CHAPTER 11

POPULATION AND ENVIRONMENT: A SITUATION ANALYSIS OF POPULATION, CULTIVATED LAND AND BASIC CROP PRODUCTION IN NEPAL IN 2001

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11.1 Introduction

For all practical purposes the territory of Nepal is finite. There is a limit to the environmental resources within this territory that Nepalese citizen can utilize. The increasing presence of people on its territory is presenting economic, social and ecological problems. It is only over the last two decades that we have raised questions regarding multifaceted implications of our increasing presence. At the world scale during 1980s the Brundtland Report (*WCED,* 1987) brilliantly presented the idea of sustainable development. It stated that development should meet the needs of present generations without compromising the ability of future generations to meet their needs. This statement is ambiguous and as *Sutton* (2003:294) states "it is both difficult to disagree with while at the same time imposes many implicit constraints as to how development should take place." Over the course of time, sustainable development has been interpreted differently for reason that it contains ideas of environmental sustainability, economic efficiency and human equity (*Costanza and Folke,* 1997). Subsequently for collective human objective the environmentalists pursued "sustainability' as the primary theme, while economists went on to persue 'efficiency' and for many other social scientists and humanists 'equity' became the main concern due to increasing presence of human beings on the specific territorial unit. In all these, the concern remains of balancing human impact on earth's ability to absorb the impact. In pursing the interpretations and attempting to examine population-environment relations further measures such as environmental sustainability index (see, *Sutton,* 2003; *Samuel-Johnson and Esty,* 2001) have been developed. Likewise, the concepts such as 'carrying capacity' and 'population pressure' have gained further attention in the literature (see, *Daily and Ehrlich, 1992*).

In Nepal there have been some attempts in the past to highlight the population environment relations some explicitly while others implicitly (see, Shrestha and Sharma, 1980; Shrestha and Conway 1982; Shrestha, Conway and Bhattarii 1999; Subedi 1995). These attempts are worth

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mentioning. However, in the context of Population Census 2001 and other recent information the need for updating and/or reassessing the population resource situation has become imperative. This paper is based on the broader framework of population and environment relations using Nepal as a case. Because the scope of human environment relation study is vast this paper concentrates only on existing population, land resource and adequacy of basic crop production in the country. The food crop production is considered as an expression of human effort to maximize the utilization of available land resource amidst increasing presence of human number. For this and for data limitation (discussed later) the conclusions should be taken as indicative rather than comprehensive.

This paper is divided into six sections. The first section gives an introduction to population and sustainable development issues. The second section briefly mentions the materials used in this paper and methods of analysis. The third section discusses land resources situation in terms of cultivated land in the country. The fourth section deals with basic crop production for the last five years for which data are available. The fifth section is about cereal crop availability and requirement in the district. The last section concludes the paper with some limitations and policy implications.

11.2 Materials and Methods

Three main sources of data have been utilized. *Population Census 2001* is the main data source for size and distribution of population. Similarly data on proportion of cultivated land for 75 districts of Nepal is obtained from *Japan Forest Technology Association* (JAFTA) 2000. Data on cropped area and production of food crops are taken from *Statistical Information on Nepalese Agriculture.* Five crops namely barley, maize, millet, paddy and wheat are considered as primary food crops in general. However, in the Mountain region potato is consumed as basic crop. Therefore, inclusion of potato production as part of basic crop is considered desirable. Consequently, production of potato is included in the figure on total food crop production.

Data quality and adequacy are always issues for the comprehensive analysis of population and basic crop availability situation in Nepal. There are some inherent limitations of data on land resources and crop production that are utilized in this paper. But under the given circumstances these are the best available sources that provide district level information on land and crop production covering all 75 districts. Department and Directorates within the Ministry of Agriculture and Cooperatives are the primary institutions responsible for providing reliable data on cropped area and crop production. On the other hand JAFTA has provided data on land

resources through utilization of latest remote sensing technology. It would have been better if land use data were available in the disaggregated form for agriculture and grassland. Apparently this was not possible for 2000. Agriculture land in the data set included grassland also. The resulting proportion of land under agriculture is thus higher than what it really is.

The adequacy of food production in the district is based on nutrition requirement of individuals in the district. The *Report of the Commission on Strengthening the Supplies System 2051* (pp. 146–148) gives the calorie requirement of the individual. Individual calorie requirements are stated to be different for the Tarai and the Hills (including Mountain). Accordingly in the Hills (including Mountain region) the total calorie requirement is 2,344 calories per person per day. The corresponding requirement in the Tarai is 2,144 calories. Of the total requirement it is also estimated that 87.3 percent should be available from cereals (see*, Gautam,* 1993). Therefore, the adequacy of food supply is based on the proportion of cereal needs in the total amount. Thus, the cereal requirement is estimated at 2046.3 calories for the Hill and 1871.7 calories for the Tarai. The national average is estimated to be 1999.7.

The calorie values for various basic crops differ. Annex 11.1 gives the calorie values of six crops considered in this paper. This difference is taken into account while analyzing the adequacy of basic crop production in the region and the districts. Details are discussed in the fifth section of the paper.

11.3 Distribution of Cultivated Land

Land is the primary resource for agrarian economies. Nepal is no exception. The importance of land as a resource is further warranted in Nepal since overwhelming majority of population i.e., more than 85 percent, live in rural areas and more than 60 percent economically active population has agriculture as their primary occupation. Data on agriculture land for all 75 districts in the country are available from two sources and for two time periods. These sources are: Land Resource Mapping Project (*LRMP*) 1978/79 and Japan Forest Technology Association (*JAFTA*) 2000. These two sources are not necessarily comparable in the categories to which they report the land use situation but these are the best available sources for data on distribution of land resource by district at present in the country. The distribution of land resource situation in both these time periods is discussed below.

11.3.1 Distribution of Cultivated Land in 1978/79

11.3.1.1 Cultivated Land 1978/79

Of the total land in the country only 18 percent was classified as cultivated land in 1978/79. This proportion is based on air photo data of Land Resource Mapping Project 1978/79. Data on proportion of land under cultivation is important because the size of rural population that can be supported in a given area depends upon the proportion of land under cultivation at present and the proportion that could be brought under cultivation in the near future. The proportion of cultivated land varies by ecological regions and by districts in the country. Generally, the proportion decreases from south to north. Districts located in the Tarai region have higher proportion. For example on an average, districts in Tarai have 40 percent of their total land used for cultivation. This high proportion is primarily because of the plain landform and high fertility of soil there. It is also to be noted that most of the land brought under cultivation in the Tarai is also of recent origin. On the contrary, districts in the mountain region have limited proportion of land suitable for cultivation. More specifically, only 4.4 percent of the total land is used for cultivation in this region. The rugged terrain, altitude and steep slope are the main limiting factors. Moreover, a large proportion of land in the mountain region is rocky and barren. The hill region, which is situated in between two extremes, occupies an intermediate position in the proportion of cultivated land. Of the total land 17.2 percent is cultivated there. This proportion is less than half of the proportion in the Tarai. There is also an east-west variation in this proportion. Districts located in the east have higher proportion of cultivated land and the proportion gradually decreases towards west. This applies to all ecological zones.

Jhapa district has the highest proportion of land under cultivation. Of its total land, 68.2 percent is under cultivation. Manang represents the contrary with negligible proportion i.e., 0.3 percent under cultivation. Among 75 districts, largest proportion of districts (26.6%) has 20-30 percent of their total land under cultivation. Districts with 10-20 percent land under cultivation follow this (25.3%). Districts from Mid-western and Far-Western Hills are among districts having this proportion. Districts with higher proportion of cultivated land are located in the eastern Tarai.

Despite hilly terrain, districts in the eastern hills are almost comparable with Mid-western and Far-western Tarai in the proportion of cultivated land. While long history of settlement, high population growth and sufficient rainfall may have collectively resulted into relatively high proportion of cultivated land in the Eastern hills, the Mid-western and Far-western Tarai are among relatively newly inhabited areas in Nepal Tarai.

Almost one-fourth or eighteen districts have very limited proportion of cultivated land i.e., less than ten percent. Generally districts in the Mountain region have this situation but a number of hill districts in the Mid-west and Far west also fall in this category. More importantly, among eighteen districts three have as low as less than one percent of their total land under cultivation. Humla, Dolpa and Manang are among the districts having lowest proportion of land under cultivation.

11.3.1.2 Cultivated Land Per Capita

The proportion of cultivated land gives an indication of land resource situation in the given district or region. However, in the population resource context the per-capita distribution is more meaningful. Table 11.1 gives the land resource per capita by ecological zones (regions) for 1981. Cultivated land per capita at the national level was o.176 ha or roughly 3.5 *ropani.* This refers to net cultivated land. In the mountain region and also in the high hills livestock farming is important part of livelihood. Thus, it is desirable to include area under grassland while calculating per capita land availability. With inclusion of grassland the per capita land availability is 0.29 ha or 5.76 *ropani* (Table 11.1).

Table 11.1: Cultivated land per person by ecological zones, 1981.

Region (Zones)	Cultivated Land Per Capita (in ha)	
	Cultivated Land Only	**Cultivated Land Including Grass Land**
Mountain	0.17438	1.04733
Hill	0.14718	0.22337
Tarai	0.20729	0.21861
Nepal	**0.17578**	**0.29275**

Note : In this table data on land is taken from LRMP 1978/79 and data on population is from Population Census 1981.

Variation by ecological region is obvious. Per capita cultivated land (net) is highest in the Tarai followed by the Mountain region. The Hill region has the lowest per capita net cultivated land. This generalization does not hold true when grassland is included as part of cultivated area. The Mountain ranks highest with more than a hectare of land per capita. Pastures (locally known as *kharka*) are common features of overall landscape in the Mountain region. The area under grassland decreases from north to south or from the mountain to the plains. Tarai with minimal or no grassland ranks lowest. The Hill occupies a middle position with 0.22 ha per capita land.

11.3.1.3 Man-Land Ratio

Man-land ratio is a very common way of expressing population resource situation in the country. In general this ratio is considered as indicative of the pressure of population on land resources. Areas with high ratios are indicative of higher stress of population on land resources. Man-land ratios discussed in this section is calculated using data for population and the land availability in a roughly comparable time frame. While population data is for 1981, data on cultivated land refers to 1978/79. Accordingly, at the national level man-land ratio is 5.6 persons per hectare. It is high in the districts located in the Central and Western Hill. Kathmandu and Manang are two extremes. Districts located in the Mountain region have relatively lower ratios.

Based on the value of man-land ratio in 1981, the seventy-five districts of the country have been categorized into five categories (Table 11.2). There are four districts having less than four persons per hectare. While three of them are from the Tarai one is from the Mountain. None of the Tarai districts have more than six persons per hectare in 1981. They demonstrate moderate situation i.e., four to six persons per hectare. Some Tarai districts especially those from the Mid-west and Far-west are among districts demonstrating low man-land ratios. On the contrary, the Hill districts in general and Kathmandu valley districts and Kavrepalanchok in particular exhibit high man-land ratios.

Table 11.2: Man-land ratio by districts 1981.

Categories (persons per ha)	Number (percent) of Districts	**Name of the Districts**
Less than Four	4 (5.3 %)	Mustang, Kailali, Bardiya, Kapilvastu
Four to Five	18 (24.0 %)	Humla, Mugu, Dolpa, Solukhumbu, Sankhuwasabha, *Jajarkot, Dhankuta, Tehrathum, Panchthar, Ilam,* Kanchanpur, Banke, Dang, Rupandehi, Siraha, Saptari, Sunsari, Jhapa
Five to Six	27 (36.0 %)	Bajhang, Jumla, Rasuwa, Taplejung, *Dadeldhura, Doti, Achham, Dailekh, Surkhet, Salyan, Rolpa, Rukum, Sindhuli, Ramechhap, Udayapur, Okhaldhunga, Khotang, Bhojpur,* Nawalparasi, Chitwan, Parsa, Bara, Rautahat, Sarlahi, Mahottari, Dhanusha, Morang
Six to Ten	22 (29.4 %)	Darchula, Bajura, Kalikot, Manang, Sindhupalchok Dolakha, *Baitadi, Arghakhanchi, Pyuthan, Gulmi, Palpa, Baglung,Myagdi, Parbat, Kaski, Syangja, Tanahun, Lamjung, Gorkha, Dhading, Nuwakot, Makwanpur*
More than Ten	4 (5.3 %)	*Kathmandu, Lalitpur, Bhaktapur, Kavrepalanchok*

Note : For the convenience of readers, whereas districts located in the Mountain region are underlined, the Hill districts are italicized. Likewise the Kathmandu valley districts are both underlined and italicized.

Over the past two decades the population has grown rapidly. Between 1981 and 2001 more than 8.1 million people have been added in the country. Two censuses have been conducted successively in between. They have recorded more than 2.0 percent annual growth rate during these years. On the other hand, comparable and comprehensive data on land resources as per LRMP are not available. It is widely reported that with population increase some marginal areas have also been brought to cultivation over these years. This leads to the likelihood of increase in the proportion of cultivated land. In the mean time, several studies in Nepal have noted that the amount of land that can be brought under cultivation at present in Nepal is limited (see, *Ives and Messerli,* 1989).

11.3.2 Distribution of Cultivated Land in 2001

Japan Forest Technology Association (*JAFTA*) 2001 has provided area of agriculture and grass land for 75 districts of the country. This data is used as the latest information on distribution of cultivated land by district. In a strict sense, the categories of land use under LRMP and JAFTA may not be comparable. Nonetheless, broader generalizations are possible in terms of direction and extent of change. Moreover, in this section the focus is on the state of affairs than a comparative assessment.

11.3.2.1 Cultivated Land 2000

According to JAFTA 2000 the total cultivated (agriculture) land including grassland in the country is 4,061,631 ha which constitutes 27.6 percent of the total area of the country. This high proportion is due to the inclusion of grassland in the same category. Separate categories of land for agriculture and grassland are not available in this source. Unless specified, cultivated land in the following discussion includes grassland.

Regional variation is evident in the proportion of cultivated land and grassland. The Mountain region has 10 percent of its total area under cultivation in 2000. The corresponding proportions are 27.2 percent and 55.2 percent in the Hill and the Tarai. Variation by 15 eco-development regions is also apparent. The two extremes in this case include Western Mountain with 0.1 percent and Eastern Tarai with 75.6 percent of total area under cultivation. The proportion of cultivated land decreases from East to West except Mid-western region. Of the fifteen eco-development regions three namely Eastern, Central and Western Tarai have more than 50 percent of their total land under cultivation. Similarly, three regions namely Eastern and Central Hills and

Far-western Tarai have 40-50 percent of their total land under cultivation. Eastern and Central Mountains, and Western and Far-western Hills have 20-25 percent of their land under cultivation. Mid-western Mountain has only 3.2 percent of total land under cultivation. Moreover, Mid-western Hill and Far-western Mountain are roughly comparable with 14.5 and 13.6 percent of their total land under cultivation respectively. In all eco-development regions north-south variation is more distinct than the east-west variation.

At the district level the differences are far greater than the eco-development regions. Jhapa with 88 percent of its land under cultivation represents one end whereas Dolpa with less than 0.1 percent represents another extreme. On the whole, districts located in Tarai have higher proportion of cultivated land compared with districts in the Hill and the Mountain. Generally districts from Eastern and Central Tarai have more than 50 percent of their total land under cultivation. Districts in the Hill demonstrate complex situation. The proportion of cultivated land ranges from 4.5 percent (Rukum) to 54.8 percent (Okhaldhunga) excluding Kathmandu valley. Specific generalizations are difficult to make except what the districts in the East, Center and West have higher proportion, those in the Far-west have medium and those in the Mid-west have lower proportions of total land under cultivation. Some Hill districts namely Tehrathum, Dhankuta, Okhaldhunga and Kathmandu also have more than 50 percent of their land under cultivation. More importantly, all Tarai districts have more than 40 percent of their total land under cultivation by 2000. Banke (30.6%) and Dang (36.2%) are two exceptions.

11.3.2.2 Cultivated Land Per Capita

Cultivated land per capita for 2001 is 0.175 ha or 3.4 *ropani* for the country as a whole. Among ecological regions the Hill has lowest per-capita land i.e., 0.163 ha or 3.2 *ropani*. The Mountain on the other hand, demonstrates the highest value, a result of low population size. Although the per capita land in the Tarai is higher than the Hill, the difference is rather minimal whereas the difference between the Hill and the Mountain is far higher than the difference between the Hill and the Tarai (Table 11.3).

Table 11.3: Cultivated land per person and per household 2000.

Region (Zones)	Cultivated Land Per Person (ha)	Cultivated Land Per Household (ha)
Mountain	0.307121	1.620500
Hill	0.162554	0.840429
Tarai	0.167393	0.962222
Nepal	**0.175438**	**0.954954**

Note : Population figures are from Population Census 2001 and the figures for area under cultivation is taken from JAFTA 2001.

The distribution of cultivated land per household shows a similar situation. Land per household is lowest in the Hill followed by the Tarai. Land per household in the Mountain is nearly double that of the Hill. In the country as a whole, land per household is less than one hectare. This figure is lower than the one available from the Land Resource Mapping Project. Although these two sources are not strictly comparable, the decrease in the amount of land per household is quite logical given the rapid increase of population over last two decades.

11.3.2.3 Man-Land Ratio, 2001

The overall man-land ratio for 2001 is 5.7 persons per hectare. Districts with highest and the lowest man-land ratio are from the Mountain. Whereas Dolpa has the highest man-land ratio of 383.7 persons per hectare, Solukhumbu has the lowest value of 1.6 persons. Mustang, Dhading, Kathamndu and Manang are among districts with high man-land ratios. On the contrary, Taplejung, Mugu, Sankhuwasabha and Okhaldhunga are among districts with low man-land ratios.

Broadly, districts in the Mountain and the Tarai demonstrate a special pattern. Majority Mountain districts have less than four persons per hectare of cultivated land. Likewise, majority Tarai districts have man-land ratios between six to ten persons (Table 11.4). The Hill districts are complex and demonstrate diverse situation. On the one hand, there are eight districts having less than four persons per hectare, there are five districts with more than ten persons per hectare on the other. Kathmandu valley districts especially Kathmandu and Bhaktapur have very high man-land ratio compared with other hill districts. Both these districts have more than 40 persons per hectare while Lalitpur has about 22 persons per hectare. In the context of high-man-land ratio in Kathmandu it should be noted that Kathmandu valley with the only metropolitan city is the most urbanized section of the country.

Table 11.4: Man-land ratio by districts 2001.

Categories (persons per ha)	Number (percent) of Districts	Name of the Districts
Less than Four	17 (22.7%)	Darchula, Bajhang, Bajura, Humla, Mugu, Dolakha, Solukhumbu, Sankhuwasabha, Taplejung, *Ramechhap, Makwanpiur, Khotang, Sindhuli, Bhojpur, Dhankuta, Tehrathum, Panchthar*
Four to Five	14 (18.7%)	Jumla, Manang, Rasuwa, Sindhupalchok *Dadeldhura, Doti, Gorkha, Udayapur, Ilam,* Kailali, Bardiya, Dang, Kapilvastu, Jhapa
Five to Six	13 (17.3%)	*Baitadi, Achham, Surkhet, Jajarkot, Salyan, Lamjung, Tanahun, Dhading, Nuwakot, Makwanpur, Kavrepalanchok,* Banke, Nawalparasi,
Six to Ten	20 (26.7%)	Kalikot, *Dailekh, Myagdi, Pyuthan, Gulmi, Arghakhanchi, Palpa, Syangja* Rupandehi, Chitwan, Parsa, Bara, Rautahat, Sarlahi, Mahottari, Dhanusha, Siraha, Saptari, Sunsari, Morang
More than Ten	11 (14.6%)	Dolpa, Mustang, Manang, *Rukum, Rolpa, Baglung, Parbat, Kaski, Kathmandu, Lalitpur, Bhaktapur*

Note : 1. For the convenience of readers, whereas districts located in the Mountain region are underlined, the Hill districts are italicized. Likewise the Kathmandu valley districts are both underlined and italicized.

2. While data on land resource refers to 2000, the population data refers to 2001.

With few extremes such as Dolpa, Mustang and Manang, the values of man-land ratios are comparable for 1981 and 2001. Further investigation is necessary to elucidate the extreme values. One likely explanation is the existence of large parcels of pasture in these mountain districts that are included in the current data on agriculture land. Nevertheless, this comparability of man-land ratio after two decades is a concern. As stated earlier there has been an addition of more than 8.1 million population over these years. If the cultivated land had remained the same, this additional number would mean an addition of 3.0 persons per hectare by 2001 over 1978/79. Thus, the comparability of man-land ratio therefore means a definite increase in the amount of land under cultivation. Without longitudinal data with comparable categories and definitions, the extent of increase cannot be elucidated. The specific assessment of changes in land resource in general and cultivated land in particular is difficult and this paper, being a situation analysis is beyond its scope.

Given three ecological zones (north-south) and five development regions (east-west) it is also useful to analyze man-land ratio by eco-development regions. Among fifteen eco-development regions, two regions demonstrate very high man-land ratios in 2001. These include Western Mountain and Kathmandu valley. Limited availability of cultivated land for the former and large

population size in the latter can be attributed for the high ratios respectively. On the other hand, Eastern Mountain has the lowest man-land ratio. On the whole, with an exception of Western Mountain these ratios are low in the Mountains and high in the Hills. Tarai is in-between but values of various Tarai regions are closer to the corresponding Hill regions than to the Mountain regions (Table 11.5).

Table 11.5: Man-land ratio by eco-development region, 2001.

Eco-Development Region	Cultivated Land* (ha)	Total Population**	Man-Land Ratio (p/ha)
NEPAL	**4061631**	**23151423**	**5.7**
Mountain	**518377**	**1687859**	**3.3**
Eastern	209705	401587	1.9
Central	131326	554817	4.2
Western	564	24568	43.6
Mid-western	68769	309084	4.5
Far-western	108013	397803	3.7
Hill	**1666363**	**10251111**	**6.2**
Eastern	470656	1643246	3.5
Central	441167	3542732	8.0
Western	387327	2793180	7.2
Mid-western	199545	1473022	7.4
Far-western	167668	798931	4.8
Tarai	**1876891**	**11212453**	**6.0**
Eastern	549214	3299643	6.0
Central	553045	3934080	7.1
Western	308707	1753265	5.7
Mid-western	264218	1230869	4.7
Far-western	201707	994596	4.9
Kathmandu Valley	**43670**	**1645091**	**37.7**

Note : Cultivated land in this column includes grassland. Disaggregated data for cultivated land only is not available.

Source : * Japan Forest Technology Association (JAFTA), 2001. ** CBS, 2002.

Eco-development regions in the Hill primarily Central, Western and Mid-western hills are regions with man-land ratio of more than 7 persons per hectare. Of the Tarai regions it is only Central Tarai that has this ratio of more than 7 persons per hectare. This man-land ratio when considered in the context of differences in terrain conditions, history of settlement, overall quality of soil and yield of cereal crops (see tables below) by ecological zones, the pressure of population on land resource is far higher in the eco-development regions of the Hill than in other regions.

11.4 Basic Crop Production

The proportion of cultivated land, per-capita availability and man-land ratios are expressions of population resource relations since they reflect the resource availability in the given area. Cultivated land is the prime resource for agrarian population because without this the production of varieties of food and other crops necessary to meet the daily calorie requirement is not possible. Thus, analysis of population situation must take into consideration of crop production and availability situation in the country in order to regulate population growth especially when the country such as Nepal is faced with rapid growth of population.

11.4.1 Basic Crop Production at the National Level

Six crops namely barley, maize, millet, paddy, wheat, and potato are considered as basic crops as these crops are used to meet the basic food requirement of citizens in the country. Since potato is consumed as basic crop in the Mountain region its inclusion, as part of basic crop is considered desirable. As noted earlier the production figures of these six basic crops discussed below are five-year averages of 1997/98 to 2001/02. The total basic crop production in the country is 8.04 million metric ton a year. Of all the crops, the amount of paddy production is highest in the country. Of the total basic crop production, paddy shares nearly 50 percent. Maize, potato and wheat come next with their shares 17.9 percent, 14.9 percent, and 14.1 percent respectively (Table 11.6). Paddy, maize and wheat are also the first three crops in terms of total cropped area in the country (see *Subedi et. al,* 2003). The total production amount of barley and its share in the total basic crop production is very small.

Table 11.6: Basic crops, their production and yield in Nepal.

Basic Crops	Production (5-year Average 1997/98-2001/02)		Yield (Mt/per ha)
	Total (Metric ton)	Share in Total Production (%)	
Barley	31,603	0.4	1.12
Maize	1,438,135	17.9	1.74
Millet	287,357	3.6	1.11
Paddy	3,950,233	49.1	2.53
Wheat	1,137,187	14.1	1.77
Potato	1,198,862	14.9	7.35
Total	**8,043,377**	**100**	**2.31**

Source: Based on *Statistical Information on Nepalese Agriculture*, Various Dates (1997/98 – 2001/02).

Of the six crops mentioned above except paddy and millet all others are grown in all 75 districts. However, there is a wide gap in the yields of these crops. Whereas yield of potato is more than seven metric ton per hectare i.e., highest among all basic crops, the yield of millet per hectare is only 1.1 metric ton. Moreover, yield of paddy is slightly over 2.5 metric ton per hectare. Wheat comes next in yield per unit and is followed by maize.

11.4.2 Regional Variation in Basic Crop Production

The production of basic crops varies by ecological zones and by districts. Mountain region (zone), which occupies 35 percent of the total territory, has 7.3 percent of total population in 2001, contributes only 6.7 percent in the basic crop production. Similarly, the hill, which occupies 42 percent of the territory and has 44.3 percent of total population, produces 37.9 percent of the total basic crop production. Moreover, the Tarai occupying 23 percent of the territory and 48.4 percent of population produces 55.4 percent of basic crops.

All basic crops are grown in all three ecological zones though their yields differ. However, some crops are more area specific than others. For example, there is high concentration of barley production in the Mountain districts with Jumla producing the highest amount. Paddy is grown in all districts except Manang and Mustang. Tarai districts dominate in the production of paddy although it is also commonly grown in the Hill districts. Maize is grown in all districts but more extensively in the Hill districts. Of all the crops, its share in the total cereal production is highest in the Hill districts. Wheat is also produced as widely as maize. However, its production is higher in Tarai districts. The districts of the Mid-western and Far-western Hills also produce considerable amount of wheat. Of total cereal production, the role of wheat is more important in the Hill than in other ecological zones. Potato is grown in all ecological zones and all 75 districts. It is considered more important in the Mountain districts even if its production is higher in the Hill and Tarai districts. Millet is important in the Hills and Mountain districts except Manang and Mustang.

11.4.2.1 Production in the Mountain

Based on the production of the last five years the average annual basic crop production in the Mountain is 540 thousand metric ton. By far the share of potato is highest (Table 11.7). It is followed by maize. Paddy is also produced in the Mountain especially in the low-lying river basins. Paddy contributes about 17 percent of total basic crop production in this region (zone).

Wheat and millet are other crops with their share of 11.6 percent and 10.6 percent respectively. Moreover, among six basic crops the share of barley is lowest. But if its production per district is taken into account Mountain ranks highest. Average barley production in the sixteen Mountain districts is 838 metric ton per year.

Table 11.7: Basic crops, their production and yield in the Mountain.

Basic Crops	Production (5-Year Average 1997/98-2001/02)		Yield (Mt/per ha)
	Total (Metric ton)	Share in Total Production (%)	
Barley	13,408	2.5	1.08
Maize	119,436	22.1	1.41
Millet	55,390	10.3	1.06
Paddy	91,119	16.9	1.54
Wheat	62,746	11.6	1.30
Potato	197,650	36.6	3.37
Total	***539,749***	***100.0***	***1.71***

Source : Based on *Statistical Information on Nepalese Agriculture*, Various Dates (1997/98 – 2001/02).

Compared with other ecological zones per unit yields of these basic crops are low in the Mountain. Yield of crops depends upon nature of soil, rainfall, temperature, terrain condition, duration of growing season, and other agricultural inputs. In most of these attributes the Mountain region is not privileged. Nonetheless, of all these crops in the Mountain potato has highest yield per ha. Its average yield is approximately 3.4 metric ton per ha. Barley, despite highest per district production, has the yield of 1.1 metric ton per hectare.

11.4.2.2 Production in the Hill

Land in the Hill with its long history of human settlement has been used to produce varieties of crops for centuries. Apart from hill landform the region also comprises of mid-land valleys and flood plains, which produce crops whose yields are comparable to that of the Tarai. Kathmandu valley is an exception where yields of most basic crops are highest in the country. On the average the Hill (i.e. 39 districts) produces 3 million metric ton of basic crops annually. Maize is the dominant crop there and its contribution is 32 percent in the total basic crop production. Paddy comes next with its near 30 percent contribution (Table 11.8). The share of potato is also notable.

Millet contributes 7 percent only but of all ecological zones largest amount of millet is produced in the Hill. Among 73 millet-producing districts Sindhupalchok has the highest millet production.

Table 11.8 : Basic crops, their production and yield in the Hill.

Basic Crops	Production (5-Year Average 1997/98-2001/02)		Yield (Mt/per ha)
	Total (Metric ton)	Share in Total Production (%)	
Barley	16,639	0.5	1.16
Maize	983,619	32.3	1.72
Millet	218,878	7.2	1.11
Paddy	894,390	29.4	2.36
Wheat	381,445	12.5	1.58
Potato	550,964	18.1	9.56
Total	***3,045,934***	**100.0**	***2.08***

Source: Based on Statistical Information on Nepalese Agriculture, Various Dates (1997/98 – 2001/02).

Mid-western Hill is also notable for barley production although its share in the total crop production is nominal. Wheat is as widely produced as that of maize. It is especially important in the Mid-western and Far-western Hill. Hill districts namely Kavrepalanchok, Ilam and Makwanpur are noteworthy for potato production. The yield of basic crops in the Hill in general is moderate. It is higher than the mountain but lower than the Tarai all together.

11.4.2.3 Production in the Tarai

Tarai is the main basic crop producing area in the country. The plain terrain with fertile soil plus its sub-tropical monsoon climate has facilitated the crop production in this region. Annually Tarai produces 4.46 million metric ton of basic crop. Paddy is the main crop there. Of the six crops paddy contributes 66 percent of the total production. It is for this reason Tarai is sometimes called “rice-bowl” of the country. Tarai is noted not only for highest production of paddy but also for highest yield per hectare (Table 11.9). Jhapa district ranks highest in the paddy production and is closely followed by Morang. Wheat is second to paddy in the total crop production. All Tarai districts produce wheat but it is produced in large quantity in the Western and Far-western Tarai.

Table 11.9 : Basic crops, their production and yield in the Tarai.

Basic Crops	Production (5-year Average 1997/98-2001/02)		Yield (Mt/per ha)
	Total (Metric ton)	Share in Total Production (%)	
Barley	1,556	0.0	1.12
Maize	335,081	7.5	2.0
Millet	13,089	0.3	1.21
Paddy	2,964,724	66.5	2.63
Wheat	692,996	15.6	1.97
Potato	450,249	10.1	9.65
Total	***4,457,695***	**100.0**	***2.61***

Source : Based on *Statistical Information on Nepalese Agriculture*, Various Dates (1997/98 – 2001/02).

Potato is increasingly grown in all districts of Tarai. It may be more important in the Mountain but its total production is highest in Tarai. No regional concentration is evident in its production. While Bara is noted for highest potato production, Chitwan produces largest quantity of maize in the country. As noted earlier the yield of crops is highest in the Tarai. This applies to all crops considered in this study despite some crops are grown most widely in the Hill or in the Mountain.

11.4.2.4 Basic Crop Production by District

Above discussion on regional variation by ecological zones summarized the north south variation. Discussion by districts is expected to add east-west variation within the ecological zones thereby complementing the discussion above. Basic crop production varies by district. In many instances average crop production in the district reflect larger intra-regional variation than interregional variation. Districts are not always comparable in size and proportion of cultivated land. District level variation of basic crop production should consider this variation. The average annual production of six basic crops by district is given in Annex 11.2 and the figures are self-explanatory. However, it is suffice to mention that irrespective of ecological zones the crop production is higher in the districts located in the eastern part of the country than those in the western part. Kathmandu valley districts are rather unique in crop production. For most of these crops discussed above their production levels in the valley are far higher.

11.5 Population and Adequacy of Basic Crop Production

One expression of population resource relations is adequacy or inadequacy of basic crop production in the region. This adequacy is assessed in terms of whether the production is adequate to meet the nutrition requirement of the population living in the region. For this, the total

production from basic crops is converted into total calorie value they produce. To assess the district situation, the nutritional calorie values of six crops are first calculated separately and summed up latter[1].

The calorie conversion (per 100 gram) of individual crop is based on conversion factor published in the *Agricultural Marketing Information Bulletin* (Special Issue – 2002). As stated earlier Annex 11.1 gives the calorie conversion factor for basic crops considered in this study. For calorie conversion of paddy, it is first converted into equivalent rice unit by using a conversion factor of 0.6175.

11.5.1 Adequacy by Ecological Zones

This calorie value is assessed against the calorie required for the population as of 2001. Since the timeframe of both the data sources i.e., basic crop production and population census is comparable; the results are expected to be robust. Table 11.10 gives the population and total cereal calorie available from the basic crops produced in the respective zones. A total of 18,396 billion calorie is available from six basic crops in the country annually. Regional inequality is evident (Fig.1). Of the total calorie available in the country, Tarai produces 63 percent. This is against its population share of 48.4 percent. The Hill produces nearly 32 percent of available calorie but its share of population is 44.3 percent. The Mountain has the least share both in available calorie and in resident population. But its share of resident population is greater than its share of available calorie.

Table 11.10 : Population and availability of cereal calorie by ecological zones, 2001.

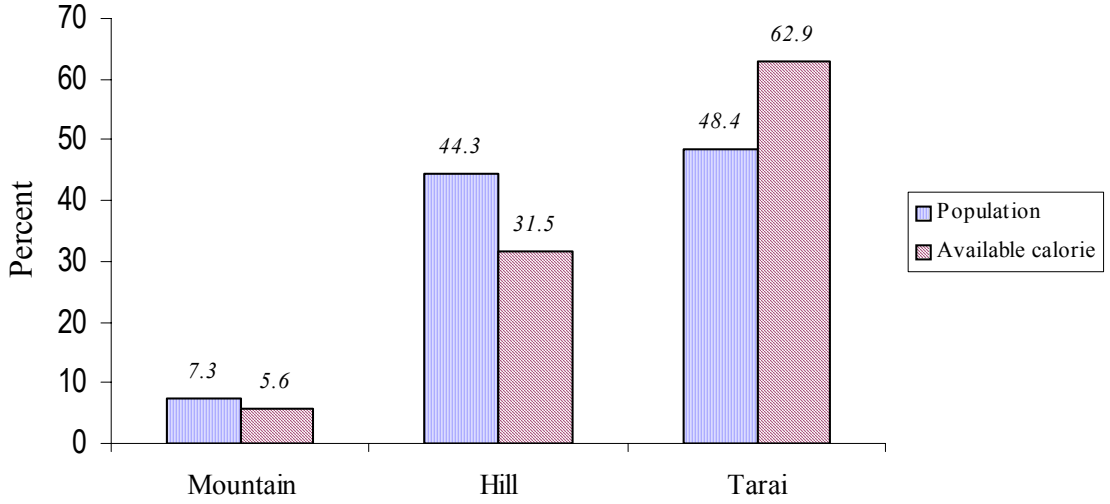
Ecological Zone	Population 2001		Production of Basic Crop (in mt) *	Calorie Available	
	Number	Percent		Total (in 000)	Percent
Mountain	1687859	7.3	539749	1033736940	5.6
Hill	10251111	44.3	3045933	5796400202	31.5
Tarai	11212453	48.4	4457694	11566199441	62.9
Nepal	**23151423**	**100**	**8043376**	**18396336583**	**100**

Note : * This includes 5-year average (1997/98-2001/02) production of barley, maize, millet, paddy, potato and wheat.

** The calculation of total calorie required is based on total population in 2001 for respective regions and districts.

[1] Since this discussion is limited to resource availability over space, policy issues primarily the management and distribution within the space (i.e., within the geographic unit), are beyond the scope of this paper.

Fig. 1. Proportional share of population and cereal calorie available by ecological zones, 2001



The proportional distribution of total cereal calorie required per person per day remains the same for the Hill and the Tarai (Table 11.11). This resemblance despite differences in the proportional share of total population is because of differential calorie requirement in the Hill and in the Tarai. On the contrary, these two regions are far apart in the total calorie available per day. While the Tarai produces 63 percent of the total calorie available in the country, the Hill produces approximately 32 percent only. The Mountain and the Hill have shortage of total calorie requirement.

Table 11.11: Adequacy of available cereal calorie and balance situation by ecological zones, 2001.

Ecological Zone	Total Calorie Required		Total Calorie Available per day*		Balance (in calorie)	Balance in person
	Total	Percent	Total	Percent		
Mountain	3453865872	7.6	2832155999	5.6	-621709872.5	-832.0
Hill	20976848439	46.2	15880548499	31.5	-5096299940	-6906.0
Tarai	20986348280	46.2	31688217648	62.9	10701869368	14328.0
Nepal	**45417062591**	**100.0**	**50400922146**	**100.0**	**4983859555**	**6590.0**

Note : * This calculation of calorie available per day is based on 5-year average (1997/98-2001/02) production of barley, maize, millet, paddy, potato and wheat.

The balance situation in terms of total calorie requirement and availability suggests that Mountain and Hill have negative balance and Tarai the positive balance. This balance situation when translated into number of person suggests a positive balance of mere 6590 persons in the country.

Obviously, Tarai appears to be able to support additional 14 thousand people at the present level of technology and production. On the contrary, the Hill has negative balance of 6906 persons and the Mountain a negative balance of 832 persons.

11.5.2 Adequacy by Development Regions

The proportional share of population and cereal calorie available by development region also shows regional inequality. But compared with inequality by ecological zones the level of inequality by development region is less convincing. Of the five development regions three namely, Eastern, Mid-western and Far-western exceed proportional share of available calorie to population (Table 11.12). However, the differences are marginal in Mid-western and Far-western region. It is only Eastern region where the difference is noticeable (i.e., 25.8 percent against 23.1 percent).

Table 11.12 : Population and availability of cereal calorie by development regions, 2001.

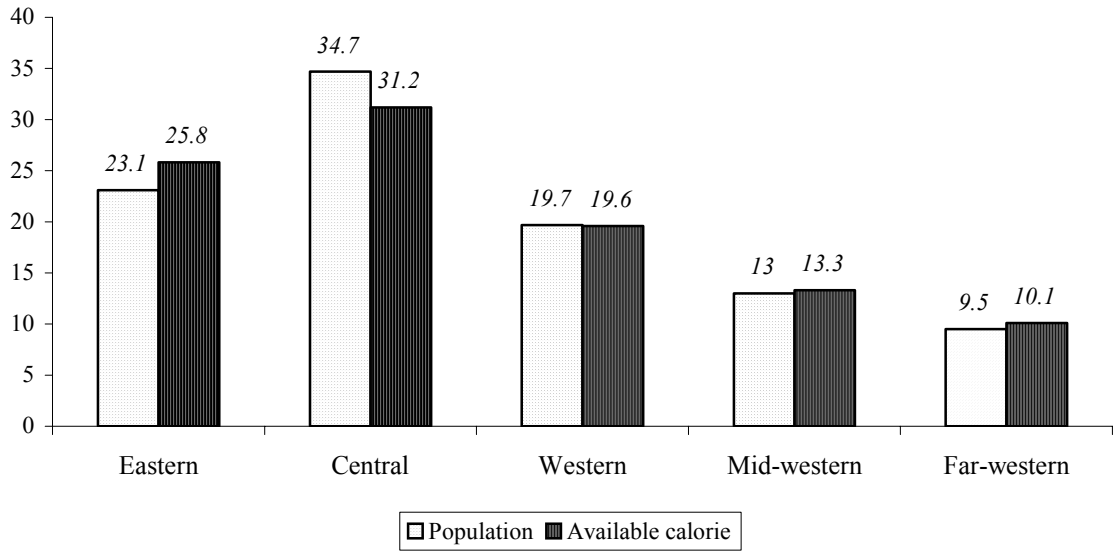
Development Region	Population 2001		Production of Basic Crop (in mt) *	Calorie Available	
	Number	Percent		Total (in 000)	Percent
Eastern	5344476	23.1	2303281	4739526755	25.8
Central	8031629	34.7	2517549	5743552067	31.2
Western	4571013	19.7	1567539	3605410492	19.6
Mid-western	3012975	13.0	1008816	2443294140	13.3
Far-western	2191330	9.5	646192	1864553130	10.1
Nepal	23151423	100.0	8043376	18396336583	100.0

Note : * This includes 5-year average (1997/98-2001/02) production of barley, maize, millet, paddy, potato and wheat.

** The calculation of total calorie required is based on total population in 2001 for respective regions and districts.

Central development region is the only region that has noticeably higher share of population than its share in available calorie (Fig.2). The Western development region shows almost identical share. Overall it is Eastern and Central development region that show noticeable difference. While the former exceeds its share in available calorie to its share of population, the latter shares more population than the available calorie. It is to be noted that Central development region is the region that has largest size of urban population including Kathmandu valley where a large proportion is dependent on non-agricultural occupation.

Fig. 2. Proportional share of population and cereal calorie available by development regions, 2001



To meet the calorie requirement of population as recorded by population census 2001 an average of 45,417 million calorie per day is necessary in the country. The development regions differ in the amount of calorie required per day and their proportional share reflects the difference. This inequality is largely due to dissimilarity in proportion of cultivated land and population size of the regions. Central region has highest calorie requirement followed by Eastern and Western region respectively (Table 11.13). There is a mismatch between necessary calorie and total available in the region. The available calorie per day clearly exceeds the requirement in Eastern region. No other regions exceed the requirement as much as this region does.

Table 11.13: Adequacy of available cereal calorie and balance situation by development regions, 2001.

Ecological Zone	Required Calorie/day		Available Calorie/day*		Balance (in calorie)	Balance in Person
	Total	Percent	Total	Percent		
Eastern	10360283571	22.8	12985004808	25.8	2624721237	3432
Central	15748232055	34.7	15735759088	31.2	-12472967	-17
Western	9047543833	19.9	9877836965	19.6	830293132	1112
Mid-western	5950541015	13.1	6693956547	13.3	743415531	995
Far-western	4310462117	9.5	5108364738	10.1	797902621	1068
Nepal	45417062591	100	50400922146	100	4983859555	6590

Note : * This calculation of calorie available per day is based on 5-year average (1997/98-2001/02) production of barley, maize, millet, paddy, potato and wheat.

The balance situation in terms of total calorie requirement and availability shows a negative situation for Central region only. All other regions have positive balance. This balance when translated into number of person is highest for Eastern region and lowest or negative for Central region. Inter-regional comparison in terms of development regions and ecological zones suggests that inequality by ecological zones is far greater than inequality by development region. Of the four development regions showing positive balance, the range is between 995 and 3432 persons only. Even the negative balance is only of 17 persons for Central zone. This is in contrast with far higher negative balance of more than 6,900 persons in the Hill.

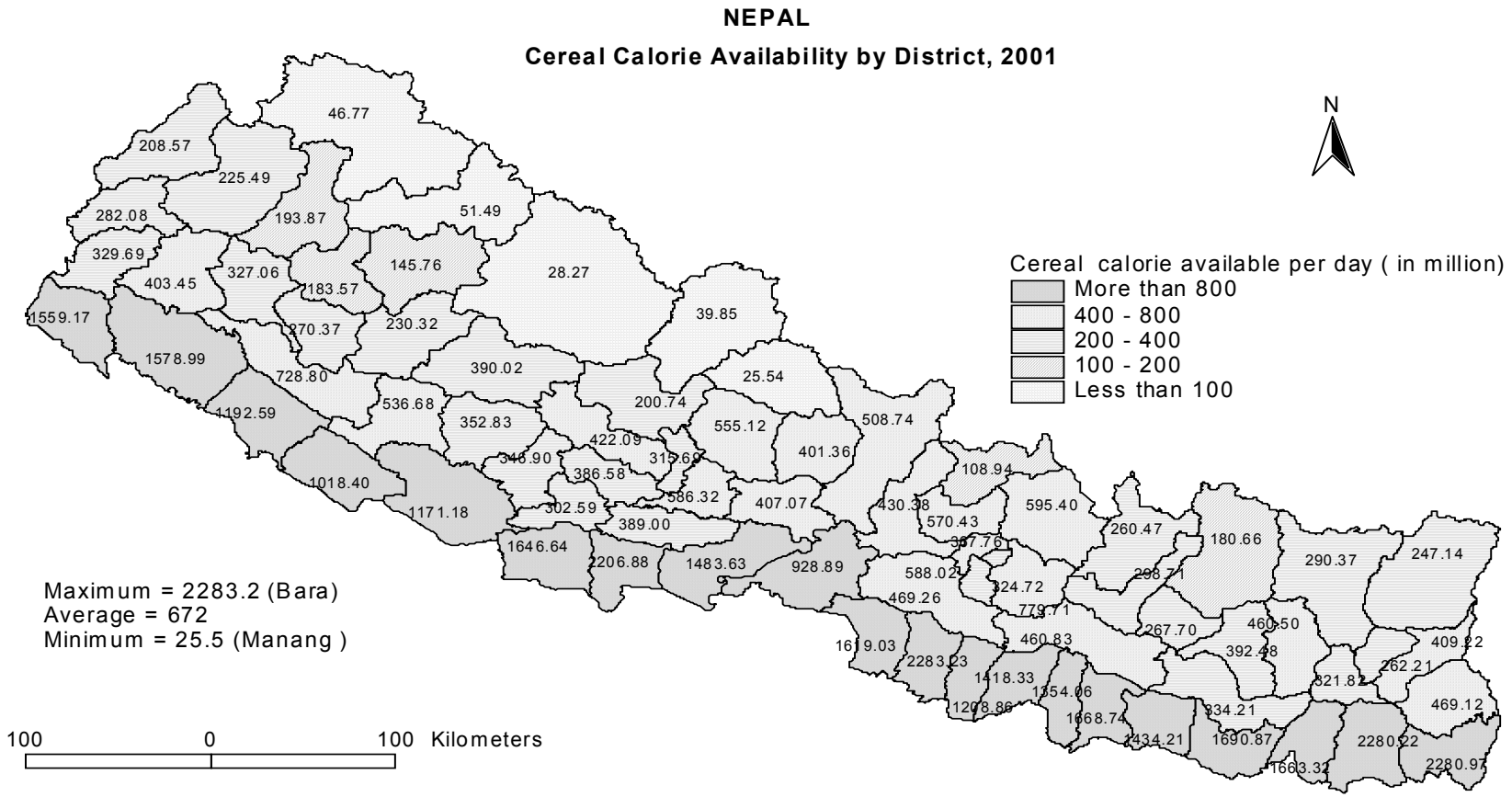
11.5.3 Adequacy by Districts

Districts differ in their land resource and population size. As a result, they differ in their proportional share of available calorie and of required amount. Population size in the districts ranges from 9,587 for Manang to 1,081,845 for Kathmandu. In terms of their share in the total population whereas Kathmandu shares nearly five percent of the total population in the country, Manang's share is less than 0.5 percent. There is huge difference in the amount of basic crop production and it is reflected in the inter-district variation in total cereal calorie available by district. Of all the districts Bara has highest available calorie and Manang the lowest. Bara, topping the rank of districts is largely because of its wheat production. Bara ranks highest in wheat production of all 75 districts and it is wheat that has highest calorie value per 100 gram. Apart from Bara, other districts with high values with regards to available calorie include Jhapa, Morang, Rupandehi, Saptari, Dhanusha, Sunsari, Kapilvastu, Parsa, Kailali and Kanchanpur respectively (Map 11.1). Among districts falling at the bottom include, Dolpa, Mustang, Humla, Mugu and Rasuwa. A detail of population and available calorie by district is presented in Annex 11.3.

Because of the size and locational difference (ecological zones) in calorie requirement of the residents, districts differ. Total calorie requirement in the districts ranges from 19.6 million per day for Manang to 2.2 billion for Kathmandu. In the total calorie requirement of the nation as a whole, the share of Manang comes out to be less than 0.5 percent whereas the share of Kathmandu is almost five percent. Districts namely Morang, Rupandehi, Jhapa, Dhanusha, Sarlahi, Sunsari, and Kailali are among districts that have higher calorie requirement (Map 11.2).

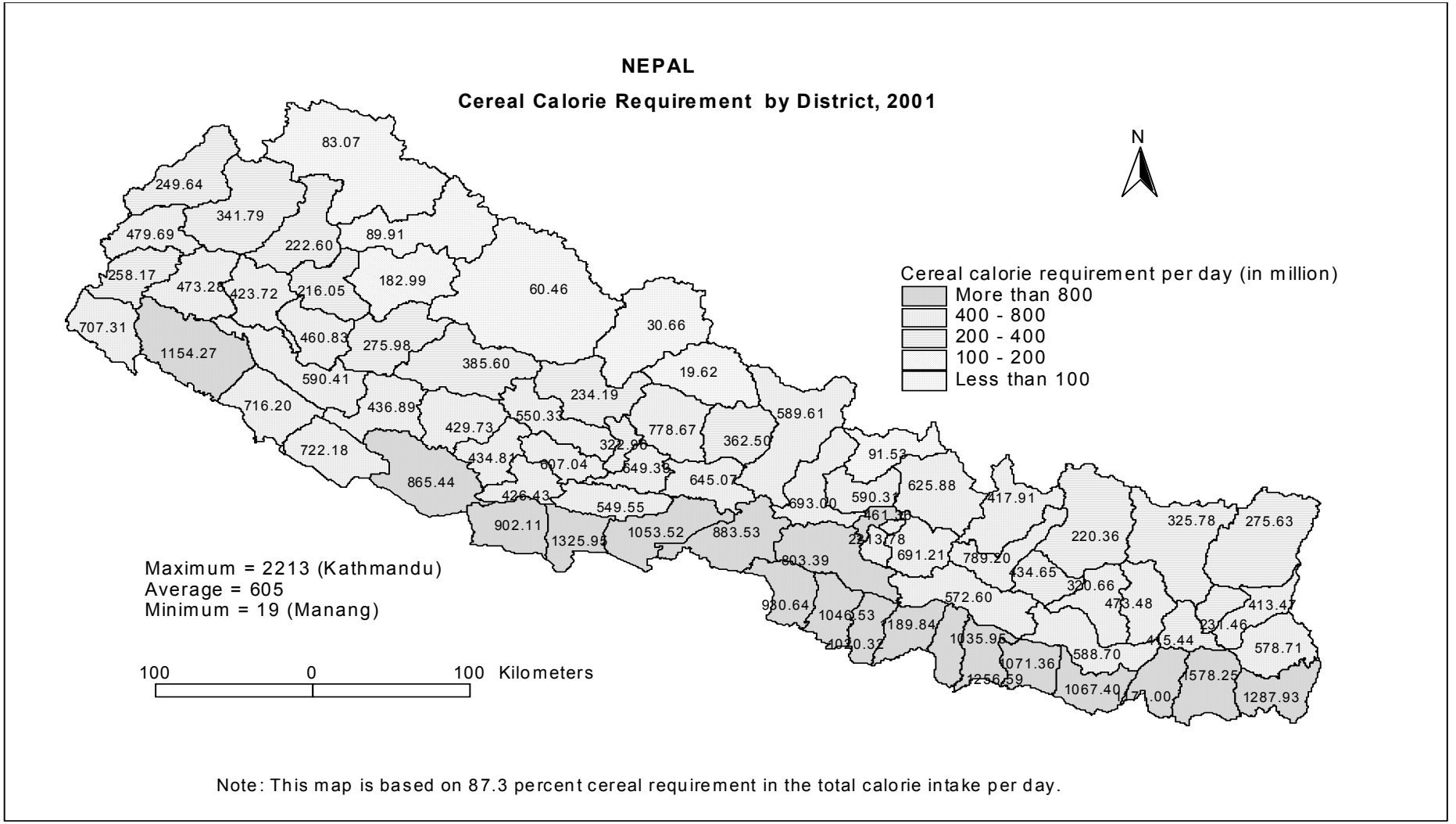
Since the production and yield of basic crops is high in Tarai districts, the available calorie per day is also high there. The balance situation between requirement and availability suggests that 46 out of 75 districts have negative balance. Among districts with negative balance 13 (out of 16) are

Map 11.1



Note: The availability figures are based on 5 year average production (1997/98 - 2001/02) of crops namely barley, maize, millet, paddy, wheat and potato.

Map 11.2



Note: This map is based on 87.3 percent cereal requirement in the total calorie intake per day.

from the Mountain and 33 (out of 39) are from the Hill. Six districts in the Hill and three districts in the Mountain have positive balance (see, Annex 11.4). All Tarai districts have positive balance. The existing positive balance in terms of number of persons ranges from 1656 (Bara) to six (Rukum). Likewise, the negative balance in the districts ranges from six in Panchthar to 2,177 in Kathmandu. The positive balance reflected in 29 districts shows that the available calorie is adequate to supply necessary daily calorie for additional 14,328 persons. On the contrary, 46 districts with negative balance show calorie shortage equivalent to 7,738 persons. Therefore, despite 61.3 percent districts showing shortage of necessary cereal calorie the overall national balance appears positive equivalent to 6,590 persons. In other words if these 75 districts are to be interpreted in terms of over population and under population 46 districts are over populated i.e., negative food balance. On the contrary, only 29 districts are under populated (Map 11.3). In its entirety positive numerical balance of more than 6,500 persons suggested a positive direction but for a nation of more than 23 million people with more than 2 percent growth rate per annum this is not a situation to be content with.

11.6 Conclusion

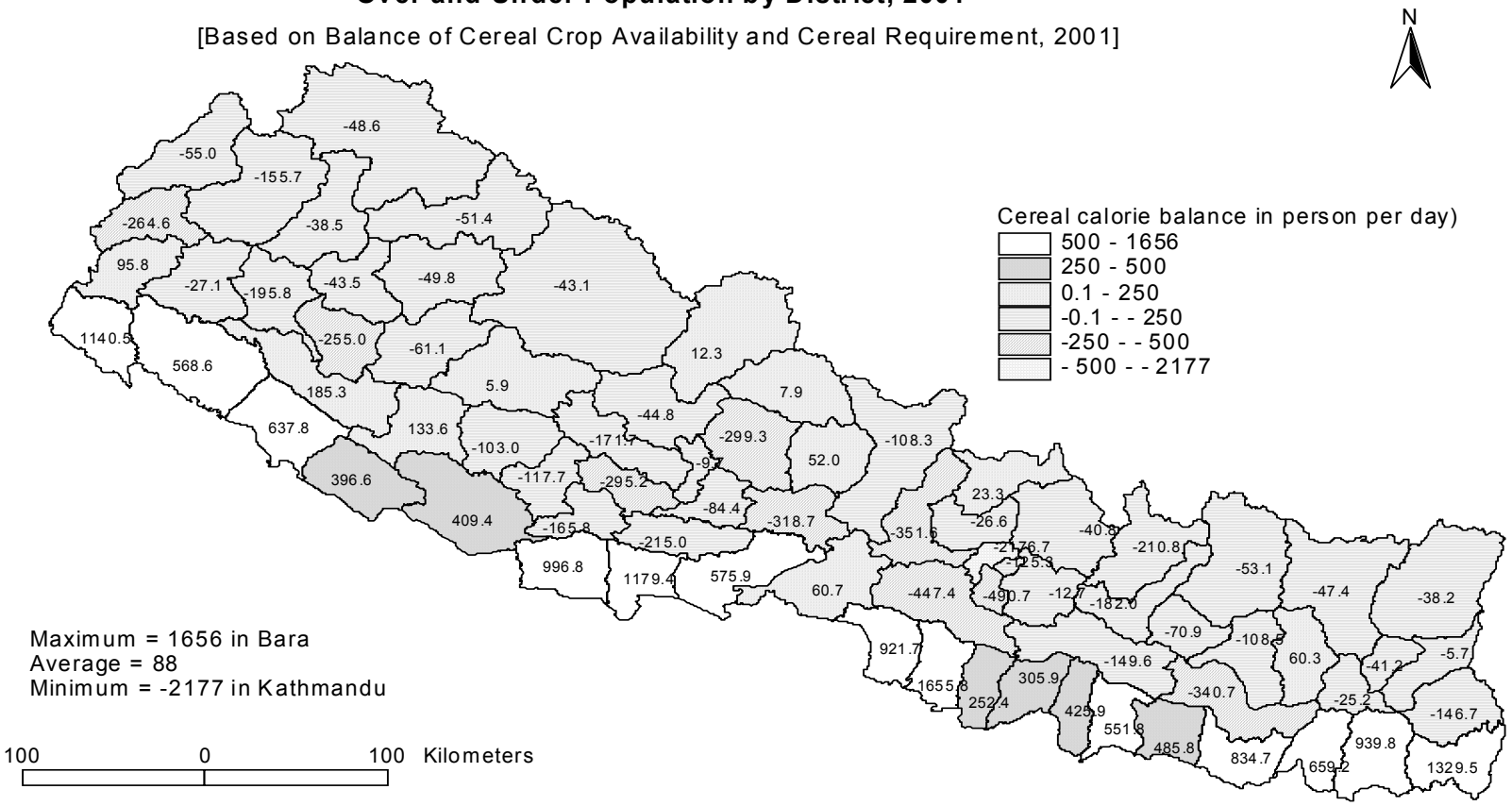
Because of the multi-faceted and multidisciplinary nature plus multiplicity of approaches, the experiences and interpretations related to population-environment relations are varied and often contested. Environmental concerns are not only matters for natural scientists but also matters for social scientists and therefore they are equally considered social issues (Blaikie 1995: 2). In Nepal whereas there has been increasing realization of rapid growth of population in recent decades as undesirable (NPC 1992; 1998), the implications of accelerated land degradation, deforestation and depletion of other natural resources (see Blaikie and Brookfield, 1987; Ives and Messerli 1989) is also being realized ever more. As a result, the population-environment issues have gained attention in the public policy in Nepal over the last few years. However, in reality the public programs has been largely dominated by epistemology of population and environment as separate entities rather than population-environment as integrated entities.

Increasing presence of people on the finite territory of Nepal has multifaceted implications. For a landlocked hill country with the territorial size of 147181 km^2, population of 23.15 million (2001) growing at the rate of 2.25 percent per annum, the cultivated land has been the main environmental resource on which majority of its population depends for earning its livelihood. Together with grassland only 27.6 percent of the territory is arable in which inequalities abound by ecological zones, development regions and by districts. The average man-land ratio is 5.7 persons per hectare (2001). These ratios are high in the Tarai and low in the Mountains in general.

Map 11.3

Over and Under Population by District, 2001

[Based on Balance of Cereal Crop Availability and Cereal Requirement, 2001]



Note: Figures in negative (-) suggest over population whereas figures in positive suggest under population.

The available land resource translated into cultivated land is primarily used to produce six basic crops namely barley, maize, millet, paddy, potato and wheat. The crop produce of the district is assumed to meet the minimum cereal calorie requirements of the resident population. The requirements differ by ecological zones. The 75 districts in the country exhibit a wide range of man-land ratios and available cereal calorie. There are still major disparities between ecological zones and between districts. Disparities by development regions are less noticeable compared to disparities by ecological zones.

Since there is little scope for expansion of cultivated land in the country there is no option in future except producing more basic crops and other commodities from less per capita arable land. This means the need for more cereal calorie has to be met through higher yields per unit of land and better post-harvest management.

The discussion of land resources, its utilization by local population as reflected in the basic crop production and the adequacy of cereal calorie available from these produces in the district and in the regions is set in the broader framework of population-environment relations. Understanding these relations becomes critical in planning for overall development of resident population. Resources are for people and development is all about people. In countries such as Nepal the use, over use and/or misuse of available resources depends upon individual behavior of population, which in turn is governed by overall status of household economy i.e., shortage or surplus. The rural population in Nepal is still building up in absolute number. This addition is likely to overuse or degrade the productivity of resources especially that of land. Occupational changes from agriculture to non-agriculture are expected to take place over time but the pace is likely to be slow given stagnant economy of the country. Channels of communications plus inter-sectoral coordination are imperfect and districts differ in the extent of their commitment to improving the welfare of their resident population.

Rapid population growth and increasing pressure on land resources to earn the much-needed calorie is a major challenge in the country. In this respect, strong efforts are needed to attain stability in the level of population. In the mean time, large increases in basic crop production in the country are essential to meet the basic calorie requirement of current as well as increasing population. The environmental dimension of this increased presence of population especially the one related to people's attempts at using resources to meet basic requirement is a major policy concern. The concerns are further worrisome due to individual behavior of people where priorities are given to meeting immediate individual needs and broader community goals are pushed to the periphery.

In order to regulate population so that they do not put additional stress on environment, the state must place emphasis on improving family welfare. From the existing emphasis on family planning there is a need to move towards family welfare. The programs of population should never be an isolated activity. As Salim (1997) pointed out, the emphasis on family welfare signifies things closely related to environment such as clean water and sanitation. One can link the programs with what it signifies to daily activities of people. For example one can start programs with the campaign that clean water is needed to wash hands to pray for which clean river is a necessity. Ensuring clean rivers mean keeping forest cover or plantation of trees. Indonesian story is an important lesson to learn. In this respect Salim (1997) putting forward the success story of Indonesia stressed this approach of linking environment issues with daily activities and posits that this way there is incentive to plant trees to ensure clean water for praying and thus ensure a clean environment. All this in turn promotes family welfare.

This paper should be considered as preliminary cross-sectional assessment. Inclusion of temporal aspect and further disaggregation of data would certainly give precision and further our understanding of this critical issue. While discussing the adequacy of cereal calorie this paper discussed availability of food, which is a function of production. This is only one of five major dimensions of sustainable development and food security. Four other dimensions as highlighted in *Food Insecurity Atlas of Rural India* (*Vepa et al.* 2001) include access to food, absorption of food in the body, vulnerability to transient hunger and sustainability of production. These dimensions need to be taken seriously in further analysis.

In sum the lessons from situation analysis of population, land and adequacy of food production in Nepal implies that there is a need of population regulation together with ecological, social and economic sustainability. The use of natural resources must be based on principles of ecological sustainability and equity to save the children of today and tomorrow (see, also Swaminathan, 2002). Population growth should be regulated as per available resources and the level of technology and that care must be taken so that social practices do not unnecessarily harm the environment. Moreover, sound economic policies capable of addressing interregional inequalities are also integral to attain sustainable development of the nation.

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Annex 11.1 : Calorie conversion factor for basic crops (per 100 gram).

Barley	336
Maize	342
Millet	309
Rice	345
Wheat	346
Potato	097

Note : Conversion factor of paddy to rice is 0.6175.

Source : *Agricultural Marketing Information Bulletin (Special Issue – 2002),* HMG, Department of Agriculture, Marketing Development Directorate, Harihar Bhawan, Lalitpur, Nepal 2059.

Annex 11.2 : Basic crop production by districts (in metric ton).

District	Total Area	Cereal Crop Production (5-Year Average 1997/98-2001/02)						
		Barley	Maize	Millet	Paddy	Wheat	Potato	Total
Mountain								
Taplejung	3646	310	16466	5577	12903	2650	27019	64925
Sankhuwasabha	3480	131	19137	8141	20362	2966	17118	67855
Solukhumbu	3312	642	12219	1775	2142	3560	30145	50484
Dolakha	2191	182	9173	4006	6361	7097	20310	47129
Sindhupalchok	2542	597	33205	21554	19181	11782	27620	113939
Rasuwa	1544	338	3546	1417	2418	1161	21763	30643
Manang	2246	254	287	0	0	446	5565	6553
Mustang	3573	890	372	0	0	1110	4037	6409
Dolpa	7889	199	2668	688	464	272	4812	9103
Mugu	3535	990	382	1076	801	1356	1144	5749
Jumla	2531	3004	4761	3067	2544	2001	14896	30272
Kalikot	1741	1170	2803	1203	2850	7049	4935	20009
Humla	5655	892	115	1060	658	716	4612	8053
Bajura	2188	1269	1569	2689	6326	6073	3023	20949
Bajhang	3422	1473	3030	1927	7650	7390	4393	25863
Darchula	2322	1067	9704	1211	6458	7118	6258	31816
Hill								
Panchthar	1241	461	26553	7629	19238	6676	38484	99040
Ilam	1703	78	43931	3842	26000	7859	51168	132878
Bhojpur	1507	65	37643	8237	42087	4758	20641	113430
Dhankuta	891	25	29524	7588	21369	4627	17084	80218
Tehrathum	679	129	18079	3471	19808	4050	14931	60468
Okhaldhunga	1074	106	15024	7542	15919	3404	17230	59225
Khotang	1591	183	32651	12308	24296	5563	15028	90028
Udayapur	2063	30	23040	2709	25888	7751	5189	64608
Ramechhap	1546	230	29182	6789	14537	4796	24034	79567
Sindhuli	2491	190	34610	12890	21185	9809	15584	94268
Kavre	1396	712	48855	1627	38501	20458	56088	166240
Bhaktapur	119	36	6159	1202	24110	9322	15361	56190
Lalitpur	385	222	11598	1685	21122	8693	8002	51322

District	Total Area	Cereal Crop Production (5-Year Average 1997/98-2001/02)						
		Barley	Maize	Millet	Paddy	Wheat	Potato	Total
Kathmandu	395	9	16786	1144	50047	12556	18612	99155
Nuwakot	1121	36	32598	6921	43246	11344	17033	111178
Dhading	1926	346	30711	7439	31781	7350	15120	92746
Makwanpur	2426	35	38131	3327	29958	7526	46683	125660
Gorkha	3610	255	31616	15791	35431	6561	15894	105548
Lamjung	1692	187	19866	10264	25490	7407	9165	72379
Tanahu	1546	10	42085	8016	39892	4951	4875	99829
Kaski	2017	190	28294	12244	40710	10184	7580	99203
Syangja	1164	80	44921	17852	32721	12354	3990	111918
Palpa	1373	271	37768	3314	23280	10906	6395	81934
Gulmi	1149	613	30158	5498	24044	9807	3460	73581
Arghakhanchi	1193	713	27233	891	14678	10186	4067	57768
Myagdi	2297	714	13345	3070	8147	5054	9544	39873
Parbat	494	225	20642	8850	18685	5585	9170	63156
Baglung	1784	1446	22754	13205	13075	10411	9198	70089
Rukum	2877	1141	31485	1393	8751	15233	11104	69108
Rolpa	1879	1113	18054	940	8824	13334	11964	54229
Pyuthan	1309	244	17273	2458	11694	12834	5145	49649
Salyan	1462	1347	35192	4003	12206	21053	8398	82199
Jajarkot	2230	1873	14302	2645	6905	7337	4544	37607
Dailekh	1502	554	14578	3208	13781	7816	3899	43835
Surkhet	2451	1032	27622	1916	30824	26699	7490	95584
Achham	1680	270	7512	2068	15270	10881	4832	40833
Doti	2025	362	4531	2591	15232	14646	4967	42330
Baitadi	1519	754	12578	1289	9955	10226	5033	39835
Dadeldhura	1538	350	6735	1024	15703	11437	3977	39226
Tarai								
Jhapa	1606	48	30663	2358	275302	28384	44668	381423
Morang	1855	12	24404	1355	261006	32560	49487	368823
Sunsari	1257	7	9065	945	163982	34112	20759	228870
Saptari	1363	4	3548	280	177720	29620	34940	246112
Siraha	1188	8	4060	836	156957	26135	6898	194895
Dhanusa	1180	11	4161	717	145012	41222	14744	205867
Mahottari	1002	78	5648	986	115810	31786	26306	180614
Sarlahi	1259	91	16427	612	108949	39807	9810	175697
Rautahat	1126	217	19396	116	114624	25768	19245	179366
Bara	1190	77	11244	119	173414	57948	66636	309437
Parsa	1353	87	11780	216	141728	40383	10534	204728
Chitwan	2218	343	61896	1790	95209	16244	18321	193803
Nawalparasi	2162	117	16990	2085	123464	38325	8234	189215
Rupandehi	1360	40	1795	58	194939	52706	28133	277670
Kapilbastu	1738	110	1541	111	160131	35562	14958	212413
Dang	2955	73	42296	241	109705	25463	18139	195917
Banke	2337	18	16600	0	89505	23739	18196	148058
Bardiya	2025	35	16671	10	95483	31456	15789	159444
Kailali	3235	134	20618	152	148721	35460	15066	220151
Kanchanpur	1610	46	16278	100	113063	46317	9386	185190

Annex 11.3 : Population and availability of cereal calorie by district, 2001.

District	Population 2001		Production of Basic Crop (in mt) *	Calorie Available	
	Number	Percent		Total (in 000)	Percent
Mountain					
Taplejung	134698	0.6	64925	90205323	0.5
Sankhuwasabha	159203	0.7	67855	105983976	0.6
Solukhumbu	107686	0.5	50484	65941111	0.4
Dolakha	204,229	0.9	47129	95069969	0.5
Sindhupalchok	305,857	1.3	113939	217322489	1.2
Rasuwa	44731	0.2	30643	39764717	0.2
Manang	9587	0.0	6553	9320642	0.1
Mustang	14981	0.1	6409	14545170	0.1
Dolpa	29,545	0.1	9103	10317958	0.1
Mugu	43,937	0.2	5749	18793878	0.1
Jumla	89,427	0.4	30272	53202998	0.3
Kalikot	105,580	0.5	20009	67001989	0.4
Humla	40595	0.2	8053	17071893	0.1
Bajura	108,781	0.5	20949	70761966	0.4
Bajhang	167026	0.7	25863	82304825	0.4
Darchula	121996	0.5	31816	76128036	0.4
Hill					
Panchthar	202056	0.9	99040	149363906	0.8
Ilam	282806	1.2	132878	171228398	0.9
Bhojpur	203018	0.9	113430	168084165	0.9
Dhankuta	166479	0.7	80218	117464525	0.6
Tehrathum	113111	0.5	60468	95706394	0.5
Okhaldhunga	156702	0.7	59225	97709186	0.5
Khotang	231385	1.0	90028	143254317	0.8
Udayapur	287689	1.2	64608	121985540	0.7
Ramechhap	212408	0.9	79567	109027505	0.6
Sindhuli	279,821	1.2	94268	168203194	0.9
Kavre	385672	1.7	166240	284594114	1.5
Bhaktapur	225461	1.0	56190	134234011	0.7
Lalitpur	337785	1.5	51322	118521539	0.6
Kathmandu	1081845	4.7	99155	214625930	1.2
Nuwakot	288478	1.2	111178	208205491	1.1
Dhading	338658	1.5	92746	157087394	0.9
Makwanpur	392604	1.7	125660	171279658	0.9
Gorkha	288134	1.2	105548	185691120	1.0
Lamjung	177149	0.8	72379	146495085	0.8
Tanahu	315237	1.4	99829	148579684	0.8
Kaski	380527	1.6	99203	202619406	1.1
Syangja	317320	1.4	111918	214005726	1.2

District	Population 2001		Production of Basic Crop (in mt) *	Calorie Available	
	Number	Percent		Total (in 000)	Percent
Palpa	268558	1.2	81934	141984514	0.8
Gulmi	296654	1.3	73581	141102743	0.8
Arghakhanchi	208391	0.9	57768	110444614	0.6
Myagdi	114447	0.5	39873	73271069	0.4
Parbat	157826	0.7	63156	115225379	0.6
Baglung	268937	1.2	70089	154064643	0.8
Rukum	188438	0.8	69108	142357276	0.8
Rolpa	210004	0.9	54229	128784365	0.7
Pyuthan	212484	0.9	49649	126618005	0.7
Salyan	213,500	0.9	82199	195886603	1.1
Jajarkot	134868	0.6	37607	84066468	0.5
Dailekh	225201	1.0	43835	98685472	0.5
Surkhet	288,527	1.2	95584	266012523	1.4
Achham	231285	1.0	40833	119375708	0.6
Doti	207066	0.9	42330	147258840	0.8
Baitadi	234418	1.0	39835	102960371	0.6
Dadeldhura	126162	0.5	39226	120335320	0.7
Tarai					
Jhapa	688,109	3.0	381423	832553026	4.5
Morang	843220	3.6	368823	832279513	4.5
Sunsari	625633	2.7	228870	607112989	3.3
Saptari	570282	2.5	246112	617166711	3.4
Siraha	572,399	2.5	194895	523487675	2.8
Dhanusa	671364	2.9	205867	609091788	3.3
Mahottari	553481	2.4	180614	494231197	2.7
Sarlahi	635701	2.7	175697	517688974	2.8
Rautahat	545132	2.4	179366	441232636	2.4
Bara	559135	2.4	309437	833380670	4.5
Parsa	497219	2.1	204728	590946248	3.2
Chitwan	472048	2.0	193803	339044543	1.8
Nawalparasi	562870	2.4	189215	541525875	2.9
Rupandehi	708419	3.1	277670	805510084	4.4
Kapilbastu	481976	2.1	212413	601024737	3.3
Dang	462380	2.0	195917	427482398	2.3
Banke	385840	1.7	148058	371716460	2.0
Bardiya	382649	1.7	159444	435295854	2.4
Kailali	616697	2.7	220151	576329814	3.1
Kanchanpur	377899	1.6	185190	569098249	3.1

Annex 11.4 : Adequacy of available cereal calorie and balance situation by district, 2001.

Districts	Required Calorie/day		Available Calorie/day*		Balance (in calorie)	Balance in Person
	Total	Percent	Total	Percent		
Mountain						
Taplejung	275632517	0.6	247137870	0.5	-28494647	-38
Sankhuwasabha	325777099	0.7	290367057	0.6	-35410042	-47
Solukhumbu	220357862	0.5	180660579	0.4	-39697283	-53
Dolakha	417913803	0.9	260465670	0.5	-157448133	-211
Sindhupalchok	625875179	1.4	595404079	1.2	-30471100	-41
Rasuwa	91533045	0.2	108944430	0.2	17411385	23
Manang	19617878	0.0	25536005	0.1	5918127	8
Mustang	30655620	0.1	39849781	0.1	9194161	12
Dolpa	60457934	0.1	28268378	0.1	-32189555	-43
Mugu	89908283	0.2	51490078	0.1	-38418205	-51
Jumla	182994470	0.4	145761638	0.3	-37232832	-50
Kalikot	216048354	0.5	183567092	0.4	-32481262	-43
Humla	83069549	0.2	46772309	0.1	-36297240	-49
Bajura	222598560	0.5	193868401	0.4	-28730159	-38
Bajhang	341785304	0.8	225492671	0.4	-116292633	-156
Darchula	249640415	0.5	208569961	0.4	-41070454	-55
Hill						
Panchthar	413467193	0.9	409216181	0.8	-4251011	-6
Ilam	578705918	1.3	469118899	0.9	-109587019	-147
Bhojpur	415435733	0.9	460504560	0.9	45068827	60
Dhankuta	340665978	0.8	321820618	0.6	-18845360	-25
Tehrathum	231459039	0.5	262209299	0.5	30750259	-41
Okhaldhunga	320659303	0.7	267696399	0.5	-52962904	-71
Khotang	473483126	1.0	392477581	0.8	-81005545	-108
Udayapur	588698001	1.3	334206958	0.7	-254491042	-341
Ramechhap	434650490	1.0	298705494	0.6	-135944996	-182
Sindhuli	572597712	1.3	460830669	0.9	-111767043	-150
Kavre	789200614	1.7	779709901	1.5	-9490713	-13
Bhaktapur	461360844	1.0	367764414	0.7	-93596430	-125
Lalitpur	691209446	1.5	324716545	0.6	-366492901	-491
Kathmandu	2213779424	4.9	588016246	1.2	-1625763178	-2177
Nuwakot	590312531	1.3	570426003	1.1	-19886528	-27
Dhading	692995865	1.5	430376421	0.9	-262619444	-352
Makwanpur	803385565	1.8	469259338	0.9	-334126227	-447
Gorkha	589608604	1.3	508742796	1.0	-80865808	-108
Lamjung	362499999	0.8	401356397	0.8	38856398	52
Tanahu	645069473	1.4	407067626	0.8	-238001847	-319
Kaski	778672400	1.7	555121661	1.1	-223550739	-299
Syangja	649331916	1.4	586317059	1.2	-63014857	-84
Palpa	549550235	1.2	388998668	0.8	-160551567	-215
Gulmi	607043080	1.3	386582856	0.8	-220460224	-295

Districts	Required Calorie/day		Available Calorie/day*		Balance (in calorie)	Balance in Person
	Total	Percent	Total	Percent		
Arghakhanchi	426430503	0.9	302587984	0.6	-123842519	-166
Myagdi	234192896	0.5	200742655	0.4	-33450241	-45
Parbat	322959344	0.7	315685969	0.6	-7273375	-10
Baglung	550325783	1.2	422094913	0.8	-128230870	-172
Rukum	385600679	0.8	390019934	0.8	4419254	6
Rolpa	429731185	0.9	352833877	0.7	-76897308	-103
Pyuthan	434806009	1.0	346898645	0.7	-87907364	-118
Salyan	436885050	1.0	536675625	1.1	99790575	134
Jajarkot	275980388	0.6	230319089	0.5	-45661299	-61
Dailekh	460828806	1.0	270371155	0.5	-190457651	-255
Surkhet	590412800	1.3	728801433	1.4	138388633	185
Achham	473278496	1.0	327056735	0.6	-146221761	-196
Doti	423719156	0.9	403448877	0.8	-20270279	-27
Baitadi	479689553	1.1	282083208	0.6	-197606345	-265
Dadeldhura	258165301	0.6	329685810	0.7	71520509	96
Tarai						
Jhapa	1287933615	2.8	2280967195	4.5	993033579	1330
Morang	1578254874	3.5	2280217844	4.5	701962970	940
Sunsari	1170997286	2.6	1663323259	3.3	492325973	659
Saptari	1067396819	2.4	1690867702	3.4	623470882	835
Siraha	1071359208	2.4	1434212808	2.8	362853600	486
Dhanusa	1256591999	2.8	1668744623	3.3	412152625	552
Mahottari	1035950388	2.3	1354058073	2.7	318107685	426
Sarlahi	1189841562	2.6	1418325956	2.8	228484394	306
Rautahat	1020323564	2.2	1208856537	2.4	188532972	252
Bara	1046532980	2.3	2283234713	4.5	1236701733	1656
Parsa	930644802	2.0	1619030816	3.2	688386014	922
Chitwan	883532242	1.9	928889160	1.8	45356918	61
Nawalparasi	1053523779	2.3	1483632534	2.9	430108755	576
Rupandehi	1325947842	2.9	2206876943	4.4	880929101	1179
Kapilbastu	902114479	2.0	1646643115	3.3	744528636	997
Dang	865436646	1.9	1171184651	2.3	305748005	409
Banke	722176728	1.6	1018401261	2.0	296224533	397
Bardiya	716204133	1.6	1192591382	2.4	476387248	638
Kailali	1154271775	2.5	1578985793	3.1	424714018	569
Kanchanpur	707313558	1.6	1559173284	3.1	851859726	1141