6

NUWAKOT DISTRICT

Performance of the District Economy

Introduction

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

Crop Area

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

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

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

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

Crop Yield

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

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

Fertiliser Use

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

The average sale of fertiliser per hectare of cropped are in Nuwakot increased from 67kg in 1982 to 94 kg in 1989, at an annual growth of about five per cent. There was a sudden rise in sales during 1990 and 1991. While information regarding the actual fertiliser consumption level in the district is not available, the Irrigation Master Plan assumes it to be 18 kg/ha in the hill regions, which is far below the sale rate reported in Table 6.4. Even if the current level of fertiliser use is assumed to be three times greater than this, the actual consumption of fertiliser in the district comes to be about 2,384 MT, which is still lower than the reported sale in the year 1991. A large gap between the reported sales' figure and the actual consumption level could be the result of fertiliser leakage from the district to other areas or faulty statistics on sales or areas under different crops.

In order to forecast the fertiliser sales in the district, a simple linear time trend equation was fitted to this historical data, and the result is presented below.

Fertiliser Sale= 1713.63 + 352.66 time
(448.610) (49.39) R^2 = 0.86

Chart 6.1

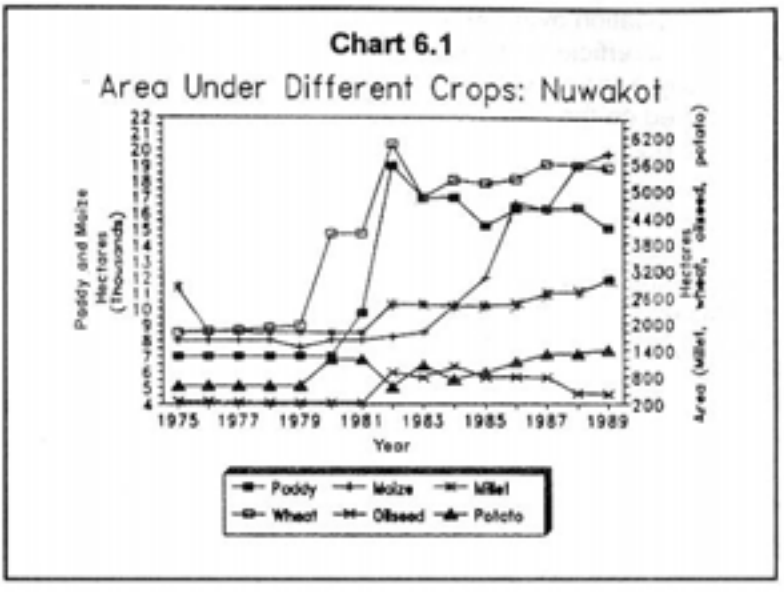
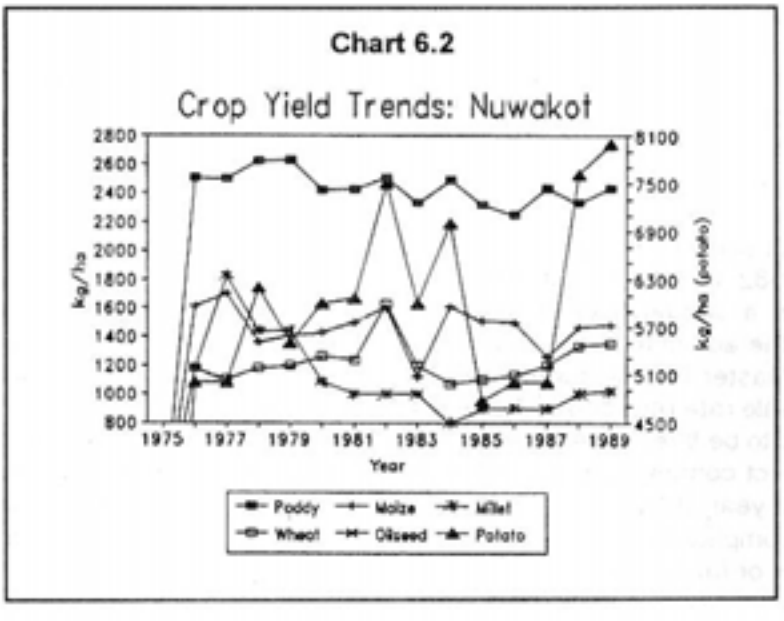


Chart 6.2



Livestock

Historical data on the livestock population by type of animal and its products in Nuwakot district, as reported by DFAMS, is presented in Table 6.5. A close examination of the trends in livestock population indicates positive growth in all type of animals with the exception of goats and pigs. During the same period, the goat

population annually decreased by nine per cent and pigs by 19 per cent. Consequently, their meat production also declined. Among the large animals, the cattle population registered the highest growth rate (5.6%), followed by buffaloes (5%), milch cows, and milch buffaloes (3%). The sheep population, however, increased (3.7% per annum). The downward trend in goat population, an important source of cash income for marginal and poor households, cannot be readily explained, especially since a large market (Kathmandu Valley) for goat meat is easily accessible from Nuwakot.

Many buffaloes are unproductive, as indicated by the low proportion of milch buffaloes in the total buffalo population which decreased over time from 22 per cent in 1984 to 20 per cent in 1988. On the other hand, the proportion of milch cows to cows remained almost stagnant at 10 per cent over the same period. Milk production from buffaloes increased at a faster rate (5% a year) than from cows (4.7%). While the buffalo milk yield increased at the rate of 1.6 per cent per year, the average annual growth in cow milk yield was less than one per cent. The average annual yield of buffalo milk is estimated to be 0.91 MT compared to 0.33 MT per milch cow. The declining proportion of milch buffalo population and their increasing milk yield suggest that households are becoming selective in their choice of animals.

Table 6.5 also shows that the meat production from goats and pigs has decreased by about nine per cent and 19 per cent per annum respectively, simply because of decline in their population, and there has been no improvement in the productivity (meat) of these animals over the period from 1984 to 1988. In order to project the livestock population, cross-sectional data on livestock population provided by the LRMP have been regressed with different land use categories as described in the methodology section.

Land Use Changes

Time series' data on land use statistics in the district are not available. The land use statistics reported by the LRMP pertain to the year 1978 and these data were projected, using the assumption regarding the interclass land transfer over the period. As described in the methodological framework (Chapter 2), the land use changes in most hill districts of Nepal result primarily from deforestion, which is assumed to have taken place at the rate of one per cent per annum in the mid-hill region over the decade (Master Plan). The deforested area was first converted to shrubland, grassland, and eventually to agricultural land. Table 6.6. presents the projected land use changes in Nuwakot over the period from 1978-1990.

Nuwakot district is comprised of three ecological belts, viz., mid-mountains, high mountains, and high Himal, covering 83 per cent, 10.6 per cent and 2.2 per cent respectively of the districts' total area. Over 97 per cent of the district's net cultivated area (and also population) lies in the mid-mountain belt and the rest in the high mountains. Over 57 per cent of the cultivated land in the district is unirrigated and the rest is monsoon irrigated (18.7%) with 24 per cent under year-round irrigation. The potential area that can be brought under irrigation in Nuwakot

is estimated to be 15,047 hectares. According to the LRMP estimate, a large portion (over 75%) of the mapped cultivated area (i.e., adjacent NCI plus gross cultivated area) in the district is comprised of level terraces and rest consists of sloping terraces (11.2%), lower foot slopes (100.5%), and valley floor (2.8%)/.

Although about two-thirds of the district's natural forest lie in the mid-mountain region, the share of natural forests in the total area in the mid-mountain region is less than 13 per cent compared to over 65 per cent in the high mountains. In other words, the ratio between forest and agricultural land in the mid mountains is less than 0.45 hectares, which is far below the suggested level required for sustainable agriculture under the current state of technology and prevailing practices in the hills. This implies there is excessive pressure on natural forests which are all accessible in the mid-mountains. Even if all the shrub and grasslands are afforested, the forest-cultivated land ratio would increase to only 1.15 which is still lower than the suggested level required to sustain hill agriculture.

The situation is quite the reverse in the high mountains with the forest-cultivated ratio being as high as 10. The high value of this ratio is due to the fact that about 40 per cent of the total area in the high mountains is under natural forests (accessible), whereas the cultivated area accounts for only four per cent.

The species' composition of the total forest area in the mid-mountains is predominantly hardwood (86%) with a larger proportion of the forest area under low crown density (10-25%) and low maturity classes (97%). Both the crown density and the maturity class of the forest improve as one moves from low to higher elevations in the district and as more forest areas become inaccessible. The overall land use changes in the district by ecological belt over the period from 1978-1990 are presented in Table 6.6. The total forest area in the mid-mountain region of the district is projected to decline at the rate of 1.44 per cent per year whereas, in the high mountains, natural forests have declined by one per cent per annum. Since a major portion of the deforested area is assumed to have been converted to shrub and grasslands, the area under these land classes has increased at a relatively higher rate per annum. The net cultivated area in the high mountains has increased at a faster rate than that in the mid-mountain region. In the district as a whole, natural forests have decreased at the rate of 1.3 per cent per year while the areas under shrubs and grass, and the cultivated area increased by 0.56 per cent, 0.96 per cent, and 0.15 per cent per annum respectively during the 1978-1990 period as reported in Table 6.6.

It should be noted that a significant portion of the district's total area falls within Shivapuri (6.4%) of the mid-mountain region and Langtang National Parks (35.3%) of the high mountain region. Since the park areas are not likely to change, they are excluded from the land use categories reported in Table 6.6. All of the high Himal area falls into this excluded category under the Langtang National Park. Limited seasonal grazing is, however, allowed in the Park, and this factor is taken into account later while evaluating livestock carrying capacity.

Economic and Natural Resource Conditions: Baseline Scenario

Prices

The national forecasted price was calibrated to reflect the price situation in Nuwakot district. Data on prices for Dhading, a neighbouring district, were used to calibrate the prices for Nuwakot and are presented in Table 6.7. The last column of Table 6.7 also presents the growth rate of prices calculated by using the end points' values.

Among the foodgrains considered, millet and oilseed prices have the highest growth rates while wheat prices have the lowest growth. The aggregate cereal grain price has a growth rate of about 9.64 per cent. The table also contains the forecasted prices of other food products and production factors.

Crop Area and Yield

Table 6.8 provides the results of the forested area under different crops and Table 6.9 provides the respective crop yield projections based on the assumption of non-constant crop prices and variable inputs. Area growth follows a time trend based on historic data series. The growth rates forecasted for crop area over time indicate almost negligible growth rates in the areas under different crops in Nuwakot, which average about one per cent per annum.

Fertiliser sale is expected to grow at about six per cent per annum based on fertiliser sales in the district over the past few years. The sale of fertilisers in Nuwakot, as reported by the AIC, exceeds the per hectare use rates on the crops as was reported for other districts in the Bagmati zone. Other more recent estimates that reflect current fertiliser use in the district are not available for confirmation of the sales' figures. However, field observations indicate that fertiliser use in the district is increasing over time and more and more farmers have begun to use fertiliser.

Table 6.9 provides the future yield trend of six crops in Nuwakot on the basis of past trends. Forecasting is based on the assumption that the crop technology will remain the same over time. Despite the positive trend in the crop yield rates in Nuwakot, the forecasted growth rates are well below the population growth, which is not encouraging. The results indicate that, over time, Nuwakot faces a declining trend in food sufficiency (from its own source base) under the existing state of technology in this sector. Although Nuwakot is self-sufficient in food at present, the declining trend in food sufficiency has implications over time for the land resources (these are examined later below).

Crop Production

According to the model, crop output or production is determined by the area and yield outcomes discussed above. The resulting growth in production (Table 6.10)

of the different crops is positive. The higher production growth rates observed are mainly due to the growth in area discussed above.

Gross Margin

Gross margins were calculated for each of the six crops, based on existing information provided in the Irrigation Master Plan (1989). Table 6.11 also presents the total gross margin and cost of cultivation per hectare of cultivated crops. All crops registered positive gross margins. Millet gross margin has the highest growth rate, despite the fact that its area and yield remain almost constant over time. The increase in the gross margins reported in Table 6.11 is primarily the result of the increase in nominal crop prices over time. Maize, however, has the highest per hectare gross margin in Nuwakot, followed by paddy and oilseeds.

Livestock

The manner in which livestock numbers were forecasted has already been explained in the methodology section. The livestock sector results indicate that the average annual growth in LSU in the district is negative (Table 6.12). Based on data collected by the Department of Food and Agricultural Marketing Services' Department (Agricultural Statistics of Nepal) (DFAMS 1990), livestock products (meat, milk, ghee, and wool) were derived and also applied to estimate the gross margins from livestock over time. Trend equations were fitted to the data series and the results linked with the forecasted livestock population to project livestock products for Nuwakot.

The average annual increases in the different types of livestock products are reported in Table 6.13. The reason why pork and chicken meat production register the same growth rate is because these two products are not linked to the land-use sector as already discussed in the methodology section. Simple time trends were fitted to the past data to forecast the future populations of chicken and pigs.

Gross margins were also calculated for livestock enterprises. Livestock raising costs were calculated after consultation with livestock experts. The average increase in LSU cost over time is about seven per cent. Gross margins from livestock were also derived (Table 6.14). The average annual increase in per LSU gross margin is about 11 per cent.

Food Availability and Demand

Assuming different waste, loss, and seed allowance factors, the total cereal availability in the district was derived from the production of the four cereal grains (rice, wheat, maize, and millet) reported above. The per capita availability was then derived. A similar exercise was carried out to obtain the per capita domestic (district) supplies of meat (mutton, buffalo, pork, and chicken), oils and fat (derived from oilseed production and ghee), vegetables (assumed to be potatoes only), and milk. Tables 6.15, 6.16, and 6.17 provide estimates of the forecasted food availability, demand, and food balance situation in the district.

Crop yield rates are important in determining food supplies, given that land is almost inelastic in terms of supply in Nuwakot. Despite the low growth in crop yield rates, Nuwakot appears to be self-sufficient in cereal grains. As a matter of fact, Nuwakot is surplus in cereal grains as can be observed from Table 6.17. Nuwakot has a surplus production of potatoes and meat but faces a deficit in milk and oils and fat supply.

Land Use Changes

Land use in the district includes agriculture, forests, grazing land, shrubland, non-cultivated inclusions, and other categories. Because of the interaction between competing land uses, land use is subject to change over time in the district. Table 6.18 provides details on the changes in land use over time in Nuwakot.

The results given in Table 6.18 indicate that land use changes, albeit small, have occurred in the district. The share of the forest area declines over time at a rate of one per cent annually and the forest area is forecasted to constitute only 11 per cent of the district's total area by 1998, from the share of 14 per cent in 1991. Marginal gains are forecasted for shrub and grass lands. Other land use categories tend to remain unchanged over time.

The cultivated areas given in Table 6.8 and in Table 6.18 appear to be different. This discrepancy in the two figures arises because they come from two different datasets, namely, DFAMS and LRMP. It was not possible to obtain the net cultivated area in the district from the data reported by DFAMS and the LRMP for the area under different crops is not provided. To derive the cultivated area reported in Table 6.8, it was assumed that the cultivated area is the sum of the areas under paddy and maize, i.e., non-competing crop areas. From the results reported in Table 6.8, the percentage of the cultivated area is about 30 per cent, compared to 26 per cent reported in Table 6.18. In other districts, the discrepancy is larger.

Forest Products

The section on methodology has elaborated on how the forestry sector has developed, based on LRMP and other data sources. Only the results will be discussed in this section. Forests are assumed to provide three primary products, namely, fuelwood, timber, and fodder. The supplies of these resources over time were derived and compared with the demand.

Fuelwood

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

Table 6.19 provides an estimate of the fuelwood supply from different sources in Nuwakot. Non-cultivated inclusions (NCI) are the main source of fuelwood supply in Nuwakot. Accessible forest is the third important source of fuelwood in the district, following shrubland. The contributions of NCI and shrubland increase over time and those of forests decline over time. Crop residue is also an important source of fuelwood in Nuwakot. The contribution of fuelwood from farmlands is negligible. The corresponding estimates of fuelwood from different sources in terms of air dry tonnes (adt) are provided in Table 6.20. Nuwakot is already experiencing a fuelwood deficit which is seen to increase over time.

Fodder

Fodder is also an important forest product. Fodder is supplied by various sources as highlighted in Table 6.21. Forests are not the most important source of fodder supply in the district, as they contribute only about five per cent, and this share shows a decline over time. The main source of fodder is crop residue, followed by NCI land. Other sources reported in the Table contribute a small percentage of the district's total fodder supply.

Labour Supply and Use

Labour supply is determined by the size of the active population. Households devote labour to crop production, livestock raising, and other activities. An active person is assumed to have at his/her disposal 240 mandays. Each active member supplies labour for crop production, and livestock raising (100 mandays per LSU). Other, more specific, information on labour use patterns for Nuwakot is not directly available. The Multipurpose Household Budget Survey - Nepal Rastra Bank (M-NRB) report, however, provides information on the percentage of the population engaged in other activities in the hill region of Nepal. An assumption that 240 mandays of labour in a year are supplied by persons engaged in activities other than agriculture and livestock has been made. The number of persons engaged in other activities (Table 6.22), multiplied by the number of working days in a year, provides an estimate of employment in other sectors in Nuwakot district.

In terms of the labour use pattern in the district, labour use as a percentage of availability declines marginally over time as indicated by the "Labour Use" row in Table 6.22. Members of the households spend time collecting fuelwood and water and carrying out other crop production activities. These activities have not been taken into account in the present exercise. As a result, the percentage of unutilised labour in the district appears to be large. But, even if these activities are taken into account, it is unlikely that labour utilisation in the district will increase substantially to make Nuwakot a labour-deficit district. Currently, only about 70 per cent of the available labour in the district is gainfully employed. Another reason why the results indicate a high underemployment rate is because, while the active population is taken into account in the model, the participation rate is not considered, which, if accounted for, would reduce the size of the total active population, and, hence, the underemployment rate.

Trade

Many food and non-food items are imported into Nuwakot. The exact amount of imports into the district is not known. However, the Multipurpose Household Budget Survey provides information on the average monthly household expenditure on non-food items. The results are for 1984, i.e., the year the survey was conducted. The values of imports were aggregated and, allowing for inflation, these values were updated to 1991 (base year). The expenditure figures are given for food and non-food imports.

The method of estimating the non-food import demand growth rate has already been described in Chapter 2. It is important to emphasise that calculation of the import demand growth rate requires information on the income growth discussed in the following section. The growth in import demand is driven by the income and population growth. The results are presented in Table 6.23.

The average growth in non-food demand is about one per cent per year and is solely determined endogenously by the model. The per capita value of non-food import in 1992 was Rs 985, and this will increase to Rs 988 by 1998 at a rate of less than one per cent growth.

Also presented in Table 6.23 is the value of food exports, since, as has already been discussed above, Nuwakot is surplus in some food items. Food export was derived from the excess food demand determined from the model. More specifically, the demand for food imports is conditioned by the differences in domestic supply (district) and domestic demand. The difference between supply and demand is carried over to the trade section. The value of food surplus, including cereals, meat, milk, vegetables, and oils and fat, is multiplied by the aggregate price of cereals and the respective food prices. The value of per capita food exports increases over time by about nine per cent.

Income

Income is also determined endogenously by the model. The per year gross margins originating from the crop and livestock sectors and income accruing from the different employment activities were added to derive the aggregate income for Nuwakot district. Tables 6.24, 6.25, and 6.26 present the magnitude of nominal, real, and income shares originating from different sectors.

The per capita nominal income grows at about 11 per cent per annum, but, when real incomes are taken into account, the growth in real per capita income is only about one per cent, indicating a very rough time ahead for the district.

The share of income originating from the crop sector tends to increase marginally over time. The share of income from the livestock sector, however, deteriorates marginally, even though the real income from this sector registers positive growth. The share of income from other off-farm activities declines over time, and so does

the real income as employment in the other sectors is assumed to remain at a fixed percentage of the total population.

Environment: Sustainability and Carrying Capacity

The purpose of this section is to assess the performance of the district in terms of selected sustainability indicators and explore the carrying capacity of the district, given the human and livestock populations and the demand and supply of natural resource-based products in the district. In particular, the natural resource products considered are the land and the various products that can be produced from it to meet human and livestock needs.

The performance of the district in terms of some selected sustainability indicators can be judged from the results presented in Table 6.27. In the hill-farming system, forests are an important source of the fodder needed by livestock, which, in turn, provide nutrients (manure) to the fields. In addition, forests also provide fuelwood and timber to households. Besides these three resources, forests also provide leaf litter as a nutrient-supplement to the fields. As the area under accessible forests declines over time, the supply of fodder and leaf litter also declines, leaving negative implications for agricultural productivity. Therefore, the forest-cultivated land ratio in a district gives an idea of the amount of resources that can be harvested sustainably to meet the households' requirements for forest resources.

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

Similar estimates have not been derived for this study, but some indication can be provided by the results derived from the model. For example, the accessible forest-cultivated land ratio in Nuwakot is currently 0.55 hectare, which is very low compared to the Wyatt-Smith estimate of 3.5 hectares. If it is assumed that 3.5 hectares of forest land are required to support one hectare of agricultural land to make the hill farming system sustainable, then the existing ratio estimated for Nuwakot is alarming. This ratio in Nuwakot shows a declining trend over time (Table 6.27).

The ratio of shrubland to accessible forest land is another indicator which explains partially the extent of forest degradation, since, as forests degrade, they are first converted into shrubland. The shrubland-forest ratio in Nuwakot is currently estimated to be 1.43, indicating that the area under shrubland far exceeds the area under forests, and this ratio increases over time. The dependency on forest is also seen to increase over time. Livestock also continue to exert increasing pressure on forests, but livestock pressure on cultivated land and grazing land decreases over time (Table 6.27).

Population

The population of the district continues to grow over the timeframe covered by the study. The size and growth of population in Nuwakot over time are given in Table 6.28. The increase in labour force and its appropriate use will have to be examined in terms of the employment situation as well as food supply among other considerations, under the current trend scenario. For many years to come, the district will have to rely on the existing natural resource base to use the labour force gainfully as well as to feed the total population. In addition, the fuelwood demand will also increase due to the increase in population.

During 1990-91, the bulk of the employment generated in the district was in the agricultural and livestock sectors. According to the results derived from the model, the agricultural area is not increasing to the extent needed to utilise the expanding labour force. If it is assumed that the new labour force will be employed in the agricultural sector, new areas will have to be brought under cultivation.

If new areas are brought under cultivation, the current land use situation in the district will have to change. For example, more forest areas will have to be converted into agricultural land. This option may not be viable or sustainable given the already constraining situation in the forestry sector in terms of meeting the fuelwood and fodder demands. It is possible, however, that the adjacent NCI, which occupies vast tracts of land in the district, could be used for agriculture. But the use of such land will not be sufficient to generate employment to absorb all the new entries into the labour force, and there is not enough land in the first place, even if the limitations in the form of financial and technical constraints did not exist.

It can be urged that employment can be generated in the livestock sector. Under the current trend scenario, this too does not appear to be a viable alternative. Even though the livestock carrying capacity appears to be relatively better compared to other districts in the Bagmati Zone, the livestock productivity is similar. What appears to be imperative in the livestock sector is the reduction of numbers and the increase in productivity per animal, and this is not likely to generate further employment. In this situation, labour is more likely to be displaced rather than to be employed in the livestock sector. If a district's sustainability is viewed in terms of the labour use situation, clearly Nuwakot does not qualify as sustainable because an increasing number of people remain either unemployed or underemployed.

Food

This section examines the implications of the expanding population in terms of the carrying capacity of land to meet the food requirements. Table 6.29 provides the calorie demand and availability situation over time for Nuwakot. Under current trends, the calorie supply will decrease marginally from 4,223,000 calories per ha in 1991 to 4,217,000 calories per ha in 1998, primarily due to decreasing crop yields, despite some growth in the cropped area. The calorie supply over time

meets the calorie demands, even though the growth in calorie demand (due to population growth) exceeds the growth in calorie supply.

The present supply of calories per hectare supported 5.84 adults in 1991, and this situation remains more or less the same until 1998. On the other hand, given an adult's calorie need (2,410), the load on one hectare of land in 1991 was about 5.30 adults, and this also remains fairly constant till 1998. The results indicate that Nuwakot will continue to be surplus in food (cereals and potato) over the 1991-1998 period.

It is worth noting that access to calories may, in fact be less than availability and needs indicate. Access to food is determined by income and relative prices, given base year consumption levels. Table 6.29 presents the results in terms of one's food need. The Table indicates that Nuwakot is surplus in cereals, potatoes, and meat but deficit in milk and oils and fats, even from the consumption point of view.

Fuelwood

The fuelwood situation is presented in Table 6.30. The supply per hectare decreases over time as the accessible forest area also decreases. The pressure on a hectare of forest land increases due to the population growth. It can be observed that the demand is already higher than the supply. This pattern continues to deteriorate over time. The supply position is currently 75 per cent of the demand and, by the year 1998, the supply will decrease to 67 per cent. The carrying capacity will also decline as the forest quality deteriorates, leading to an increase in the load factor. The load factor (which indicates the fuelwood requirements of the persons that a hectare of land can support given the per capita need of 0.588 adt) will increase from 4.66 persons per hectare in 1992 to 5.04 persons per hectare by 1998. On the other hand, the carrying capacity will decrease from 3.51 persons per hectare to 3.37 persons per hectare by 1998. Clearly, the fuelwood situation in Nuwakot is alarming.

Fodder

Under the existing trend, given the livestock growth and changing patterns of land use generated by the model, the capacity of forest, grazing, and agricultural lands and other fodder supply sources to support the livestock population appears to be sustainable in Nuwakot as indicated by the results given in Table 6.31. Under the current trend of land use change and livestock population growth, the capacity of land to support the livestock population appears to be satisfactory. Currently, the livestock population (expressed in terms of LSU) that can be supported by one hectare of land is about 1.09 LSU, whereas the current load factor is smaller (0.84 LSU/ha). The present situation indicates a surplus in fodder supply compared to the fodder demand in Nuwakot.

Conclusion

Under the current state of technology and infrastructure, the capacity of the district to sustain the increasing human and livestock populations in Nuwakot appears to be fairly satisfactory. One major advantage of the district is that it continues to produce surplus food. This factor is important since Nuwakot can diversify its crop sector by including more high-value crops to generate a higher level of income and employment. Enough scope exists within the crop sector to improve crop yields and cropping intensity so as to generate more income and employment. The natural resource scenario in the district indicates that the fuelwood situation should be given more attention. The quantity and quality of forests are deteriorating fairly rapidly in Nuwakot, and it is likely that greater pressure will be exerted on forests to meet the growing fuelwood demand. The fodder supply problem in the district is not serious currently, as indicated by the surplus, based on the results derived from the model.

The overall results suggest that the natural resource and environmental conditions in Nuwakot are not as alarming as those in the other two districts of Bagmati Zone, namely Kabhre and Sindhupalchok. The carrying capacity and load analyses indicate that pressure on agricultural land in Nuwakot is not likely to be serious over time since the current capacity exceeds the load factor in terms of calories. This implies that agriculture in Nuwakot may not pose a threat to forest lands since the district's food produce is in surplus. However, the threat to forests, from the fuelwood point of view, cannot be ruled out. Fuelwood demand already exceeds the current sustainable yield rates. But, since forest resources complement agricultural productivity, the deteriorating forest conditions will have a negative implication on agriculture.

Policy Scenario and Impact Analysis

Introduction

This section examines the impact of different policies on the food supply and natural resource base of Nuwakot district. A population policy is also examined.

Population Policy Scenario and Impact

Nuwakot's population growth according to the 1991 census is about 1.46 per cent compared to the national average of 2.3 per cent. Over time, even with the small increase in population, Nuwakot's economic situation is likely to deteriorate, although the economic situation in Nuwakot is relatively better compared to other districts in the Bagmati Zone. As a result, a 'population reduction policy' was examined within the simulation model developed for Nuwakot.

The population reduction policy is assumed to start in 1993 and continues till 1998. Initially only a small reduction (growth rate) is envisaged, and this is allowed to decrease each year till it reaches 0.9 per cent in 1998. The growth allowed in 1998

is about half the existing growth trend and it also matches with the overall target of 50 per cent reduction in the population growth envisaged in the Eighth Plan Period (1993-1997). The growth assumptions made for each year are given in Table 6.32.

The impact of the population policy, as defined by the growth rate assumptions noted in Table 6.32, indicates that population reduction gradually increases over time from 258 persons in 1993 to over 5,000 by 1998. This reduction implies that by the end of 1998 the population reduction policy will have reduced the total population of Nuwakot by over 13,600 persons. A reduction of 13,600 in a five-year period is not insignificant, and the impact of this reduction will affect other sectors. The annual impacts will occur primarily to the reduction in population which is an extremely small percentage of the total population (Table 6.32)

The impact of the population policy on the calorie balance situation does not change since the policy does not affect the calorie supply. On the demand side, the calorie situation does not change very much (although it decreases) since the reduction in population is still small compared to the total population. Likewise, the impacts of this policy on other variables of interest are also small and hence not reported.

Crop Sector Policy Scenarios and Impacts

The impacts of alternative policy scenarios dealing mainly with fertiliser, irrigation, and combined policy in the crop sector are examined in this section. The first policy scenario envisages the development of all the potential irrigable areas in the district (estimated to total 15,047 hectares). Under the fertiliser policy scenario, the present level of fertiliser use rate in the district is assumed to increase by 25 per cent. Finally, the combined policy scenario refers, in particular, to the combination of irrigation and fertiliser policies in addition to the cropping intensity effect resulting from the net increment in potato area equal to the additional irrigation area developed. All other cropping intensity effects that can be expected to occur during the non-potato season are held constant to simplify matters. The relative merits of these alternative policy scenarios are assessed in terms of the yield, food balance, trade, income, employment, etc and are discussed in the following sections.

Impacts on the Food Sector

Crop Yield: With the introduction of the irrigation policy, the existing irrigated area in the district almost doubles to 15,047 hectares by 1993, and this area is assumed to remain constant over the projected period. This change in irrigated area will affect the yield of all crops except millet, depending on the irrigation elasticities and parameters of crop yield response functions used in the model. The results presented in Table 6.33 (Chart 6.2) indicate that both the magnitude and trend in crop yields will improve significantly due to this policy. For example, the magnitude of increase in crop yields is more pronounced in the case of potatoes, followed by wheat and paddy, whereas the average annual growth rate of crop yields, although less than one per cent, is among the highest for paddy (0.85%), followed by potatoes (0.5%), and wheat (0.4%).

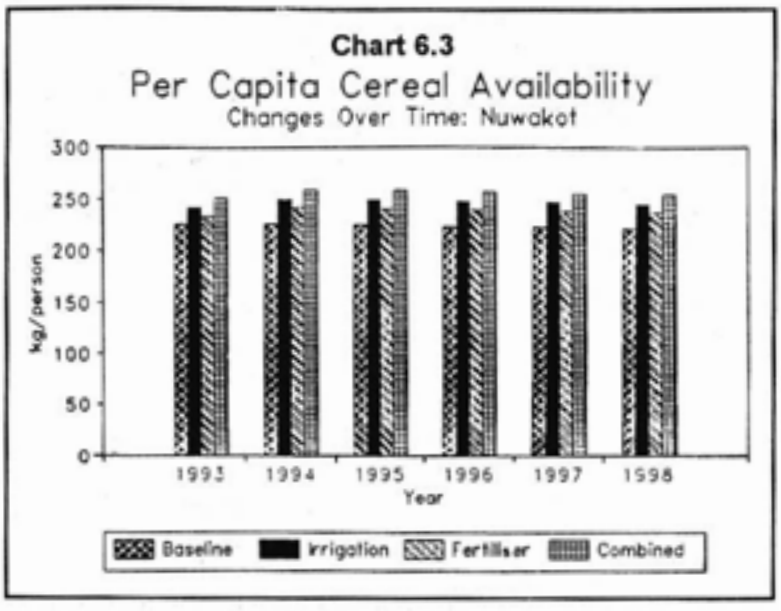
The impact of the 25 per cent increase in the per hectare fertiliser use rate on yield improvement is lower than that of the irrigation policy, whereas the long-run growth trend under the fertiliser policy is relatively higher than under the irrigation policy. Other considerations remaining the same, a 25 per cent increase in the use rate of fertiliser increases the yield of paddy and wheat by over five per cent and that of potatoes and maize by less than three per cent, given the fertiliser elasticities assumed in the model. Since no fertiliser is assumed to be applied to millet, its yield remains unchanged under this policy as in the case of the irrigation policy.

When both irrigation and fertiliser policies are introduced jointly together with the expansion in the area under potatoes, as indicated above, the wheat yield is expected to increase the most (by 28%), followed by oilseeds (20%), paddy (15%), and potatoes (13%), whereas the maize yield is expected to increase by less than five per cent compared to the hectare yield in 1993 under the baseline scenario. Despite the improvement in crop yields due to this combined policy, it is interesting to note that the projected growth rate of crop yields under this policy is lower than under the fertiliser policy.

Food Supply: The impacts of different policies on the food availability situtation in Nuwakot are given in Table 6.34 (Chart 6.3). The results indicate that the magnitude and trend of the per capita food availability by food types under the different policy scenarios are similar. That is, while the irrigation policy increases the level of per capita food availability more than the fertiliser policy, the long-run growth trend of the per capita food availability under the former policy is, however, relatively higher than under the later policy.

Food Demand: The rural households' demand for food is assumed to be influenced by the changes in the income and price of different food items. The food policy scenarios considered in the present exercise, however, affect household incomes (through increased crop production), and, hence, the per capita food demand increases depending upon the growth in income and the magnitude of income elasticity of the food demand. The changes in the per capita demand for different food groups generated by the model under each policy scenario are given in Table 6.35.

The results indicate that the per capita demand for most food items under both the irrigation and fertiliser policies, in general, do not increase much compared to the baseline situation. Since food is a necessity, its income elasticity is generally inelastic, indicating that the rural demand for food does not change proportionately with the change in income. The results further indicate that the per capita demand under each policy, especially under the irrigation policy, declines at a faster rate than under the baseline scenario. This trend is in line with Engel's Law which states that the share of the food basket gradually declines as household incomes rise. When both the irrigation and fertiliser policies are introduced jointly with increased cropping intensity, the per capita demand for all food, however, increases considerably in the initial years and then begins to decline over time.

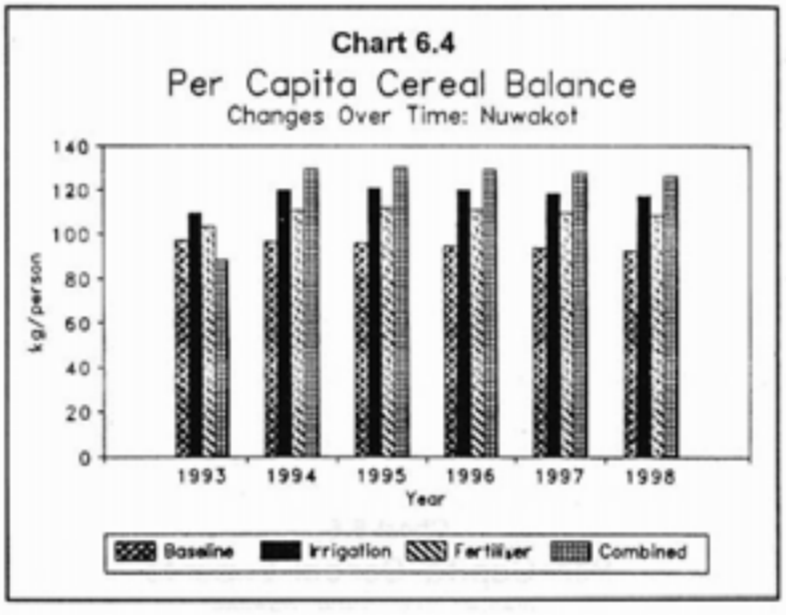


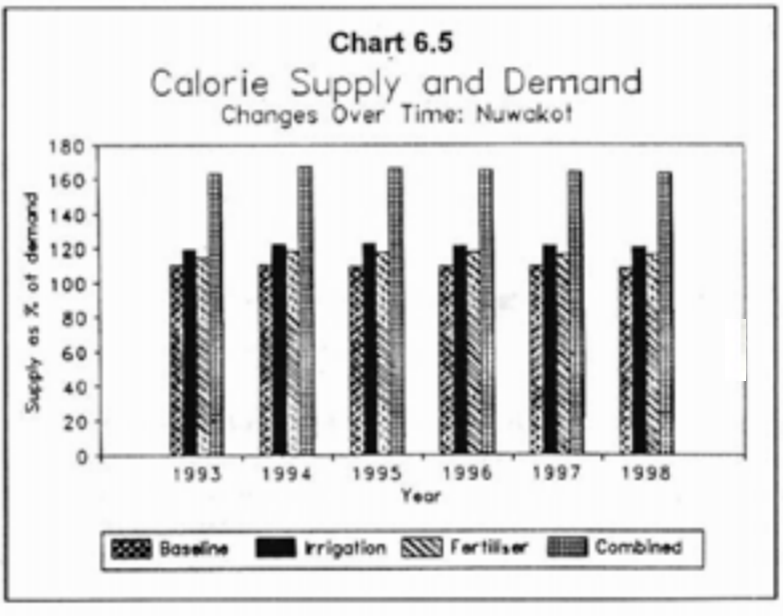
Food Balance: The per capita food balance situation, with and without food policy interventions, in the district over the 1993-1998 period is presented in Table 6.36 (Chart 6.4). Even under the baseline situation, the district continues to experience a net surplus in food despite the declining trend in food surplus. Under the irrigation and fertiliser policy interventions, the district's food balance situation improves and shows a positive trend in the per capita food surplus over time. It should, however, be noted that the per capita oil and fat balance situation in the district does not improve under these policy interventions, because of the little or no effect of such policies on the supply of this food group, including not only oilseeds but livestock products such as ghee.

When both the irrigation and fertiliser policies are introduced jointly along with expansion in one existing area under potatoes, the net surplus in the food balance situation declines drastically in 1993, mainly due to a sudden rise in income which induces food demand more than the policy impact on supply. From 1994 onwards, the surplus in food balance, however, improves considerably due to the decline in per capita demand resulting from the gradual decline in income growth.

Calorie Balance: Table 6.37 provides the forecasted calorie demand and supply situation in the district under each policy scenario (Chart 6.5). Under the current state of technology, the estimated calorie supply (from cereal and potato only) is over 1.10 times greater than the total calorie requirement, and this calorie surplus declines marginally over time. Both the irrigation and fertiliser policies enhance the calorie supply compared to the baseline situation, but the impact of the irrigation policy is relatively more pronounced than that of the fertiliser policy. For example, in 1993, the calorie supply under the former policy would be about 1.19 times higher than the calorie demand, compared to 1.14 times higher under the latter policy. When both these policies are introduced jointly, along with expansion in the

cropping intensity, the calorie supply is expected to exceed the calorie demand considerably, the per hectare calories being 1.62 times greater than the per hectare calorie demand. It should be noted that all the policies scenarios, except the joint policy, enhance the calorie supply rather than the calorie demand.

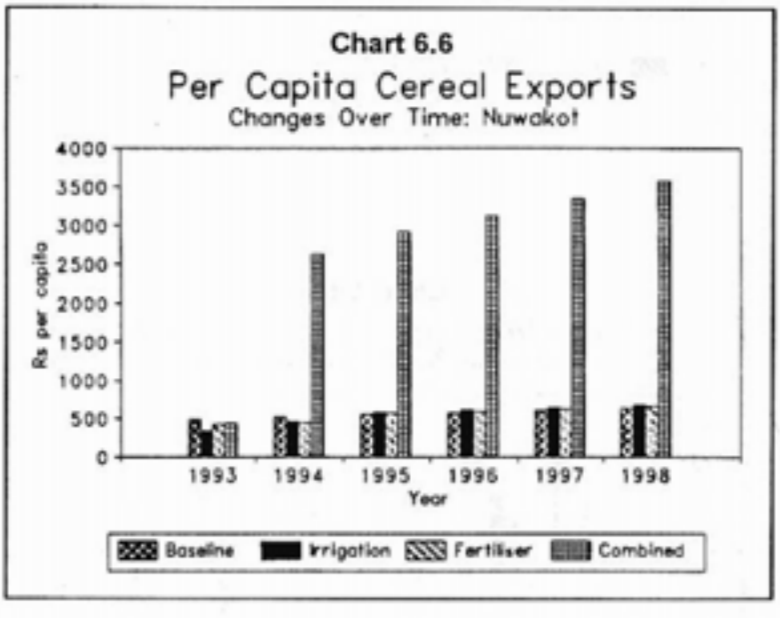




Impact on Trade

The manner in which both food and non-food exports/imports in the district are forecasted has already been described. The impact of alternative policy options on food and non-food export/import is examined in this section and the results generated by the model under each policy scenario are presented in Table 6.38 (Chart 6.6).

Food:: Currently, the district is a net exporter of food with the value of exports increasing at the rate of about seven per cent per annum under the baseline scenario trend. The value of food exports, under both irrigation and fertiliser policies, increases at a much faster rate than under the baseline scenario, but the annual growth of the value of food export under the former policy is relatively higher (17%) than under the latter (11%). However, the value of exports under all policy scenarios declined drastically in 1993 due to the sudden rise in income which induces higher food consumption. Under the joint policy, the value of aggregate food exports is expected to increase considerably from Rs 109 million in 1993 to Rs 972,4 million in 1988 at the average growth rate of about 55 per cent, primarily as a result of the large surplus in potato production. The value of per capita food exports under each policy scenario is given in Table 6.38.



Non-Food: The extent to which the demand for non-food imports is influenced by policy interventions depends very much upon the magnitude of income growth resulting from policy action, together with the strength of income elasticity for non-food demand, other considerations remaining the same. The results presented in Table 6.38 indicate that the value of non-food imports under the joint policy is more

pronounced than under the single policy, taken separately. The value of non-food imports under the single policy does not change from the baseline scenario. This is perhaps because the annual growth in income (which is declining) resulting from the policy interventions is not strong enough to induce import demand growth over time. The joint policy has a greater impact on non-food imports than the other two policies.

Impact on Labour Use

Before examining the employment impacts of the different policy interventions, it is important to emphasise that any increase in total labour utilisation results primarily from the crop sector rather than from the livestock and non-agricultural sectors. Therefore, it is only under the joint policy that the additional labour force can be used in the crop sector, due to the increased cropping intensity effect. While development of irrigation facilities would also help to generate considerable employment opportunities, at least in the short run, this effect has not been taken into account in the present exercise. As a result, the total labour utilisation rate under both irrigation and fertiliser policies remains unchanged from the baseline situation, whereas the joint policy improves the labour use rate significantly. The results presented in Table 6.39 indicate that an additional seven per cent of the total labour force would be used in the crop sector if all the potential irrigated area in the district is brought under potato cultivation. It is also possible to grow other crops during the non-potato season, hence increasing labour utilisation, but this has not been considered in the present exercise to simplify matters. It is further evident from the Table that, although the labour use rate is expected to increase from 69 per cent under the baseline condition to 77 per cent under the joint policy, the labour use situation under both scenarios declines over time as the population grows.

Impact on Income

All the policies examined above affect the income through their impacts on the crop sector. Income originating from the livestock and other non-agricultural sectors, is not directly affected by these policies. The estimated nominal income originating from all these sources was converted to real incomes, using the weighted cereal grain price index at 1991 constant prices as mentioned in the baseline results described above. The results presented in Table 6.40 indicate that the real per capita income, which is estimated to be Rs 1,174 in 1993 under the baseline situation, is expected to reach Rs 1,322 under the irrigation policy, Rs 1,241 under the fertiliser policy, and Rs 2,563 under the joint policy. Irrigation development is seen to have a larger impact on the income level than the fertiliser policy. Yet the long-run (1993-1998) growth rate of the real per capita income under the fertiliser policy is slightly higher than under the irrigation policy (Table 6.40, Chart 6.7) because the growth in crop yields under the former policy is found to be relatively higher than under the latter policy.

The relative shares of income from different sources in the total income, with and without policy interventions, are provided in Table 6.41. The contribution of the

crop sector to the total income, which was about 50 per cent under the baseline scenario in 1993, is expected to reach 56 per cent, 53 per cent, and as high as 78 per cent respectively under the irrigation, fertiliser, and under joint policy interventions. The results further indicate that the projected share of crop income under the fertiliser policy grows at a slightly higher rate than under the irrigation and joint policy interventions. The declining share of livestock and non-agricultural income over time is also discernible from Table 6.41.

Natural Resource Base: Policy Scenarios and Impacts

The impacts of different policies on the natural resource sector are examined in this section. Two sets of policy interventions, dealing with both the demand and supply sides of the natural resource sector (forest), have been considered. While the demand side policy refers in particular to a 10 per cent reduction in the per capita consumption of fuelwood, the supply side policy involves improved management of all the existing accessible forests in the district. The effects of these two policies on demand and supply reduces the rate of deforestation, thereby more fuelwood will be available to meet the fuelwood demand. The results presented in Table 6.42 are, therefore, the results of these simultaneous effects. This also explains why the total supply of fuelwood under the demand policy decreases at a slower rate (1.54%) than under the baseline situation (1.68%).

The results of the supply side policy are also presented in Table 6.42. As is evident from the Table, the fuelwood balance situation improves in comparison to the baseline situation, but the situation is less pronounced compared to the demand

side policy. What is more interesting, however, is that the long-run growth (1993-1998) also reported in the Table indicates that the supply side policy has a better impact in terms of reducing the fuelwood deficit (in the long-run) than the demand side policy. The supply side policy induces better growth of forests over time adding to the biomass stock. The total effect of the supply side policy will become visible after 15 years or so, and cannot be covered by the model. Thus, each year, a larger biomass stock is added to the existing forest area, and this explains the relatively lower negative long-run growth under the supply side policy (indicating relatively larger supplies in the long run).

When the demand reduction and supply management policies are simultaneously examined (joint policy), the fuelwood situation in the districts does not change very much compared to the demand side policy in the initial years. The effect of this policy on fuelwood is visible in the following years when compared to the fuelwood balance situation under the above two policies.

Impact on Fodder

Compared to the fuelwood situation, the fodder situation in Nuwakot is relatively better. Currently, there appears to be an excess supply in Nuwakot. Crop residue is the most important source of fodder in Nuwakot and it continues thus under the different policy scenarios as highlighted in Table 6.42.

The fodder situation in Nuwakot under the baseline scenario improves over time and this trend continues under all the policy options. The different policies do not have much impact on the fodder balance situation in the district (Table 6.42). The long run growth observed in the fodder balance situation is also positive under all scenarios.

Environment and Carrying Capacity

The quality of environment depends substantially upon the nature and extent of the relationship existing between the population and land resources in a given area. The direction and magnitude of inter-class land transfers that have taken place in the district,along with the deforestation rate, have grave environmental implications. The impacts of different policies on some selected indicators of sustainability, such as the changing pressure on the natural resource base, the forest-cultivated land ratio, and deforestation, were assessed against the capacity of land resources. The associated demand pressure on these resources was also determined.

Pressure on the Resource Base

Per Capita Cultivated Land: Under the current population growth trend, the pressure on the natural resource base and environment results primarily from natural resource deficit, leading to deforestation and land use changes. In the case of Nuwakot, the population growth rate of about 1.46 per cent per annum (Table

6.43) exceeds the growth in agricultural land, and, as a result, the per capita cultivated land declines steadily over time at about 1.73 per cent per annum, indicating the increasing pressure on agricultural land. The different policy options do not have any visible impact on agricultural land in terms of reducing the human pressure over time.

Per Capita Accessible Forest: The pressure on accessible forests (land) will continue to grow over the projected period under all policy scenarios simply because the accessible forest area under all policies decreases at a faster rate than the population growth, but the pressure on forest lands is not reduced by the policy interventions. Compared to the baseline scenario, the population density per hectare of forest land under the demand side and joint policy options is projected to grow at a relatively lower rate (3.58%) than under the supply side policy (7.79%).

Cultivated-Forest Area Ratio: Forests are an important source of fodder for livestock, which, in turn, provide nutrients (manure) to farmers' fields. In addition, forests also provide litter as a nutrient supplement to farmers' fields. As the accessible forest area declines over time, the supply of fodder and leaf litter will decline also and this will have negative implications for agricultural productivity. Therefore, the cultivated-forest land ratio in a district provides an idea of the amount of resources that can be harvested sustainably to meet the households' needs.

Wyatt-Smith (APROSC 1982) in his study estimates that 3.5 hectares of accessible unmanaged forest are required to support one hectare of agricultural land in the context of the hill farming system in Nuwakot. This ratio is very small and is seen to decline over time. The different policy options do not have appreciable impacts on this ratio.

The forest-cultivated land ratio in Nuwakot declines over time and is fairly below the optimum level as described earlier (Table 6.43). But the rate of decline in this ratio is much lower (2.37%) under the demand policy than under the supply side policy (3.65%). This implies that the demand reduction policy leads to less accessible forests being deforested than the supply side policy. Stated differently, the accessible forest area under the demand policy decreases at a lower rate than under the supply side policy. The impact of the joint policy is more pronounced as the growth rate is even lower.

Shrub-Forest Land Ratio: The ratio between shrub and forest lands is often used as an indicator of forest degradation, particularly since deforestation in most hilly areas of Nepal leads to the conversion of forest into shrubland. The ratio between shrub and forest lands increases over time under all policy intervention, but this ratio is expected to grow at a slightly lower rate (2.91%) under the demand policy than under the supply policy (3.44%), and at a lower rate still under the joint policy (2.64%).

Deforestation: Table 6.44 shows the estimated magnitude and trend of deforestation under the different policy scenarios. Under the baseline scenario, the deforested area in the district as a whole increases from 406 hectares in 1993 to 565 hectares in 1998, at the rate of 6.83 per cent per annum. The results indicate that the magnitude of deforestation under the demand policy is relatively lower than under the supply policy. It should, however, be noted that the rate of deforestation under the demand policy increases at a much faster rate (10.16%) than under the supply policy (3.56%) (Chart 6.8). However, the demand reduction policy reduces the total deforested area substantially compared to the baseline scenario (from 406 ha under the baseline scenario to 217ha under the demand reduction policy), indicating the strong positive impact of the policy. The supply policy's impact is not readily felt in the few years covered by the model, but the low long-run growth in deforestation indicates a positive impact over an extended period.

Carrying Capacity

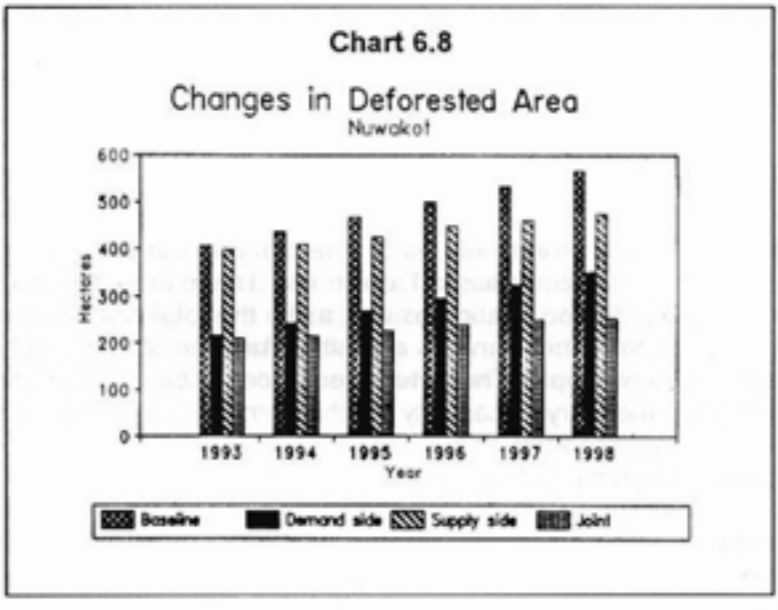
Food: The impacts of different policies on the carrying capacity of crop land to meet the calorie needs are presented in Table 6.45. The load or demand pressure is driven by the size of the population as well as by the total cultivated area. The carrying capacity, on the other hand, is a positive function of crop yield rates and the area under different crops. The natural resource policies do not affect any of the variables (neither the carrying capacity nor the demand side of the crop sector), and hence they are not reported. Thus, only the crop sector policies affecting the carrying capacity of agricultural land are examined.

The results indicate that the irrigation policy has a stronger impact in terms of improving the carrying capacity of crop land than the fertiliser policy. While the demand pressure per hectare of crop land or the current load remains unchanged under the irrigation and fertiliser policies, these interventions have positive impacts. The ability of cropland to sustain the population in terms of the calorie requirements is estimated to be 6.30 persons per hectare of crop land under the irrigation policy compared to 6.06 persons per hectare under the fertiliser policy (in 1993), and, under both policies, this capacity increases over time. It is, however, interesting to note that, although the impact of the irrigation policy is seen to be much stronger than that of the fertiliser policy, the carrying capacity under the fertiliser policy exhibits a higher long-run growth. Since the population remains constant, and these two policies do not affect the cultivable area, the demand pressure or the load factor remains the same under these two policy scenarios.

When both these policies are jointly introduced with the potato promotion policy, the carrying capacity of cropland to sustain the population is expected to increase to 6.72 persons per hectare compared to 5.85 persons per hectare under the baseline scenario. The demand pressure per hectare of cropland also decreases due to this policy, because of the increased area under crops (i.e., potatoes) thereby reducing the load factor to 4.13 persons per hectare in 1993. Consequently,the capacity of crop land to meet the calorie requirements of the population increases substantially due to this combined policy as indicated above under the crop sector analysis.

Fuelwood: Table 6.46 presents the impacts of different policies on the carrying capacity of land in terms of fuelwood (Charts 6.9 and 6.10). The carrying capacity of land in terms of fuelwood is estimated to be 3.76 persons per hectare of land (in 1993), whereas the current demand pressure (i.e., load) is 5.04 persons per hectare under the baseline scenario. The per hectare supply of fuelwood is declining at the rate of 0.68 per cent per annum, while the demand is increasing at the rate of 1.11 per cent per annum.

Chart 6.8



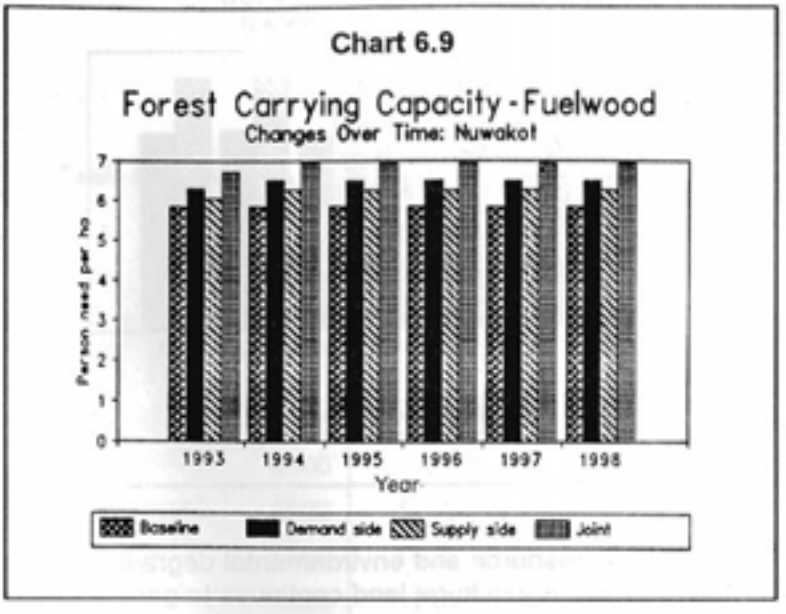
The impact of the supply policy on the carrying capacity is, however, not very pronounced so as to ease the demand pressure, although the long-run growth is reversed from negative to positive due to the policy. The demand policy helps to ease some of the pressure exerted on forests in the short run, but not in the long run. The effect of the joint policy is similar to that of the supply policy, since the demand is also reduced under this policy scenario. Table 6.47 presents the results in terms of the fuelwood situation (forests are considered to be the sole source of fuelwood). Finally, Table 6.48 shows the changing share of fuelwood originating from different sources under different policy scenarios.

Fodder: The extent to which the carrying capacity of land resources, in terms of fodder, is influenced by both the demand and supply policies also depends on the relative share of forests in the total supply of fodder in the district. As a result, the carrying capacity of both aggregate land and forest land were estimated and the impacts of policy alternatives assessed. As can be seen from Table 6.49, the baseline scenario capacity of land to support the existing livestock population in the district is 1.78 LSU per hectare (in 1993), whereas the current pressure is only 1.35 LSU per hectare. This implies that the carrying capacity of land is about 31 per cent higher than the load. Table 6.50 shows the fodder situation (only forests are

considered) and Table 6.51 shows the changes in fodder sources under different policy scenarios.

The different policy options do not have any impact on the fodder supply situation in Nuwakot, and, as a result, the carrying capacity of the district to meet fodder needs as well as the load factor do not change. Changes that may occur due to the supply policy cannot be captured within the five-year time frame of the study.

Chart 6.9

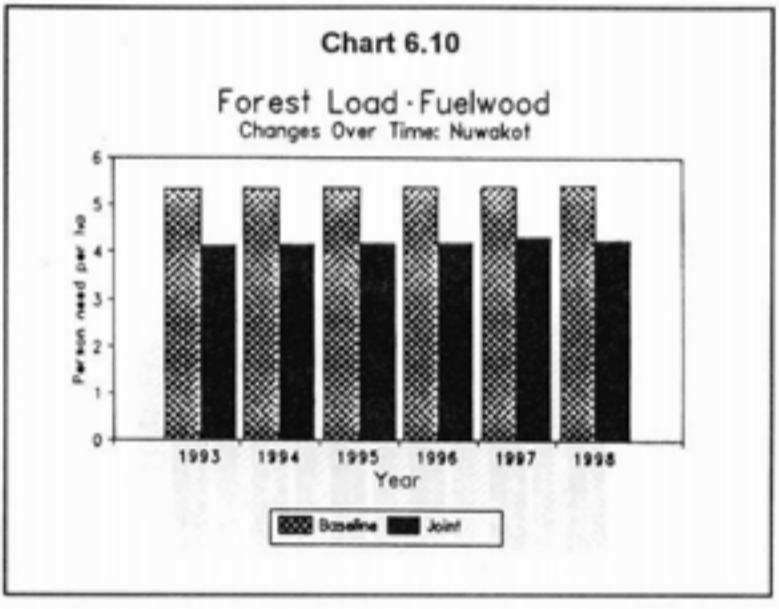


Conclusion

One major conclusion that emerges from the above analysis of the crop sector policy scenarios is that pursuing a combination of policy actions will have far-reaching effects on the food sector than the introduction of a single policy such as irrigation development and increased use of fertilisers. With the introduction of a joint or combined policy consisting of the above options, the present level of per capita income would double as the per hectare gross margin from crops improves substantially, and the district's current food export capacity would also improve considerably. Secondly, if a single policy is pursued, the planner has to choose between long-run growth and equity based on the results. While the fertiliser policy was seen to be more effective in enhancing the long-run growth, the irrigation policy was found to bring about a larger magnitude of change. If short-term employment generation is taken into account through this policy, the impacts in terms of employment could be stronger, and this is likely to benefit the poor. Clearly, generating employment appears to be more difficult than improving income. The combined policy scores better on both fronts. Population reduction was also seen to have negligible impacts, since the reduction was less than one per cent of the total population. The population reduction policy should, however, not be

undermined and should be examined over a longer period (which could not be covered by the model).

Chart 6.10



In the context of natural resource and environmental degradation, the results for Nuwakot are fairly mixed. Agricultural land continues to generate food surplus in the district over time, even though the growth in surplus declines marginally over time. Although no immediate threat to forest land from agriculture is evident, the declining food surplus on one hand and the population growth, on the other, are likely to exert greater pressure on forests. Furthermore, if forests are viewed as a complementary to agricultural productivity, then the dwindling area under forests as well as the decline in biomass will obviously cause a reduction in the food supply, exerting additional pressure on forests. Small reductions in the population are not likely to affect this trend, at least not in the five-year period covered by the study. This, however, does not mean that the population reduction policy should be underestimated, since, over an extended period, population reduction will lead to less pressure in terms of food supply and, hence, on forests.

The existing forests are already in a poor state. The area under forests in Nuwakot is already decreasing and so is the quality of forests. Since the present fuelwood demand cannot be met by the current yield rates, deforestation is increasing fairly rapidly in the district. The population growth adds incremental pressure on deforestation annually. Livestock do not appear to threaten forests from the fodder demand point of view since the existing fodder demand is met from other sources besides forests.

The policy options examined in the natural resource sector indicate the need for immediate action in the forestry sector to control deforestation as well as increase the forest yield rates. The supply policy was seen to have a pressure impact on yield rates, and, hence, deforestation over an extended period (not within the model's framework). The demand policy has an immediate effect on deforestation as the fuelwood demand was curtailed by 10 per cent, but the demand policy is not sustainable from a long term perspective. The joint policy aimed at controlling the demand and improving the supply of forest products, primarily fuelwood, was found to have more desirable impacts.

Table 6.1: Areas under Different Crops: Nuwakot (ha)

Year	Paddy	Maize	Wheat	Millet	Oilseeds	Potato
1975	7000	8000	2820	1800	250	600
1976	7000	8000	1820	1836	245	600
1977	7000	8000	1820	1850	230	610
1978	7000	8000	1800	1900	220	600
1979	7000	7600	1800	1950	220	600
1980	7010	8000	1790	4000	220	1200
1981	9750	8000	1790	4000	220	1200
1982	18970	8200	2420	6000	900	570
1983	16920	8510	2420	4810	780	1060
1984	16950	10200	2370	5190	1050	750
1985	15190	11900	2400	5140	780	900
1986	16240	16570	2440	5220	800	1130
1987	16260	16210	2670	5580	780	1310
1988	16380	19040	2700	5550	430	1320
1989	15090	19780	3000	5500	420	1400
Average	12250	11067	2270	4021	503	923
St. Dev.	4664	4327	415	1607	295	307
Coef. Var.	38	39	18	39	58	33

Table 6.2: Estimated Regression Results for Areas under Different Crops: Nuwakot

Crops	Semilog function	
Paddy Area =	3236.17 + 4846.63 ln (time) (3104.01) (1060.88)	R2 = 0.62
Maize Area =	3870.71 + 3869.25 ln (time) (3427.45) (1171.43)	R2 = 0.47
Millet Area =	1897.71 + 200.52 ln (time) (415.51) (142.01)	R2 = 0.13
Wheat Area =	551.95 + 1865.52 ln (time) (830.53) (283.85)	R2 = 0.77
Oilseeds Area =	67.45 + 234.17 ln (time) (257.71) (87.05)	R2 = 0.36
Potato Area =	390.90 + 286.26 ln (time) (235.14) (80.36)	R2 = 0.50

Note: Figures in parentheses indicate standard errors in estimate

Table 6.3: Crop Yield Trend: Nuwakot (kg/ha)

Year	Paddy	Maize	Millet	Wheat	Oilseeds	Potato
1975	2501	1615	1177	1180	404	5000
1976	2500	1700	1824	1100	404	5000
1977	2624	1360	1440	1178	609	6197
1978	2629	1400	1444	1200	500	5500
1989	2420	1429	1083	1262	500	6000
1980	2425	1500	1000	1235	500	6067
1981	2501	1600	1000	1630	545	7500
1982	2332	1122	1000	1200	600	6000
1983	2489	1610	798	1071	692	7000
1984	2319	1514	899	1098	495	4773
1985	2250	1496	900	1128	603	5000
1986	2435	1260	889	1199	600	5000
1987	2331	1467	1000	1330	654	7603
1988	2432	1480	1019	1350	605	8000
Mean	2442.00	1468.07	1105.21	1225.79	550.79	6045.71
Std.	106.22	145.87	270.80	137.11	83.87	1055.23
Co. Var.	2298.96	1006.45	408.13	894.04	656.75	572.93

Table 6.4: Sale of Chemical Fertilisers in Nuwakot District

Year	Quantity Supplied (MT)	Sale Per Cropped Area (kg/ha)
1982	2468	67
1983	2547	74
1984	2975	82
1985	2998	83
1986	2887	68
1987	3431	80
1988	3844	85
1989	4255	94
1990	5689	120
1991	5440	134

Source: Agricultural Inputs Corporation

Table 6.5: Livestock Population and Livestock Products

	1984	1985	1986	1987	1988
Population					
Buffaloes	52205	53881	56720	63148	63224
Milch Buffaloes	11224	11584	12200	12176	12712
Cattle	80664	81519	83590	101520	100505
Milch Cows	8679	8771	9600	10161	9958
Goats	75235	76491	75725	50750	51765
Sheep	15165	15744	16020	16810	17533
Pigs	2915	3070	2980	1180	1216
Products					
Meat: Buffalo (MT)	1535	1584	1668	2043	2045
Goat (MT)	224	228	225	151	154
Mutton (MT)	33	34	35	37	39
Pork (MT)	42	44	43	17	18
Chicken (MT)	94	99	99	92	97
Milk: Buffalo (lit)	10023	10345	10895	11550	12058
Cows (lit)	2839	2869	3141	3531	3460

Source: DFAMS 1989

Table 6.6: Land Use Changes in Nuwakot Over Time (ha)

	1978	1979	1980	1985	1986	1987	1988	1989	1990
Total Area	119649	119649	119649	119649	119649	119649	119649	119649	119649
Mid-mountains	93291	93291	93291	93291	93291	93291	93291	93291	93291
Natural Forests	12498	12373	12249	11649	11532	11417	11303	11190	11078
Accessible Forests	12498	12373	12249	11649	11532	11417	11303	11190	11078
Shrublands	19317	19379	19441	19742	19800	19857	19915	19971	20027
Grasslands	2166	2185	2203	2293	2311	2328	2345	2362	2379
Mapped Cultivation	56755	56792	56830	57010	57045	57079	57114	57147	57181
Adjacent NCI	20368	20380	20393	20453	20465	20476	20488	20499	20510
Gross Cultivation	36387	36412	36437	36557	36580	36603	36626	36649	36671
NCI Within	6808	6808	6808	6808	6808	6808	6808	6808	6808
Net Cultivation	29579	29604	29629	29749	29772	29795	29818	29841	29863
MM Calculated	90736	90730	90724	90694	90688	90682	90676	90671	90665
High Mountains	11181	11181	11181	11181	11181	11181	11181	11181	11181
Natural Forests	6755	6706	6658	6425	6380	6335	6291	6247	6203
Accessible Forests	4857	4808	4760	4527	4482	4437	4392	4349	4305
Shrubland	999	1023	1047	1164	1187	1209	1231	1253	1275
Grasslands	1299	1306	1313	1348	1355	1362	1369	1375	1382
Mapped Cultivation	1609	1624	1638	1708	1722	1735	1748	1761	1775
Adjacent NCI	789	794	799	822	827	831	835	840	844
Gross Cultivation	820	830	839	886	895	904	913	922	930
NCI within	183	183	183	183	183	183	183	183	183
Net Cultivation	637	647	656	703	712	721	730	739	747
HM Calculated	10662	10660	10657	10646	10643	10641	10639	10637	10634
Nuwakot (Total)									
Forests	19253	19079	18908	18074	17912	17752	17594	17437	17281
Accessible Forests	17355	17181	17009	16176	16014	15854	15695	15538	15383
Shrublands	20316	20403	20489	20905	20986	21066	21146	21224	21302
Grasslands	3465	3491	3517	3642	3666	3690	3714	3737	3761
Adjacent NCI	21157	21174	21192	21275	21291	21307	21323	21339	21354
NCIG	6991	6991	6991	6991	6991	6991	6991	6991	6991
Net Cultivated	30216	30251	30285	30452	30484	30516	30548	30579	30610
Nuwakot (Calculated)	101398	101389	101381	101339	101331	101323	101315	101307	101299
Residual (including)	18251	18260	18268	18310	18318	18326	18334	18342	18350
Conservation Area	5731	5740	5748	5790	5798	5806	5814	5822	5830

Table 6.7: Forecasted Product and Factor Prices

Products & Factors	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Products									
Units (Rs/kg)									
Paddy	5.62	6.22	6.89	7.61	8.40	9.25	10.19	11.21	10.45
Wheat	5.72	6.13	6.57	7.04	7.54	8.07	8.64	9.25	7.13
Maize	4.96	5.43	5.94	6.49	7.08	7.71	8.39	9.11	9.17
Millet	5.33	5.97	6.68	7.45	8.29	9.20	10.21	11.30	11.47
Oilseeds	17.08	18.97	21.06	23.38	25.95	28.81	31.98	35.51	11.02
Potatoes	5.76	6.18	6.62	7.10	7.62	8.18	8.78	9.43	7.27
Mutton	65.76	72.17	79.30	87.23	96.06	105.89	116.82	128.99	10.04
Chicken meat	60.05	65.92	72.37	79.45	87.22	95.75	105.11	115.39	9.78
Buffalo meat	26.37	29.40	32.77	36.54	40.73	45.41	50.62	56.44	11.48
Pork	31.26	34.27	37.57	41.19	45.16	49.51	54.28	59.51	9.64
Wool	80.25	85.87	91.88	98.31	105.19	112.55	120.43	128.86	7.00
Cereal grains	5.31	5.84	6.42	7.04	7.71	8.43	9.22	10.06	9.64
Aggregate Oils and Fat	83.50	91.52	100.38	110.13	120.84	132.62	145.56	159.79	9.65
Aggregate Meat	34.53	38.30	42.51	47.20	52.42	58.23	64.71	71.92	11.03
Milk (Rs/lit)	8.99	9.78	10.65	11.60	12.63	13.76	14.98	16.31	8.89
Mustard Oil (Rs/lit)	49.13	54.43	60.30	66.80	74.00	81.98	90.82	100.61	10.78
Ghee (Rs/lit)	108.26	118.87	130.52	143.31	157.35	172.78	189.71	208.30	9.80
Factors									
Wage Rate (Rs/day)	33.52	35.87	38.38	41.06	43.94	47.01	50.31	53.83	7.00
Bullocks (Rs/pair day)	26.82	28.69	30.70	32.85	35.15	37.61	40.24	43.06	7.00
Fertiliser price (Rs/kg)	4.28	4.58	4.90	5.24	5.61	6.00	6.42	6.87	7.00

Table 6.8: Forecasted Area under Different Crops (hectares)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	16674	16968	17245	17507	17755	17992	18217	18433	1.50
Maize	19599	19833	20054	20263	20462	20651	20831	21003	1.03
Millet	2954	2966	2977	2988	2998	3008	3018	3026	0.36
Wheat	5724	5837	5944	6045	6140	6232	6318	6401	1.68
Oilseeds	717	731	744	757	769	780	791	802	1.68
Potatoes	1435	1451	1466	1481	1495	1508	1520	1532	0.98
Total Cropped Area	47102	47786	48431	49041	49620	50170	50695	51197	1.24
Total Cultivated Land	36272	36801	37299	37770	38217	38643	39048	39435	1.25
Area under Irrigation	7646	7799	7955	8114	8276	8442	8611	8783	2.00
Total Fertiliser Sale	4888	5240	5593	5946	6298	6651	7004	7356	6.23

Table 6.9: Forecasted Yield Rates of Different Crops (kg/ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	2563	2573	2569	2565	2562	2559	2556	2554	0.56
Maize	1498	1503	1502	1501	1500	1500	1499	1498	0.26
Wheat	1269	1271	1270	1268	1267	1266	1265	1264	0.38
Millet	1111	1113	1113	1113	1113	1112	1112	1112	0.08
Oilseeds	563	565	564	564	564	564	564	564	0.29
Potatoes	6217	6231	6228	6225	6223	6221	6218	6216	0.35

Table 6.10: Forecasted Changes in Crop production (MT)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Paddy	42739	43659	44301	44910	45490	46044	46569	47075	2.07
Maize	29366	29806	30120	30417	30700	30969	31223	31468	1.29
Wheat	7264	7422	7548	7667	7780	7888	7990	8089	2.06
Millet	3281	3301	3313	3325	3336	3346	3356	3366	0.44
Oilseeds	404	413	420	427	434	440	446	452	1.98
Potatoes	8919	9041	9132	9218	9300	9378	9452	9523	1.33

Table 6.11: Forecasted Revenue, Cost, and Gross Margins Per Hectare of Cultivated Land under Different Crops (Rs/ha)

Crops	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Revenue									
Paddy	15.05	16.67	18.35	20.17	22.17	24.34	26.70	29.27	10.67
Maize	7.98	8.72	9.48	10.30	11.18	12.12	13.12	14.20	8.91
Wheat	7.66	8.20	8.75	9.33	9.96	10.62	11.33	12.09	7.20
Millet	6.33	7.05	7.84	8.69	9.62	10.64	11.76	12.97	10.98
Oilseeds	9.63	10.71	11.89	13.19	14.64	16.26	18.04	20.03	11.34
Potatoes	35.83	38.49	41.24	44.22	47.42	50.88	54.60	58.62	7.64
Cost:									
Paddy	9.72	10.41	11.15	11.94	12.79	13.69	14.66	15.70	7.08
Maize	7.12	7.62	8.16	8.73	9.34	10.00	10.70	11.45	7.02
Wheat	6.72	7.19	7.69	8.23	8.80	9.41	10.07	10.77	6.97
Millet	6.11	6.54	7.01	7.51	8.04	8.61	9.22	9.87	7.09
Oilseeds	4.33	4.65	4.99	5.35	5.74	6.16	6.61	7.09	7.29
Potatoes	15.31	16.39	17.55	18.79	20.13	21.56	23.10	24.74	7.09
Per Hectare Gross Margin									
Paddy	5331	6261	7199	8235	9380	10644	12036	13573	16.78
Maize	863	1101	1327	1572	1835	2119	2423	2752	23.07
Wheat	937	1007	1055	1105	1156	1210	1264	1320	9.26
Millet	215	510	827	1184	1585	2035	2538	3102	
Oilseeds	5292	6059	6899	7843	8905	10097	11434	12935	14.31
Potatoes	20520	22097	23694	25422	27293	29318	31505	33874	8.06

Table 6.12: Forecasted Livestock Population

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cattle	100374	100233	100071	99884	99668	99418	99130	98797	-0.21
Milch Cow	41756	41697	41629	41552	41462	41358	41238	41099	-0.21
Bullock	58618	58536	58441	58332	58206	58060	57892	57687	-0.21
Buffalo-total	63140	63051	62948	62830	62694	62537	62355	62145	-0.21
Milch Buffalo	36368	36317	36258	36190	36112	36021	35917	35796	-0.21
Sheep	17507	17480	17449	17413	17372	17324	17268	17204	-0.24
Goat	51739	51712	51681	51645	51604	51556	51500	51436	-0.08
Pig	1252	1290	1329	1369	1410	1452	1496	1540	3.00
Chicken	61674	63525	65430	67393	69415	71497	73642	75852	3.00
Total LSU	125163	124995	124801	124577	124318	124020	123675	123276	-0.21

Table 6.13: Forecasted Annual Production and Growth in Livestock Products (MT)

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cow's Milk	4067	4061	4055	4047	4038	4028	4017	4003	-0.21
Buff's Milk	6932	6922	6911	6898	6883	6866	6846	6823	-0.21
Ghee	153	153	152	152	152	151	151	150	-0.21
Net Milk Supply	7699	7688	7676	7662	7645	7626	7604	7578	-0.21
Oils and Fat	262.84	265.04	266.83	268.48	269.98	271.34	272.56	273.63	0.72
Buffalo Meat	1033.45	1032.00	1030.32	1028.39	1026.16	1023.59	1020.61	1017.17	-0.21
Goat and Sheep Meat	204.61	204.46	204.28	204.08	203.84	203.57	203.26	202.90	-0.11
Chicken Meat	81.41	83.85	86.37	88.96	91.63	94.38	97.21	100.12	3.00
Pork	11.77	12.13	12.49	12.86	13.25	13.65	14.06	14.48	3.00
Aggregate Meat Available	1331.24	1332.43	1333.46	1334.29	1334.88	1335.18	1335.14	1334.67	0.04
Wool Production (kg)	7706.16	7694.25	7680.52	7664.69	7646.43	7625.33	7600.94	7572.68	-0.24

Table 6.14: Forecasted Cost and Returns from Livestock (Rs '000)

Livestock Type	1991	1992	1993	1994	1995	1996	1997	1998
Buffaloes	14491	16704	19202	22018	25189	28754	32755	37237
Sheep and Goats	7472	8358	9360	10491	11767	13205	14822	16640
Pigs	189	218	252	290	334	384	442	508
Poultry	4024	4575	5200	5910	6716	7630	8668	9846
Cows (Milk+Ghee)	24266	26767	29508	32508	35790	39376	43290	47555
Buffaloes (Milk+Ghee)	49239	54104	59423	65233	71575	78490	86020	94210
Total Gross Margin From LV	99681	110726	122944	136451	151372	167839	185997	205996

Table 6.15: Forecasted Per Capita Food Supply (kg/adult)

Food (Edible Form)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal Grains	225.00	225.60	225.04	224.32	223.49	222.54	221.49	220.38	-0.30
Meat	5.42	5.34	5.27	5.19	5.12	5.05	4.98	4.90	-1.42
Milk	31.34	30.83	30.33	29.82	29.33	28.83	28.34	27.84	-1.68
Oils and Fat	1.07	1.06	1.05	1.05	1.04	1.03	1.02	1.01	-0.89
Vegetables	27.95	27.92	27.78	27.63	27.46	27.29	27.11	26.93	-0.53

Table 6.16: Forecasted Per Capita Food Demand (kg/adult)

Food (Edible Form)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal Grains	218.25	218.42	217.56	217.01	216.32	215.51	214.56	213.57	-0.31
Vegetables	26.73	26.54	25.09	25.94	25.78	25.62	25.43	25.25	-0.81
Meat	5.24	5.12	4.96	4.89	4.82	4.75	4.68	4.61	-1.79
Milk	35.58	35.17	34.25	33.65	33.05	32.45	31.85	31.27	-1.83
Oils and Fat	1.18	1.09	1.07	1.06	1.05	1.04	1.03	1.02	-2.08

Table 6.17: Forecasted Per Capita Food Balance Situation (kg/adult)

Food (Edible Form)	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Cereal Grains	6.74	7.18	7.47	7.31	7.17	7.04	6.93	6.81	0.15
Vegetables	1.22	1.37	1.69	1.69	1.68	1.68	1.68	1.68	4.61
Meat	0.18	0.22	0.31	0.30	0.30	0.29	0.29	0.29	6.72
Milk	-4.23	-4.34	-3.93	-3.82	-3.72	-3.62	-3.52	-3.43	-2.98
Oils and Fat	-0.11	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-23.79

Table 6.18: Forecasted Changes in Land Use (%)

Land Use	1991	1992	1993	1994	1995	1996	1997	1998
Forests	14	14	13	13	13	12	12	11
Shrublands	18	18	18	18	19	19	19	19
Grasslands	3	3	3	3	3	3	4	4
Adjacent NCI	18	18	18	18	18	18	18	18
Net Cultivated	26	26	26	26	26	26	26	26
Residual (including)	15	15	15	15	15	16	16	16
Shivapuri, Langtang Net	5	5	5	5	5	5	5	5
Total	100	100	100	100	100	100	100	100
Total (ha)	119649	119649	119649	119649	119649	119649	119649	119649

Table 6.19: Supply Fuelwood from Different Sources and the Total Annual Supply (%)

Sources	1991	1992	1993	1994	1995	1996	1997	1998
Forests	23	22	22	21	20	20	19	18
Shrub Lands	24	24	25	25	25	26	26	27
Grazing Lands	0	0	0	0	0	0	0	0
Adjacent NCI	40	40	41	41	41	41	41	41
Cultivated Area	1	1	1	1	1	1	1	1
Crop Residue	11	11	12	12	12	12	12	12
Total	100	100	100	100	100	100	100	100
Total Supply (adt)	110948	110812	110641	110438	110201	109932	109630	109296

Table 6.20: Forecasted Fuelwood Supply from Different Sources (air dry tonne (ADT))

Sources	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Forest: Hardwood	20838	20258	19634	18964	18246	17481	16667	15803	-3.73
Conifer	477	465	453	440	426	411	395	378	-3.14
Mixed	4115	4050	3983	3913	3840	3765	3686	3605	-1.83
Shrublands	26871	27115	27378	27659	27959	28278	28618	28977	1.06
Grazing Lands	382	388	394	401	408	416	424	432	1.76
Adjacent NCI	44647	44729	44817	44911	45011	45117	45231	45351	0.22
Cultivated Area	1074	1077	1080	1083	1086	1090	1094	1098	0.30
Crop Residue	12544	12729	12904	13069	13225	13374	13516	13652	1.26
Total Fuelwood Supply (adt)	110948	110812	110641	110438	110201	109932	109630	109296	-0.20
Per Capita ss: Fuelwood (adkg)	452	444	437	430	423	416	409	402	-1.47
Per Capita Deficit (adkg)	-106	-114	-121	-128	-135	-142	-149	-156	
Total Deficit	-26122	-28337	-30599	-32907	-35262	-37661	-40104	-42591	

Table 6.21: Forecasted Fodder Supply by Source (MT-total digestible nutrient (TDN))

Source	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Forests	6916	6743	6558	6360	6149	5925	5687	5435	-3.26
Shrublands	16552	16703	16865	17038	17223	17419	17628	17850	1.06
Grazing Lands	1736	1755	1776	1798	1821	1845	1871	1898	1.27
Adjacent NCI	29950	30005	30064	30127	30194	30266	30342	30422	0.22
Risers and Bunds	2148	2154	2160	2166	2173	2180	2187	2195	0.30
Fallow Grazing	1841	1846	1851	1856	1862	1868	1875	1882	0.30
Tree Fodder	4296	4307	4319	4332	4345	4359	4375	4391	0.30
Crop Residue	37633	38188	38711	39206	39676	40123	40549	40956	1.26
Total Fodder Supply (tdn)	101073	101701	102303	102883	103443	103985	104513	105029	0.56

Table 6.22: Labour Use by Sector

Labour Use & Activity	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Labour Days Available	41442	42182	42931	43690	44458	45236	46006	46784	1.47
Labour Use in the Crop Sector	8360	8484	8601	8711	8816	8915	9010	9101	1.27
Livestock	12516	12499	12458	12458	12432	12402	12368	12328	-0.21
Professional Workers	637	648	650	671	683	695	707	719	1.47
Office Workers	716	729	742	755	768	782	795	808	1.47
Sales and Service Workers	1512	1539	1586	1594	1622	1650	1678	1707	1.47
Production Workers	1671	1701	1731	1762	1793	1824	1855	1886	1.47
Construction, etc.	398	405	412	419	427	434	442	449	1.47
General Labourers	3461	3523	3566	3649	3713	3778	3842	3907	1.47
Total Labour Use	29271	29528	29777	30018	30253	30480	30697	30905	0.71
Labour Use as % of Available Labour	71	70	69	69	68	67	67	66	-0.74

Table 6.23: Forecasted Values of Food and Non-food Imports (Rs '000)

Import/Export	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Growth Rate of Non-food Imports		0.018	0.017	0.017	0.017	0.017	0.017	0.017	
Total Food Imports	-34065	-38919	-38734	-42437	-46507	-50981	-55765	-61247	8.74
Total Non-food Imports	-241960	-242966	-247257	-251541	-255862	-260219	-264611	-269037	1.53
Value of Total Imports	-276025	-281885	-285991	-293978	-302369	-311200	-320376	-330284	2.60
Value: Per Capita Food (Rs)	-139	-156	-153	-165	-178	-193	-208	-225	7.16
Value: Per Capita N-food (Rs)	-985	-974	-977	-979	-981	-984	-986	-988	0.05

Table 6.24: Forecasted Nominal Income by Source (Rs '000)

Source of Income	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	145042	171946	199373	229821	263585	300990	342323	388102	17.51
Livestock	99681	110726	122944	136451	151372	167839	185997	205996	10.95
Professional Workers	7113	7240	7368	7498	7630	7764	7896	8029	1.47
Office Workers	7432	7565	7700	7836	7973	8113	8251	8391	1.47
Sales and Service Workers	17387	17698	18012	18330	18653	18979	19302	19629	1.47
Production Workers	12265	12484	12706	12930	13157	13387	13615	13846	1.47
Construction, etc	3497	3559	3622	3686	3751	3817	3882	3948	1.47
General Labourers	23140	23553	23972	24395	24824	25258	25688	26123	1.47
Total Income	315556	354770	395696	440948	490946	546147	606955	674063	12.24
Per Capita Income	1285	1423	1563	1716	1883	2065	2262	2476	10.81

Table 6.25: Forecasted Real Income by Source (Rs '000)

Source	1991	1992	1993	1994	1995	1996	1997	1998	Growth
Crops	131569	141808	149736	157401	164830	172046	179036	185887	7.18
Livestock	90422	91319	92335	93453	94658	95937	97277	98665	1.19
Professional Workers	6452	5971	5534	5136	4771	4438	4130	3846	-7.46
Office Workers	6742	6239	5783	5367	4986	4637	4315	4019	-7.46
Sales and Service Workers	15772	14596	13528	12554	11664	10848	10095	9401	-7.46
Production Workers	11125	10296	9542	8856	8228	7652	7121	6632	-7.46
Construction, etc	3172	2935	2721	2525	2346	2182	2030	1891	-7.46
General Labourers	20990	19425	18004	16708	15524	14438	13435	12512	-7.46
Total	286244	292588	297182	301999	307007	312178	317439	322852	2.37
Per Capita Real Income	1165	1173	1174	1176	1178	1180	1183	1186	1.06

Table 6.26: Forecasted Income Shares by Source (%)

Source	1991	1992	1993	1994	1995	1996	1997	1998
Crops	45.96	48.47	50.39	52.12	53.69	55.11	56.40	57.58
Livestock	31.59	31.21	31.07	30.94	30.83	30.73	30.64	30.56
Professional Workers	2.25	2.04	1.86	1.70	1.55	1.42	1.30	1.19
Office Workers	2.36	2.13	1.95	1.78	1.62	1.49	1.36	1.24
Sales and Service Workers	5.51	4.99	4.55	4.16	3.80	3.48	3.18	2.91
Production Workers	3.89	3.52	3.21	2.93	2.68	2.45	2.24	2.05
Construction, etc	1.11	1.00	0.92	0.84	0.76	0.70	0.64	0.59
General Labourers	7.33	6.64	6.06	5.53	5.06	4.62	4.23	3.88
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 6.27: Performance and Sustainability Indicators

Indicators	1991	1992	1993	1994	1995	1996	1997	1998
Per Capita Cultivated Land (ha/person)	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Per Capita Accessible Forest Land	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.04
Cultivated Area-Forest Area Ratio	0.55	0.54	0.52	0.50	0.49	0.47	0.45	0.43
Shrub-Forest Area Ratio	1.43	1.49	1.54	1.61	1.69	1.78	1.88	1.99
Population Density Per Cultivated Land	8.00	8.11	8.20	8.30	8.40	8.49	8.59	8.68
Population Per Accessible Forest Land	7.41	7.58	7.78	8.00	8.25	8.53	8.84	9.20
LSU Per Cultivated Area	4.08	4.06	4.05	4.03	4.01	3.98	3.96	3.93
LSU Per Forest Area	8.35	8.56	8.80	9.07	9.38	9.73	10.14	10.61
LSU Per Grazing Area	0.12	0.12	0.11	0.11	0.11	0.10	0.10	0.09
Per Capita Nominal Income	1285	1423	1563	1716	1883	2065	2262	2467
Per Capita Real Income	1165.27	1173.31	1174.08	1175.59	1177.69	1180.24	1182.97	1186.09

Table 6.28: Forecasted Population and Changes in the Size of the Active Population

Composition	1991	1992	1993	1994	1995	1996	1997	1998
Active Male Population	85761	87429	89128	90857	92617	94410	96118	97853
Active Female Population	80005	81298	82598	83904	85216	86532	87905	89284
Total Active Population	165767	168728	171726	174761	177833	180943	184024	187137
Total: Male Population	127669	129744	131843	133966	136114	138285	140399	142532
Total: Female Population	117976	119626	121276	122925	124572	126218	127942	129667
Total Population	245645	249370	253119	256891	260686	264503	268341	272199

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

Table 6.29: Carrying Capacity of Agricultural Land in Terms of Calorie

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998
Calories ('000)								
Per ha Calorie Supply	4223	4237	4233	4229	4226	4223	4220	4217
Per ha Calorie Demand	3831	3833	3839	3848	3860	3874	3889	3907
Supply as % of Demand	110.25	110.54	110.26	109.90	109.49	109.02	108.50	107.95
Carrying Capacity Per ha	5.84	5.86	5.85	5.85	5.84	5.84	5.83	5.83
Current Load	5.30	5.30	5.31	5.32	5.34	5.36	5.38	5.40

Table 6.30: Carrying Capacity of Land in Terms of Fuelwood

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998
Fuelwood Supply Per ha	2.11	2.10	2.09	2.08	2.07	2.05	2.04	2.02
Per ha Demand	2.80	2.83	2.87	2.90	2.93	2.96	3.00	3.03
Supply as % of Demand	75	74	73	72	70	69	68	67
Carrying Capacity Per ha	3.51	3.50	3.48	3.46	3.44	3.42	3.40	3.37
Current Load	4.66	4.72	4.78	4.83	4.89	4.94	4.99	5.04

Table 6.31: Carrying Capacity of Land in Terms of Fodder

Capacity & Load	1991	1992	1993	1994	1995	1996	1997	1998
Total Fodder SS/ha	1.09	1.10	1.11	1.11	1.12	1.13	1.13	1.14
Total Demand/ha	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.83
Supply as % of Demand	129.47	130.45	131.43	132.41	133.41	134.43	135.49	136.60
Carrying Capacity	1.75	1.77	1.78	1.79	1.80	1.81	1.82	1.83
Current Load	1.35	1.35	1.35	1.35	1.35	1.34	1.34	1.34

Table 6.32: Population Reduction Growth Assumption

Year	1993	1994	1995	1996	1997	1998
Growth Rates (%)	1.40	1.30	1.20	1.11	1.01	0.90
Total Population	252861	256148	259222	262074	264694	267077
Reduction due to Policy	258	743	1464	2429	3647	5122
Reduction as % of Total	0.1	0.3	0.6	0.9	1.4	1.9

Table 6.33: Impacts of Alternative Policies on Crop Yield (kg/ha)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Paddy	2569	2565	2562	2559	2556	2554	-0.12
Maize	1502	1501	1500	1500	1499	1498	-0.05
Wheat	1270	1268	1267	1266	1265	1264	-0.10
Millet	1113	1113	1113	1112	1112	1112	-0.01
Oilseeds	564	564	564	564	564	564	-0.01
Potatoes	6228	6225	6223	6221	6218	6216	-0.04
Irrigation							
Paddy	2791	2924	2921	2917	2914	2911	0.85
Maize	1550	1583	1583	1582	1581	1580	0.40
Wheat	1548	1592	1590	1588	1587	1586	0.48
Millet	1113	1113	1113	1112	1112	1112	-0.01
Oilseeds	673	686	686	685	685	685	0.37
Potatoes	6853	7035	7033	7030	7027	7025	0.50
Fertiliser							
Paddy	2716	2853	2850	2846	2843	2840	0.90
Maize	1518	1552	1551	1551	1550	1549	0.41
Wheat	1343	1389	1388	1387	1385	1384	0.61
Millet	1113	1113	1113	1112	1112	1112	-0.01
Oilseeds	568	582	582	582	582	581	0.46
Potatoes	6401	6591	6588	6586	6583	6581	0.56
Combined							
Paddy	2951	3092	3088	3085	3081	3078	0.85
Maize	1566	1600	1599	1598	1597	1597	0.39
Wheat	1637	1683	1681	1680	1678	1677	0.48
Millet	1113	1113	1113	1112	1112	1112	-0.01
Oilseeds	677	690	690	690	689	689	0.36
Potatoes	7044	7231	7229	7226	7223	7221	0.50

Table 6.34: Impacts of Alternative Policies on Food Availability (kg/person)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Cereal Grains-(Edible Form)	225.04	224.33	223.49	222.55	221.50	220.38	-0.42
Meat	5.27	5.20	5.13	5.05	4.98	4.91	-1.42
Milk	30.35	29.85	29.36	28.86	28.37	27.88	-1.69
Oils and Fat	1.05	1.05	1.04	1.03	1.02	1.01	-0.94
Vegetables	27.78	27.63	27.47	27.29	27.11	26.93	-0.62
Irrigation							
Cereal Grains-(Edible Form)	241.81	249.24	248.35	247.34	246.21	245.00	0.26
Meat	5.27	5.20	5.13	5.05	4.98	4.91	-1.42
Milk	30.35	29.85	29.36	28.86	28.37	27.88	-1.69
Oils and Fat	1.14	1.15	1.14	1.13	1.12	1.11	-0.67
Vegetables	31.04	31.83	31.64	31.45	31.24	31.03	-0.01
Fertiliser							
Cereal Grains-(Edible Form)	232.84	240.48	239.61	238.62	237.51	236.34	0.30
Meat	5.27	5.20	5.13	5.05	4.98	4.91	-1.42
Milk	30.35	29.85	29.36	28.86	28.37	27.88	-1.69
Oils and Fat	1.06	1.06	1.05	1.04	1.03	1.02	-0.72
Vegetables	28.68	29.52	29.35	29.17	28.98	28.78	0.07
Combined							
Cereal Grains-(Edible Form)	250.42	258.16	257.25	256.22	255.05	253.82	0.27
Meat	5.27	5.20	5.13	5.05	4.98	4.91	-1.42
Milk	30.35	29.85	29.36	28.86	28.37	27.88	-1.69
Oils and Fat	1.15	1.15	1.14	1.13	1.12	1.11	-0.67
Vegetables	328.69	333.77	328.76	323.88	319.11	314.48	-0.88

Table 6.35: Impacts of Alternative Policies on the Per Capita Food Demand (kg/person)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Cereal Grains	127.61	127.70	127.77	127.83	127.87	127.92	0.05
Vegetables	21.60	21.60	21.59	21.59	21.57	21.57	-0.02
Meat	3.16	3.17	3.17	3.16	3.16	3.16	-0.02
Milk	20.16	20.14	20.11	20.09	20.07	20.05	-0.11
Oils and Fat	2.10	2.10	2.10	2.10	2.10	2.09	-0.04
Irrigation							
Cereal Grains	132.36	129.73	127.75	127.80	127.85	127.89	-0.68
Vegetables	26.81	23.68	21.56	21.55	21.54	21.53	-4.29
Meat	4.21	3.60	3.16	3.16	3.16	3.15	-5.60
Milk	23.11	21.44	20.09	20.07	20.04	20.02	-2.83
Oils and Fat	2.46	2.23	2.10	2.09	2.09	2.09	-3.21
Fertiliser							
Cereal Grains	129.74	129.92	127.75	127.81	127.85	127.89	-0.29
Vegetables	23.83	23.90	21.58	21.57	21.56	21.55	-1.99
Meat	3.63	3.64	3.16	3.16	3.16	3.16	-2.75
Milk	21.61	21.58	20.11	20.08	20.06	20.04	-1.50
Oils and Fat	2.24	2.25	2.10	2.10	2.09	2.09	-1.35
Combined							
Cereal Grains	162.23	128.85	127.11	127.20	127.28	127.35	-4.73
Vegetables	86.28	22.27	20.96	20.98	21.00	21.02	-24.60
Meat	21.74	3.40	3.04	3.04	3.04	3.05	-32.48
Milk	52.16	20.87	19.70	19.70	19.69	19.69	-17.70
Oils and Fat	5.29	2.18	2.06	2.06	2.06	2.06	-17.19

Table 6.36: Impacts of Alternative Policies on the Per Capita Food Balance (kg/person)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Cereal Grains	97.42	96.63	95.72	94.72	93.63	92.46	-1.04
Vegetables	6.18	6.03	5.87	5.71	5.54	5.36	-2.82
Meat	2.11	2.03	1.96	1.89	1.82	1.75	-3.67
Milk	10.19	9.71	9.24	8.77	8.31	7.83	-5.13
Oils and Fat	-1.04	-1.05	-1.06	-1.07	-1.08	-1.09	0.84
Irrigation							
Cereal Grains	109.45	119.51	120.60	119.54	118.36	117.11	1.36
Vegetables	4.23	8.15	10.08	9.89	9.70	9.50	17.55
Meat	1.07	1.60	1.97	1.89	1.83	1.75	10.50
Milk	7.24	8.41	9.26	8.80	8.33	7.86	1.66
Oils and Fat	-1.32	-1.09	-0.96	-0.97	-0.98	-0.99	-5.64
Fertiliser							
Cereal Grains	103.10	110.56	111.86	110.81	109.67	108.44	1.02
Vegetables	4.85	5.62	7.77	7.59	7.42	7.23	8.30
Meat	1.64	1.56	1.96	1.89	1.82	1.75	1.31
Milk	8.75	8.27	9.25	8.78	8.31	7.84	-2.16
Oils and Fat	-1.18	-1.19	-1.05	-1.05	-1.06	-1.07	-1.92
Combined							
Cereal Grains	88.20	129.31	130.14	129.01	127.78	126.46	7.47
Vegetables	242.41	311.00	307.80	302.90	298.11	293.45	3.90
Meat	-16.47	1.80	2.09	2.01	1.94	1.86	ERR
Milk	-21.80	8.99	9.66	9.17	8.68	8.19	ERR
Oils and Fat	-4.14	-1.03	-0.92	-0.93	-0.94	-0.95	-25.50

Table 6.37: Impacts of Alternative Policies on Calorie Supply and Demand ('000 calorie)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Per ha Calorie Supply	4233	4230	4226	4223	4220	4218	-0.07
Per ha Calorie Demand	3839	3848	3860	3874	3889	3907	0.35
Supply as % of Demand	110	110	109	109	109	108	-0.42
Irrigation							
Per ha Calorie Supply	4555	4706	4703	4701	4698	4695	0.61
Per ha Calorie Demand	3839	3848	3860	3874	3889	3907	0.35
Supply as % of Demand	119	122	122	121	121	120	0.26
Fertiliser							
Per ha Calorie Supply	4380	4535	4532	4529	4526	4523	0.64
Per ha Calorie Demand	3839	3848	3860	3874	3889	3907	0.35
Supply as % of Demand	114	118	117	117	116	116	0.29
Combined							
Per ha Calorie Supply	4861	5018	5014	5010	5006	5003	0.58
Per ha Calorie Demand	2988	3004	3022	3040	3060	3081	0.61
Supply as % of Demand	163	167	166	165	164	163	-0.03

Table 6.38: Impacts of Alternative Policies on the Food and Non-food Trade (Rs/person)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Value: Per Capita Food	488	517	546	576	606	635	5.40
Value: Per Capita N-food	-965	-967	-970	-972	-974	-976	0.24
Irrigation							
Value: Per Capita Food	337	465	581	614	647	680	15.05
Value: Per Capita N-food	-965	-970	-974	-976	-979	-981	0.32
Fertiliser							
Value: Per Capita Food	413	440	562	593	624	655	9.69
Value: Per Capita N-food	-965	-969	-972	-975	-977	979	0.29
Combined							
Value: Per Capita Food	431	2635	2907	3117	3339	3572	52.63
Value: Per Capita N-food	-965	-996	-999	-1001	-1003	-1005	0.82

Table 6.39: Impacts of Alternative Policies on Labour Use

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline, Irrigation, and Fertiliser							
Labour Use as % of Available Labour	69	69	68	67	67	66	-0.97
Combined							
Labour Use as % of Available Labour	76	75	75	74	73	72	-1.04

Table 6.40: Impacts of Alternative Policies on Real Income (Rs '000)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Crops	149739	157405	164834	172051	179042	185894	4.42
Livestock	92410	93535	94749	96038	97390	98792	1.34
Professional Workers	5534	5136	4771	4438	4130	3846	-7.02
Office Workers	5783	5367	4986	4637	4315	4019	-7.02
Sales and Service Workers	13528	12554	11664	10848	10095	9401	-7.02
Production Workers	9542	8856	8228	7652	7121	6632	-7.02
Construction, etc	2721	2525	2346	2182	2030	1891	-7.02
General Labourers	18004	16708	15524	14438	13435	12512	-7.02
Total	297260	302085	307102	312285	317559	322986	1.67
Per Capita Real Income	1174	1176	1178	1181	1183	1187	0.21
Irrigation							
Crops	187436	213794	221870	229721	237330	244793	5.48
Livestock	92232	93312	94546	95854	97223	98639	1.35
Professional Workers	5523	5123	4761	4429	4122	3840	-7.01
Office Workers	5772	5354	4975	4628	4308	4013	-7.01
Sales and Service Workers	13502	12524	11639	10828	10078	9387	-7.01
Production Workers	9524	8834	8210	7638	7109	6621	-7.01
Construction, etc	2715	2519	2341	2178	2027	1888	-7.01
General Labourers	17969	16668	15490	14410	13412	12493	-7.01
Total	334672	358129	363834	369685	375608	381674	2.66
Per Capita Real Income	1322	1394	1396	1398	1400	1402	1.18
Fertiliser							
Crops	166801	193465	201379	209067	216513	223812	6.06
Livestock	92277	93319	94524	95803	97143	98532	1.32
Professional Workers	5526	5124	4760	4427	4119	3836	-7.04
Office Workers	5774	5354	4974	4626	4304	4008	-7.04
Sales and Service Workers	13508	12525	11636	10822	10069	9377	-7.04
Production Workers	9529	8835	8208	7634	7103	6614	-7.04
Construction, etc	2717	2519	2340	2176	2025	1886	-7.04
General Labourers	17978	16669	15487	14402	13401	12479	-7.04
Total	314110	337811	343309	348957	354679	360544	2.80
Per Capita Real Income	1241	1315	1317	1319	1322	1325	1.31
Combined							
Crops	501785	534851	536958	539434	542163	545222	1.67
Livestock	92101	93177	94408	95711	97074	98484	1.35
Professional Workers	5515	5116	4754	4423	4116	3834	-7.01
Office Workers	5763	5346	4968	4622	4301	4006	-7.01
Sales and Service Workers	13483	12506	11622	10811	10062	9372	-7.01
Production Workers	9510	8822	8198	7626	7098	6611	-7.01
Construction, etc	2712	2515	2337	2174	2024	1885	-7.01
General Labourers	17944	16644	15468	14388	13391	12473	-7.01
Total	648813	678977	678714	679189	680230	681888	1.00
Per Capita Real Income	2563	2643	2604	2568	2535	2505	-0.46

Table 6.41: Impacts of Alternative Policies on the Share Distribution of Income (%)

Alternative Policies	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Crops	50.37	52.11	53.67	55.09	56.38	57.55	2.70
Livestock	31.09	30.96	30.85	30.75	30.67	30.59	-0.32
Professional Workers	1.86	1.70	1.55	1.42	1.30	1.19	-8.55
Office Workers	1.95	1.78	1.62	1.48	1.36	1.24	-8.55
Sales and Service Workers	4.55	4.16	3.80	3.47	3.18	2.91	-8.55
Production Workers	3.21	2.93	2.68	2.45	2.24	2.05	-8.55
Construction, etc	0.92	0.84	0.76	0.70	0.64	0.59	-8.55
General Labourers	6.06	5.53	5.05	4.62	4.23	3.87	-8.55
Total	100.00	100.00	100.00	100.00	100.00	100.00	0.00
Irrigation							
Crops	56.01	59.70	60.98	62.14	63.19	64.14	2.75
Livestock	27.56	26.06	25.99	25.93	25.88	25.84	-1.28
Professional Workers	1.65	1.43	1.31	1.20	1.10	1.01	-9.42
Office Workers	1.72	1.49	1.37	1.25	1.15	1.05	-9.42
Sales and Service Workers	4.03	3.50	3.20	2.93	2.68	2.46	-9.42
Production Workers	2.85	2.47	2.26	2.07	1.89	1.73	-9.42
Construction, etc	0.81	0.70	0.64	0.59	0.54	0.49	-9.42
General Labourers	5.37	4.65	4.26	3.90	3.57	3.27	-9.42
Total	100.00	100.00	100.00	100.00	100.00	100.00	0.00
Fertiliser							
Crops	53.10	57.27	58.66	59.91	61.04	62.08	3.17
Livestock	29.38	27.62	27.53	27.45	27.39	27.33	-1.44
Professional Workers	1.76	1.52	1.39	1.27	1.16	1.06	-9.57
Office Workers	1.84	1.58	1.45	1.33	1.21	1.11	-9.57
Sales and Service Workers	4.30	3.71	3.39	3.10	2.84	2.60	-9.57
Production Workers	3.03	2.62	2.39	2.19	2.00	1.83	-9.57
Construction, etc	0.86	0.75	0.68	0.62	0.57	0.52	-9.57
General Labourers	5.72	4.93	4.51	4.13	3.78	3.46	-9.47
Total	100.00	100.00	100.00	100.00	100.00	100.00	0.00
Combined							
Crops	77.34	78.77	79.11	79.42	79.70	79.96	0.67
Livestock	14.20	13.72	13.91	14.09	14.27	14.44	0.35
Professional Workers	0.85	0.75	0.70	0.65	0.61	0.56	-7.94
Office Workers	0.89	0.79	0.73	0.68	0.63	0.59	-7.94
Sales and Service Workers	2.08	1.84	1.71	1.59	1.48	1.37	-7.94
Production Workers	1.47	1.30	1.21	1.12	1.04	0.97	-7.94
Construction, etc	0.42	0.37	0.34	0.32	0.30	0.28	-7.94
General Labourers	2.77	2.45	2.28	2.12	1.97	1.83	-7.94
Total	100.00	100.00	100.00	100.00	100.00	100.00	0.00

Table 6.42 Impacts of Different Policies on Supply and Demand of Forest Products

(Supply as % of Demand)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fodder	131	132	133	134	135	136	0.752
Fuelwood	74	73	72	71	70	68	-1.677
Demand Reduction							
Fodder	131	132	133	134	135	135	0.623
Fuelwood	83	81	80	79	78	77	-1.54
Management							
Fodder	131	132	133	134	135	136	0.734
Fuelwood	75	75	74	73	73	73	-0.539
Joint							
Fodder	131	132	133	134	134	135	0.595
Fuelwood	83	83	83	82	82	82	-0.35

Table 6.43: Changing Pressure on Land under Baseline and Policy Scenarios

Year	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Per Capita Cultivated Land (ha/person)	0.12	0.12	0.12	0.12	0.12	0.12	0.000
Per Capita Accessible Forest Land	0.06	0.05	0.05	0.05	0.05	0.04	-7.789
Cultivated Area-Forest Area Ratio	0.53	0.51	0.49	0.48	0.46	0.44	-3.654
Shrub-Forest Area Ratio	1.51	1.58	1.65	1.74	1.83	1.95	5.247
Population Density Per Cultivated Land	8.22	8.31	8.41	8.51	8.6	8.69	1.118
Population Per Accessible Forest Land	7.68	7.89	8.13	8.4	8.71	9.06	3.360
LSU Per Cultivated Area	4.05	4.04	4.02	3.99	3.97	3.94	-0.549
LSU Per Forest Area	8.67	8.93	9.23	9.57	9.96	10.41	3.726
LSU Per Grazing Area	0.12	0.11	0.11	0.1	0.1	0.1	-3.581
Demand Reduction							
Per Capita Cultivated Land (ha/person)	0.12	0.12	0.12	0.12	0.12	0.11	-1.725
Per Capita Accessible Forest Land	0.06	0.06	0.05	0.05	0.05	0.05	-3.581
Cultivated Area-Forest Area Ratio	0.53	0.52	0.51	0.5	0.48	0.47	-2.374
Shrub-Forest Area Ratio	1.51	1.55	1.59	1.64	1.69	1.76	3.112
Population Density Per Cultivated Land	8.22	8.32	8.43	8.54	8.64	8.75	1.258
Population Per Accessible Forest Land	7.68	7.81	7.95	8.11	8.29	8.49	2.026
LSU Per Cultivated Area	4.05	4.04	4.03	4.02	4	3.99	-0.298
LSU Per Forest Area	8.67	8.82	8.99	9.19	9.41	9.66	2.186
LSU Per Grazing Area	0.12	0.11	0.11	0.11	0.11	0.1	-3.581
Management							
Per Capita Cultivated Land (ha/person)	0.12	0.12	0.12	0.12	0.12	0.11	-1.725
Per Capita Accessible Forest Land	0.06	0.05	0.05	0.05	0.05	0.04	-7.789
Cultivated Area-Forest Area Ratio	0.53	0.51	0.5	0.48	0.46	0.44	-3.654
Shrub-Forest Area Ratio	1.51	1.58	1.65	1.72	1.81	1.9	4.702
Population Density Per Cultivated Land	8.22	8.32	8.41	8.51	8.61	8.7	1.142
Population Per Accessible Forest Land	7.68	7.89	8.11	8.36	8.64	8.94	3.085
LSU Per Cultivated Area	4.05	4.04	4.02	4	3.97	3.95	-0.499
LSU Per Forest Area	8.67	8.93	9.21	9.52	9.87	10.25	3.405
LSU Per Grazing Area	0.12	0.11	0.11	0.11	0.1	0.1	-3.581
Joint							
Per Capita Cultivated Land (ha/person)	0.12	0.12	0.12	0.12	0.12	0.11	-1.725
Per Capita Accessible Forest Land	0.06	0.06	0.05	0.05	0.05	0.05	-3.581
Cultivated Area-Forest Area Ratio	0.53	0.52	0.51	0.5	0.49	0.48	-1.962
Shrub-Forest Area Ratio	1.51	1.55	1.59	1.63	1.67	1.72	2.639
Population Density Per Cultivated Land	8.22	8.33	8.43	8.54	8.65	8.76	1.281
Population Per Accessible Forest Land	7.68	7.8	7.93	8.07	8.22	8.38	1.760
LSU Per Cultivated Area	4.05	4.04	4.03	4.02	4.01	4	-0.248
LSU Per Forest Area	8.67	8.82	8.97	9.14	9.32	9.51	1.867
LSU Per Grazing Area	0.12	0.11	0.11	0.11	0.11	0.11	-1.725

Table 6.44: Impacts of Different Policies on Deforestation (Hectares)

	1993	1994	1995	1996	1997	1998	Growth %
Baseline							
Deforested Area	-406	-436	-468	-500	-532	-565	6.833
Demand Reduction							
Deforested Area	-217	-243	270	-297	-324	-352	10.158
Management							
Deforested Area	-398	-408	426	-446	-461	-474	3.557
Joint							
Deforested Area	-210	-215	227	-241	-249	-253	3.796

Table 6.45: Impacts of Different Policies on Agricultural Land (Adults per hectare)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Carrying Capacity Per ha	5.85	5.85	5.84	5.84	5.83	5.83	-0.07
Current load	5.31	5.32	5.34	5.36	5.38	5.40	0.35
Irrigation							
Carrying Capacity Per ha	6.30	6.51	6.50	6.50	6.49	6.49	0.61
Current load	5.31	5.32	5.34	5.36	5.38	5.40	0.35
Fertiliser							
Carrying Capacity Per ha	6.06	6.27	6.26	6.26	6.26	6.25	0.64
Current load	5.31	5.32	5.34	5.36	5.38	5.40	0.35
Combined							
Carrying Capacity Per ha	6.72	6.94	6.93	6.93	6.92	6.92	0.58
Current load	4.13	4.15	4.18	4.20	4.23	4.26	0.61

Table 6.46: Impacts of Different Policies on the Carrying Capacity and Demand Pressure (Fuelwood per hectare)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fuelwood Supply	2.1	2.08	2.07	2.06	2.05	2.03	-0.676
Fuelwood Demand	2.81	2.85	2.88	2.91	2.94	2.97	1.114
Supply as % of Demand	74	73	72	71	70	68	-1.677
Carrying Capacity	3.76	3.74	3.71	3.69	3.67	3.64	-0.647
Current Load	5.04	5.1	5.16	5.21	5.27	5.32	1.087
Demand Reduction							
Fuelwood Supply	2.10	2.09	2.08	2.08	2.07	2.06	-0.32
Fuelwood Demand	2.53	2.57	2.60	2.63	2.66	2.69	1.24
Supply as % of Demand	83	81	80	79	78	77	-1.54
Carrying Capacity	3.38	3.37	3.36	3.35	3.34	3.33	-0.32
Current Load	4.08	4.14	4.19	4.24	4.29	4.34	1.24
Management							
Fuelwood Supply	2.11	2.12	2.13	2.14	2.15	2.16	0.470
Fuelwood Demand	2.81	2.85	2.88	2.91	2.94	2.97	1.114
Supply as % of Demand	75	75	74	73	73	73	-0.539
Carrying Capacity	3.77	3.81	3.82	3.83	3.85	3.88	0.577
Current Load	5.04	5.1	5.16	5.22	5.27	5.33	1.125
Joint							
Fuelwood Supply	2.11	2.13	2.15	2.16	2.18	2.20	0.92
Fuelwood Demand	2.53	2.57	2.60	2.63	2.66	2.70	1.27
Supply as % of Demand	83	83	83	82	82	82	-0.35
Carrying Capacity	3.40	3.44	3.46	3.48	3.51	3.55	0.92
Current Load	4.08	4.14	4.19	4.24	4.30	4.35	1.27

Table 6.47: Impacts of Different Policies on the Carrying Capacity and Demand Pressure

(Fuelwood from Forests Only)

(Person need per hectare)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fuelwood Supply	21.16	21.73	22.36	23.07	23.87	24.78	3.209
Fuelwood Demand	27.41	28.68	30.09	31.67	33.47	35.5	5.309
Supply as % of Demand	77.22	75.77	74.31	72.83	71.33	69.8	-2.000
Carrying Capacity	37.93	38.94	40.07	41.34	42.78	44.41	3.205
Current Load	49.12	51.39	53.92	56.76	59.97	63.63	5.313
Demand Reduction							
Fuelwood Supply	21.16	21.49	21.86	22.27	22.73	23.24	1.89
Fuelwood Demand	24.67	25.48	26.38	27.36	28.44	29.63	3.74
Supply as % of Demand	85.80	84.35	82.89	81.42	79.93	78.43	-1.78
Carrying Capacity	34.14	34.67	35.26	35.92	36.66	37.49	1.89
Current Load	39.79	41.10	42.54	44.12	45.87	47.80	3.74
Management							
Fuelwood Supply	21.27	22.13	22.93	23.78	24.8	25.95	4.058
Fuelwood Demand	27.41	28.66	30.01	31.5	33.14	34.95	4.980
Supply as % of Demand	77.6	77.22	76.4	75.5	74.83	74.25	-0.879
Carrying Capacity	38.12	39.66	41.09	42.62	44.44	46.51	4.059
Current Load	49.12	51.36	53.79	56.45	59.39	62.63	4.980
Joint							
Fuelwood Supply	21.27	21.90	22.44	22.99	23.68	24.45	2.83
Fuelwood Demand	24.67	25.47	26.31	27.21	28.17	29.19	3.42
Supply as % of Demand	86.22	85.98	85.27	84.51	84.06	83.77	-0.57
Carrying Capacity	34.30	35.32	36.19	37.09	38.19	39.43	2.83
Current Load	39.79	41.08	42.44	43.88	45.43	47.07	3.42

Table 6.48: Impacts of Different Policies on Fuelwood Supply from Different Sources (%)

	1993	1994	1995	1996	1997	1998
Baseline						
Forests	22	21	21	20	19	18
Shrublands	25	25	25	26	26	26
Grazinglands	0	0	0	0	0	0
Adjacent NCI	40	41	41	41	41	41
Cultivated Area	1	1	1	1	1	1
Crop Residue	12	12	12	12	12	12
Total	100	100	100	100	100	100
Total Supply (adt)	110821	110619	110384	110117	109817	109485
Demand Reduction						
Forests						
Shrublands	22	22	21	21	20	20
Grazinglands	25	25	25	25	25	26
Adjacent NCI	0	0	0	0	0	0
Cultivated Area	40	40	41	41	41	41
Crop Residue	1	1	1	1	1	1
Total	12	12	12	12	12	12
Total Supply (adt)	100	100	100	100	100	100
Management	110821	110771	110693	110586	110451	110287
Forests						
Shrublands	22	22	21	21	20	20
Grazinglands	25	25	25	25	25	26
Adjacent NCI	0	0	0	0	0	0
Cultivated Area	40	40	41	41	41	41
Crop Residue	1	1	1	1	1	1
Total	12	12	12	12	12	12
Total Supply (adt)	100	100	100	100	100	100
Joint	110821	110771	110693	110586	110451	110287
Forests						
Shrublands	22	23	23	24	24	25
Grazinglands	24	24	24	24	24	24
Adjacent NCI	0	0	0	0	0	0
Cultivated Area	40	40	39	39	39	38
Crop Residue	1	1	1	1	1	1
Total	12	12	12	12	12	12
Total Supply (adt)	100	100	100	100	100	102
	111364	112912	113868	114765	116105	117702

Table 6.49: Impacts of Different Policies on the Livestock Carrying Capacity and Fodder Load (LSU per hectare)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fodder Supply	1.11	1.11	1.12	1.13	1.13	1.14	0.535
Fodder Demand	0.84	0.84	0.84	0.84	0.84	0.83	-0.239
Supply as % of Demand	131	132	133	134	135	136	0.764
Carrying Capacity	1.78	1.79	1.8	1.81	1.82	1.82	0.445
Current Load	1.35	1.35	1.35	1.35	1.34	1.34	-0.149
Demand Reduction							
Fodder Supply	1.11	1.11	1.12	1.12	1.13	1.14	0.535
Fodder Demand	0.84	0.84	0.84	0.84	0.84	0.84	-0.239
Supply as % of Demand	131	132	133	134	135	136	0.764
Carrying Capacity	1.78	1.78	1.79	1.80	1.81	1.82	0.445
Current Load	1.35	1.35	1.35	1.35	1.35	1.34	-0.149
Management							
Fodder Supply	1.11	1.11	1.12	1.13	1.13	1.14	0.535
Fodder Demand	0.84	0.84	0.84	0.84	0.84	0.84	0.000
Supply as % of Demand	131	132	133	134	135	136	0.734
Carrying Capacity	1.78	1.79	1.8	1.81	1.81	1.82	0.445
Current Load	1.35	1.35	1.35	1.35	1.34	1.34	-0.149
Joint							
Fodder Supply	1.11	1.11	1.12	1.12	1.13	1.14	0.535
Fodder Demand	0.84	0.84	0.84	0.84	0.84	0.84	0.000
Supply as % of Demand	131	132	133	134	134	135	0.595
Carrying Capacity	1.78	1.78	1.79	1.8	1.81	1.82	0.445
Current Load	1.35	1.35	1.35	1.35	1.35	1.35	0.000

Table 6.50: Impacts of Different Policies on the Livestock Carrying Capacity and Load (Fodder from Forests only)

(per hectare)

	1993	1994	1995	1996	1997	1998	Growth
Baseline							
Fodder Supply	7.1	7.37	7.67	8.01	8.4	8.85	4.505
Fodder Demand	5.41	5.57	5.76	5.97	6.21	6.49	3.707
Supply as % of Demand	131	132	133	134	135	136	0.764
Carrying Capacity	11.38	11.81	12.3	12.85	13.48	14.2	4.527
Current Load	8.67	8.93	9.23	9.57	9.96	10.41	3.726
Demand Reduction							
Fodder Supply	7.1	7.27	7.45	7.66	7.9	8.16	2.822
Fodder Demand	5.41	5.5	5.61	5.73	5.87	6.02	2.160
Supply as % of Demand	131	132	133	134	135	135	0.623
Carrying Capacity	11.38	11.65	11.95	12.29	12.66	13.08	2.824
Current Load	8.67	8.82	8.99	9.19	9.41	9.66	2.186
Management							
Fodder Supply	7.1	7.36	7.65	7.97	8.32	8.7	4.148
Fodder Demand	5.41	5.57	5.74	5.94	6.15	6.39	3.386
Supply as % of Demand	131	132	133	134	135	136	0.734
Carrying Capacity	11.38	11.81	12.27	12.77	13.33	13.95	4.157
Current Load	8.67	8.93	9.21	9.52	9.87	10.25	3.405
Joint							
Fodder Supply	7.1	7.26	7.44	7.62	7.81	8.02	2.467
Fodder Demand	5.41	5.5	5.6	5.7	5.81	5.93	1.852
Supply as % of Demand	131	132	133	134	134	135	0.595
Carrying Capacity	11.38	11.65	11.92	12.21	12.53	12.86	2.475
Current Load	8.67	8.82	8.97	9.14	9.32	9.51	1.867

Table 6.51: Impacts of Different Policies on Fodder Supply from Different Sources

(in per cent)

	1993	1994	1995	1996	1997	1998
Baseline	7	6	6	6	6	5
Forests	16	16	17	17	17	17
Shrublands	2	2	2	2	2	2
Grazinglands	29	29	29	29	29	29
Adjacent NCI	2	2	2	2	2	2
Risers and Bunds	2	2	2	2	2	2
Fallow Grazing	4	4	4	4	4	4
Tree Fodder	38	38	38	39	39	39
Crop Residue	100	100	100	100	100	100
Total	102261	102840	103399	103942	104469	104984
Total Supply (tdn)						
Demand Reduction	7	6	6	6	6	6
Forests	16	16	16	16	17	17
Shrublands	2	2	2	2	2	2
Grazinglands	29	29	29	29	29	29
Adjacent NCI	2	2	2	2	2	2
Risers and Bunds	2	2	2	2	2	2
Fallow Grazing	4	4	4	4	4	4
Tree Fodder	38	38	38	39	39	39
Crop Residue	100	100	100	100	100	100
Total	102261	102804	103326	103831	104320	104795
Total Supply (tdn)						
Management	7	6	6	6	6	5
Forests	16	16	17	17	17	17
Shrublands	2	2	2	2	2	2
Grazinglands	29	29	29	29	29	29
Adjacent NCI	2	2	2	2	2	2
Risers and Bunds	2	2	2	2	2	2
Fallow Grazing	4	4	4	4	4	4
Tree Fodder	38	38	38	39	39	39
Crop Residue	100	100	100	100	100	100
Total	102261	102839	103393	103927	104444	104946
Total Supply (tdn)						
Joint	7	6	6	6	6	6
Forests	16	16	16	16	16	17
Shrublands	2	2	2	2	2	2
Grazinglands	29	29	29	29	29	29
Adjacent NCI	2	2	2	2	2	2
Risers and Bunds	2	2	2	2	2	2
Fallow Grazing	4	4	4	4	4	4
Tree Fodder	38	38	38	39	39	39
Crop Residue	100	100	100	100	100	100
Total	102261	102803	103320	103816	104294	104755
Total Supply (tdn)						