

**A Study of Food System Characterization in Rapti -Tinau and
Banganga River Basin of Western region of Nepal**

Thesis

**Submitted in Partial Fulfilment for the Requirement
Master of Arts in Rural Development**

To

**The Faculty of Humanities and Social Sciences
Central Department of Rural Development
Tribhuvan University
Kirtipur, Kathmandu**

By

**Deeb Raj Rai
March 2008**

RECOMMENDATION

It is with great pleasure that I recommend the thesis entitled "**A Study of Food System Characterization in Rapti -Tinau and Banganga River Basin of Western region of Nepal**" prepared by **Deebraj Rai**. The report has been prepared under my supervision for the partial fulfilment of the requirements of Master's Degree in Rural Development. I recommend the thesis for evaluation.

.....

Suman Baskota

Supervisor

Central Department of Rural Development

Kirtipur, Kathmandu

APPROVAL SHEET

This is to certify that this thesis entitled “**A Study of Food System Characterization in Rapti -Tinau and Banganga River Basin of Western Region of Nepal**” submitted by **Deebraj Rai** has been prepared in the prescribed format of the faculty of Humanities and Social Sciences, Tribhuvan University and is approved by the undersigned evaluation committee.

Evaluation Committee

External Supervisor

Umesh Acharya

Central Department of Rural Development

TU.Kritipur

Supervisor

Suman Baskota

Central Department of Rural Development

TU.Kritipur

Prof.Dr. Pradeep Kumar Khadka

Head

Central Department of Rural Development

TU.Kritipur

ACKNOWLEDGEMENT

This project work would not have been possible without help of members of community and my debts to them are incalculable. I would like to express my profound appreciations to my respected supervisor Mr. Suman Baskota, an assistance lecturer Central Department of Rural Development of Tribhuvan University, Kirtipur and Coordinator of Rural Development Department of Tri-Chandra College, for his precious suggestions, encouragements, incredible supports and constructive criticisms as well as considerable comments.

Likewise, I would like to express my gratitude to my respected teachers Pro.Dr. Pradeep Kumar Khadka, Department Head of Central Department of Rural Development Tribhuvan University, Kirtipur; Pro. Dr. Puskar Pradhan, Department of Geography and lecturer in Department of Rural Development, TU, Kirtipur and Mr. Paras Acharya, a service holder in UNDP, Banke, Nepalgunj for their valuable suggestions, supports and criticisms and appreciable comments during various stages as well as endeavors of preparing this project work.

My greatest debts are to my fellows' city dwellers and villagers of Rupandehi, Nawalparasi and Kapilbastu whose knowledge, friendship and willingness to share their ideas and experiences with me made this project work possible. In the same way, I am also thankful to the Project Coordinator Shiva Basyal and staffs of RSDC, Kapilbastu, help me data collection and providing suggestions as well as their friendly behaviours.

I would also like to thanks my adorable and hearty friends Mr. Rameshwor Acharya, Mr. Ajaya Khati, Mr. Rajesh Saru Magar, Mr. Santa Gurung, Mr. Madan Paudyal, Mr. Nilakantha Gautam, and Mr. Home Subedi for their incredible helps, constructive suggestions, encouragements and inspirations during the various stages of this project work.

Last but not least, I wish to express my sincere gratitude to my parents Mr. Abir Man Rai and Mrs. Lal Hira Rai for their inspiration, encouragement, warm family affections and constant economic support up to this level. My younger niece Bhumika is truly indispensable for her assistance.

Deeb Raj Rai

ABSTRACT

Food system is dynamic. It interacts between and within the biogeophysical and human environments that result in the production, processing, distribution, preparation and consumption of food. Socioeconomic and biogeophysical factors both determine food security. Three principal component encompass (i) food availability (production, distribution, and exchange), (ii) food access (affordability, allocation and preference), and (iii) food utilization (nutritional value, social value, and food safety).

Climate probably has the greatest effect on production and distribution. The study aimed to find out the food production under water stress and food security. Survey tools and PRA tools were used for primary data collection. A total of 303 households were surveyed, 20 FGDs were held and 10 key informants were interviewed. Gender role was discussed in 10 separate groups.

Major summer crops such as paddy, sugarcane, pulses, and vegetables are exposed to floods, sand casting and erosion during the monsoon. Traditional method of farming is sensitive to water stresses. There is no regulation for crop production and no regulation for processing and packaging exists. The Price is very sensitive to water stress. Prices of commodities go up during the monsoon season and dry season. Unserviceable roads, damaged infrastructures and swollen rivers make mobility difficult during the monsoon. Food prices fluctuate depending upon the market forces. About 99 percent of the households prefer rice as staple food. To avoid storage loss, farmers' sale food immediately after harvest, save money to buy food. The stress remains sensitive to water stress for three months of the rainy season.

Key words: Food system, Food access, Production Nutritional and social Value, Food Safety, Affordability, Allocation, Preference, Distribution, Exchange,

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CHAPTER 1: BACKGROUND

1.1 Introduction

This region within 82°36' to 84° 23' east longitude and 27°18' to 27°48' north latitude covers an area of 5,260 square kilometer. Drained by (RTB) Rohini, Tinau, and Banganga rivers and their smaller tributaries, RTB straddles the districts of Rupandehi, Kapilbastu and Nawalparasi. While the former two are within Tarai, Nawalparasi has hills, valley and Tarai land types. The RTB basin encompasses only the Tarai part of the district. The RTB basin has three distinct geographical zones: the Siwalik, the bhabhar and the Tarai. More than 60 percent of the RTB is occupied by plain, while the Siwalik occupies about 33 per cent and about 6 percent is occupied by mid hills. The basin is continuation of the Ganga plain to the north and its average north-south width is about 40 km.

The area is located in the historical North South trade route from Gorakhpur in India and Bhairahawa in Nepal to Mustang in the North. Nepali people from western hill districts seeking employment, trade and pilgrim in India travel through this region. As a result tourism, hotels and alternate source of income have gradually developed in the region. Like all Tarai districts this area also faced malarial disease in the past. After malaria was eradicated in the early 1960s people from hills and mountains began settling in the region. The reason for migration was two folds. First, there was plenty of land (forested but could be cleared) available for agriculture. Secondly, the area was accessible to many hill districts with low agriculture production whose local economy depended on remittances earned by workers in India. Migration has led to changes in the demographic features of the area. Unlike eastern and western Tarai, the communities in this region consist of a mixture of hill and Tarai origin people.

About 36% of the local people have lived in the area for more than 20 years, whereas almost 64% has migrated in the recent past. Heterogeneity of the community and opportunities made available by travel route has introduced innovation. This is seen in case of irrigation systems built centuries ago.

The region has faced rapid population and urban-industrial growth since the 1960s. Clearing of forest for settlement and East-West Highway were two major processes. The pace of change accelerated when Nepal's East-West Highway was completed along the foothills. The highway linked the region with other parts of the country encouraging migration and the growth of ribbon settlements along the highway. Following its construction, towns like Butwal began to grow rapidly, which now has become one of the major industrial towns of Tarai. Access to market and services improved, too. However, a large number of populations in the hinterland still depend on farming. Physical interventions such as highways, canals, feeder roads, and residential and other types of buildings have also changed hydrological character of the basin at local level.

1.2 Statement of the problem

Since many years The Rohini Tinau and Banganga rivers basin is undergoing changes in water regime, food production, market entry, community composition, employment and migration. New opportunities provided by tourism add to income sources to those with skills and knowledge. At the other extreme, seasonal water scarcity has introduced new stress layers that have implication to food production, nutrition, health and hygiene. Pollution by industries has further compounded the problem. In many localities of the districts arsenic in groundwater has emerged as serious contaminant. In this background it is very important to study the status of the food system in the region.

The Nepal Water Conservation Foundation has undertaken local water management investigation in the Rohini basin since 1997 and has worked with local partners. These lessons can then be interwoven to understand the impact of climate change on food systems. One of the studies, for example, revealed significant micro level variation in rainfall and water use. Such information is not available for many other areas and though variation is significant there is no information. Another study examined community adaptation and strategy to cope with floods in the Rohini Basin. These past studies have generated information about local climate particularly rainfall, and flood and other water-induced disasters, infrastructures, and institutions. Regional or district level information available in secondary sources do not provide micro level insights which has been supplemented by these studies. The NWCF maintains contact with local partners in the basin. The partners are engaged in disaster mitigation, preparedness and community development activities. This was an added advantage.

1. 3 Objectives

The main aim of the study is to find out the status of food system characterization and food security in the Rohini Tinau River Basin in Rupandehi, Nawanparasi and Kapilbastu districts.

The specific objectives of the study are as follow:

- i. To identify the food system characterization in Rapti Tinau and Banganga rivers basin.
- ii. To find out the food production under water stress and water stress versus food production.

1. 4 Limitation of the study

In the information collection and data analyses processes, site selection was done on the basis of river basin and places were selected purposively both urban (municipality) and remote rural (villages). Survey tools and

PRA tools were used for primary data collection and secondary data was taken from the published and unpublished books and reports, magazines, newspapers, and journals. All the information was collected and analysed under the objectives.

- I. Somdih and Bhalubari VDCs were selected in Kapilbastu district; Betkuiya and Makrahar VDCs in Rupandehi district; and Rampur Khadauna and Jamuniya VDCs in Nawalparasi were selected. Four municipalities: Kapilbstu, Ramgram, Siddhartha Nagar and Butawal were included in the study.
- II. Standard PRA tools such as Focus Group Discussions (FGD), Key Informant (KI) survey and household surveys were used to collect information. Gender role in labor distribution and ownership of the property were determined by holding separate discussions with women. FGD were held at each site to collect qualitative information on market, transportation, institutions, cropping pattern, and so on. Semi-structured questionnaire was administered on selected households.
- III. A total of 303 households were surveyed, 20 FGDs were held and 10 key informants were interviewed. Gender role was discussed in 10 separate groups.
- IV. SPSS programme was used to analyse the data.

CHAPTER 2: REVIEW OF LITERATUR

2.1 Reviews on the Study Area

The area is located in the historical north south trade route from Gorakhpur in India and Bhairahawa in Nepal to Mustang in the north. Like all Tarai districts this area also faced malarial disease in the past. After malaria was eradicated in the early 1960s people from hills and mountains began settling in the region. Migration has led to changes in the demographic features of the area. Unlike eastern and western Tarai, the communities in this region consist of a mixture of hill and Tarai origin people. About 36% of the local people have lived in the area for more than 20 years, whereas almost 64% has migrated in the recent past.

Heterogeneity of the community and opportunities made available by travel route has introduced innovation. This is seen in case of irrigation systems built centuries ago. The region has faced rapid population and urban-industrial growth since the 1960s.

Ten per cent of the district's population lives in the hills. The remaining 90 per cent lives in the Tarai and inner Tarai regions. About 40 km away to the west of Rohini is Lumbini. The catchment area lies between the municipality of Butwal in Rupandehi and the Daunne hills of Nawalparasi District. The eastern part of Butwal located in the watershed of river Tinau also drains into the Rohini. The Rohini and its tributaries drain the area between Narayani (the Gandak) River in the east and the Tinau River (called the Kuda in India) in the west. Its main-stem begins at Chauranghi in the Chure hill and flows in the basin's western region. A number of tributaries (*khahare, khola and streams*) flow into main stem as it flows south. The tributaries change course, split into distributaries and capture neighbouring streams as they flow from north to south. In Nepal, the tributaries of the Rohini are the Jharahi, Dhanewa, Bhumahi, Bhaluhi and the Somnath. Each begins as a *khahare*, on the Chure slopes.

They join the Rohini before it enters Uttar Pradesh at Mishrauli of Nautanawa Block.

The upper part comprises of the Chure, bhabar and Nepal tarai. Lower catchment consists of parts of the basin in India. Shortly after it originates in the hills, the river flows over *bhabar* and the upper tarai. The main stem of the Rohini has a total length of 122 km. Of this total length, 43 km lies in Nepal and the rest is in India. Along with its tributaries from Nepal and Uttar Pradesh, the Rohini joins the West Rapti River near Gorakhpur. The drainage area of the river in the plains of both Nepal and Uttar Pradesh overlaps with that of the Tinau (the Kuda) in the west and the Gandak in the east. The Rohini has a catchment area of 2,686 km², of which 794 km² (30 per cent) is in Nepal. Of its area in Nepal, 505 km² is in Nawalparasi and 289 km² in Rupandehi districts. Rohini river system and its tributaries drain almost all of the tarai of Parasi.

From the Chure hills, the Rohini flows over the *bhabar*, this is a stretch of land, composed of poorly sorted, boulders, stones, and gravel and sand deposits. It is between 5 and 10 kilometres wide and runs along the foothill. The *bhabar* forms the transition between the end of the Gangetic plain in the north and the hills. As the rivers and its tributaries flow south, their slope reduces and they begin meandering. At the Nepal-India border the number reduces to ten. At the head region the catchment of the Rohini is about 50 km wide and the highest altitude here is 850 m. above msl. At the Nepal-India border the elevation reduces to about 103 metres, which further decreases to 70 metres at Nausadh near Gorakhpur. At the foothills of the Chure is 350 m above msl. From north to south Rohini region can be divided into five zones; Chure (Siwalik), bhabar, upper tarai, middle tarai and the lower tarai. In the foothills and *bhabar* in Nepal, the tributary streams of the Rohini number about 30. Both its

upper and lower regions are prone to flooding. Sediment deposition is higher in the upper reaches even though slope is high because in the upper sections, bulk of the sediment is derived from mass wasting, and the sediments in large size ranges like cobbles and pebbles. Smaller sized sediment move downstream along with river flow. The lower reaches get sediment from upstream sections as well as erosion of bed and banks. With cessation of the rainfall, flow velocity reduces and sediment begins to deposit in the riverbed and flood plains. Wash and finer suspended loads are transferred further downstream. In the lower reaches the stream gradient is less than 0.1 (Kolavalli, undated). As a result, the effects of floods events are severe and can be devastating.

In the lower tarai, land systems are classified as *kachhar*, *majhar* and *doab* depending on the impact of flooding and the land profile. *Kachhar* land remains submerged in the monsoon, where kharif crop is not cultivated. Though floods inundate land every year, they cause no serious damage to settlements. The majority of the land of the middle and lower region falls under this category. *Majhar* lies between forest and river, where the risk of flooding is high every year. The *doab* lies between two rivers. *Kachhar* experiences regular floods, inundation and water logging where socially and economically backward communities live.

2.2 Food System Characterization

The food system characterization incorporates the concept of Food utilization (Nutritional Value, social value and food safety), food access (affordability allocation and preference) and food availability production distribution and exchange).

Many countries experience perpetual food shortages and distribution problems. These result in chronic and often widespread hunger amongst significant numbers of people. Human populations respond to chronic hunger and malnutrition by decreasing body size, known in medical terms

as [stunting](#) or stunted growth. It leads to higher infant and child mortality, but at rates far lower than during famines. Once stunting has occurred, improved nutritional intake later in life cannot reverse the damage. Stunting itself is viewed as a coping mechanism, designed to bring body size into alignment with the calories available during adulthood in the location where the child is born. Limiting body size as a way of adapting to low levels of energy (calories) adversely affects health.

As the [Nobel Prize](#)-winning economist [Amartya Sen](#) has observed “there is no such thing as an apolitical food problem.” While drought and other naturally occurring events may trigger famine conditions, it is government action or inaction that determines its severity, and often even whether or not a famine will occur. The 20th century is full of examples of governments undermining the food.

ESSP Report No. 2 explains "Food Systems are a set of dynamic interactions between and within the biophysical and human environments that result in the production, processing, distribution, preparation and consumption of food. They encompass i) food availability (with elements related to production, distribution and exchange); ii) food access (with elements related to affordability, allocation and preference); and iii) food utilization (with elements related to nutritional value, social value and food safety)."

When governments compromise security of their own nations – sometimes intentionally, come to power by force or rigged [elections](#), and not by way of fair and open elections, their base of support is often narrow and built upon [cronyism](#) and [patronage](#). Under such conditions “The distribution of food within a country is a political issue. Governments in most countries give priority to urban areas, since that is where the most influential and powerful families and enterprises are usually located. The government often neglects subsistence farmers and rural areas in general. The more

remote and underdeveloped the area the less likely the government will be to effectively meet its needs. Many agrarian policies, especially the pricing of agricultural commodities, discriminate against rural areas. Governments often keep prices of basic grains at such artificially low levels that subsistence producers can not accumulate enough capital to make investments to improve their production. Thus, they are effectively prevented from getting out of their precarious situation (Cuny, 1999)".

There are many economic approaches advocated to improve food security in developing countries. Conventional thinking in westernized countries is that maximizing the farmers profit is the surest way of maximizing agricultural production; the higher a farmer's profit, the greater the effort that will be forthcoming, and the greater the risk the farmer is willing to take. This view holds that it is the governments job to place into the hands of farmers the largest number and highest quality tools possible (tools is used here to refer to improved production techniques, improved seeds, secure land tenure, accurate weather forecasts, etc.) However, it is left to the individual farmer to pick and choose which tools to use, and how to use them, as farmers have intimate knowledge of their own land and local conditions.

An alternative view takes a collective approach to achieve food security. It notes that globally enough food is produced to feed the entire world population at a level adequate to ensure that everyone can be free of hunger and fear of starvation. That no one should live without enough food because of economic constraints or social inequalities is the basic goal. This approach is often referred to as [Food Justice](#) and views food security as a basic [human right](#). It advocates fairer distribution of food, particularly grain crops, as a means of ending [chronic hunger](#) and [malnutrition](#). The core of the Food Justice movement is the belief that what is lacking

is not food, but the political will to fairly distribute food regardless of the recipient's ability to pay.

A third approach is known as [Food Sovereignty](#); though it overlaps with Food Justice on several points, the two are not identical. It views the business practices of multinational corporations as a form of [neocolonialism](#). It contends that multinational corporations have the financial resources available to buy up the agricultural resources of impoverished nations, particularly in the tropics. They also have the political clout to convert these resources to the exclusive production of [cash crops](#) for sale to [industrialized nations](#) outside of the [tropics](#), and in the process to squeeze the poor off of the more productive lands. Under this view [subsistence farmers](#) are left to cultivate only lands that are as marginal in terms of productivity as to be of no interest to the multinational corporations. It advocates banning the production of most cash crops in developing nations, thereby leaving the local farmers to concentrate on subsistence crops. In addition it opposes allowing low-cost subsidized food from industrialized nations into developing countries, what is referred to as "import dumping".

World Food Summit 13-17 November 1996 states "The Rome Declaration on World Food Security and the World Food Summit Plan of Action lay the foundations for diverse paths to a common objective - food security, at the individual, household, national, regional and global levels. Food security exists when all people, at all times, 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. In this regard, concerted action at all levels is required. Each nation must adopt a strategy consistent with its resources and capacities to achieve its individual goals and, at the same time, cooperate regionally and internationally in order to organize collective solutions to global issues of food security. In a world of increasingly interlinked institutions, societies

and economies, coordinated efforts and shared responsibilities are essential Rome."

"Food system around the world reveals the frame work of 'globalization'. There is a brisk and growing trade in foodstuffs supplying affluent urban population in exotic, high-value and all-season food is supplied through global sourcing. Yet only about 20 percent of the world's six billion people participate in the cash or consumer credit economy and about 90 percent of the world's food consumption occurs in the country in which it is produced. While urbanites depend on the market for almost all their food consumption, rural population consumes 60 percent of the food they produce. In other words, there is a discrepancy between the image and affluent experience of globalization and global reality. But it is this very discrepancy that drives the politics of globalization (V Lal and Ashish Nandy, 2005)."

2.3 Food Security

"Food security is underpinned by food systems. Food security is the state achieved when food system operate such that "all people, at all times, 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)."

"The number of people without enough to eat on a regular basis remains stubbornly high, at over 800 million, and is not falling significantly. Over 60% of the world's undernourished people live in Asia, and a quarter in Africa. The proportion of people who are hungry, however, is greater in Africa (33%) than Asia (16%). The latest FAO figures indicate that there are 22 countries, 16 of which are in Africa, in which the undernourishment prevalence rate is over 35%." - Food and Agriculture Organization (FAO). Food security defined as " When all people at all times have both physical and economic access to sufficient food to meet their dietary needs in order to lead a healthy and productive life" USAID.

World Vision Africa define as "Food security is the ability of households sustainably meet their own food needs"

Food security historically referred to scales, regional, national and global scale food supply and shortfalls in supply in compared to requirements with increased observation of disparities in the sufficiency of intake by certain groups despite overall adequacy of supply, the term has recently been considered at local, household and individual level (Foster 1992) and broadened beyond notions of supply include access (Sen 1981), vulnerability (Watts and Bohle 1993) and sustainability (Chambers 1989). Major components of the most common definitions of food security are summed up by Maxwell and Frankenberger as " secure access at all time to sufficient food for a healthy life (1992, p.8). First, the household is the logical, social unit through which to view the queation of access to food inspite of intra household inequalities in the distribution of food (Bently and Pelto 1991). This demand not only knowledge of overall household needs and consumption, but also an understanding of intra household dynamics affecting procurement and distribution of food. Second, household food security should be considered a necessary, but not sufficient conditions for adequate nutrition. Stated differently, food security at the household or even individual level is an "input", not an "outcome"- hence the distinction between food security and nutrition security (Babu and Pinstруп-Anderson 1994; Haddad, Kennedy and Sullivan 1994). Third, food security must be understood in terms of the rationality and logic of the persons or social units involved. Acquiring food and provision of adequate nutrition are among the most basic of human pursuits. Human beings are not simply passive victims of either adequate or inadequate nutrition (de Garine 1972).

CHAPTER 3: METHODOLOGY

3.1 Population

The total number of population is 1,753,265 within the total households 289,128 in 2001 population census. Average household size is about 6.06 and the average population density is 333 per square kilometer. Rupandehi, has the highest population density of 521 persons per square kilometer compared to the other two districts. Household sizes in Nawalparasi and Rupandehi have been gradually decreasing, whereas in Kapilvastu it is increasing over the years (CBS, 2004). Male to female ratio is 1:0.97 and overall literacy rate is 48 percent.

3.2 Sample Size and Selection technique

A total of 303 households were surveyed. There are two municipalities in Runpadehi and one each in the other two districts. VDCs were selected on the basis of their proximity to the highways and urban areas. The households were selected using multistage sampling technique. In Kapilvastu district, Somdih and Bhalubari VDCs were selected. Betkuiya and Makrahar VDCs were selected in Rupandehi district. In Nawalparasi, Rampur Khadauna and Jamuniya selected. Two municipalities are located along the highway and the other two are away from the East-West highway. Selection of Village Development Committee (VDC) was based on the distance from city centers or main highway. 30 households from each VDC and municipality were interviewed. Selection of the houses was done randomly taking every tenth house for survey.

3.3 Research Design

Both exploratory and descriptive methods were used in the study. The study employed direct survey to solicit details on food system, economic activities, income level and sources, and means of livelihood. Both rural and urban areas of the RTB basin were purposively selected to capture distinct characteristics in the RTB basin. From east to west, the plain of

Tarai varies considerably in terms of availability of water, population pressure, flood and disaster problems, demographic composition, development indices and potentials for economic growth. For the proposed study of food system we have selected the Western Tarai.

3.4 Nature of Data

The study employs both the primary and secondary sources of data. The primary data was collected with the already structured questionnaires that were asked to the people in the study area with the above mentioned approaches and methods. Both the quantitative and qualitative methods have been used in this study. Similarly, the secondary data has been employed to review the study area and the concept of the food system characterization and the status of the people living in the River Basin so as to give an input to the study of the food system characterization of the people living in the Rohini, Tinau and Banganga rivers Basin.

3.5 Tools and Techniques of Collection of Data

Standard PRA tools such as Focus Group Discussions (FGD), Key Informant (KI) survey and household surveys were used to collect information. Gender role in labor distribution and ownership of the property were determined by holding separate discussions with women. FGD were held at each site to collect qualitative information on market, transportation, institutions, cropping pattern, and so on. Semi-structured questionnaire was administered on selected households. , 20 FGDs were held and 10 key informants were interviewed. Gender role was discussed in 10 separate groups. A field crew of 20 individuals including 5 women carried out the activities in fifteen days. The crew was given orientation and training on the objective of the study particularly on the food system to distinguish it from agriculture production and socioeconomic condition.

3.6 Analysis of Data

SPSS programme was used to tabulate and analyse the data collected. Upon completion of the entry they were combined and output tables were developed. I maintained communication between data processor and the field crew throughout the period to ensure consistency. The collected data were tabulated and studied so as to reach the conclusion on the objectives of the study.

CHAPTER 4: GENERAL FEATURES OF STUDY AREA

4.1 Location and Physical characteristics of selected study area

This region within 82°36' to 84° 23' east longitude and 27°18' to 27°48' north latitude covers an area of 5,260 square kilometer. Drained by (RTB) Rohini, Tinau, and Banganga rivers and their smaller tributaries, RTB straddles the districts of Rupandehi, Kapilbastu and Nawalparasi. While the former two are within Tarai, Nawalparasi has hills, valley and Tarai land types. The RTB basin encompasses only the Tarai part of the district. The RTB basin has three distinct geographical zones: the Siwalik, the bhabhar and the Tarai. More than 60 percent of the RTB is occupied by plain, while the Siwalik occupies about 33 per cent and about 6 percent is occupied by mid hills (Table1). The basin is continuation of the Ganga plain to the north and its average north-south width is about 40 km.

Table 1: Geographic area and distribution (Number in parenthesis is percent of total land area)

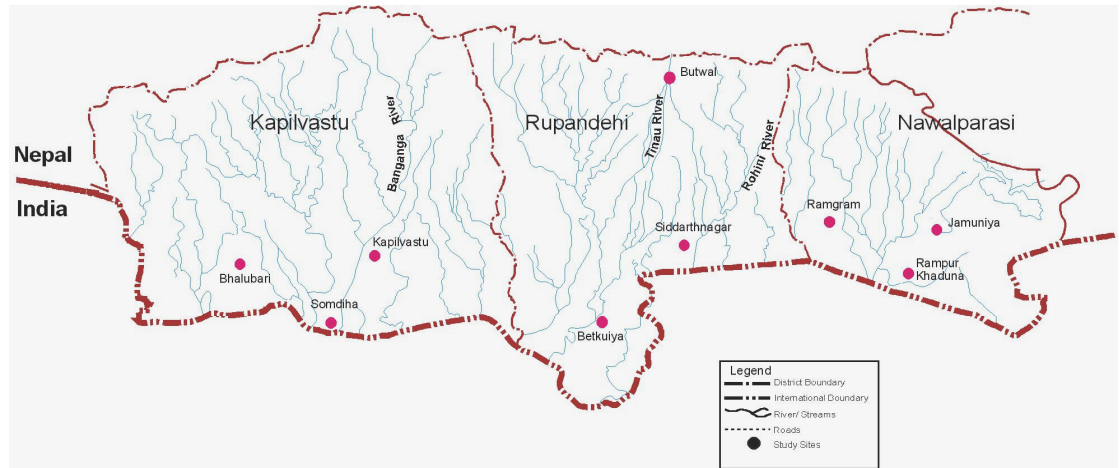
Area (km ²)	Elevation (m amsl)	Mid mountains in ha	Chure in ha	Tarai in ha
5260	91 - 1936	32757 (6.53%)	172251(33.21%)	312543(60.26%)

Source: NIDI, 2006.

4.2 Rivers and tributaries

The area has a high density of rivers and streams (Map 1). Major rivers flowing through the area are Tinau, Rohini, Banganga, Jharahee, Dhanewa, and other smaller tributaries. Except the Tinau, all rivers originate in the Chure range. The Tinau originates in the mid mountains in the adjoining district of Palpa in the north. The mean annual discharge in Banganga, Tinau, and Rohini rivers in Nepal are 15, 24, and 22 m³/s respectively.

Map 1: Map of RTB basin and study sites



4.3 Landuse

Landuse is broadly categorized into agriculture, forest, grassland and others. About 50 percent of the area is occupied by agriculture while almost 44 percent is forest. Most of the forests are found in the Chure range. Grassland and other types such as rivers, flood plains, settlements, wetlands, and eroded areas occupy about 5 percent of the area. Landuse distribution within districts show that Rupandehi has less forests than the other two districts (Table 2)

Table 2: Landuse distribution

Agriculture		Forest		Grassland		Others	
Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
261903	50.4	232060	44.7	6244	1.2	18941	3.6

Source: Source: NIDI, 2006

4.4 Soil type

About 40 percent of the land has loamy soil. Clayey soil is present in about 20 percent of the land. Sandy soil covers about 14 percent of the area. Clay loam and silty soils are present in small areas only (Table 3). About 32,000 hectares of cultivated land is yet to be surveyed for soil type.

Table 3: Broad soil type of agriculture land

Sandy		Loamy		Silty		Clayey		Clay Loam	
<i>Area (ha)</i>	<i>(%)</i>	<i>Area (ha)</i>	<i>(%)</i>	<i>Area (ha)</i>	<i>(%)</i>	<i>Area (ha)</i>	<i>(%)</i>	<i>Area (ha)</i>	<i>(%)</i>
30,244	14.61	81,822	39.53	7,452	3.6	41,023	19.82	9,254	4.47

Source: Source: NIDI, 2006

4.5 Rainfall and temperature

The basin receives monsoon as well as winter rains. More than 86 per cent of the annual rainfall occurs in the monsoon between July and September. Cloudbursts are regular in the later stages of the monsoon. Rainfall along the foothills is higher than the southern plains. Winter rainfall occurs in December and January. Pre-monsoon rains are active after March and are accompanied by strong winds and hailstorms.

Even within the small region of RTB rainfall shows high annual variability. The district of Nawalparasi receives an average annual rainfall of about 2317 mm, which decreases to about 1868 mm in Rupandehi and increases again to about 1950 mm in Kapilvastu. The rainfall intensity varies considerably (Table 8). The intra-basin variations among individual rainstorms are significant. This is true of both monthly and annual rainfall. The striking point about local variation is that the monthly rainfall is higher at foothill areas than in the south.

Maximum average temperature in the basin is around 30 degrees Celsius. Average minimum temperature is about 18 degrees Celsius. On an average about 225 days have maximum temperature of 30 or more degrees Celsius (Table 4). Fog is common in the winter months long enough to damage potato and wheat. Relative humidity ranges from about 50 per cent in the pre-monsoon months to about 70 per cent in the monsoon and winter months.

Table 4: Average rainfall and temperature (1991 – 2000)

Average temperature (^o C)		No of days with <i>Max</i> ≥ 30	Average annual rainfall mm	Maximum rainfall intensity in 24 hours	No of rainy days
Max	Min				
30.9	18.5	226	2045	82 – 269	87

Source: DHM (1991-2000)

4.6 Environment and Ecology

The basin has numerous ecologically sensitive wetlands. In the Rohini basin alone, about 25 per cent of the area is recognized as ecologically sensitive wetlands. However, encroachment and deforestation of the past few decades have adversely affected them. Till the 1960s the region was under dense malarial jungles, called '*chaar kose jhadi*'. In past 40 years forest land in the Tarai has steadily decreased due to encroachment by settlers from the hills, immigrants from India and political refugees. From 1979 to 1991 about 8,400 ha of forest was cleared in Nawalparasi District alone.

4.7 Water sources

Groundwater is the major source of water in RTB basin. The groundwater aquifers of the northern Ganga plains are recharged from the *bhabar*; however, the actual amount of recharge is un-assessed. Aquifer recharge along the base of the Siwalik Hills is high and groundwater flows towards

the south. The large number of ponds and wetland while providing some flood cushions also contribute to groundwater recharge.

The groundwater table varies seasonally. The static water tables of the groundwater aquifers normally lie between 3 to 10 m below the ground surface. Following the onset of the monsoon, the water table begins to rise, and continues to do so throughout monsoon. When the monsoon is over, the water level starts to decline. In the *bhabar* region, the water table is deep.

4.8 Hydrology and Floods

The run off volume in July is less than that in August though the amount of rainfall in July is higher. The reason for discrepancy is saturation of land, as monsoon rains fill the storage. The result is that subsequently almost the entire rain turns into surface run off, which in turn lead to higher discharges, leading to erosion and sedimentation.

Landslides, mass wasting and debris flow are sources of sediment, as is the erosion of the beds and banks of rivers. Many times cloudbursts trigger landslides, which is common in the Siwalik. Sediment deposition is higher in the upper reaches even though slope is high because in the upper sections, bulk of the sediment is derived from mass wasting, and the sediments in large size ranges like cobbles and pebbles. Smaller sized sediment move downstream along with river flow. The lower reaches get sediment from upstream sections as well as erosion of bed and banks. With cessation of the rainfall, flow velocity reduces and sediment begins to deposit in the riverbed and flood plains.

4.9 Pollution and Degradation

Pollution is an emerging problem. The main sources of pollution are the effluent discharged by industries and wastes from municipalities. For

example, the sugar factory at Sunawal in Nawalparasi district disposes effluent into the Jharahi River a tributary of the Rohini. The Tinau also faces pollution from liquor industry. Because of the low discharge in dry seasons the extent of pollution is high till monsoon rains augment flow and flush out the wastes. Some times the effect of pollution is seen in the lower reaches but this depends on the location of the pollution sources. Wastes from municipalities are other sources of pollution. Lower regions of the basin face water logging. Migration and urbanisation introduce new forms of stress to water sources. The region is source of high volume of export of stones and pebbles to the neighboring state of Uttar Pradesh. The export is source of revenue for the District Development Committees (DDCs).

4.10 Demography

The 2001 population census of the districts is given in Table 7. Rupandehi, has the highest population density of 521 persons per square kilometer compared to the other two districts. The average population density is of 333 persons per square kilometer. The household size is about 6.06. Household sizes in Nawalparasi and Rupandehi have been gradually decreasing, whereas in Kapilvastu it is increasing over the years (CBS, 2004).

Table 5: Area and population as of 2001

Area (Sq.km.)	Population density	Household number	Household size	Male	Female	Total population
5,260	333	289,128	6.06	886,905	866,360	1,753,265

Source: CBS, 2004

Male to female ratio is 1:0.97 and overall literacy rate is 48 percent. However, literacy rate in Rupandehi is more than 62 percent but that of Kapilvastu at 35.8 percent is much lower. Per capita income of the people is US \$ 232 (NIDI, 2006). Nawalparasi (For the whole district and not

just Tarai part of it) has more female than male, which is just opposite in Kapilvastu. The difference in sex ratio and the per capita income is manifested in the overall poverty index (Table 12), where Kapilvastu district is seen to be poor in all indicators.

4.11 Agriculture

The soil, climate and rainfall in RTB are favorable for agricultural activities. The region is extensively cultivated. About 91 percent of the agricultural land is cultivated (table 6). About 60 percent of the cultivated area is irrigated. Irrigated land is higher in Nawalparasi and Rupandehi but less in Kapilvastu District. Farming in the unirrigated land is dependent on rainfall. When monsoon is late or inadequate food production suffers substantially. Primary source of irrigation water comes from groundwater; however, information on the depletion of groundwater level is anecdotal.

Table 6: Cultivation and irrigation

Cultivation				Irrigation			
Cultivated Area		Non Cultivated		Irrigated Area		Unirrigated Area	
Hectares	%	Hectares	%	Hectares	%	Hectares	%
238305	91	23598	9	144114	60	94191	40

Source: CBS, 2004

Though, irrigation systems cover 60% of the farms, functioning of many systems is poor. The Gandak canal is a case in point. Water flow in the canal is erratic because the head work is managed by Government of Bihar and the canal system is poorly managed. In the rainy season, the canals bring obstruct flood water and cause inundation. In both situations food production suffers.

4.12 Landholding

A large number of population (about 42 percent) own less than 0.5 hectares of land while about 30 percent own more than one hectares. About 25 percent own between 0.5 and 1 hectare (Table 7). This distribution of landholding indicates that nearly 90 thousand households live on the food produced from 0.5 hectare or less land. Taking general productivity of the land in to consideration one can suggest that a single household in the lower bracket of the landholding sustains on 1500 kg of paddy and about 1000 kg of wheat or maize.

Table 7: Land holding by holding size

Holding size (ha)	Total households	Percent of hh
< 0.1	16690	7.4
0.1 to <0.2	22591	10
0.2 to < 0.5	57962	25.8
0.5 to <1	58095	25.8
1 to < 2	46272	20.6
2 to < 3	14155	5.86
3 and above	9654	4.3

Source: CBS, 2004

4.13 Livestock

In 2003/04, the livestock density in RTB was about 1.75 livestock unit per household. Both improved and local breeds of buffalo are common. Families also raise sheep, goat, and pigs (Table 8). There is significant number of poultry including ducks.

Table 8: Livestock per household (2003/04)

Type of animal	Cattle	Buffalo	Sheep	Goat	Pig
Total number	432625	26036	17241	331953	23678
LSU	389363	26036	3448	82988	4735

Source: MOAC, 2005

(PS: Cattle = 0.9, buffalo = 1, sheep = 0.2, goat = 0.25, pig = 0.2; Total LSU = 506570; Total household = 289128; Total Livestock Unit per household = 1.75)

4.14 Crop productivity

The area under cereals and pulses has changes from year to year and so does their productivity. An average of both area and productivity between 1991 and 2004 is taken to calculate productivity. In case of sugarcane, the highest figure for area under it is taken because this area gradually expanded after 2000 and covered 35,000 hectares. It also indicates the potential of growing sugarcane if conditions are favorable. The sugarcane farming is influenced by government policy, market. It is preferred as an insurance against paddy which is likely to get damaged by recurrent floods.

Table 9: Average yield of major crops for 2000- 2004 (Area in hectares, yield in kg per hectare)

Paddy		Maize		Wheat		Oil seed		Sugarcane		Pulses	
Area	Yield	Area	Yield	Area	Yield	Area	Yield	Area	Yield	Area	Yield
187619	2701	10497	1818	71515	2080	16574	685	16083	41287	26520	640

Source: MOSC, 2005.

Table 10: Average area and productivity of pulses for 2000- 2004 (Area in hectares and productivity in kg per hectare)

Lentil		Chick pea		Pigeon pea		B. gram		Grass pea		H. gram		Soybean		Others	
Area	Yield	Area	Yield	Area	Yield	Area	Yield	Area	Yield	Area	Yield	Area	Yield	Area	Yield
13760	615	2702	662	4950	672	660	562	1760	493	327	521	703	712	1537	688

Source: MOSC 2005

4.15 Drinking water

RTB basin is well covered by drinking water supply systems. About 80% of the households are served by hand pumps drawing water from shallow aquifers (Table 11). But, the region's groundwater contains high level of arsenic contamination. About 15 percent of the tested wells in Nawalparasi have been found to contain more than 50 ppb of arsenic.

Table 11: Source of drinking water

Source of drinking water								
Water Source	All sources	Tap/pipe	Well	Tube well	Spout water	River/stream	Others	Unstated
Total HHs	289128	139744	15731	119125	3158	1068	7901	2409
Percent		48.3	5.4	41.2	1.1	0.4	2.7	0.8

Source: NIDI, 2006

4.16 Poverty and empowerment indices

Poverty and empowerment indices of the three districts are listed in tables 17 and 18. From the human poverty indices point of view, Rupandehi lies between Nawalparasi and Kapilvastu. Kapilvastu appears poorer than Nawalparasi in many respects. Infant mortality, for example, is above 60 percent and chronic malnourishment among children under 5 years of age is more than 65 per cent in Kapilvastu. The figures for Nawalparasi are 55 and 51. Similarly, houses with radio, telephone connection, electricity, access to institutional credit is lower for Kapilvastu than for the other two districts.

Table 12: Human poverty index

District	Without access to safe water (%)	Adult literacy (15+) (%)	Infant mortality (per '000)	Chronic malnourishment (%)	With access to sanitation (%)
Nawalparasi	17.97	53.1	55.35	51.9	32.03
Rupandehi	3.71	46.9	35.43	50.4	34.74
Kapilvastu	19.21	35.8	60.74	65.1	13.03

Source: NIDI, 2006

Table 13: Empowerment index

District	HH with radio	HH with telephone	Electrified HH	Access to credit	Labor in non-agriculture jobs
Nawalparasi	40.08	0.99	38.45	36.69	28.11
Rupandehi	43.84	6.33	42.57	28.14	37.45
Kapilvastu	35.00	0.82	18.61	19.80	23.97

Source: NIDI, 2006

Although, we did not intend to compare food system between the districts, poverty and empowerment indices were helpful in verifying information from the field.

About 66.5 percent of the households in the study area is dependent on agriculture. 10.6 percent depend upon business (of which two third are in municipalities). Almost the same percentage is dependent on service (more than four fifth of this is in the municipalities). A small number of people (1.33 per cent) work in industry as source of livelihood. About 10 percent of the households depend on other sources such as wage labor etc (Table 14).

Table 14: Major source of livelihood (%hh)

Total HHs	Major source of Livelihood				
	Agriculture	Business	Service	Industry	Others (Labors)
303	66.6	10.6	11.6	1.3	9.97

Source: Field survey, 2007

Within agriculture, some households carry only crop farming, while some raise livestock only. Others families have poultry as their source of income. Some households have combination of farm and livestock or livestock and poultry (Table 15).

Table 15: Household having agriculture land, livestock, and poultry (%hh)

Households having							
Only			Land and livestock	Land and poultry	Livestock and poultry	All three	None of three
Land	Livestock	Poultry					
13.3	2.7	0.8	37.8	2	1.3	25.3	16.9

Source: NIDI, 2006

Some households also operate non agricultural activities. About 21 percent of the households are engaged in some kind of non-agriculture activities, of which about 16.9 percent have no agricultural resources.

Table 16 gives an indication of households involved in nonagricultural activities.

Table 16: Household operating small scale non-agriculture activities (%hh)

District	Having economic activities	Type of activities				
		Manufacturing	Trade business	Transport	Services	Others
Nawalparasi	20851	1526	6452	610	7886	5077
Rupandehi	25464	1169	9088	1136	7592	6479
Kapilvastu	15984	784	4202	336	4053	5709
	21	5.6	31.7	3.3	31.4	27.7

Source: NIDI, 2006

CHAPTER 5: ANALYSIS AND INTERPRETATION OF DATA

5.1 Major crops grown

Paddy is the major crops grown in the RTB basin. About 98 percent of the households grow paddy as major crop followed by wheat and maize (Table 17). Millet is grown by negligible number of households.

Table 17: Major crop grown (% hh)

Total HHs	Major crop				
303	Paddy	Maize	Wheat	Millet	Other
	98	0.5	1.5	Negligible	

Source: Field survey, 2007

5.2 Land preparation

Land preparation is mainly done by using oxen. About a third of the household reported that they use tractor. Labor comes mostly from family members (Table 18). There is overlap in use of ox and human labor. As a result, the total exceeds 100 percent.

Table 18: Land preparation

Total HHs	Land ploughed by (% hh)		
303	Ox	Tractor	Family labor
	52.7	30.5	16.8

Source: Field survey, 2007

5.3 Choice of seeds

About 53 percent farmers prefer both local and hybrid seeds. About 22 percent households prefer only hybrid seeds and about 24 percent prefers only local seed (table 19). The choice was voluntary.

Table 19: Seed preferences (% hh)

Total HHs	Seeds preference (% hh)		
303	Local	Hybrid	Both
	24.3	22.6	53.2

Source: Field survey, 2007

Majority of households use hybrid seeds purchased from sources other than government outlets. About 81 percent farmers get hybrid seeds from other sources. Only about 18 percent farmers get it from Agriculture Input Corporation (AIC) or cooperatives (Table 20).

Table 20: Source of hybrid seeds

Total HHs	Bought hybrid seeds from (% hh)		
	Cooperative	AIC	Other (Including India)
303	7	11.3	81.7

Source: Field survey, 2007

Sources of hybrid seeds are numerous. Not all 'hybrid seeds' sold in market centers are genuine. There is a risk for those using only hybrid seeds. Farmer's use of the seeds is also determined by cost. Those using local and hybrid seeds are at a lesser risk because of the cost and susceptibility of such seeds to diseases, lack of irrigation and so on.

About 31 percent farmers maintain seeds storage at home whereas some households purchase local seeds. About 25 percent farmers purchase local seeds in the market while about 42 percent store seed at home and also buy from the market (table 21).

Table 21: Managing local seeds (%hh)

Total HHs	Local seeds management		
	Purchase upon need	Store at home	Both
303	25.4	31.7	42.9

Source: Field survey, 2007

Table 22 shows methods of storing seeds. A large number of farmers use traditional method of storage. They do not use any insecticide.

Table 22: Storage of major seeds at home (%hh)

Total HHs	Crop	Traditional storage %	Modern storage %	Use of insecticide %	
				Yes	No
303	Paddy	97	3	37	63
	Wheat	98	2	54	46
	Maize	100	-	-	100
	Potato	89	11	7	93
	Other seeds	100	-	30	70

Source: Field survey, 2007

5.4 Fertilizer use

According to the government sources use of chemical fertilizer in the RTB basin is higher in comparison to other regions of the Tarai. The survey showed that about 17 percent farmers use only chemical fertilizer. About 79 percent of the farmers use both compost as well as chemical fertilizer. A small percentage (about 3.8) of the household cannot afford to buy chemical fertilizers and are dependent on compost fertilizer (Table 23). Farmers with large holdings cannot afford to use compost and rely on chemical fertilizers.

Table 23: Use of fertilizer (%hh)

Total HHs	Fertilizers		
	Compost	Chemical	Both
303	3.8	16.9	79.2

Source: Field survey, 2007

Chemical fertilizers are purchased from various sources. The AIC distributes substantial amount of fertilizer, though it did not seem popular among the farmers surveyed. Only about 7.7 percent households confirmed that they buy fertilizer from AIC and another 10 percent from cooperatives. A large number of the households (about 81.6 percent) buy chemical fertilizers from other sources, which include local traders in Nepal as well as in India (Table 24). It must be pointed out that though fertilizer from these other sources are available in time and are widely used, quality may not be reliable.

Table 24: Source of fertilizer (%hh)

Total HHs	Source of fertilizer		
	Cooperative	AIC	Other
303	10.7	7.7	81.6

Source: Field survey, 2007

5.5 Farm labor

Farm labor for different activities is met by family members. About 46 percent use only family members as farm labor. About 15.8 percent of the households have access to hired labors. About 26 percent use both hired labor and family members. There is also tradition of using *perma*, which means sharing of labor. About 11 percent farmers practice *perma* (Table 25).

Table 25: Farm labor availability (%hh)

Total HHs	Source of labors			
303	Family	Laborer	Family and laborer	Parma
	12.3	15.8	26.4	11.3

Source: Field survey, 2007

5.6 Use of technology

Traditional methods of farming are common. About 89 percent said that they do not use improved techniques of farming. Only about 10 percent farmers use modern methods of farming. These farmers live in village as well as in municipal area (Table 26). Farmers are very critical of lack of technical support from agricultural agencies.

Table 26: Use of improved technique of farming

Total HHs	Yes	No
303	10.7	89.3

Source: Field survey, 2007

About 37 percent of the households use tractors and 52 percent use ox to plough land. Nine percent of farmers don't use tractor or ox but their muscle power to plough land (Table 27).

Table 27: Farm power

Total HHs	Land preparation		
303	Ox	Tractor	Muscle
	52%	37%	9%

Source: Field survey, 2007

5.7 Crop productivity

Crop productivity shows a declining trend in some cases and increasing in others. Those who use improved techniques use adequate fertilizer or get water for irrigation mention that productivity has increased in the last five years. About 16.6 percent households found their crop productivity increasing over the period. Forty six percent households reported that their production has declined in the same period. About 37.4 percent households found no change in the production level (Table 28).

Table 28: Production trend of major crops (%hh)

Total HHs	Production in last five years		
303	Decreasing	Increasing	Same
	46	16.6	37.4

Source: Field survey, 2007

Farmers have experienced rise and fall in production of different crops. Only a small percentage of households have found rising production of paddy, wheat, maize, pulses and vegetables (Table 29).

Table 29: Crop-wise production trend (%hh)

Total HHs	Paddy		Wheat		Maize		Pulses		Vegetables	
	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up
303	74.8	25.2	77	23	90	10	83.6	16.4	80	20

Source: Field survey, 2007

There are different perceptions as to why productivity has declined. About 30.9 percent of the farmers believe that production has declined mainly due to shortage of irrigation water. About 16 percent opine that lack of fertilizer is the main reason. About 12.6 percent of the households reported that poor soil quality is the reason for lower production (Table 30).

Table 30: Reason for decrease in production

Total HHs	Poor soil quality	Poor irrigation	Scarce fertilizer	Disease	Poor seed quality	Other
303	12.6	30.9	16.4	28	5.3	6.8

Source: Field survey, 2007

Households provided the reasons for increasing trend in production. Half of those who reported increasing trend (16 percent) reported that uses of hybrid seed increased production (Table 49). About 28 percent households Fertilizer as a reason was reported by. Only 21 percent households felt that access to irrigation raised production (Table 31).

Table 31: Reason for increase in production

Total HHs	Hybrid seed	Enough fertilizer	Proper irrigation	Other
303	40	28	21.3	10.7

Source: Field survey, 2007

5.8 Tenancy

About 40 percent of the households are tenants: they do not own the land they cultivate. This factor does not encourage them to invest in land for achieving better productivity. Though the input is poor farmers are able to produce food because about 89.3 percent of the land falls under *Abal* (good quality) class.

5.9 Processing and packaging

Processing and packaging is not significant, because use of processed food is not common in the RTB basin. Rice is processed and polished at the mills. Table 40 shows number of food processing industries in the basin. The number of industries indicates that a large quantity of food is processed and exported. Processing of other food is not common. Fruits, vegetable, and pulses are sold without processing. Packaging of food varies according to food and its transportation. Processed rice is packed in jute or plastic bags for storage and distribution. Jute bags are used for local distribution. For long-distance transportation, jute bags lined with plastic sheets are used. Vegetables are usually transported in bamboo baskets or jute bags. Baskets keep the vegetables fresh for longer time but

it is difficult to handle. Jute bags get warm in transportation and vegetables do not remain fresh. However, jute bags are easy to handle and are popular means of packing vegetables. Local newspaper report that some unscrupulous individuals add chemical to keep vegetables fresh, but this is anecdotal. Potato and onion are always transported in jute bags.

Table 32: Food processing industries

Districts	No of mills and industries	Remarks
Nawalparasi	31	These industries include Rice processing, oil and flour mills, biscuits, noodles, <i>dal</i> , tea, <i>daltho</i> , bread and bakery, etc
Rupandehi	90	
Kapilvastu	7	

Source: NIDI, 2006

Rice is processed before it brought to the market. Use of traditional *dhiki* has declined. If at all used, it is done during festivals. Wheat is turned into wheat flour at the local flour mills. Large mill owners make their own arrangement of purchasing grains and wheat. The products from the mills are exported to other parts of the country. A small fraction of the processed food goes back to the villages.

5.10 Distribution and retail

Various kinds of transport systems are common. Bicycle, carts, *ladia*, *rikshaw*, jeeps, and trucks are used for transporting food. Bicycle and carts are commonly used in the villages. Most village roads are operational except during the rainy season.

Only about 10 percent of the households reported that bullock carts in operation. The total number of carts among 300 households was only 31. However, almost two third of the households has oxen, which means that the 300 households have a total of 215 bulls. Twenty-six households own tractors as majority of the people cannot purchase or maintain carts and tractors. Instead, they hire tractors as and when needed. The rent amount varies from village to village.

Table 33: Payment mode (%hh)

Tools	Number of respondent	Cash			Number of respondent	Kind	
		Immediately	Credit	Both		Immediately	Credit
Cart	10	90%	10%		12	100%	
Tractor	137	85%	12%	3%	13	8%	92%

Source: Field survey, 2007

In use of both tractor and cart the rent is paid in kind. Tractors are also used for preparing land. In this case payment in kind is made after a crop is harvested. When carts are hired, the rent again in kind, is paid immediately. Cart owners cannot wait until the crop is harvested.

Local markets exist at village as well as at the district levels. Most farmers prefer to sell their products at the local market. The scale of the market determines the amount sold (Table 34). Markets in RTB basin are not as organized as *mundis* across the border in India.

Table 34: market to sale food

Food	Food sold (mt) in		Total amount sold last year
	Local market	Market out side the district including India	
Cereals	4534	130	4664
Vegetable	63.5	2.7	66.2
Fruits	86	Nominal	86
Ghiu, oil	16.55	0	16.55

Source: Field survey, 2007

Well developed market centers exist within a range of 10 and 20 kilometers from the villages. Small shops sell essential commodities in small quantities are located within a kilometer of the villages. For selling rice farmers go to developed markets but the price is fixed by the traders. Lack of information and compulsion to use available transport systems force many farmers to sell their produce at the price fixed by the traders. Their choice is limited.

Farmers also import food. A substantial amount of food is imported from India. About 38 percent of cereal, same percent of pulses, about 48

percent of fruits, and more than half of the imported *ghiu* and oil comes from India (Table 35).

Table 35: Import of food in the villages

Food	Food purchased (mt) from		Total quantity purchased last year
	Local market	Market out side the district including India	
Cereals	1120	713 (38%)	1833
Vegetable	1156	764 (39.8%)	1920
Fruits	161	150 (48.2%)	311
Ghiu, oil	112	122 (52%)	234

Source: Field survey, 2007

5.11 Trade pattern

Trade pattern is guided by local needs, presence of traders, and time of harvest. Marketing for cereals, pulses, and sugarcane is mostly done by traders from outside the area. Vegetables and fruits are usually traded by local traders and villagers.

5.12 Government policy

Nepal government has no policy on trading of food. In the past food could not be exported from one district to the other. This arrangement has waned following the political impasse that began as the politics in Nepal has become more polarized. Had the political situation been normal, restriction would still be in place because more and more families report food shortages. Nepal Food Corporation (NFC) has its outlet and distributes food at a regulated price. The NFC was established to distribute food to those unable to afford to buy food at the market price and by doing the aim was to regulate market price. FNC has not been effective in controlling the food price, particularly the seasonal variation.

5.13 Consumption

5.13.1 Food preparation

There is no special way of food preparation. Households cook food with spices and oil. Boiled food is not common. Households cook main food

two times a day. Unlike urban areas where storing food in refrigerator is emerging, food is fresh cooked in rural areas. Some households keep leftovers from the morning and use it as snacks for the children. Hygienic condition in the kitchen demands improvements. There are rooms for improving hygiene conditions especially in food storage. Vegetables are stored in open. Cleaning of vegetables is done as a ritual rather than for hygienic quality. Rice and leftovers are stored in a pot closed with a lid but may not necessarily keep the food from getting contaminated. There is a tradition of eating processed food (*bhujiya*) for snacks. Storing *bhujiya* and similar food in the rainy season is difficult due to high humidity.

5.13.2 Price of food

Price is a major determinant of food consumption. Households also import food from India. Usually traders fix the prices. Indian market provide cushion to regulate the price. As far as preference is concerned people tend to sell good quality rice and buy low-cost rice of inferior quality. It is one of the local strategies of meeting food requirements by selling good quality food for a better price.

5.14 Diseases

Health status is crucial in consumption and intake of nutrition. Arsenic has emerged as one of the major contaminant in the RTB basin. About 6% of the population reported skin disease caused by arsenic in water. Abdominal pain and gastritis are also common. Though, people visit hospitals with various ailments, no other serious disease is reported. Jaundice, meningitis, and cholera outbreak is occasional. The respondents did not see diseases as a major problem (Table 36).

Table 36: Disease record

Population	OPD	Skin	ARI	Ear	Eyes	Urinary	Bronchitis	Gastritis	Pyrexia	Injuries	Abdominal Pain	Tooth
1,753,265	596,610	103,500	54,474	26,210	18,957	9,478	24,782	32,498	39,551	12,093	16,372	12,212
percent	34.0	5.9	3.1	1.5	1.1	0.5	1.4	1.9	2.3	0.7	0.9	0.7

Source: NIDI, 2006

5.15 Culture/tradition

The RTB basin has three distinct regions where population composition differs. In Nawalparasi, the population is by and large mixture of both hill and Tarai origin. This mixed composition has given rise to a different culture than that of Kapilvastu where people of Tarai origin and Muslims dominate. In Rupandehi also has mixed. In the north live migrants from the hills while the south has predominance of people of Tarai origin. No particular differences in food consumption were reported.

5.16 Source of food

All households produce food in their farms, however, the quantity of food produced is not sufficient for all households to meet their food requirements. About 54% of the households lack sufficient food to feed the family. They meet the shortfall by purchasing food from the market or by borrowing from neighbors. The percentage of population who borrow is about one percent. Vegetables have become increasingly popular as a source of cash. About 82 percent farmers grow vegetables to earn cash income. Farmers have begun to grow sugarcane too. Currently, about 16 percent farmers grow sugarcane on a commercial basis. A little over one percent farmer grows other cash crops such as oil seeds and pulses.

5.17 Food sufficiency

About 54% of the households do not produce enough rice to meet their needs (Table 37). They rely on imported rice and wheat. This figure corresponds with the data given by the Ministry of Agriculture and Cooperatives (MOAC), which suggests that about 55 percent of the

farmers face food deficit. But data differs substantially in terms of the period (shown in tables 37 and 38) for which the deficit lasts.

Table 37: Food sufficiency

Total HHs	Just enough	Not enough	More than enough
303	26.5	54.1	19.4

Source: Field survey, 2007

Household production lasts for different periods for different respondents. About 35 percent of the households face food deficit for more than 10 months. Another 31 percent face food shortage for 4-6 months, about 16 percent lack food for 1-3 months. More households have moved to the category of food deficit for more than 10 months. The government data reports 18 percent of the household are in this category but our survey showed that the percentage has increased to 35 percent.

Table 38: Insufficiency period (% hh)

Total HHs	Months			
	1-3	4-6	7-9	10-12
303	15.9	31.7	17.1	35.4

Source: Field survey, 2007

Table 39: Food balance from district level information

Household		Period of insufficiency			
Sufficient	Insufficient	1-3 m	4-6 m	7-9 m	10-12 m
44.34	55.66	22.12	43.45	15.3	18.96

Source: CBS, 2004

Only about 19.5 percent of the people make surplus production (Table 37). Most of (about 78 percent) sell the surplus. About 21.8 percent store the surplus (Table 40)

Table 40: Storing or selling surplus food (%hh)

Total HHs	Surplus food	
	Stored at home	Sold in the market
303	21.8	78.4

Source: Field survey, 2007

Of the 78 percent households, which sell the surplus, about 26 percent sell it in the neighborhood and about 35 percent take their produce to markets outside the village (Table 41).

Table 41: Place for selling surplus food (%hh)

Total HHs	Place of sale			
303	Neighborhood	Local Market	Big market	Other (traders)
	26	13.7	35.6	24.7

Source: Field survey, 2007

There is another category of farmers who sell food even if they don't have surplus. About 3.51 percent of the farmers sell part of the food produced immediately after harvest. About 11.31 percent sell some and store some.

Table 42: Sale of food by food-deficit farmers (%hh)

Total HHs	Farmers' activities		
303	Sale	Store	Both
	3.51	85.15	11.32

Source: Field survey, 2007

Out of 237 households reporting shortage or just enough food, 40 households (about 17%) reported that they sale food produced immediately after harvests. There are various reasons for this. Out of 40 households, 22 households (about 55%) prefer to be on safe side by selling food. This strategy implies that food is sold when the market is accessible due to presence of the traders in the village. The prices are also set. When the traders leave the village the opportunity is lost and farmers cannot turn food into cash. Only about 20 percent of the 40 households sold their produce to pay debt. About 10 percent households sell their produce because of lack of storage facility. Another 15 percent households assume they get good price for their products during the time of harvest (Table 43).

Table 43: Reason for selling immediately

HHs reporting immediate sale	Reasons for selling			
	Pay debt	Lack of storage	Good market price	To be on the safe side
40	20%	10%	15%	55%

Source: Field survey, 2007

Pulses production

Very small number of farmers produces enough pulses for their consumption. More than 79 percent did not produce enough pulses (Table 44). Unlike cereals, pulses are mainly purchased from local market and not from the neighborhood. About a third of the households purchase pulses from big markets outside the villages (Table 45).

Table 44: Household producing enough pulses for consumption

	Yes	No	Total
HH	58	226	284
%	20.4	79.6	

Source: Field survey, 2007

Table 45: Source of buying pulses (%hh)

Total HHs	Pulses market		
	Neighborhood	Local Market	Big Market
303	3.8	62.3	33.9

Source: Field survey, 2007

Vegetables

About 68 percent of the households eat potato as vegetable, 30 percent eat green vegetable regularly, and about 1.7percent eat preserved vegetable (*gundruk, maseura*). Only about 9.7 percent produce their own vegetable, while about 32 percent depend on market located in local areas (Tables 46 and 47).

Table 46: Consumption of vegetable (%hh)

Total HHs	Green vegetables	Preserved vegetables (<i>Gundruk, Masuera</i>)	Others (potato etc)
303	30.1	1.7	68.2

Source: Field survey, 2007

Table 47: Source of vegetable (%hh)

Total HHs	Own farm	Market	Both
303	9.7	32.4	57.9

Source: Field survey, 2007

Vegetables market

Households prefer to buy vegetable from local markets. A small number of households buy vegetable in the neighborhoods (Table 48).

Table 48: Location of vegetable market (%hh)

Total HHs	Neighborhood	Local Market	Other (vendors)
303	2.9	88.9	8.2

Source: Field survey, 2007

Ghiu and oil

Ghiu and oil are very important part of the food system. Irrespective of their economic status, households use *ghiu* and oil in their food. However, only about 20 percent people produce enough oil and *ghiu* to meet needs. About 50 percent do not produce *ghiu* or oil. About 30 percent people said that they produce some *ghiu* and oil and they buy the rest (Table 49).

Table 49: Source of *Ghiu* and mustard oil (%hh)

Total HHs	Own production	Market	Both
303	19.5	50.2	30.3

Source: Field survey, 2007

Households who produce *ghiu* and oil (about 94 percent) consume the produce themselves. Only 6 percent of the people sell *ghiu* and oil (Table 51). Selling of *ghiu* and oil is (about 70 percent) done at the village. Only

about 10 percent of the households go to outside market to sell *ghiu* and oil.

Table 50: Households selling *ghiu* and mustard oil

	HH not selling	HH selling
Total HH	158	10
%	94	6

Source: Field survey, 2007

Table 51: Market place to sell *Ghiu* and mustard oil (%hh)

Total HHs	Village	Local Market	Big Market	Other
10	70	10	20	

Source: Field survey, 2007

Most of the households (64 percent) buy *ghiu* and oil in the local market and 30 percent go to larger market to buy (table 52). Households prefer to go to outside market to sell and buy locally. Though difficult to explain, the incentive to larger market for selling is to good return. For household consumption a small quantity would be required as local market is sufficient.

Table 52: *Ghiu* and mustard oil market (purchase)

Village	Local Market	Big Market
5.7	64.1	30.2

Source: Field survey, 2007

Pricing of food

The price of the food produced in RTB basin is affected by the market in India. While all major cost of production is dependent on the input price based on the market in Nepal, the values of produced goods are settled by the Indian market because lower price of food across the border is a powerful force. The outcome is due t firstly, the agriculture policy in India supporting zero tariff irrigation facility where as farmers in Nepal pay. Thus production cost in India becomes lower than that in Nepal. The difference in exchange rate of Nepali and India is the second reason.

Control over production

Farmers have control over food. As mentioned earlier many households need to get rid of the food produced to be on the safe side. This implies several things: loosing food to insects and pests, fire, theft, and the hassle of storing them for longer time. Also selling food immediately allows farmers to get the market price when buyers are at the door step. It is a social cushion that the buyers provide to the farmers rather than the modern markets that operate on economic theories. When farmers are forced by circumstances to sell the products they seem to have less control over their own produce.

Transportation

Transportation is available during dry season in all villages. Cart is the most common artifact in rural areas. In the municipalities trucks and jeeps are used. Trucks and jeeps move to rural areas during the dry season. Road in the villages become wet and vehicular movement declines after the rainy season begins, when carts become the source of transportation. When a road collapses or become muddy and rivers begin to swell even carts cannot operate. In such circumstances porters are the only means of transportation. Unlike in the hills, storage in the villages is difficult because most houses are single storied and are prone to damages by flood. Incidentally rainy season is also a period of food shortages (Table 53).

Table 53: Road density

District	Road density (km/100 km ²)		Electrified village/municipality	Telephone connection (2062)	Credit institutions (banks)
	Seasonal	Annual			
Nawalparasi	5.04	6.5	45	4200	9
Rupandehi	10.88	11.2	54	21642	12
Kapilvastu	10.82	8.51	50	2136	8

Source: NIDI, 2006

Storage of food

Grains and pulses are stored in traditional storage systems made of homemade insecticides for paddy and wheat (Table 54). Insects and pests are a common problem when storing food. About 47 percent farmers reported that hybrid seeds are more prone to pests than local varieties. About 21 percent farmers found insect pests a problem even in local varieties. About 30 percent farmers said it is a problem for both local and hybrid varieties. When pests attack crops, most farmers use some control measures. About 85 percent farmers buy insecticides from the market. About 7 percent farmers seek suggestion from neighbors. Nearly 6 percent farmers consult government agriculture officer. About 1.8 percent farmers do nothing.

Table 54: Storage of grains, pulses and potato

Crop	Traditional storage %	Modern storage %	Use of insecticide %		
			Home made	Chemical market	from
Paddy	98	2	66	34	
Wheat	97	3	53	47	
Maize	94	1	1	-	
Millet	100	-	-	-	
B. gram	95	5	5	-	
Lentil	96	4	6.5	10	
Arhar	93	8	8	4	
H.gram	100	-	-	-	
Others	100	-	7	12	
Potato	99	1	3	-	
Onion	98	2	2	2	

Source: Field survey, 2007

Table 55: Land rendered uncultivable due to flood and erosion

Holdings	Area (ha)	Land made uncultivable due to flood/soil erosion	
		No. of holdings reporting	Area (ha)
224,420	206,978	19,297	4,896
		8.6	2.4

Source: CBS, 2004

Exchange

All those having food shortage depend on purchased food and only about 1.2 percent of the households burrow during the period of shortage. Those buying from the market have differential market access. About 23 percent buy it locally in the neighborhood (limited choice and low level of competition). Forty one percent responded that they buy it from local markets close to villages (availability of choice and competitive price). Only 36 percent people said that they go to bigger market centers where big traders are involved in food supply.

About 80 percent households purchase some pulses from the market as their own production is not sufficient. About 62 percent of those buying pulses buy them in the local markets. The rest 33 percent go to bigger market. A small number of people buy pulses in the villages.

Money to buy food comes from various sources. Wage labor which accounts for more than 52 percent, is the major source. About 29 percent of the people make earning from some kind of services. A few (about 1.91 percent) earn money by selling their own produces. Only about 1.27 burrows from money lenders. About 14 percent have other options of earning including remittance.

Farmers go to different places to sell food. About 26 percent, which also includes (about one third) from the municipalities sell food in the neighborhood. These are small farmers with little to sell. About 13 percent people (all from villages) go to local market. About 35 percent go to bigger markets. This percentage includes about a fifth of the farmers from municipalities. About 24 percent people sell produces in other places including selling directly to mills.

Making food available

Those not having enough food buy it in the market or burrow from the neighbor. About 98 percent household with food deficit purchase and only 1.2 percent burrow (Table 56).

Table 56: Making food available (%hh)

Purchase	Burrow
98.8	1.2

Source: Field survey, 2007

Table 57: Buying place

	Neighborhood	Local Market	Big Market	Total HH
HH	37	66	58	161
%	23	41	36	

Source: Field survey, 2007

Table 58: Source of cash income to buy food (%hh)

Production income	Wage labor	Service	Burrow	Other
1.9	52.9	29.9	1.3	14

Source: Field survey, 2007

Table 59: Coping strategy as indicated by government information

Food deficit household	Coping strategy				
	Burrowing	Meeting food with wage earning			Others
		Within district	Outside district	Outside Nepal	
124,909	9,242	90,727	11,301	13,063	8,808
55.66 %	7.4%	72.63%	9.05%	10.46%	7.05%

Source: CBS, 2004

Exchange determinants

About 88 percent of the households buy vegetables in the local market. Only about 3 percent buy it in the neighborhood. As mentioned earlier about 54 percent people do not produce enough food because either people have limited land or large family size. About 44 percent people have limited land and another 20 percent have large family. Improving availability of fertilizer and improved seeds is not going to help a large number of people to produce enough food for themselves. Because only about 7 percent farmers said that they could produce enough had they

enough fertilizer, and 2.9 percent could produce enough if they had reliable source of good seeds. Quality of land is not a major issue because only about 4 percent people said that their land has low productivity.

Table 60: Annual income through cash crop (Rs. Per year)

Statistics	Sugarcane	Vegetable	Tobacco	Other cash crops
Average	32441	3386	3540	3156
Mode	20000	1000	3540	8000
Minimum	250	1	3540	250
Maximum	225000	30000	3540	8000

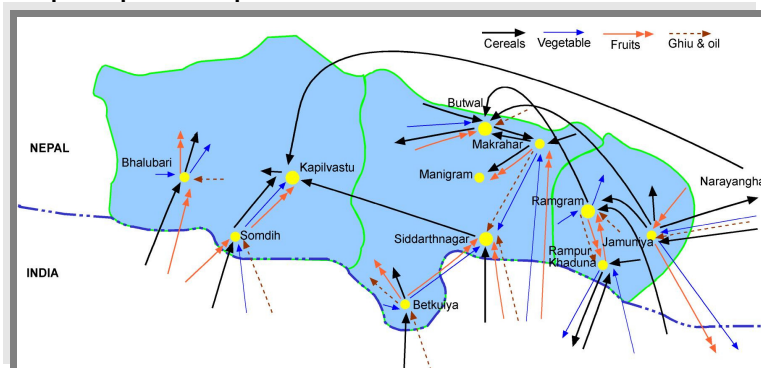
Source: Field survey, 2007

Table 61: Export import of food (mt)

Particular	Import into the area from			Export from the area to			Remarks
	Total	Local market	India	Total	Local market	India	
Cereals	1833	1120	713 (38%)	4664	4534	130 (2.8%)	49.5 mt of pulses imported from India, 4.5 mt exported to India.
Vegetable	1920.5	1156.5	764 (39.8%)	66.2	63.5	2.7(4%)	
Fruits	311.05	160.8	150.25(48.2%)	86	86	Nominal	
Ghiu/tel	234.94	112.24	122.7 (52%)	16.5	16.55	0	

Source: Field survey, 2007

Map 2: Export and import trend



In each study site there is the trend of importing and exporting food. All sites along the border import food from India. Some sites also export to India, but the volume of export is lower than import. Map 4 shows a web of export and import trends. Kapilvastu imports cereals from Siddharthnagar as well as from Narayanghat in central Nepal.

Preference

Green vegetable is not common and about 68 percent people mostly eat potato and onion as vegetable. Only about 30 percent people said that they often eat green vegetable. About 1.73 percent people mostly eat preserved vegetable such as *gundruk* and *maseura*. Thirty two percent people did not grow their vegetable. They are in village as well as in the municipalities. They always buy it from the market. About 9 percent people grow their own vegetable. Even in municipalities they grow vegetable though their number is very small (about 31 percent). About 68 percent people do both i.e. grow some and buy some.

Table 62: Fruit consumption (%hh)

Total HHs	Fruit consumption pattern				
303	Daily	Weekly	Once in 15 days	Sick Period	Festival
	6.2	30	37.6	11.7	14.5

Source: Field survey, 2007

Eating fruit is common. About 67 percent people eat fruits either weekly or every fortnight. About 6 percent people eat fruits daily. About a fourth of the population (26 percent) eat fruits only when they are sick or during the festivals.

CHAPTER 6: SUMMARY and CONCLUSION

We have categorized significance by comparing all selected determinants for specific activity. The following description of significance is applicable only for the specified activity.

6.1 Production

Six determinants were found to be critically important for production.

1. Adopted technology: In the RTB basin farmers still practice traditional method of farming and improved technology is not in use
2. Source of seeds: A large number of farmers buy seeds (including local seeds) from different sources. Public sources such as government corporations and cooperatives are used by small number of farmers. They are not reliable.
3. Fertilizer sources: Many times, fertilizer bought from such sources are of inferior quality.
4. Land holding sizes:
5. Labor availability: Many farmers either use their family members as labor or exchange labor with neighbors.
6. Cropping cycle: it is important, many farmers grow only one crops a year due to lack of inputs and poor irrigation.

Highly important determinant:

- Many farmers have experienced decline in the food production whereas a small number of farmers experience increase in production. Declining production is critical for production.
- Many farmers have to sale their produce even if they do not have enough produce for consumption. The reasons are many but most striking were paying debt, lack of storage

facility, and easy access to market when buyers are in the village. Other inputs such as seeds, irrigation water, and land size also came under this category.

- It must be pointed out that access to fertilizer is not a problem. The problem is timely availability and quality of the fertilizer.

6.2 Distribution

Four determinants were found to be highly important for distribution.

1. Infrastructure (mainly roads): it is the most critical determinant for distribution. The existing road density of 10 km per 100 square kilometer is concentrated around the municipalities. Many remote villages either don't have the road or only earthen road.
2. Governance was another major critical factor because systematic way of distributing food has a role. Distribution takes place in the informal way by traders.
3. Public safety nets for food storages or distribution does not exist in Nepal. NFC go-downs distribute the corporation's own food distribution and not accessible to other suppliers.
4. Transportation is a critical determinant for rural areas where trucks and big vehicles cannot operate. Distribution in the rural areas is done either by bullock carts or small jeeps and porters. During the monsoon season transportation is largely restricted to municipalities.

Highly important determinant:

- Storage facility for distribution is highly important. Many households store food in traditional storage even though loss is high. Very few households have modern storage facilities. Due to problem of storage, many farmers sell food immediately after the harvest.

- Two determinants are moderately important: food deficiency period and post harvesting processing. About 54 percent of the households do not have enough food produced for consumption. Again, linking this determinant with 'declining trend' under production activity, in future, it can be assumed that more households may report food shortage. Post harvesting processing is another determinant found important because many farmers sale food without any processing. When stored, though in a limited scale, food is dried in the sun and cleaned before storing. Mill owners add value by processing. Mill processing is sometimes debilitating.
- In case of sugarcane for example, farmers have to wait for many days to register sugarcane at the mill. When that is done the weight of the sugarcane reduces and farmers lose.

6.3 Exchange

Only two determinants are critically important for food exchange: subsidies and informal social arrangements. There is no subsidy policy for food except when the food is distributed by NFC. But this distribution occupies a small part of food exchange. Subsidy provided to farmers in India has an impact on the food price in Nepal, which also affects exchange capacity of the Nepali farmers. Similarly, informal social arrangement is critically important because there is no mechanism as social arrangement for food exchange. Occasionally farmers burrow food from neighbors but the quantity is small.

Highly important determinant:

- Seven determinants are highly important. They include migration, income level, purchasing power, currency value, market and local customs of gifts. Purchasing *ghiu* and mustard oil is also highly

important. Most of the farmers did not produce sufficient food at home and migrate in search of livelihood. They use the income to buy food. Migration has enabled them to buy food even though their own production is inadequate. There is, however, diversity in income sources. Besides agriculture many farmers have other sources of income. Livestock, poultry, and cottage industry are alternate sources of income. In municipalities production of service provides substantial income. However, the income level of many households is not very high. About 40 percent of the households earn less than Rupees 50,000 a year. About 14 percent households (mostly from municipalities) earn more than Rupees 200,000 a year. Similarly, purchasing power is low to medium for about 85 percent of the households. Currency value plays a significant role in exchange of food. The exchange rate of 1.6 to Indian rupees discourages farmers to export food to India. Only about 4 percent being exported. The cheaper food in India is one of the reasons for import of 40 percent of the food. Market is thus highly important factor. Most transactions on food takes place in the rural markets. Gifting food is not common in the municipalities but exist to some extent in the rural areas.

6.4 Affordability

We have used six determinants leading to affordability.

1. Of the six determinants, pricing policy and annual income were found to be critically important.
2. There is no policy to set food prices, which is by and large set by market forces and often by traders. Farmers seldom have control over the price of what they sale.
3. The ability to afford to buy food depends on a household's willingness to pay in the market. This in turn depends on annual

income level which is another critical factor. Annual income of about 40 percent households is less than Rs 50,000 a year which is barely enough to buy required food items.

4. Mode of payment (in kind) was a highly important determinant.
5. Similarly, seasonal variation is equally important because for four monsoon months food prices are high. Prices are critical in remote villages where transportation is restricted to porters and or bicycles.
6. Livelihood source is diverse in the region and therefore was seen to be low important to affordability because 66 percent households depend on agriculture for livelihood whereas 22 percent have business or service as livelihood source. A small population has other sources. Diverse livelihood sources do not, however, translate into diverse income sources.

6.5 Allocation

Government policy and political capital were critically important because there is no government policy for food allocation. Political capital is also not conducive to allocation of food. In absence of policy food allocation depends on market or households own production. With current political situation the nature of future government is uncertain. If a government, dominated by communist ideology, comes to power it may impose policy barring export of certain food items. If a liberal government or a combination of different ideology takes power, food allocation probably will remain as it is and will not change. Political capital on the other hand is unlikely to improve because of diverse ideology and no one able to dominate. Partisan politics at the rural level divide people ideological grounds which contribute to weak political capital.

Highly important determinant:

- There are five determinants fall under highly important category. Social capital is one. Traditional social capital is eroding and new

is yet to emerge. In about 60 percent of the households especially in the remote villages social capital has eroded in the last decade. In the municipalities new arrangements based on trade and business is emerging. Food sufficiency was highly important determinant. The reason is straightforward because over 54 percent of the households lack sufficient food. They have to find food or cash to buy food from other sources. Cash income source within the village is not easily available. People move out for cash income. But not all can go outside the village and therefore are important in allocating food to meet their need. Source of vegetable, oil, and *ghiu* is important because about 50 percent of the most farmers buy this food rather than producing themselves.

- Vegetable market and income diversity were seen to be moderately important. A large number of households buy vegetables from market, which makes vegetable consumption low. Members of a small number of households eat green vegetables obtained either from their own production or from market. Most farmers eat potato and onion. From dietary point of view they do not eat required amount of green vegetables. Income diversity was seen as moderately important because only about 25 percent of the households maintain a combination of agriculture, livestock, and poultry as source of income. About 53 percent of the households have only one of the three sources. About 21 percent depends on non-agricultural sources for income.

6.6 Preference

Though rice, maize, and wheat are grown, about 99 percent of the people of RTB basin prefer rice as staple. Paddy is cultivated as major crop by about 98 percent households. Rice production depends upon availability of water and labor. However, rice is also easily damaged by inundation,

sand casting or bank erosion. Lack of water also affects rice. If the first plantation, sowed with the onset of monsoon, is inundated for more than a week, the seedlings die and second plantation would be needed, if seedlings are available. Farmers carry out third plantation if the second plantation is damaged. When the third plantation is damaged by flood, farmers give up plantation. Cereals are critically important. Another critically important determinant is advertising. About 17 percent households have show preference for commercial food for snacks, which has replaced the more nutritious traditional *khaja*.

Highly important determinant:

- Preference of pulses is highly important because only lentil (*museura*) is preferred by 65 percent of the households. Other pulses are exported. Problem with lentil production will affect a large population. Preparation requirement is highly important, too. About 50 percent of the population has some kind of preparations requirement that they must follow. Main food of the day must include combination of rice, lentil and vegetable prepared in a particular way. Use of spices and oil is a must. People do not eat boiled food except potato or tubers during fasting. Seasonal effect on the preferred food is important because food availability and its quality are affected by season. Choice of food reduces during the monsoon because of lack of access to markets and storage facilities. Such outcomes are low in municipalities.
- Preference of fuel for cooking is moderately important. About 81 percent people use firewood and animal dung as fuel. Firewood is made available from forest and farm residues and will not be of a problem. About 15 percent of the people mostly in municipalities use LPG and kerosene. Supply of both depends on external market. Trade relation between Nepal and India usually affects both the

availability and prices of these products, which are also determined by internal politics of the country. The price of LPG and kerosene has increased substantially in the last decade and has forced many people to switch back to firewood.

6.7 Nutritional value

Fuel was critically important for nutritional value because proper cooking depends on the amount of wood available. Firewood and animal dung is used by a large number of people. People collect it themselves. Shortage of firewood can impact what is being cooked and how. Monsoon dampness affects firewood making cooking tedious.

In the RTB basin a large number households grow limited variety (maximum five) of crops. Only less than 4 percent of the households grow about twelve varieties of crops. Since a large number of people have access to a limited varieties of crops nutritional intake is limited.

The quantity of meat consumed is a critical determinant because about 60 percent of the households eat only about 0.25 kg of meat a month. About 10 percent households eat more than 3 kg of meat in one month.

Highly important determinant:

- Meat eating frequency was highly important to nutritional value because only about 20 percent of the households eat meat daily. The remaining 40 percent eat once in a month and another 40 percent eat only during festivals. Similarly education was a high category. We have considered literate and illiterate population for prioritizing. About 48 percent of the population is literate while the rest is illiterate.
- Though arsenic is an emerging problem and many tubewells have been found with contamination beyond permissible limit, access to clean water was only moderately important. About 38 percent households (mostly in municipalities) have piped water supply

system that does not face arsenic contamination. About 46 percent of the population uses other sources of drinking water. These sources are contaminated during the monsoon but are usually safe at other times. About 15 percent of the tubewells are acutely contaminated by arsenic.

- Even with arsenic contamination and moderately important drinking water supply disease incidents are not rampant in the area. Disease incidents are found to be of low significance. About 10 percent of the population is exposed to either skin diseases or some kind of abdominal problem. Diseases such as meningitis and cholera appear sometimes.

6.8 Social value

Food for guests, festivals and high value food are critically important determinants of social value. People regard food for guest valuable and try to make it available even if they themselves lack sufficient food. Same is the case with food for festival. Irrespective of economic or social status of the households they people prepare meat dishes available during the festivals. Fruits are also similarly made. People would burrow money for the purpose and maintain social value of celebrating festivals. On the average people in the RTB basin in a year celebrate about 10 major and about 15 minor festivals. Major festivals like *Dasain* and *Chatth* are celebrated with families' members. Festivals are also time for family reunion. Minor festivals like *Maghe Sankranti* are celebrated with neighbors and near and dear ones. Guests are considered 'God' and *athiti deva bhava* (Treat a guest like a God in common lingo) is a popular saying about guests.

Highly important determinant:

- Families eat together. Maintaining spiritual purity of food is important. Using left hand to eat is considered unholy. Women

(mother or daughter in law) serve the meal and eat after every one in the family has eaten.

6.9 Food safety

Food safety depends on regulation present in production, processing and packaging. Since there no specific regulatory mechanism for production or processing or packaging of food, they are all critical for food safety.

CONCLUSION

About 66.5 per cent households of the study area are dependent on agriculture. Remaining is in business, service and labor activities. Still two-thirds of population is dependent on agriculture. About 98 per cent households grow paddy as major crop followed by wheat and maize. Land preparation is done by animal power. 53 per cent farmers prefer both local and hybrid seeds. Still farmers don't believe and dependent on hybrid seeds. 47 per cent farmers reported that hybrid seeds are more prone to pests than local varieties. Only 22 per cent households prefer hybrid seeds. 18 per cent farmers get hybrid seeds from agriculture input corporation (AIC), it clears that the government's responsibilities towards farmers so negligible. About 31 per cent farmers maintain seeds storage at home. 25 per cent farmers purchase local seeds whereas 42 per cent done both purchase from market and some store at home. Survey fined that 17 per cent farmers use only chemical fertilizers. About 79 per cent use both compost and chemical mixed. A large number of households (82 %) buy from markets of India as well as Nepal. Parma culture (mutual exchange labour) still exists in rural villages. Household members engage predominantly in agriculture practices in Nepal. About 46 per cent households use only family members in their farm activities. About 89 per cent respondent said that they don't use improved techniques of farming. About 37 per cent households use tractors to prepare agriculture

land. 52 per cent farmers use oxen to prepare their farm land. Still 10 per cent are using muscle power to prepare their farm land. Those who use improved techniques use adequate fertilizers and irrigation facilities available and they mentioned that productivity has been increasing since last five years. There are different perception why the productivity declining. 31 per cent said shortage of irrigation facilities. 16 per cent and 13 per cent said respectively lack of fertilizers and poor soil quality. About 40 per cent households are tenants; they don't have ownership of land they cultivate. Bicycle, cycles, ladiya (bullock cart), riksha (three while), tractors, jeep and trucks are used for transporting food. Local markets has main role for exchange food grain and vegetable production. Most farmers prefer to sell their products at local markets. Well developed market centers exist within a range of 10 to 20 km from the village. Lack of information of current prices of the farmers production and transportation cost they sell their products as the traders fixed. Trade pattern is guided by local needs, presence of traders, and time of harvest. Marketing for cereals, pulses and sugarcane is mostly done by traders from out side the villages. Nepal government has no specific policy on food security balance and food pricing and trading. Nepal food corporation (NFC) was established to distribute food to those who are unable to afford food in market price and to regulate market prices too. The FNC has not been effective in controlling the food prices.

Price is a major determinant of food consumption. Indian market provide cushion to regulate the market price. As far as preference is concerned people tend to sell good quality of rice and buy low-cost rice of inferiority quality.

Health status is crucial in consumption and intake of nutrition. Arsenic has emerged as one of the major contamination in the RTB basin. About 6 per cent population reported skin disease caused by arsenic. Abdominal

disease and gastritis are common. All households produce food in their farms, however, the quality of food produced is not sufficient to meet their food requirements. About 54 per cent households lack of sufficient food, they don't produce enough rice to meet their needs. They are dependent on imported rice and wheat. About 35 per cent of households face food deficit for more than 10 months. 31 percent households for 4 to 6 months and 16 per cent households 1 to 3 months faced food shortage. Food storing, packaging and distribution are great issues in RTB basin. Insects and pests problems are common phenomenon.

Out of 237 households reporting shortage or just enough food, 40 households (17%) reported that they sale food produced immediately after harvest. 22 households (about 55%) prefer to be safe side by selling, 20 per cent households sold to pay their debt, and 10 per cent sell due to lack of storage out of 40 households. Unlikely cereals, pulses are mainly purchased from local market but not from the neighborhood. Potato is consumed as main vegetables. 68 per cent households eat potato as vegetable, 30 per cent eat green vegetable regularly. 10 per cent people produce green vegetable for their own consumption whereas 32 per cent depend on local market. Therefore, households prefer to buy vegetable from local markets. 20 per cent people produce enough oil and ghee to meet needs. 50 per cent households completely depend on market for their oil and ghee. Only 6 per cent households sell oil and ghee in the villages. Most of the households about 64 per cent buy ghee and oil in the local market. 30 per cent go to the large market for purchasing ghee and oil. The price of the food produced in RTB basin is affected by the market of India. Major cost of production is dependent on the input price based on the market in Nepal. Indian cheaper prices of food commodity influence whole prices of food commodity in Nepal.

Monsoon season is the most difficult period when food distribution is difficult due to limited transportation. Floods damage road and irrigation canals. Food preparation is very difficult during flooding. Major summer crops such as paddy, sugarcane, pulses, and vegetables are exposed to floods, sand casting, and erosion during the monsoon. Farmers living close to the rivers are more exposed to floods and sand casting. Paddy and lentil are highly valued food in RTB. Paddy is exposed to both floods and lack of rain. Inundation also easily damages paddy. Similarly, lentil is a winter crop and needs adequate irrigation and lack of rain can severely affect production of lentils. Both paddy and lentil are sensitive to water stresses. Damages in rice and lentil will affect a large number of people.

Though primary protein is obtained from pulses and meat is also prime factor which provide sufficient protein. 91 percent households eat meat. About 60 percent of the non-vegetarian population eats about 0.25 kg of meat in a month, which is actually a small quantity. There is a tradition of eating meat, fruits, milk-based sweets, and varieties of breads during the festivals.

In many places of the basin, lack of water for irrigation prevents cultivation of winter crops. In such cases, households use groundwater to irrigate crops, but declining groundwater table is an emerging threat. About 51 percent households expressed that shortage of water has been a major constraint to grow food. Another issue is increasing level of pollution as industries and factories dispose wastes into the rivers.

Price is a result of production cost, transportation, risks involved, extent of damages during storage and transportation, and return on investment. These factors are directly or indirectly affected by the amount of water available for production or the damage caused by floods. Prices of commodities go up during the monsoon season. Foods that can be grown in the region in winter are imported because they cannot be grown due to lack of irrigation water.

Price of imported food goes up during the period of flood and dry season. Price is very sensitive to water stress because if a bridge is washed by flood, prices especially of vegetables and fuel for cooking increase temporarily. But farmers have no control over the mechanics of price and market, which is mostly dominated by external actors. As a strategy people travel to municipalities and urban centers seeking employment and make cash income.

However, in absence of policy for food allocation, food prices fluctuate depending upon the market forces. Food sufficiency is another important determinant in RTB. About 54 percent of the households have food insufficiency for different period. About 45 percent of the households have experienced declining level of production. About fifty percent of the households assume that lack of irrigation water is a major constraint for producing sufficient food. About 99 percent of the households prefer rice as staple food. Water stress affects production of preferred food.

Adopted technology is one of the highly important determinants, because most of the households still practice traditional method of farming. Traditional method of farming is sensitive to water stresses. Lack of irrigation is another threat to about 40 percent of the farmers without any access to irrigation. Some farmers have begun adopting water resistant crops that would reduce the damages due to water stresses. About 50 percent of the households own less than one hectare of land. Damaged by river cutting or sand casting reduces food-producing area. Lack of irrigation restricts farmers from carrying out intensive farming. Small farmers are sensitive to this determinant. As a strategy, some household store food before the stress is felt.

Farmers' sale food immediately after harvest, save money to buy food as and when needed. Stored foods are exposed to insects and fungus. Storing food is very sensitive to water stress. Income is sensitive to water stress. The strategy of farmers is to take advantage with what is available at home and

in the village. The stress remains sensitive to water stress for three months of the rainy season. The strategy of farmers is to make do with what is available at home and in the village.

- About 51 percent households expressed that shortage of water has been a major constraint to grow food.
- Damages in rice and lentil will affect a large number of people because the former is preferred food of 99 percent households while 65 percent households prefer lentil.
- About 54 percent of the households have food insufficiency for different period. If flood damage is taken into consideration the number of households with food shortages goes even higher in some years. About 45 percent of the households have experienced declining level of production. About fifty percent of the households assume that lack of irrigation water is a major constraint for producing sufficient food.
- Lack of irrigation is another threat to about 40 percent of the farmers without no access to irrigation.
- About 50 percent of the households own less than one hectare of land. Damaged by river cutting or sand casting reduces food-producing area.

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