

# Analysis of food availability and food security status in Nepal for forest resource conservation purpose

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## Abstract

Agriculture and forest are basis for livelihood in Nepal while both sectors constitute around 40 percent of the national product and over two-thirds of the economically active population is dependent on agriculture. However, radical changes in land use, depletion in crops production and food availability are major threats due to loss of soil fertility and severe environmental degradation. In this study, we used time series data from 1986/87 to 2005/06 about food crop production and population published by Government of Nepal, Ministry of Agriculture and Cooperatives and Central Bureau of Statistics. Descriptive statistics and ArcGIS were used to assess and map the food security status of Nepalese Terai based on the local food demand and supply system. Food supply to demand ratio (FSDR) was the main idea of assessment. Our results showed that out of 20 districts, only 8 districts were categorised under secured food districts whereas 5 districts were still under food unsecured situation. The analysis further revealed that 7 districts had faced food deficit more than 8-16 times during the last 20 year periods. Data further showed that there was surplus food supply relative to the requirements dictated by FSDR. However, the average FSDR was less than 1.2 (less than 20% surplus) exploring fact that most of the districts were not producing sufficient food to cope up the food shock and after 1995 it was relatively stagnant. Our prediction reveals that food supply in Terai even in the future would remain at almost the same level as now, and there will not more than 16-17 % surplus by 2021 considering medium vibrant population growth. The findings thus, indicate that Terai may not be a food secure region in the future, even though the region is considered as a food storage house of Nepal. In addition, this paper suggests ways to make future comprehensive case studies more widely comparable in Terai, Nepal.

**Keywords :** Time series data; CBS; Food security; ArcGIS; Descriptive statistics; Nepalese Terai

## 1. INTRODUCTION

Agriculture and forest are the main subsistence for people's livelihood in Nepal. Both sectors constitute around 40% of the national product and more than two-thirds of the economically active population is dependent

on agriculture. Being an agricultural base country its economic development (Ness and Golay, 1997) and 81% of labour forces employed mainly relies on agriculture sector (CBS, 1995). Food security is a major issue worldwide, with 852 million people living

under an insecure food supply (FAO, 2007). Obviously, lack of sufficient food production at the household level and less income to buy food is the core reasons for food insecurity. Population growth and losses of agricultural productivity are also responsible factors for shortage of food in many developing countries including Nepal. According to World Bank report Nepal has the highest ratios of population to arable land in the world where population has led to fragmented land holdings and depletion of the forest (IRIN, 2008).

Food security primarily depends on natural resources such as forest and their utilization, availability of land for cultivation, water supply are directly related to the food production. Traditionally, food security was seen only as a national production and supply problem. However, it is now more dependent on purchasing power. This is reflected in the evolution of the concept of food security (Maxwell and Berger, 1992 in Hilderink, 2004). Nevertheless, in the developing and poorest countries, food security still mainly depends on the national food production and food supply system. Nepal has a long history of food deficiency mostly in its far western Hilly region. World Food Program reported that about 3.8 million people in Nepal faced food insecurity. Lack of agricultural management and effective food delivery mechanisms are some of reasons that further wedged the food security (IRIN, 2008).

About 80% of rural residents are also reliance in forest for food security and increase basic cash income in Nepal. But, those valuable forest resources are under threat due to over exploitation. The long term vision of the Master Plan for the Forestry Sector has also

emphasized to promote food production by bringing effective coordination between the forestry and agricultural sectors to protect the region from other environmental imbalances (NPC, 2002/03).

This research undertakes the current food supply and demand ratio and food security status at a regional level in Nepal based on last 20 years agri census data. It further explores and discusses how achievements can help to overcome challenges of food security problem and searches the ways to obtain better food security information, in order to support committed decision-making platforms in Nepal to fight against food deprivation and poverty.

## **2. METHODS AND MATERIALS**

### **2.1. Study area**

Nepal is a relatively small country, where diverse landscape, ranging from the humid Terai plains in the south to the mountainous Himalayan in the north. It is commonly divided into three physiographic areas: The Mountain, Hill and Terai regions. These ecological belts run east-west and are vertically intersected by Nepal's major, north to south flowing river systems. Terai region is a lowland tropical and subtropical belt of flat, alluvial land. It covers nearly 17% of the total land of the country and ranges from 60-100m from mean sea level (Figure 1). Terai was becoming Nepal's richest economic region in terms of both agriculture and forest lands and the most favorable region for development of Nepal's economy, as compared to the Hill and Mountain regions (ADB, 2005). Due to flat terrain, drained and nourished by several rivers Terai has a greater availability of agricultural land. Terai is also called as food storage house of the country

while Terai provides food for other parts of the nation. Additionally, it has the largest commercially exploitable forests in the past; however, the forests were being increasingly destroyed because of growing demands for timber and agricultural land.

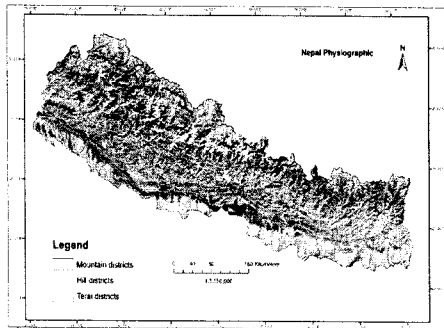


Figure 1. Red line box indicating a study area Terai districts of Nepal.

## 2.2. Data use and data analysis

We used series of areas covered by single crop and production, population data on 1991 and 2001 published by Central Bureau of Statistics and Ministry of Agriculture and Cooperatives along with district boundary of Nepal published by the Department of Survey, Government of Nepal. However, in this analysis we do not state any calculation and results of the productivity of crops and caloric production. We follow the model developed by (Neupane, 2006) for the food crops estimation in Nepal and used ArcGIS and some descriptive statistics to calculate Food Demand to Supply Ratio and mapped the food security status in Terai. Based on crops estimation we mapped the food security status in 20 Terai districts of Nepal to explore the existing level of food crops productivity and food availability in the region. It can influence not only food consumption but also can affect

land use change and forest resource deterioration. We also consider some household socio-demographic variables that affect food demand and consumption process.

The important aspect to consider modeling food security is to explore food availability. This is quite complex and depends on various socioeconomic factors. The hunger and food insecurity situation can be only eliminated when a greater Supply to Demand Ratio will maintain (Fisher *et al* 2002 in Hilderink, 2004). In this context, the modeling of food security and the food stability since 1986/87-2005/06 in Terai has been accomplished by adopting the food availability approach (Food Supply to Food Demand Ratio). This information is subjectively linked with other indicators such as population growth, poverty, income, and child malnutrition to establish the status of food access utilization. The aggregate data is used to depict the regional level trends of food production and supply.

## 3. RESULTS

### 3.1. Caloric production and food balance

Total supply of calories in the spatial location is estimated after deduction of the parts of crops that are used for seed purpose, loss after harvest, and parts of the crop that are used for other purposes. The parts of crop that are available for food purpose was transformed into calories produced from each crop by using the standard conversion rate. The balance of food was determined by the Food Supply to Demand Ratio (FSDR). To depict the temporal and spatial extent of the food supply, maps are prepared with the help of ArcGIS 9.0 based on the 5 year average food supply to demand ratio.

### 3.2 Food availability at district level

The status of food availability at the district level is depicted based on the FSD ratio. Mathematically, the ratio 1 is a balanced situation and the ratios less than 1 reflect a situation of deficit and more than 1 surplus of food production (Table 1). In reality, this relation may be considered somewhat arbitrary. Thus, we assume that at least a 20-25% surplus of food in any geographical boundary can overcome the unforeseen shock of food deficit. Hence, districts are classified according to criteria followed by Table 1.

Table 1: Criteria define for Food Supply and Demand Ratio.

Average FSDR	Insecure	Potentially Insecure	Secure
<1			
1-1.20			
>1.2			

The analysis shows the food supply status by district level based on the five year average FSDR indicator. Between 1986/87-1990/91, only the Nawalparasi had a food deficit and most of the eastern Terai districts were potentially food secure. However, the food deficit trend increased in the subsequent period (1991/92-1995/96) and 11 districts fall in the food insecure category. The situation improved to some extent during 1996/97-2005/06 and most of the districts fall in a potentially secure category, though 5 districts still in (25%) food insecure category. Overall, during this 10 year period, 8 districts (40%) fall in the food secure category.

### 3.3 Stability of food production, demand and food insecurity in Terai

Rapid population growth has caused undue pressure on natural resources (land and forest), and thereby productivity and availability of resources has been depleted in Terai. Stability of local food production in any spatial location can be described on the basis of the number of years where there was a food deficit based on the local food production system. We argue that the higher the period of low food supply, the higher will be the risk of food insecurity in any geographical boundary.

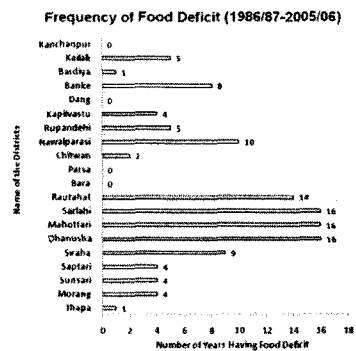


Figure 2. The number of years having food deficit by Terai districts.

Figure 2 shows that Dhanusha, Mahottari, Sarlahi, and Rautahat districts have 16/16 and 14 periods of food deficit, followed by Nawalparasi, Siraha, and Banke. Thus, these districts are more insecure to food security. The trend of food production in Terai region is not hopeful considering the present trends of population growth and food crops productivity. However, during the study period the produced calories is a slight surplus over the requirements and the food supply fell below the requirement from 1992-1996 (Figure 3).

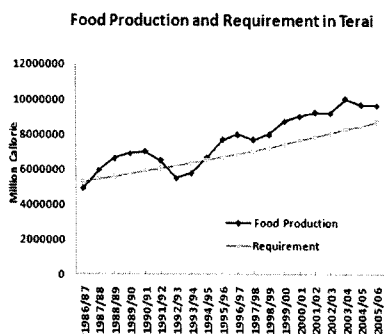


Figure 3. Trends of food production and requirements in Terai

Data indicated that the average FSDR is less than 20% of surplus during the study period, and after 1995 the FSDR is somehow stagnant. This indicates that Terai is not a potentially food secure region based on the local production of calories.

### 3.4. Future situation of food production and supply in Terai

The future situation of the food production in whole region is predicted by ordinary least square method and predicted population is acquired from the Central Bureau of Statistics World Wide Web page [www.cbs.gov.np](http://www.cbs.gov.np). Based on this prediction, we concluded that the food supply situation in Terai will remain almost at the same level as that of today, only a 16-17% (Table 2) surplus until 2021. Terai is also potentially not secure to food supply, even though the region is considered a storage house of food. The increasing demand of food in Hills and Mountain including rapid urbanization in major cities of Terai may reduce the food supply in the future.

Table 2: Predicted Food Supply and Demand in Terai.

Items	2011	2016	2021
Estimated Population	14648770	15454964	16894748
Food Requirement (Million Cal)	9599203	10560068	11543844
Estimated Calorie Production (Million Cal)	11119832	12315735	13511639
Balance (+ or -)	-1320650	-1755668	-1967795
Food excess (Percent)	16	17	17

### 3.5. Food availability and adequacy at a household level in Terai

Food access refers to the ability to obtain appropriate and nutritious food in the case of a particular household or individual. Based on the Agriculture Census 2001, food supply and food availability at a household level did not meet the food demand of most households in Terai districts. Generally, the landless are poor in Terai and in other parts of the country so most of the agricultural households (about 41.2 % of total households) have small land holding size of less than 0.5 hectare.

Figure 4 reveals that 35% of the holdings in Kanchanpur the lowest level, and 75% of the holdings in Dhanusha the highest level, reported insufficient to feed their households from their own agriculture production. Similarly, data shows that in most of the Terai districts more than 60% of the holdings out of the total holdings reported insufficient to feed their households from their own production. Data further shows that about 59% of holdings out of total holdings reported having insufficient food stores to feed households.

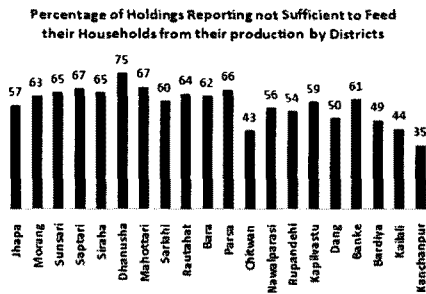


Figure 4. Percentage of holdings reporting not enough to feed from their production.

Figure 5 further shows that 17% of holdings reported insufficient food stores for 1-3 month, 39% report for 4-6, 17% report for 7-9, and 27% report for 10-12 months in Terai. This presents a clear picture of food insecurity in rural Terai and large sections of holdings were under food deprivation, even though the region produced at least the required level of calories.

**Period of Insufficiency to Feed the Household**

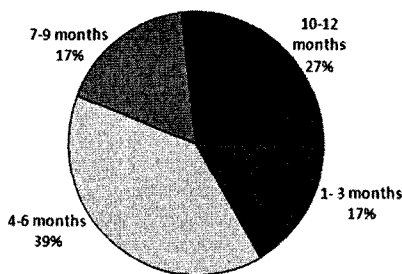


Figure 5. Periods of insufficiency to feed the household.

### 3.6. Poverty

Poverty is a complex occurrence. Food security concerns are mostly important in the developing world's cities, where the rate of poverty frequently exceeds (FAO, 2007a/2006). Incidence of poverty in Nepal is widespread still 31 % of the population lives below the

national poverty line (A to Z Nepal, 2007; IRIN, 2008). Poverty is comparatively lower in the Terai (28%) than in others two regions. However distribution of poor by head count (45%) and poor population (51%) is relatively high. Marginalized poor have less access to assets, education and are trapped in a vicious circle of poverty (ADB, 2005).

### 3.7. Access of Land resource

Terai is home for about 44% of the households out of the total agricultural households of the country. Average size of land holding has also decreased in Nepal (CBS, 2003/04). The % of land holdings having less than 0.5 hectares of land in Terai is about 41.2 % and the proportion of households' decreases considerably as the size of the land holding increases (Figure 6).

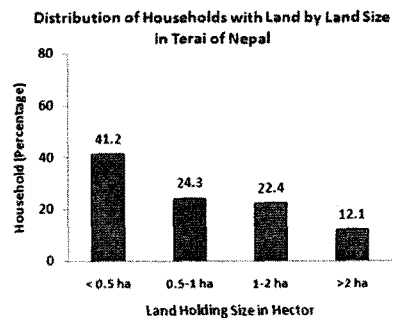


Figure 6. Distribution of household by land holding size in Terai.

Figure 7 also reveals that the distribution of poor decreases significantly with an increase in land holding size. Out of the total poor, about 76% of poor fall in the category of having less than 1 ha land in Terai.

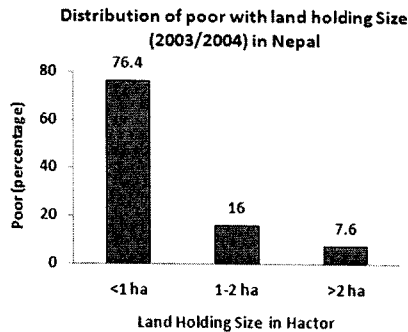


Figure 7. Distribution of poor by land holding size in Terai.

### 3.8. Other indicators

Based on social indicators of Terai in 2001 the health situation of children is inferior and chronic malnutrition among children below 5 years of age about 47% and the infant mortality rate was about 60% in Terai. Similarly, the life expectancy is 63 years including about 16% of population with life expectancy rate less than 40%. This indicates that a large proportion of children and adults do not obtain sufficient nutritious food in Terai.

## 4. DISCUSSION AND CONCLUSION

Most of the poorest and hungriest groups of people primarily depend on arable and forest land. The increasing demand for food and relative scarcity of land has forced expansion of cultivation in forest frontiers nearby settlements. It is still widely assumed, farmers and poor are considered to be main agents in deforestation process (UNCED, 1992). Forests are also clear-cut for cultivation to meet the food requirements of the growing population (DFRS, 1999). NLSS II (2003/04) reported that the % of farm holdings having < 0.5 hectare had 40.1 % in 1996 but it increased by 44.8% in 2004 in Nepal. Our study also depicted that

about 41.2 % of households had holdings of < 0.5 hectare in Terai (Figure 6). Experience has also shown that food supply is always limited than demand in Nepal. This could be the reason people migrated from Hill and Mountain regions to the Terai, which is increasing pressure on forests resources day by day.

The World Food Summit Plan of Action states that, "Food security exists when all people, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life"(FAO, 1996). Rapidly growing population in Nepal (CBS, 2004) obviously increases the demand for food, but the low productivity of agriculture, cannot cope with demand. Thus, this could be the cause of food insecurity and poverty in Nepal. Efforts on promote food security and environmental sustainability often reinforce each other (FAO, 2005). Jeanty (2006) also concluded that civil wars and conflicts are commonly detrimental to food security. This situation was also supported in food security problem in Nepal with last 13 years moist insurgency in different parts of the country.

About 59% of holdings out of the total households report not have sufficient food in Terai. In 12 districts out of 20 in Terai, about 60 or more than 60% of holdings, report not having sufficient food from their own production. The predicted future situation of food production and supply in Terai also reveals that Terai is potentially not safe to food supply in future and expected to remain at almost the same level as today, only 16-17% surplus up to 2021 (Table 2). Around 50% of Nepal's districts recorded food grain deficits (NPC/HMGN, 2003). This analysis also found

that food accessibility in Terai districts is still insecure, except in few districts.

It is frequently observed that most poor farmers have insufficient land for crop production (Graves et al., 2004) and have less access to other assets (NPC/UNICEF, 2006). Still, food production trends and food demand to supply ratios do not meet the situation for food security in Terai. Consequently, 5 Terai districts namely Rautahat, Sarlahi, Mahottari, Dhanusa, and Siraha are under food deficit conditions since 1991/92-2005/06.

Hence, mapping of crop production and food deficit areas facilitates improvement of the targeting of aid measures. Joma (2007) also realized the importance of food security information and an understanding of status to improve coordination between the actors working in the food security sector. These analyses provide practical references for resource (agricultural and forest) management authorities to understand the spatio-temporal dimensions of food security and deficit status and their environmental impacts in forest resources and livelihoods of rural people at regional scale. Therefore, based on identifying areas or districts with low crops productivity and food insecurity situations, decision makers may prioritize areas when implementing agricultural programs, thereby potentially leading to increased productivity of crops and reduce the degree of forest dependency as well.

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