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

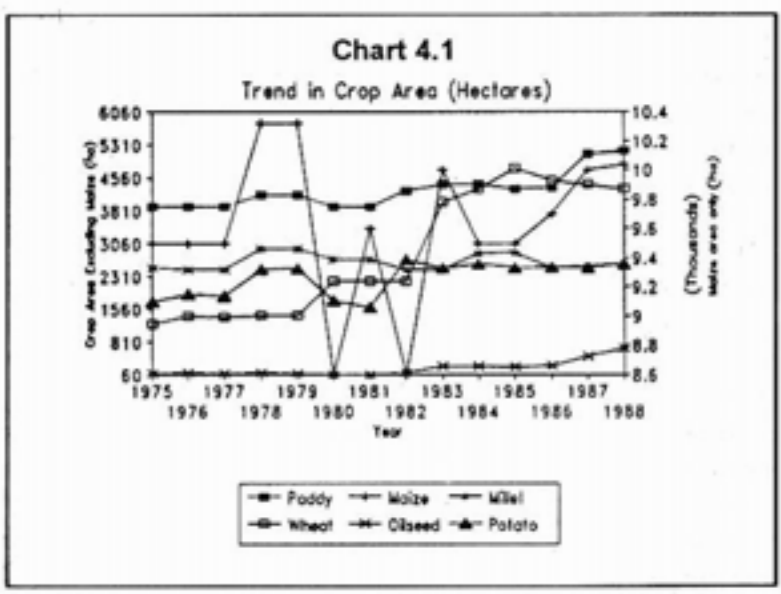
Paddy, maize, millet, wheat, oilseeds, and potatoes are the main crops grown in the district. These crops altogether account for about 95 per cent of the district's total cropped area (the remaining five per cent is shared by sugarcane and barley). The historical data on the areas under these crops reported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

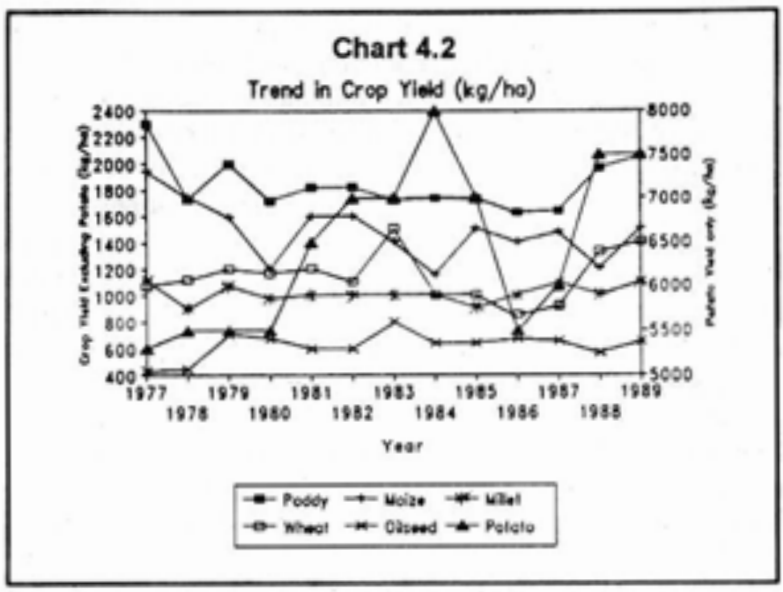
Maize is by far the most important crop, and it accounted for about 40 per cent of the district's total cropped area in 1988/89. Paddy ranks second in terms of cropped area, followed by wheat (17%), millet (10%), and potatoes (10%). The monsoon crops, out of which paddy and maize are predominant, are 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.





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.

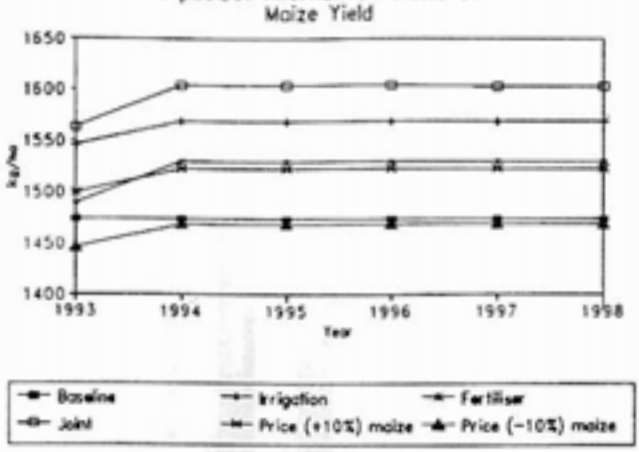
A maize price policy intervention was also considered by allowing the maize price to alter by 10 per cent. The results are given in Table 4.44. The price policy has the desired effect on maize supply as reflected by corresponding changes in yield following changes in prices. The maize price is not assumed 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.

Chart 4.3



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.

Chart 4.4

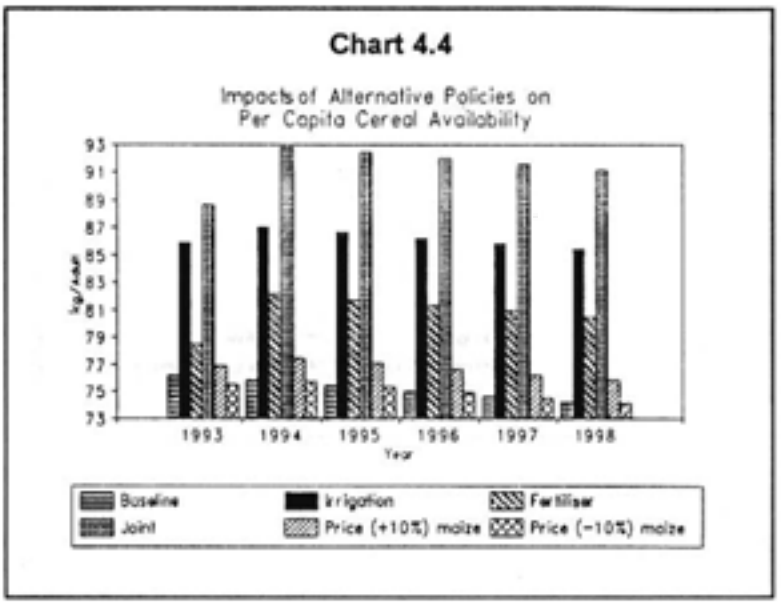
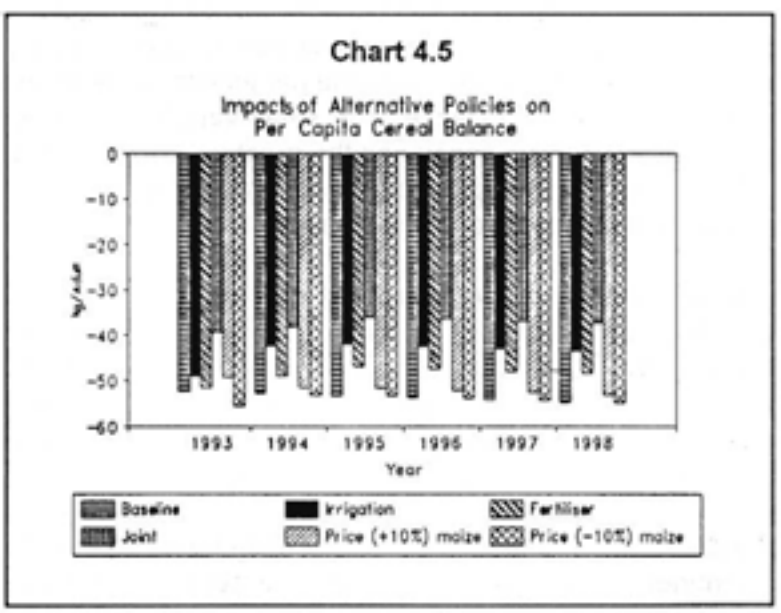


Chart 4.5



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

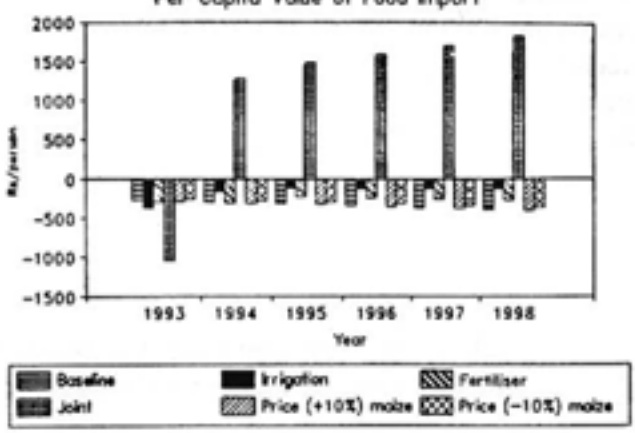
Each policy affects the trade sector in different ways. The irrigation policy influences the trade sector in two different ways. Firstly, as food production improves, the net imports decline in terms of value. The decline in the quantity of imports is reflected in the reduction in the per capita deficit 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.

Chart 4.6



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.

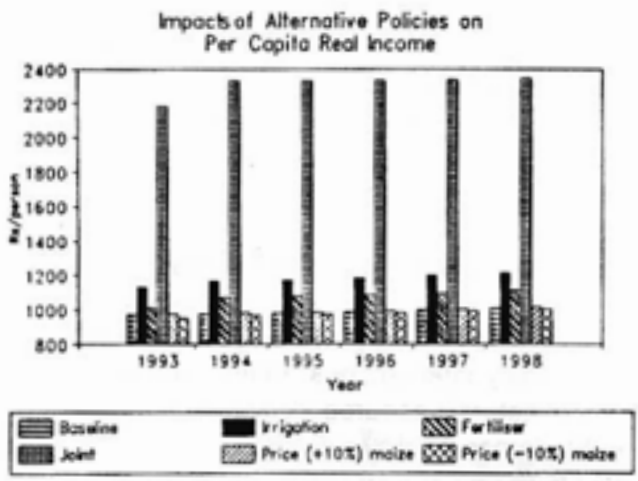
The labour use rate changes only under the joint policy. Under the joint policy, the cropping intensity impact results in a net increase in labour use in the district. It increases to 64 per cent in 1993 from 60 per cent under the baseline scenario. Over time, however, it will decrease to 63 per cent 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.

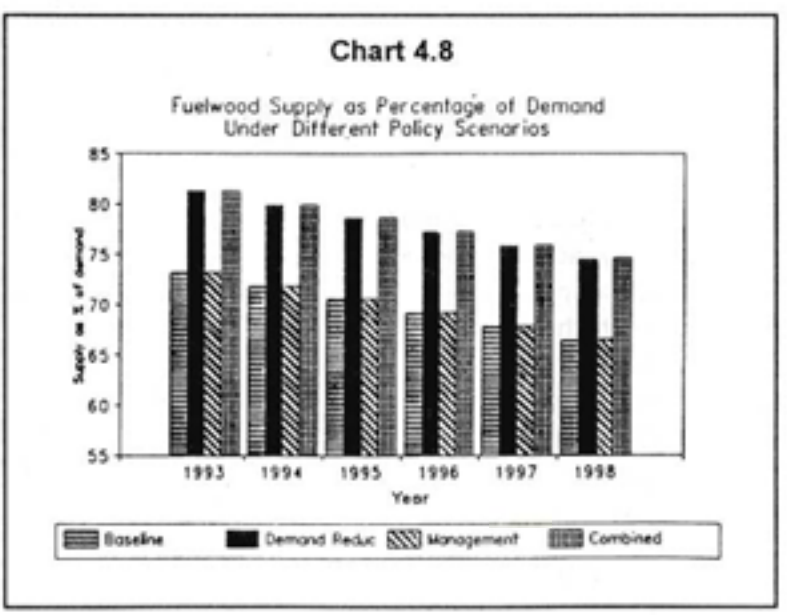
Impact on Fuelwood

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



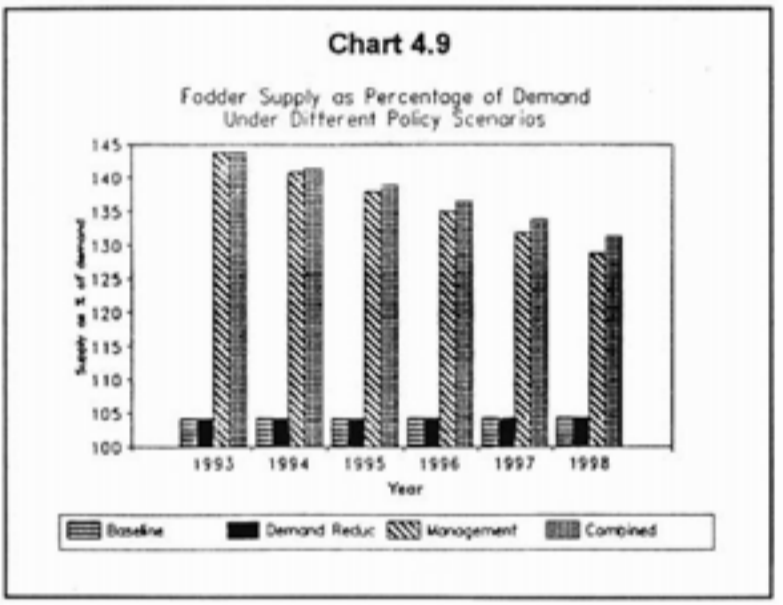
Impact on Fodder

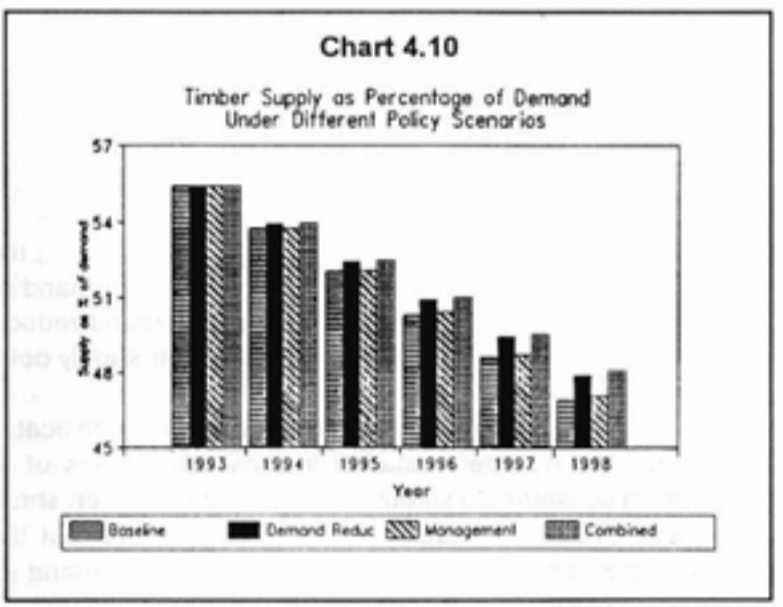
Currently about 23 per cent of the total fodder supply in the district is estimated to come from forests and the remaining from shrub and grazing lands, adjacent NCI, and private lands. When all the accessible forests in the mid-mountains are brought under improved management, the total fodder supply 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).

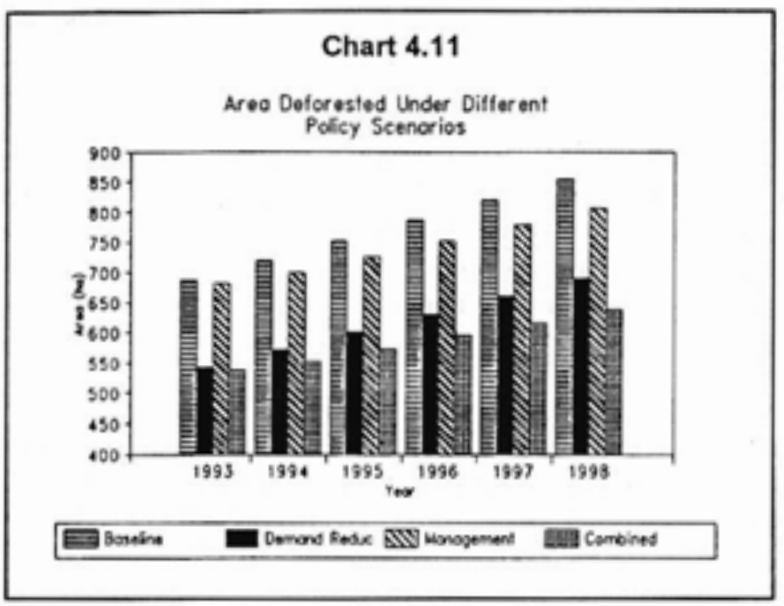
The forest-cultivated land ratio in Sindhupalchok shows a declining trend over time and is fairly below the optimum level as described in the previous chapter. But, the rate of declining in this ratio is much lower (1.79%) under the demand policy than under the supply policy (-2.08%). This implies that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

Chart 4.11



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	0.06

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	0.96
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	24.89	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	-1.06
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	-1.06
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