorie Demand	5226	5244	5265	5289	5315	5344	5374	5406	5443	5482	5523	5567	5612	0.595
Supply as % of Demand	76	78	78	77	77	76	76	76	75	74	74	73	73	-0.428
Carrying Capacity Per ha	5.52	5.68	5.66	5.64	5.66	5.64	5.65	5.64	5.64	5.63	5.63	5.63	5.63	0.165
Current Load	7.22	7.25	7.28	7.31	7.35	7.39	7.43	7.47	7.52	7.58	7.64	7.70	7.76	0.595
Fertiliser														
Per ha Calorie Supply	3973	4095	4079	4066	4076	4063	4069	4067	4061	4059	4058	4057	4055	0.171
Per ha Calorie Demand	5226	5244	5265	5289	5315	5344	5374	5406	5443	5482	5523	5567	5612	0.595
Supply as % of Demand	76	78	77	77	77	76	76	75	75	74	73	73	72	-0.422
Carrying Capacity Per ha	5.49	5.66	5.64	5.62	5.64	5.62	5.63	5.62	5.61	5.61	5.61	5.61	5.61	0.171
Current Load	7.22	7.25	7.28	7.31	7.35	7.39	7.43	7.47	7.52	7.58	7.64	7.70	7.76	0.595
Population+Irrigation+ Fertiliser														
Per ha Calorie Supply	4263	4388	4369	4353	4361	4344	4352	4348	4342	4338	4335	4333	4330	0.129
Per ha Calorie Demand	4857	4864	4867	4866	4860	4848	4857	4868	4880	4894	4910	4926	4945	0.149
Supply as % of Demand	88	90	90	89	90	90	90	89	89	89	88	88	88	-0.019
Carrying Capacity Per ha	5.89	6.07	6.04	6.02	6.03	6.01	6.02	6.01	6.00	6.00	5.99	5.99	5.99	0.129
Current Load	6.71	6.72	6.73	6.73	6.72	6.70	6.71	6.73	6.75	6.77	6.79	6.81	6.84	0.149

Table 7.41: Impacts of Alternative Policies on the Per Capita Value of Food and Non-Food Trade (Rs)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Value: Per Capita (Food)	292	322	352	378	388	433	446	483	518	545	575	607	639	6.729
Value: Per Capita (N-food)	944	947	949	951	954	956	958	961	963	965	967	970	972	0.241
Population														
Value: Per Capita (Food)	294	328	367	406	435	506	548	614	680	746	821	903	992	10.659
Value: Per Capita (N-food)	944	947	949	952	954	957	959	962	964	966	969	971	974	0.255
Livestock														
Value: Per Capita (Food)	161	472	537	575	602	658	690	742	795	841	893	946	1002	16.480
Value: Per Capita (N-food)	949	952	954	956	958	960	963	965	967	969	971	974	976	0.233
Irrigation														
Value: Per Capita (Food)	265	351	458	492	513	567	593	642	689	730	776	823	872	10.444
Value: Per Capita (N-food)	946	949	951	954	956	958	961	963	965	967	970	972	974	0.246
Fertiliser														
Value: Per Capita (Food)	264	337	439	473	492	544	568	615	661	699	742	787	833	10.038
Value:Per Capita (N-Food)	945	949	951	953	956	958	960	963	965	967	969	972	974	0.247
Population+Irrigation+ Fertiliser														
Value: Per Capita (Food)	188	894	1034	1112	1192	1309	1406	1524	1643	1768	1905	2052	2210	22.785
Value: Per Capita (N-food)	954	958	960	962	964	966	969	971	973	975	977	980	982	0.237

Table 7.42: Impacts of Alternative Policies on Labour Use (%)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Labour Use as % of	83	81	81	81	80	80	79	79	78	78	78	77	77	-0.616
Labour Balance (SS)	17	19	19	19	20	20	21	21	22	22	22	23	23	2.482
Population														
Labour Use as % of	83	82	81	82	82	82	82	81	81	81	81	81	80	-0.252
Labour Balance (SS)	17	18	19	18	18	18	18	19	19	19	19	19	20	1.129
Livestock														
Labour Use as % of	81	80	79	79	79	79	78	77	77	76	76	76	75	-0.606
Labour Balance (SS)	19	20	21	21	21	21	22	23	23	24	24	24	25	2.218
Irrigation														
Labour Use as % of	83	81	81	81	80	80	79	79	78	78	78	77	77	-0.616
Labour Balance (SS)	17	19	19	19	20	20	21	21	22	22	22	23	23	2.482
Fertiliser														
Labour Use as % of	83	81	81	81	80	80	79	79	78	78	78	77	77	-0.616
Labour Balance (SS)	17	19	19	19	20	20	21	21	22	22	22	23	23	2.482
Population+Irrigation+ Fertiliser														
Labour Use as % of	85	83	83	84	83	84	83	83	83	82	82	82	82	-0.296
Labour Balance (SS)	15	17	17	16	17	16	17	17	17	18	18	18	18	1.467

Table 7.43: Impacts of Alternative Policies on Real Per Capita Income (Rs)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Per Capita Income	880	896	906	914	933	941	958	972	983	995	1007	1018	1030	1.321
Population														
Per Capita Income	880	899	912	924	948	964	986	1005	1022	1041	1059	1078	1096	1.841
Livestock														
Per Capita Income	1044	1073	1080	1085	1101	1107	1121	1133	1141	1151	1161	1171	1180	1.030
Irrigation														
Per Capita Income	927	985	995	1003	1021	1029	1046	1059	1070	1081	1093	1104	1115	1.549
Fertiliser														
Per Capita Income	920	976	986	994	1013	1021	1038	1051	1062	1073	1085	1096	1107	1.553
Population+Irrigation+Fertiliser														
Per Capita Income	1243	1304	1307	1310	1328	1336	1352	1364	1374	1385	1397	1409	1422	1.129

Table 7.44: Impacts of Alternative Policies on Income Shares Originating From Different Sources

Sources	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Crops	35.99	36.80	37.45	38.14	39.04	39.51	40.18	40.61	40.95	41.31	41.63	41.90	42.13	1.319
Livestock	38.72	38.68	38.92	39.29	39.24	39.64	39.72	39.93	40.25	40.54	40.84	41.14	41.46	0.573
Professional Workers	2.54	2.46	2.37	2.27	2.18	2.09	2.02	1.95	1.89	1.82	1.76	1.70	1.65	-3.539
Office Workers	2.65	2.57	2.48	2.37	2.28	2.19	2.11	2.04	1.97	1.90	1.84	1.78	1.72	-3.539
Sales and Service Workers	6.21	6.02	5.80	5.54	5.33	5.12	4.94	4.78	4.61	4.45	4.30	4.16	4.03	-3.539
Production Workers	4.38	4.25	4.09	3.91	3.76	3.61	3.48	3.37	3.25	3.14	3.04	2.94	2.84	-3.539
Construction, etc	1.25	1.21	1.17	1.11	1.07	1.03	0.99	0.96	0.93	0.90	0.87	0.84	0.81	-3.539
General Labourers	8.26	8.01	7.72	7.37	7.09	6.81	6.57	6.36	6.14	5.93	5.73	5.54	5.36	-3.539
Population														
Crops	35.98	36.79	37.46	38.18	39.13	39.64	40.40	40.87	41.25	41.63	41.96	42.24	42.49	1.395
Livestock	38.75	38.76	39.06	39.49	39.15	39.98	40.07	40.31	40.64	40.94	41.25	41.58	41.91	0.655
Professional Workers	2.54	2.46	2.36	2.24	2.15	2.05	1.96	1.89	1.82	1.75	1.69	1.62	1.57	-3.937
Office Workers	2.65	2.57	2.46	2.34	2.24	2.14	2.05	1.97	1.90	1.83	1.76	1.70	1.64	-3.937
Sales and Service Workers	6.20	6.00	5.76	5.48	5.24	5.00	4.80	4.62	4.45	4.28	4.12	3.97	3.83	-3.937
Production Workers	4.37	4.23	4.07	3.87	3.70	3.53	3.38	3.26	3.14	3.02	2.91	2.80	2.70	-3.937
Construction, etc	1.25	1.21	1.16	1.10	1.05	1.01	0.96	0.93	0.89	0.86	0.83	0.80	0.77	-3.937
General Labourers	8.25	7.99	7.67	7.29	6.98	6.66	6.38	6.15	5.92	5.69	5.48	5.29	5.10	-3.937
Livestock														
Crops	28.74	30.72	31.42	32.14	33.08	33.61	34.34	34.85	35.26	35.70	36.09	36.44	36.75	2.068
Livestock	49.95	48.81	48.76	48.85	48.52	48.66	48.48	48.45	48.55	48.62	48.71	48.81	48.94	-0.171
Professional Workers	2.14	2.06	1.99	1.91	1.85	1.78	1.73	1.68	1.63	1.57	1.53	1.48	1.44	-3.259
Office Workers	2.24	2.15	2.08	2.00	1.93	1.86	1.80	1.75	1.70	1.65	1.60	1.55	1.50	-3.259
Sales and Service Workers	5.23	5.03	4.87	4.67	4.52	4.35	4.22	4.10	3.97	3.85	3.73	3.62	3.51	-3.259
Production Workers	3.69	3.54	3.43	3.29	3.19	3.07	2.98	2.89	2.80	2.72	2.63	2.55	2.48	-3.259
Construction, etc	1.05	1.01	0.98	0.94	0.91	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.71	-3.259
General Labourers	6.96	6.69	6.48	6.21	6.01	5.79	5.61	5.46	5.29	5.12	4.97	4.82	4.68	-3.259
Irrigation														
Crops	39.34	42.60	43.09	43.64	44.36	44.71	45.23	45.53	45.77	46.03	46.24	46.42	46.56	1.414
Livestock	36.70	35.13	35.41	35.80	35.82	36.23	36.37	36.62	36.97	37.28	37.61	37.94	38.29	0.355
Professional Workers	2.41	2.24	2.16	2.06	1.99	1.91	1.85	1.79	1.73	1.68	1.62	1.57	1.52	-3.748
Office Workers	2.51	2.34	2.26	2.16	2.08	2.00	1.93	1.87	1.81	1.75	1.69	1.64	1.59	-3.748
Sales and Service Workers	5.88	5.47	5.28	5.05	4.87	4.68	4.52	4.38	4.24	4.10	3.96	3.84	3.72	-3.748
Production Workers	4.15	3.86	3.72	3.56	3.43	3.30	3.19	3.09	2.99	2.89	2.80	2.71	2.62	-3.748
Construction, etc	1.18	1.10	1.06	1.01	0.98	0.94	0.91	0.88	0.85	0.82	0.80	0.77	0.75	-3.748
General Labourers	7.83	7.28	7.02	6.72	6.48	6.23	6.01	5.83	5.64	5.45	5.28	5.11	4.95	-3.748

Table 7.44 continued....

Sources	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Fertiliser														
Crops	38.90	42.12	42.64	43.22	43.97	44.34	44.88	45.21	45.46	45.73	45.96	46.15	46.30	1.463
Livestock	36.96	35.42	35.69	36.07	36.07	36.48	36.60	36.84	37.18	37.49	37.80	38.13	38.47	0.334
Professional Workers	2.42	2.26	2.18	2.08	2.00	1.93	1.86	1.80	1.74	1.69	1.63	1.58	1.53	-3.768
Office Workers	2.53	2.36	2.27	2.17	2.09	2.01	1.94	1.88	1.82	1.76	1.70	1.65	1.60	-3.768
Sales and Service Workers	5.93	5.51	5.32	5.08	4.90	4.71	4.55	4.41	4.26	4.12	3.99	3.86	3.74	-3.768
Production Workers	4.18	3.89	3.75	3.59	3.46	3.32	3.21	3.11	3.01	2.91	2.81	2.72	2.64	-3.768
Construction, etc	1.19	1.11	1.07	1.02	0.99	0.95	0.91	0.89	0.86	0.83	0.80	0.78	0.75	-3.768
General Labourers	7.89	7.34	7.08	6.77	6.52	6.27	6.05	5.87	5.67	5.48	5.30	5.13	4.97	-3.768
Population+Irrigation+ Fertiliser														
Crops	54.74	56.56	56.46	56.48	56.62	56.55	56.63	56.54	56.42	56.31	56.19	56.05	55.90	0.175
Livestock	27.40	26.64	27.19	27.80	28.16	28.78	29.15	29.62	30.13	30.62	31.11	31.61	32.11	1.330
Professional Workers	1.79	1.69	1.64	1.58	1.53	1.47	1.43	1.39	1.35	1.31	1.27	1.24	1.20	-3.264
Office Workers	1.87	1.76	1.72	1.65	1.60	1.54	1.49	1.45	1.41	1.37	1.33	1.29	1.26	-3.264
Sales and Service Workers	4.38	4.12	4.01	3.86	3.74	3.60	3.49	3.40	3.30	3.21	3.12	3.03	2.94	-3.264
Production Workers	3.09	2.91	2.83	2.72	2.64	2.54	2.46	2.40	2.33	2.26	2.20	2.14	2.08	-3.264
Construction, etc	0.88	0.83	0.81	0.78	0.75	0.72	0.70	0.68	0.66	0.65	0.63	0.61	0.59	-3.264
General Labourers	5.84	5.49	5.34	5.14	4.97	4.79	4.65	4.52	4.40	4.27	4.15	4.03	3.92	-3.264
	100	100	100	100	100	100	100	100	100	100	100	100	100	0.000

Table 7.45: Impacts of Alternative Policies on Land Use Changes (%)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Forests	33.07	33.02	32.96	32.88	32.78	32.66	32.52	32.36	32.17	31.97	31.74	31.48	31.20	-0.482
Shrublands	15.07	15.09	15.12	15.16	15.21	15.27	15.34	15.42	15.52	15.62	15.73	15.86	16.00	0.501
Grasslands	8.84	8.85	8.86	8.87	8.89	8.90	8.93	8.95	8.98	9.01	9.04	9.08	9.12	0.260
Adjacent NCI	15.42	15.42	15.43	15.44	15.45	15.45	15.48	15.49	15.51	15.53	15.55	15.58	15.61	0.100
Net Cultivated	19.56	19.57	19.58	19.60	19.62	19.64	19.67	19.70	19.74	19.78	19.83	19.88	19.93	0.157
Others	8.04	8.04	8.05	8.05	8.05	8.06	8.07	8.08	8.08	8.10	8.11	8.12	8.13	0.096
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000
Population														
Forests	33.07	33.02	32.97	32.90	32.82	32.73	32.63	32.52	32.39	32.25	32.10	31.93	31.75	-0.337
Shrublands	15.07	15.09	15.12	15.15	15.19	15.24	15.29	15.34	15.41	15.48	15.55	15.63	15.73	0.356
Grasslands	8.84	8.85	8.86	8.87	8.88	8.89	8.91	8.93	8.94	8.96	8.99	9.01	9.04	0.184
Adjacent NCI	15.42	15.42	15.43	15.44	15.45	15.45	15.46	15.48	15.49	15.50	15.52	15.53	15.55	0.071
Net Cultivated	19.56	19.57	19.58	19.59	19.61	19.63	19.65	19.67	19.70	19.72	19.75	19.79	19.82	0.111
Others	8.04	8.04	8.05	8.05	8.05	8.06	8.06	8.07	8.07	8.08	8.09	8.10	8.11	0.068
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000
Fuelwood Demand														
Forests	33.07	33.07	33.07	33.07	33.07	33.07	33.06	33.04	33.00	32.94	32.86	32.77	32.65	-0.105
Shrublands	15.07	15.03	15.00	14.98	14.97	14.97	14.97	14.98	15.00	15.03	15.07	15.11	15.17	0.057
Grasslands	8.84	8.83	8.82	8.82	8.81	8.81	8.81	8.82	8.82	8.83	8.84	8.86	8.87	0.029
Adjacent NCI	14.42	15.41	15.41	15.40	15.40	15.40	15.40	15.40	15.41	15.41	15.42	15.43	15.44	0.011
Net Cultivated	19.56	19.55	19.54	19.53	19.52	19.52	19.52	19.53	19.53	19.55	19.56	19.58	19.60	0.018
Others	8.04	8.11	8.16	8.20	8.23	8.24	8.24	8.24	8.24	8.24	8.25	8.25	8.26	0.221
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000
Forest Management														
Forests	33.07	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	-0.006
Shrubland	15.07	15.08	15.08	15.06	15.03	14.99	14.93	14.85	14.78	14.70	14.62	14.54	14.46	-0.343
Grassland	8.84	8.85	8.84	8.84	8.83	8.82	8.80	8.78	8.76	8.73	8.71	8.68	8.66	-0.174
Adjacent NCI	15.42	15.42	15.42	15.42	15.41	15.40	15.39	15.38	15.36	15.35	15.33	15.31	15.30	-0.066
Net Cultivated	19.56	19.57	19.56	19.56	19.55	19.53	19.51	19.48	19.45	19.41	19.38	19.35	19.32	-0.104
Others	8.04	8.04	8.05	8.08	8.13	8.21	8.33	8.47	8.61	8.77	8.92	9.07	9.22	1.149
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000
Natural Resource+Population														
Forests	33.07	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	-0.006
Shrublands	15.07	15.08	15.07	15.05	15.02	14.96	14.87	14.78	14.68	14.57	14.45	14.34	14.22	-0.483
Grasslands	8.84	8.85	8.84	8.84	8.83	8.81	8.78	8.76	8.73	8.69	8.66	8.62	8.59	-0.244
Adjacent NCI	15.42	15.42	15.42	15.42	15.41	15.40	15.38	15.36	15.34	15.32	15.30	15.27	15.25	-0.092
Net Cultivated	19.56	19.57	19.56	19.55	19.54	19.52	19.48	19.45	19.41	19.36	19.32	19.27	19.22	-0.146
Others	8.04	8.04	8.06	8.10	8.17	8.28	8.43	8.61	8.80	9.02	9.23	9.45	9.68	1.558
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000

Table 7.46: Impacts of Alternative Policies on Fuelwood Sources (%)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Forests	67.75	67.65	67.53	67.39	67.23	67.05	66.84	66.62	66.36	66.06	65.77	65.43	65.06	-0.338
Shrublands	11.61	11.63	11.66	11.71	11.76	11.83	11.91	12.01	12.12	12.25	12.39	12.56	12.74	0.774
Grasslands	0.75	0.75	0.75	0.75	0.75	0.76	0.76	0.77	0.77	0.78	0.79	0.79	0.80	0.605
Adjacent NCI	12.60	12.61	12.62	12.64	12.66	12.69	12.73	12.78	12.83	12.89	12.96	13.04	13.13	0.342
Net Cultivated	6.47	6.55	6.63	6.71	6.78	6.86	6.93	7.01	7.09	7.17	7.25	7.33	7.42	1.142
Total	99.19	99.19	99.19	99.19	99.18	99.18	99.18	99.18	99.17	99.17	99.16	99.16	99.15	-0.003
Population														
Forests	67.75	67.65	67.54	67.41	67.27	67.13	66.97	66.80	66.62	66.42	66.21	65.97	65.73	-0.253
Shrublands	11.61	11.63	11.66	11.69	11.74	11.79	11.84	11.91	11.98	12.06	12.16	12.26	12.37	0.529
Grasslands	0.75	0.75	0.75	0.75	0.75	0.75	0.76	0.76	0.76	0.77	0.17	0.78	0.78	0.409
Adjacent NCI	12.60	12.61	12.62	12.63	12.65	12.67	12.69	12.72	12.76	12.80	12.84	12.89	12.94	0.222
Net Cultivated	6.47	6.55	6.63	6.70	6.78	6.85	6.92	6.99	7.06	7.13	7.20	7.27	7.34	1.051
Total	99.19	99.19	99.19	99.19	99.19	99.18	99.18	99.18	99.18	99.17	99.17	99.17	99.16	-0.002
Fuelwood Demand Reduction														
Forests	67.75	67.73	67.70	67.66	67.63	67.59	67.54	67.47	67.39	67.29	67.17	67.02	66.86	-0.111
Shrublands	11.61	11.58	11.55	11.53	11.51	11.50	11.50	11.50	11.52	11.55	11.59	11.65	11.72	0.075
Grasslands	0.75	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.75	0.75	0.75	0.055
Adjacent NCI	12.60	12.59	12.58	12.57	12.56	12.55	12.55	12.55	12.56	12.57	12.58	12.61	12.64	0.025
Net Cultivated	6.47	6.55	6.62	6.69	6.75	6.81	6.87	6.92	6.98	7.04	7.10	7.16	7.22	0.912
Total	99.19	99.19	99.19	99.19	99.19	99.19	99.19	99.19	99.19	99.19	99.19	99.19	99.19	0.000
Forest Management														
Forests	68.27	69.66	70.52	71.34	72.51	73.60	74.33	74.71	75.31	75.63	75.95	76.29	76.86	0.992
Shrublands	11.42	10.90	10.57	10.25	9.80	9.38	9.08	8.90	8.65	8.49	8.34	8.19	7.95	-2.977
Grasslands	0.73	0.70	0.68	0.66	0.63	0.60	0.59	0.57	0.56	0.55	0.54	0.53	0.52	-2.861
Adjacent NCI	12.40	11.83	11.46	11.12	10.65	10.22	9.93	9.78	9.54	9.42	9.30	9.16	8.94	-2.687
Net Cultivated	6.37	6.15	6.03	5.91	5.72	5.54	5.44	5.41	5.32	5.30	5.28	5.24	5.15	-1.749
Total	99.20	99.25	99.26	99.28	99.31	99.34	99.36	99.37	99.39	99.40	99.40	99.41	99.43	0.019
Natural Resource+Population														
Forests	35.86	35.72	35.62	35.53	35.45	35.39	35.35	35.32	35.30	35.28	35.27	35.26	35.26	-0.140
Shrublands	18.09	18.04	17.98	17.91	17.82	17.72	17.60	17.46	17.32	17.18	17.03	16.88	16.73	-0.646
Grasslands	4.09	4.08	4.07	4.06	4.04	4.03	4.01	3.99	3.98	3.96	3.94	3.93	3.91	-0.377
Adjacent NCI	6.12	6.10	6.08	6.06	6.05	6.03	6.02	6.01	6.00	5.98	5.97	5.96	5.95	-0.226
Net Cultivated	35.84	36.05	36.25	36.45	36.64	36.83	37.02	37.22	37.41	37.60	37.78	37.96	38.14	0.519
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000

Table 7.47: Impacts of Alternative Policies on Fodder Sources (%)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Forests	25.56	25.43	25.28	25.13	24.97	24.79	24.60	24.39	24.17	23.94	23.69	23.42	23.14	-0.826
Shrublands	20.99	20.94	20.91	20.19	20.90	20.92	20.96	21.01	21.08	21.17	21.27	21.40	21.54	0.216
Grasslands	4.75	4.74	4.72	4.71	4.71	4.70	4.70	4.70	4.70	4.70	4.70	4.71	4.72	-0.054
Adjacent NCI	7.10	7.08	7.05	7.03	7.01	7.00	6.98	6.97	6.95	6.94	6.93	6.93	6.92	-0.213
Net Cultivated	41.60	41.82	42.03	42.23	42.42	42.60	42.77	42.93	43.09	43.25	43.40	43.54	43.68	0.408
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000
Population														
Forests	25.56	25.43	25.29	25.15	25.00	24.85	24.69	24.53	24.36	24.18	23.99	23.80	23.59	-0.665
Shrublands	20.99	20.94	20.91	20.8	20.87	20.87	20.88	20.90	20.93	20.97	21.03	21.09	21.17	0.070
Grasslands	4.75	4.74	4.72	4.71	4.70	4.70	4.69	4.68	4.68	4.68	4.68	4.68	4.66	-0.123
Adjacent NCI	7.10	7.08	7.05	7.03	7.01	6.99	6.98	6.96	6.95	6.93	6.92	6.91	6.90	-0.236
Net Cultivated	41.60	41.82	42.03	42.23	42.41	42.59	42.76	42.93	43.08	43.24	43.38	43.52	43.66	0.404
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000
Fuelwood Demand Reduction														
Forests	25.56	25.48	25.41	25.33	25.26	25.18	25.10	25.01	24.91	24.80	24.68	24.54	24.39	-0.391
Shrublands	20.99	20.87	20.77	20.68	20.60	20.53	20.47	20.43	20.40	20.39	20.39	20.41	20.44	-0.220
Grasslands	4.75	4.73	4.71	4.69	4.68	4.66	4.65	4.64	4.63	4.62	4.62	4.61	4.61	-0.251
Adjacent NCI	7.10	7.08	7.05	7.03	7.01	6.99	6.97	6.95	6.93	6.91	6.90	6.89	6.87	-0.269
Net Cultivated	41.60	41.84	42.06	42.27	42.46	42.64	42.81	42.97	43.12	43.27	43.41	43.55	43.69	0.409
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000
Forest Management														
Forests	35.86	35.72	35.61	35.52	35.44	35.37	35.32	35.27	35.23	35.20	35.17	35.15	35.12	-0.174
Shrublands	18.09	18.04	17.98	17.92	17.84	17.75	17.65	17.53	17.42	17.31	17.19	17.08	16.97	-0.530
Grasslands	4.09	4.08	4.07	4.06	4.04	4.03	4.01	4.00	3.99	3.97	3.96	3.94	3.93	-0.340
Adjacent NCI	6.12	6.10	6.08	6.06	6.05	6.03	6.02	6.01	5.99	5.98	5.97	5.96	5.95	-0.233
Net Cultivated	35.84	36.05	36.25	36.44	36.63	36.82	37.00	37.19	37.36	37.54	37.71	37.87	38.03	0.496
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000
Natural Resource+Population														
Forests	35.86	35.72	35.62	35.53	35.45	35.39	35.35	35.32	35.30	35.28	35.27	35.26	35.26	-0.140
Shrublands	18.09	18.04	17.98	17.91	17.82	17.72	17.60	17.46	17.32	17.18	17.03	16.88	16.73	-0.646
Grasslands	4.09	4.08	4.07	4.06	4.04	4.03	4.01	3.99	3.98	3.96	3.94	3.93	3.91	-0.377
Adjacent NCI	6.12	6.10	6.08	6.06	6.05	6.03	6.02	6.01	6.00	5.98	5.97	5.96	5.95	-0.226
Net Cultivated	35.84	36.05	36.25	36.45	36.64	36.83	37.02	37.22	37.41	37.60	37.78	37.96	38.14	0.519
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.000

Table 7.48: Impacts of Alternative Policies on the Resource Base

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Per Capita Cultivated Land	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	-1.329
Per Capita Accessible Forest Land	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	-2.030
Population Density Per Cultivated Land	7.63	7.74	7.86	7.97	8.08	8.19	8.30	8.41	8.52	8.63	8.74	8.85	8.96	1.347
Population Density Per Accessible Land	5.17	5.26	5.35	5.45	5.55	5.65	5.76	5.88	6.01	6.15	6.29	6.45	6.61	2.072
Forest-Cultivated Area	1.48	1.47	1.47	1.46	1.46	1.45	1.44	1.43	1.42	1.40	1.39	1.37	1.35	-0.710
Shrub-Forest Area	0.52	0.52	0.53	0.53	0.53	0.54	0.54	0.55	0.55	0.56	0.57	0.58	0.59	1.061
LSU Per Cultivated Area	4.42	4.42	4.41	4.41	4.41	4.40	4.39	4.39	4.38	4.37	4.36	4.35	4.34	-0.153
LSU Per Forest Area	2.99	3.00	3.01	3.01	3.02	3.04	3.05	3.07	3.09	3.11	3.14	3.17	3.20	0.561
LSU Per Grazing Area	9.77	9.77	9.76	9.74	9.73	9.71	9.69	9.66	9.63	9.60	9.56	9.52	9.48	-0.255
Population														
Per Capita Cultivated Land	0.13	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12	-0.790
Per Capita Accessible Forest Land	0.19	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.17	-1.284
Population Density Per Cultivated Land	7.61	7.70	7.78	7.85	7.90	7.94	8.00	8.07	8.13	8.19	8.25	8.31	8.37	0.796
Population Density Per Accessible Land	5.16	5.23	5.30	5.36	5.41	5.46	5.53	5.60	5.68	5.76	5.84	5.93	6.02	1.300
Forest-Cultivated Area	1.48	1.47	1.47	1.46	1.46	1.45	1.45	1.44	1.43	1.42	1.41	1.40	1.39	-0.498
Shrub-Forest Area	0.52	0.52	0.53	0.53	0.53	0.53	0.54	0.54	0.55	0.55	0.56	0.56	0.57	0.746
LSU Per Cultivated Area	4.42	4.42	4.41	4.41	4.41	4.40	4.40	4.39	4.39	4.38	4.38	4.37	4.36	-0.108
LSU Per Forest Area	2.99	3.00	3.00	3.01	3.02	3.03	3.04	3.05	3.07	3.08	3.10	3.12	3.14	0.392
LSU Per Grazing Area	9.77	9.77	9.76	9.75	9.73	9.72	9.70	9.69	9.67	9.64	9.62	9.59	9.56	-0.181
Livestock														
Per Capita Cultivated Land	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	-1.329
Per Capita Accessible Forest Land	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	-2.030
Population Density Per Cultivated Land	7.63	7.74	7.86	7.97	8.08	8.19	8.30	8.41	8.52	8.63	8.74	8.85	8.96	1.347
Population Density Per Accessible Land	5.17	5.26	5.35	5.45	5.55	5.65	5.76	5.88	6.01	6.15	6.29	6.45	6.61	2.072
Forest-Cultivated Area	1.48	1.47	1.47	1.46	1.46	1.45	1.44	1.43	1.42	1.40	1.39	1.37	1.35	-0.710
Shrub-Forest Area	0.52	0.52	0.53	0.53	0.53	0.54	0.54	0.55	0.55	0.56	0.57	0.58	0.59	1.061
LSU Per Cultivated Area	4.25	4.25	4.25	4.24	4.24	4.23	4.23	4.22	4.21	4.20	4.19	4.18	4.17	-0.155
LSU Per Forest Area	2.88	2.88	2.89	2.90	2.91	2.92	2.94	2.95	2.97	2.99	3.02	3.05	3.08	0.560
LSU Per Grazing Area	9.40	9.40	9.39	9.37	9.36	9.34	9.32	9.29	9.26	9.23	9.20	9.16	9.12	-0.257

Table 7.48 continued....

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Forest Demand Reduction														
Per Capita Cultivated Land	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	-1.466
Per Capita Accessible Forest Land	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.16	0.16	-1.602
Population Density Per Cultivated Land	7.63	7.75	7.87	8.00	8.12	8.24	8.36	8.48	8.61	8.73	8.86	8.98	9.11	1.488
Population Density Per Accessible Land	5.17	5.25	5.33	5.41	5.49	5.57	5.66	5.74	5.84	5.94	6.04	6.16	6.27	1.628
Forest-Cultivated Area	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.47	1.47	1.47	1.46	1.45	-0.138
Shrub-Forest Area	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53	0.177
LSU Per Cultivated Area	4.42	4.42	4.42	4.43	4.43	4.43	4.43	4.43	4.42	4.42	4.42	4.41	4.41	-0.018
LSU Per Forest Area	2.99	2.99	2.99	2.99	2.99	2.99	2.99	3.00	3.00	3.01	3.01	3.03	3.04	0.120
LSU Per Grazing Area	9.77	9.79	9.80	9.80	9.81	9.81	9.81	9.80	9.80	9.79	9.77	9.76	9.74	-0.029
Forest Management														
Per Capita Cultivated Land	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	-1.587
Per Capita Accessible Forest Land	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.16	0.16	-1.491
Population Density Per Cultivated Land	7.63	7.74	7.86	7.98	8.11	8.24	8.37	8.50	8.65	8.79	8.94	9.09	9.24	1.612
Population Density Per Accessible Land	5.17	5.25	5.33	5.41	5.50	5.58	5.66	5.74	5.83	5.92	6.01	6.10	6.19	1.514
Forest-Cultivated Area	1.48	1.47	1.47	1.47	1.48	1.48	1.48	1.48	1.48	1.49	1.49	1.49	1.49	0.097
Shrub-Forest Area	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.50	0.50	-0.335
LSU Per Cultivated Area	4.42	4.42	4.42	4.42	4.42	4.43	4.43	4.44	4.44	4.45	4.46	4.46	4.47	0.097
LSU Per Forest Area	2.99	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.99	2.99	2.99	0.001
LSU Per Grazing Area	9.77	9.77	9.77	9.78	9.79	9.80	9.82	9.84	9.87	9.89	9.92	9.95	9.97	0.167
Natural Resource+Population														
Per Capita Cultivated Land	0.13	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12	-1.086
Per Capita Accessible Forest Land	0.19	0.19	0.19	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.17	0.17	-0.948
Population Density Per Cultivated Land	7.61	7.70	7.79	7.86	7.93	7.98	8.08	8.17	8.27	8.37	8.47	8.57	8.68	1.098
Population Density Per Accessible Land	5.16	5.23	5.28	5.33	5.37	5.40	5.46	5.51	5.56	5.62	5.67	5.73	5.78	0.957
Forest-Cultivated Area	1.48	1.47	1.47	1.48	1.48	1.48	1.48	1.48	1.49	1.49	1.49	1.50	1.50	0.139
Shrub-Forest Area	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.40	-0.476
LSU Per Cultivated Area	4.42	4.42	4.42	4.42	4.42	4.43	4.43	4.44	4.45	4.46	4.47	4.48	4.49	0.137
LSU Per Forest Area	2.99	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.99	2.99	2.99	2.99	2.99	-0.003
LSU Per Grazing Area	9.77	9.77	9.77	9.78	9.79	9.81	9.84	9.87	9.90	9.94	9.97	10.01	10.05	0.235

Table 7.49: Impacts of Alternative Policies on Agricultural Land

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Supply as % of Demand	74	73	73	72	72	71	71	71	70	69	69	68	68	-0.699
Carrying Capacity Per ha	5.32	5.31	5.29	5.27	5.28	5.27	5.27	5.27	5.26	5.26	5.26	5.25	5.25	-0.108
Current Load	7.22	7.25	7.28	7.31	7.35	7.39	7.43	7.47	7.52	7.58	7.64	7.70	7.76	0.595
Population														
Supply as % of Demand	74	74	73	73	73	73	74	74	73	73	73	73	73	-0.113
Carrying Capacity Per ha	5.32	5.31	5.28	5.27	5.28	5.26	5.27	5.26	5.26	5.26	5.25	5.25	5.25	-0.111
Current Load	7.21	7.21	7.21	7.20	7.18	7.16	7.16	7.16	7.17	7.17	7.19	7.20	7.21	0.002
Forest Demand Reduction														
Supply as % of Demand	74	73	73	72	72	71	71	71	70	69	69	68	68	-0.699
Carrying Capacity Per ha	5.32	5.31	5.29	5.27	5.28	5.27	5.27	5.27	5.26	5.26	5.26	5.25	5.25	-0.108
Current Load	7.22	7.25	7.28	7.31	7.35	7.39	7.43	7.47	7.52	7.58	7.64	7.70	7.76	0.595
Forest Management														
Supply as % of Demand	74	73	73	72	72	71	71	71	70	69	69	68	68	-0.701
Carrying Capacity Per ha	5.32	5.31	5.29	5.27	5.28	5.27	5.27	5.27	5.26	5.26	5.26	5.25	5.25	-0.110
Current Load	7.22	7.25	7.28	7.31	7.35	7.39	7.43	7.47	7.52	7.58	7.64	7.70	7.76	0.595
Natural Resource+Population														
Supply as % of Demand	74	74	73	73	73	73	74	73	73	73	73	73	72	-0.156
Carrying Capacity Per ha	5.32	5.31	5.28	5.27	5.28	5.26	5.27	5.26	5.26	5.25	5.25	5.25	5.25	-0.113
Current Load	7.21	7.21	7.21	7.20	7.18	7.16	7.16	7.17	7.18	7.19	7.21	7.23	7.25	0.044

Table 7.50: Impacts of Alternative Policies on Land in Terms of Fuelwood

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Supply as % of Demand	96	95	93	92	90	89	87	86	84	83	81	80	78	-1.722
Carrying Capacity (persons/ha)	2.87	2.87	2.87	2.87	2.86	2.85	2.85	2.84	2.82	2.81	2.80	2.78	2.76	-0.330
Current Load (persons/ha)	2.99	3.03	3.08	3.12	3.17	3.21	3.26	3.30	3.35	3.40	3.44	3.49	3.54	1.417
Population														
Supply as % of Demand	96	95	94	93	92	92	91	90	89	88	87	86	85	-1.050
Carrying Capacity (persons/ha)	2.87	2.87	2.87	2.87	2.86	2.86	2.85	2.85	2.84	2.83	2.82	2.81	2.80	-0.213
Current Load (persons/ha)	2.98	3.02	3.05	3.08	3.10	3.11	3.14	3.17	3.19	3.22	3.25	3.27	3.30	0.845
Fuelwood Demand Reduction														
Supply as % of Demand	107	105	104	103	101	100	98	97	96	94	93	91	90	-1.447
Carrying Capacity (persons/ha)	3.19	3.20	3.21	3.21	3.22	3.22	3.22	3.22	3.22	3.22	3.22	3.21	3.20	0.030
Current Load (persons/ha)	2.99	3.04	3.08	3.13	3.18	3.23	3.27	3.32	3.37	3.42	3.47	3.52	3.57	1.499
Forest Management														
Supply as % of Demand	98	101	103	104	107	110	111	111	112	112	112	111	112	1.170
Carrying Capacity (persons/ha)	2.92	3.06	3.16	3.26	3.40	3.55	3.65	3.72	3.81	3.87	3.93	3.99	4.09	2.854
Current Load (persons/ha)	2.99	3.03	3.08	3.13	3.18	3.23	3.28	3.34	3.40	3.46	3.52	3.58	3.64	1.665
Natural Resource+Population														
Supply as % of Demand	98	101	104	106	109	113	115	116	118	118	118	118	120	1.712
Carrying Capacity (persons/ha)	2.92	3.06	3.16	3.26	3.40	3.55	3.66	3.72	3.82	3.88	3.94	4.01	4.12	2.903
Current Load (persons/ha)	2.98	3.02	3.05	3.08	3.11	3.13	3.17	3.21	3.25	3.30	3.34	3.38	3.43	1.170

Table 7.51: Impacts of Alternative Policies on Forest Land in Terms of Fuelwood

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Supply as % of Demand	69	68	66	65	64	63	62	60	59	58	56	55	54	-2.053
Carrying Capacity (Person/ha)	7.02	7.02	7.02	7.02	7.01	7.01	7.01	7.01	7.00	7.00	7.00	6.99	6.98	-0.041
Current Load (Person/ha)	10.22	10.39	10.57	10.76	10.96	11.17	11.39	11.62	11.87	12.13	12.42	12.72	13.04	2.055
Population														
Supply as % of Demand	69	68	67	66	66	65	64	63	62	62	61	60	59	-1.300
Carrying Capacity (Person/ha)	7.02	7.02	7.02	7.02	7.01	7.01	7.01	7.01	7.01	7.00	7.00	7.00	7.00	-0.028
Current Load (Person/ha)	10.20	10.34	10.47	10.59	10.69	10.79	10.93	11.07	11.22	11.37	11.54	11.71	11.89	1.289
Fuelwood Demand Reduction														
Supply as % of Demand	76	75	74	73	72	71	70	69	68	66	65	64	63	-1.607
Carrying Capacity (Person/ha)	7.80	7.80	7.80	7.80	7.80	7.80	7.80	7.80	7.80	7.80	7.80	7.79	7.79	-0.009
Current Load (Person/ha)	10.22	10.38	10.53	10.69	10.85	11.01	11.18	11.35	11.54	11.74	11.94	12.16	12.40	1.625
Forest Management														
Supply as % of Demand	70	74	76	78	82	85	87	88	89	89	89	90	91	2.174
Carrying Capacity (Person/ha)	7.19	7.70	8.04	8.38	8.89	9.40	9.76	9.95	10.27	10.44	10.61	10.80	11.14	3.720
Current Load (Person/ha)	10.22	10.38	10.54	10.70	10.86	11.02	11.19	11.35	11.52	11.70	11.87	12.05	12.24	1.514
Natural Resource+Population														
Supply as % of Demand	70	75	77	80	84	88	91	91	93	94	95	95	97	2.738
Carrying Capacity (Person/ha)	7.19	7.70	8.04	8.38	8.89	9.40	9.76	9.95	10.27	10.44	10.61	10.80	11.14	3.720
Current Load (Person/ha)	10.20	10.33	10.44	10.53	10.61	10.68	10.78	10.89	11.00	11.10	11.21	11.32	11.43	0.957

Table 7.52: Impacts of Alternative Policies on the Per Capita Fuelwood Balance and Deforestation

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Per Capita Supply (kg)	566	557	549	540	531	523	514	505	496	487	478	469	459	-1.722
Per Capita Deficit (kg)	-22	-31	-39	-48	-57	-65	-74	-83	-92	-101	-110	-119	-129	15.756
Deforested Area (ha)	85	120	156	193	231	270	311	352	396	442	490	539	590	17.499
Population														
Per Capita Supply (kg)	567	560	554	549	544	540	535	529	523	517	511	505	499	-1.050
Per Capita Deficit (kg)	-21	-28	-34	-39	-44	-48	-53	-59	-65	-71	-77	-83	-89	12.671
Deforested Area (ha)	81	108	133	155	175	191	216	241	266	293	320	348	377	13.695
Fuelwood Demand Reduction														
Per Capita Supply of Fuelwood (kg)	566	557	549	541	534	526	519	511	504	496	488	480	472	-1.498
Per Capita Deficit (kg)	37	28	20	12	4	-3	-10	-18	-26	-33	-41	-49	-57	0.000
Deforested Area (ha)	-140	-110	-79	-49	-18	13	44	76	110	146	183	222	262	0.000
Forest Management														
Per Capita Supply of Fuelwood (kg)	575	594	603	612	630	646	655	655	661	659	657	656	661	1.170
Per Capita Deficit (kg)	-13	6	15	24	42	58	67	67	73	71	69	68	73	0.000
Deforested Area (ha)	50	-23	-61	-98	-170	-241	-281	-285	-313	-309	-305	-305	-335	0.000
Natural Resource+Population														
Per Capita Supply of Fuelwood (kg)	576	597	609	622	644	667	679	682	692	693	695	697	706	1.713
Per Capita Deficit (kg)	-12	9	21	34	56	79	91	94	104	105	107	109	118	0.000
Deforested Area (ha)	45	-35	-83	-134	-224	-317	-369	-385	-427	-437	-447	-462	-507	0.000

Table 7.53: Impacts of Alternative Policies on Forest Land in Terms of Timber

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Supply as % of Demand	112	110	108	107	105	103	101	99	97	94	92	90	88	-2.030
Carrying Capacity (person/ha)	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	0.000
Current Load (person/ha)	5.17	5.26	5.35	5.45	5.55	5.65	5.76	5.88	6.01	6.15	6.29	6.45	6.61	2.072
Population														
Supply as % of Demand	112	111	110	108	107	106	105	104	102	101	99	98	96	-1.284
Carrying Capacity (person/ha)	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	0.000
Current Load (person/ha)	5.16	5.23	5.30	5.36	5.41	5.46	5.53	5.60	5.68	5.76	5.84	5.93	6.02	1.300
Fuelwood Demand Reduction														
Supply as % of Demand	112	110	109	107	106	104	103	101	99	98	96	94	92	-1.602
Carrying Capacity (person/ha)	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	0.000
Current Load (person/ha)	5.17	5.25	5.33	5.41	5.49	5.57	5.66	5.74	5.84	5.94	6.04	6.16	6.27	1.628
Forest Management														
Supply as % of Demand	112	110	109	107	106	104	102	101	295	301	306	321	323	9.213
Carrying Capacity (person/ha)	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	17.20	17.80	18.40	19.60	20.00	10.866
Current Load (person/ha)	5.17	5.25	5.33	5.41	5.50	5.58	5.66	5.74	5.83	5.92	6.01	6.10	6.19	1.514
Natural Resource+Population														
Supply as % of Demand	112	111	110	109	108	107	106	105	309	317	324	342	346	9.816
Carrying Capacity (person/ha)	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	17.20	17.80	18.40	19.60	20.00	10.866
Current Load (person/ha)	5.16	5.23	5.28	5.33	5.37	5.40	5.46	5.51	5.56	5.62	5.67	5.73	5.78	0.957

Table 7.54: Impacts of Alternative Policies on Fodder Supply and Demand

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Total Fodder Supply /ha	0.80	0.81	0.81	0.81	0.81	0.82	0.82	0.82	0.83	0.83	0.83	0.84	0.84	0.373
Fodder Demand	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.84	0.063
SS as % of Demand	97	97	97	98	98	98	99	99	99	100	100	100	100	0.310
Carrying Capacity (LSU/ha)	1.29	1.29	1.30	1.30	1.31	1.31	1.32	1.32	1.32	1.33	1.33	1.34	1.34	0.373
Current Load (LSU/ha)	1.33	1.33	1.33	1.33	1.35	1.33	1.33	1.33	1.33	1.34	1.34	1.34	1.34	0.063
Livestock														
Total Fodder Supply /ha	0.80	0.81	0.81	0.81	0.81	0.82	0.82	0.82	0.83	0.83	0.83	0.84	0.84	0.373
Fodder Demand	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.062
SS as % of Demand	80	81	81	81	82	82	82	82	83	83	83	83	83	0.311
Carrying Capacity	1.03	1.03	1.04	1.04	1.04	1.05	1.05	1.06	1.06	1.06	1.07	1.07	1.08	0.373
Current Load (LSU/ha)	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.34	0.033
Forest Management														
Total Fodder Supply /ha	0.93	0.93	0.94	0.94	0.94	0.95	0.95	0.95	0.95	0.96	0.96	0.96	0.96	0.289
Fodder Demand Per	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.84	0.84	0.84	0.84	0.115
SS as % of Demand	112	113	113	113	113	114	114	114	114	114	114	114	115	0.174
Carrying Capacity (LSU/ha)	1.49	1.50	1.50	1.51	1.51	1.52	1.52	1.52	1.53	1.53	1.54	1.54	1.54	0.289
Current Load (LSU/ha)	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.34	1.34	1.34	1.34	1.35	1.35	0.115
Natural Resource+Population														
Total Fodder Supply /ha	0.93	0.93	0.94	0.94	0.94	0.95	0.95	0.95	0.95	0.96	0.96	0.96	0.97	0.303
Fodder Demand	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.84	0.84	0.84	0.84	0.84	0.85	0.159
SS as % of Demand	112	113	113	113	113	114	114	114	114	114	114	114	114	0.144
Carrying Capacity (LSU/ha)	1.49	1.50	1.50	1.51	1.51	1.52	1.52	1.52	1.53	1.53	1.54	1.54	1.55	0.303
Current Load (LSU/ha)	1.33	1.33	1.33	1.33	1.33	1.33	1.34	1.34	1.34	1.35	1.35	1.35	1.36	0.159

Table 7.55: Impacts of Alternative Policies on Forest Land in Terms of Fodder

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Growth
Baseline														
Supply as % of Demand	25	25	25	25	24	24	24	24	24	24	24	23	23	-0.519
Carrying Capacity (LSU/ha)	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.039
Current Load (LSU/ha)	2.99	3.00	3.01	3.01	3.02	3.04	3.05	3.07	3.09	3.11	3.14	3.17	3.20	0.561
Population														
Supply as % of Demand	25	25	25	25	25	24	24	24	24	24	24	24	24	-0.363
Carrying Capacity (LSU/ha)	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.027
Current Load (LSU/ha)	2.99	3.00	3.00	3.01	3.02	3.03	3.04	3.05	3.07	3.08	3.10	3.12	3.14	0.392
Livestock														
Supply as % of Demand met	15	15	15	15	15	15	15	14	14	14	14	14	14	-0.789
Carrying Capacity (LSU/ha)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.000
Current Load (LSU/ha)	3.70	3.71	3.72	3.74	3.76	3.78	3.81	3.84	3.87	3.91	3.96	4.01	4.07	0.796
Fuelwood Demand Reduction														
Supply as % of Demand	25	25	25	25	25	25	25	25	25	25	25	24	24	-0.112
Carrying Capacity (LSU/ha)	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.008
Current Load (LSU/ha)	2.99	2.99	2.99	2.99	2.99	2.99	2.99	3.00	3.00	3.01	3.01	3.03	3.04	0.120
Forest Management														
Supply as % of Demand	40	40	40	40	40	40	40	40	40	40	40	40	40	-0.000
Carrying Capacity (LSU/ha)	1.20	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	0.000
Current Load (LSU/ha)	2.99	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.99	2.99	2.99	0.001
Natural Resource+Population														
Supply as % of Demand	40	40	40	40	40	40	40	40	40	40	40	40	40	0.003
Carrying Capacity (LSU/ha)	1.20	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	0.000
Current Load (LSU/ha)	2.99	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.99	2.99	2.99	2.99	2.99	-0.003

8

CONCLUSIONS

Outcome

This study makes an attempt to integrate and analyse the important economic and natural resource sectors of five districts of the Bagmati Zone. These two major sectors were also linked additionally to some exogenous variables. The linkages between these sectors and the extraneous factors were established through different behavioural, structural, accounting, and feed-back relationships, within the framework of an adaptive policy simulation model. The adaptive simulation model provides a flexible method by which multi-commodities and multi-market interactions can be evaluated simultaneously.

Additionally, the model framework also addresses the environmental issues. The interactions between the economic and natural resource sectors, on one hand, and the influence on these sectors of the exogenous variables, on the other, result in changes in the environment. These environmental effects were viewed in terms of selected indicators and the carrying capacity of different land uses in relation to the existing load factors, the latter being primarily determined by the resource needs of the human and livestock populations. Environment, therefore, is a dynamic element, but it is dependent on the action or inaction taking place in the economy. Any action or inaction in any one sector will have repercussions on the environment.

The base model was developed on the basis of the present state of technology and information available for each district separately and was used to evaluate the economic and environmental conditions in five districts of the Bagmati Zone. Validation of the model was conducted through calibration and sensitivity analysis. This base model developed for each district then provided the basis for policy analysis. For all the districts, except for Dhading, the time frame for the simulation exercise was taken to be the Eighth Five-Year Plan Period (1993-1998). However, in the case of Dhading, the time frame was extended to 2005 A.D. This extension made it possible to examine the effects of different policies, such as improved forest management and reduced population growth, both of which have impacts beyond the five-year period considered for other districts.

The base model projects the demand and supply of major resource commodities (food, fuelwood, fodder, and others) to obtain a range of estimates of deficit to highlight the future pressure on the resource base. The forecasted demand and supply of major resources under the current trend scenario then provided a basis

for evaluating the scale and timing of deficit or surplus of the major resources under alternative policy options.

Under the current trend scenario, the capacity of the districts to sustain the ever-increasing human and livestock population is decreasing over time. With the declining trend in agricultural productivity, on one hand, and deteriorating resource base on the other, the implications of a growing population for the carrying capacity of the district in terms of food, fuelwood, and fodder are already alarming. Despite the varying magnitudes of deficits or surplus that exist at present, all the districts appear to be on an unsustainable path in terms of the major resources, including food. The resulting magnitude of, say, a food deficit, will have to be met through imports. However, due to the high level of underemployment and the lack of off-farm employment opportunities and income, the purchasing power of the people is very low. Therefore, imports are not a likely substitute for domestic food deficits. Already, in most districts, agricultural lands are being over-used through increasing the intensity of production without gains in productivity. The analysis indicates that the dependence of people and the load on cultivated lands exceed the carrying capacity of such lands (Table 8.1).

The widening gap between the supply and demand of fuelwood, fodder, and timber implies that every year deficits have to be met through over-exploitation of forests, especially given the predominant practice of an open access regime in most of the areas. In any given year, exploitation may not appear to take place to a large extent but, as the excess demand continues unabated, the process of resource depletion at the margin continues, ultimately leading to deforestation and environmental degradation. Although the magnitude of the problem varies across districts, the carrying capacity in terms of fuelwood and fodder has already declined or will soon decline (Table 8.2). The marginal sufficiency in some resources observed in some districts does not in any way reflect that those districts have a relatively sustainable resource base, i.e., it is a manifestation of the problem.

Declining agricultural productivity and deforestation are perhaps the major causes of land-use changes in the districts. Declining agricultural productivity leads to food shortages and, since the existing agricultural technologies are unable to increase productivity, the pressure to expand cultivated land increases. While the intensification pressure, through increased cropping intensity under the current state of technology, has reached beyond the limit of sustainability, further expansion of marginal land, i.e., the extensification pressure, seems to be limited unless at the cost of a high level of environmental degradation. On the other hand, when deforestation occurs, land-use changes also begin to occur. Firstly, deforestation leads to an increase in shrublands, some of which are converted to marginal agricultural lands over time. As a result, the forest area required to sustain one hectare of cultivated land, given the prevailing farming system that is predominant

in the hills, is declining in most of the districts. This pattern over time gives rise to a vicious cycle of resource degradation and depletion. This indicator, and other indicators of land-use changes developed in the model clearly indicate that the problems related to resource depletion are already at a critical stage in most of the districts. The results further indicate that in order to minimise land use changes and mitigate the pressure on the resource base in the districts, both agricultural productivity and productivity of the forests have to increase. Population reduction definitely plays an important role.

Table 8.1: Carrying Capacity and Load on Agricultural Land in Terms of Food (Persons/ha)

	1993	1994	1995	1996	1997	1998
Kabhrepalanchowk						
Supply as % of Demand	92	92	92	93	93	93
Carrying Capacity	5.49	5.49	5.49	5.48	5.48	5.48
Load	6.02	5.99	5.96	5.94	5.92	5.9
Sindhupalanchowk						
Supply as % of Demand	51	51	51	50	50	50
Carrying Capacity	5.43	5.43	5.43	5.42	5.42	5.42
Load	10.59	10.64	10.69	10.74	10.79	10.84
Nuwakot						
Supply as % of Demand	110	110	109	109	108	108
Carrying Capacity	5.85	5.85	5.84	5.84	5.83	5.83
Load	5.31	5.32	5.34	5.36	5.38	5.4
Dhading						
Supply as % of Demand	74	73	73	72	72	71
Carrying Capacity	5.32	5.31	5.29	5.27	5.28	5.27
Load	7.22	7.25	7.28	7.31	7.35	7.39
Rasuwa						
Supply as % of Demand	97	96	96	95	94	94
Carrying Capacity	5.2	5.2	5.2	5.2	5.2	5.2
Load	5.38	5.41	5.44	5.47	5.51	5.55

The adaptive simulation model was then used to evaluate the different policy scenarios. The policies examined dealt with population reduction, and improving the food, fuel, and fodder supplies. Policies that affected directly both the demand and supply of food and natural resources were also examined jointly and their environmental implications assessed.

Table 8.2: Carrying Capacity and Load in Terms of Fuelwood (persons per hectare)

	1993	1994	1995	1996	1997	1998
Kabhrepalanchowk						
Supply as % of Demand	85	84	83	82	81	81
Carrying Capacity	3.41	3.39	3.37	3.35	3.32	3.3
Load	4.03	4.05	4.06	4.07	4.08	4.09
Sindhupalchowk						
Supply as % of Demand	73	72	70	69	68	66
Carrying Capacity	2.21	2.18	2.15	2.12	2.09	2.06
Load	3.02	3.04	3.06	3.07	3.09	3.1
Nuwakot						
Supply as % of Demand	73	72	70	69	68	67
Carrying Capacity	3.48	3.46	3.44	3.42	3.4	3.37
Load	4.78	4.83	4.89	4.94	4.99	5.04
Dhading						
Supply as % of Demand	96	95	93	92	90	89
Carrying Capacity	2.87	2.87	2.87	2.87	2.86	2.85
Load	2.99	3.03	3.08	3.12	3.17	3.21
Rasuwa						
Supply as % of Demand	188	187	185	184	183	181
Carrying Capacity	0.91	0.91	0.91	0.91	0.91	0.91
Load	0.48	0.49	0.49	0.5	0.5	0.51

In the food sector, the aggregate demand was allowed to be influenced by the population reduction policy without curtailing the base (1991) level of per capita food need. On the supply side, irrigation development and increased fertiliser application were allowed to increase food supplies, i.e., biochemical technology. The results clearly indicated that any single policy intervention is unlikely to drive the districts towards sustainable food supply. The demand policy had a positive impact over the short term, but, unless productivity growth in the agricultural sector occurs, population reduction alone does not appear to have a sustainable impact on the districts' food supplies. This clearly implies that there is already an excess population in the districts, considering the state of agricultural technology. On the other hand, a combination of the demand and supply policies had a more sustainable impact. Clearly, the scope for mitigating the pressure on agricultural

lands through the introduction of new agricultural technologies undoubtedly exists, and this should be encouraged. For example, if the paddy and maize yield rates in the five districts could be increased to the yield levels of Lalitpur or Bhaktapur, all the food deficit districts would no longer be food deficit and, at the same time, the pressure on the resource base would decline consequently.

On the resource side also, both the demand reduction and supply management policies were seen to have a more sustainable impact than a single policy option. Despite the combined policy action in the food and natural resource sectors, the districts will not be able to realise a high level of growth in real incomes or labour utilisation in a short period of time. In the short run, it is essential to improve food and forest resource supplies to mitigate the overall pressure of the districts' carrying capacity. In the long run, however, policies that emphasise high-value crops, based on the comparative advantages, should be evaluated and stressed. Furthermore, without development in the off-farm sector, it will be increasingly more difficult for the districts to increase employment opportunities and incomes and consequently improve the state of the resource base and environment to promote sustainable development.

Sustainable development is a difficult concept to operationalise and perhaps more so in a developing country like Nepal where poverty and resource-base degradation are rampant. This study makes an attempt to address the issue of sustainable development in the narrow sense of the term. Sustainable development is seen to be critically dependent on the sustainable use of a critical resource, namely, land. This resource currently is seen to determine the living standards of the people, the quality of the resource base, and, consequently, the surrounding environment. The study demonstrates clearly that the critical success factor for sustainable development in the districts will depend on how quickly the districts can improve the carrying capacity of land through the application of new technologies. Over time, as the carrying capacity improves, further assessment will be required to evaluate the new and emerging critical factors.

Further Scope of the Model

Some of the limitations of the simulation model used in the present study have already been highlighted in Chapter 1. This section will highlight further the scope of the model. In the rural districts of Nepal where food, resources, and the environmental situation are already in a critical state of balance, it is useful to evaluate the districts from a more holistic point of view. For such an evaluation, a simulation model of the type developed for this study will prove to be very useful.

The model can readily be extended to integrate other socioeconomic issues such as education, health, and drinking water and can be developed at the VDC or *illaka* level, depending on the availability of information. Carrying out such an evaluation

through the Adaptive Simulation Model (ASM) has the advantages of building intersectoral linkages and evaluating the trade-offs resulting from different policy actions.

It is well known that the agricultural and forestry sectors are highly interdependent, especially in the hill and mountain regions of Nepal. In the present exercise, it has not been possible to build this interdependency more strongly, primarily due to the lack of information on variables and parameters. For example, leaf litter is a forest product which is used extensively by households to maintain soil nutrients. Thus, forests affect crop productivity directly, and this can be specified in the model. Such a specification will make it possible to identify quite easily where agricultural productivity is more seriously affected by deforestation. Policy-makers and planners can be aided in focussing plans and programmes on a more area-specific basis.

Another issue that can be addressed through the model is the question of food sufficiency versus food security. The model has built-in demand functions for food. These demand functions are dependent on the relative food prices and incomes. A high growth rate in the real income will make it possible for households to buy food even when a district may not produce enough food to meet the food requirement. It will be possible to evaluate at what level of per capita income such a situation is likely occur in a given district. Income can be increased though off-farm development activities as well as through direct intervention in agriculture. Thus, for planners, such an exercise can be useful to understand the relative merits of a food security programme versus a food sufficiency programme. This exercise will perhaps be more useful in a district that already have some surplus, e.g., Nuwakot in the Bagmati Zone.

In the natural resource sector, the model can be extended to highlight the economic costs of deforestation by applying the full cost principle. This cost (i.e., cost of policy inaction) can be compared with the cost of policy action (e.g., afforestation or other management options) to obtain an idea of the relative benefits or desirability of different policy actions. It should be noted that, because the model is interlinked, intervention in any one sector cannot be an isolated event, since secondary repercussions will also occur in other sectors.

This type of model, therefore, can be used to interlink the different, important sectors of an economy at different levels of generalisation, depending on the information and parameters available. A more global picture will thus emerge for policy-makers to assess the outcome of different policy interventions. The outcome can then be used to rank the different sectors in terms of some defined criteria or objective function and programmes, following which the resources can be directed accordingly. The cost and benefit associated with different policy actions can also be assessed, enabling policy-makers to prioritise programmes given the resource

constraints. Finally, when the projects have been identified to mitigate certain problems and improve incomes in a district, such projects can be directly incorporated within the model to assess not only the direct benefits of the project, but also the resulting indirect benefits and costs. For example, if a buffalo development programme is identified as beneficial to a district, it can be developed separately outside the model and all the necessary evaluations can be made. But, when this buffalo development project is linked to the model, its impact on the food supply, share distribution of income from different sources, fodder supply in relation to forest stock, pressure on land, and so on can be evaluated also. There can be many further extensions of the model, depending on the data availability, parameters, and a suitable computer.

Data Requirements

Given the usefulness of an ASM in integrating and assessing different policy scenarios, the following section provides a list of necessary information that should be developed at the district level. Up to date land-use data are vital for identifying the direction and magnitude of interclass land transfers. A district's land-use dynamics' submodel can be developed from such a database. Similarly, an inventory of the forest stock by species' composition, maturity class, and density under different management regimes is useful. With the appropriate biomass stocking rates as well as harvest rates of different forest products, a more accurate picture of the forest products' supply situation can be developed. Information on indicators that provide a quantitative assessment of the resource base and environment have to be gathered periodically. Important environmental parameters related to rainfall, soil erosion, soil type, runoff, landslides, and so on should be developed. Qualitative indicators will prove to be useful also. Ownership of private plantations, area coverage, yields, and so on will prove useful in assessing the role of the private sector in renewing the natural resource base.

The agricultural database should be broadened and strengthened to highlight the current trends in productivity, technology, crop diversity, and marketable surplus of important crops as well as details on input use across crops. In the agricultural sector, the geographic diversity must be taken into account. In developing the database. More detailed livestock statistics on the age composition and herd size by type of animal, fodder, and feed intakes as well as livestock products are necessary to develop a better understanding of the hill farming system.

Detailed accounts of labour use in a district in the agricultural and forestry sectors, off-farm activities, and other domestic chores are required to develop a detailed labour sub-model. The volume of trade taking place in a district in terms of both imports and exports by major commodity type can greatly facilitate the trade sub-model. Periodic detailed household income and expenditure surveys that provide more accurate information on households, at least at the district level, are very

important. Similarly, periodic surveys of household energy consumption and sources will be useful to assess energy consumption trends.

Information on factor and product prices through farm gate and district retail outlets is virtually non-existent in the districts. Price information has to be systematically gathered at appropriate levels, e.g., whole-sale, farm gate, and retail levels. The gathered information on product and factor prices must be comprehensive so that it can be linked with household expenditure surveys. Even though the list is not exhaustive, availability of accurate and varied information is crucial to operationalising the concept of sustainable development.

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