

## PART II F3 Case Study

### From Mustang to Gorakhpur: The Central Himalayan Desakota Corridor

The report has four sections. The first section describes the general features of the study area and its socioeconomic base. The second section deals with the ecosystems and poverty along in the corridor. The third section discusses the ongoing *desakota* phenomenon. At the end of the report we present existing gaps in dealing with poverty and ecosystem services within climate change scenario in the *desakota* region and research questions.

#### Regional Description

The Mustang Gorakhpur corridor extends from the Tibetan Plateau to the Indo Gangetic plain of South Asia. The region varies in altitude of more than 7000 m to less than 100 m in a horizontal distance of less than 150 km. The corridor includes the western development region of Nepal and north Eastern Uttar Pradesh of India. It passes through major physiographic zones of South Asia: the trans Himalayan plateau, high Himalaya, the Midhills, the Chure, *bhabar* and the Tarai (map 1).

The region is home of Annapurna and Dhaulagiri mountain ranges separated by the Kali Gandaki gorge. The Kali Gandaki River flows between the two ranges forming the deepest gorge in the world. About two thirds of the upper part of the corridor falls in Nepal while a third (the lower part) is in Uttar Pradesh. In Nepal, the corridor encompasses a total of fifteen districts. The lower part of the region is northern east Uttar Pradesh and its five districts. The characteristic of the corridor is presented in Table 1.

Map 1: Mustang-Gorakhpur Corridor



In its entirety the corridor represents 18 ecological zones found in the Himalaya from the cold desert to tropical zone and transition zones in between. The ecological services and the social setting and poverty therein are as varied as the physiographic zones themselves. The Tarai is the northern flank of the Indo Gangetic plain. In Nepal the corridor extends from Mustang to Marchawar in the south. Along the corridor, the major and minor impacts of climate change intersect with both the physical and the social dynamics.

Table 1: Characteristics of the corridor

Regions	Geology and soils	Elevation (msl)	Climate	Average Temperature
High Himalaya	Limestone and shale. Physical weathering predominates, stony soils	> 4000	Alpine to arctic	< 0 to 5°C
High mountains	Phyllite, schists, quartzite. Soil is generally shallow and resistant to weathering	2200 - 4000	Cool to sub-alpine	10-15°C
Middle mountains	Phyllite, schists, quartzite, granite, limestone. Stony and coarse textured soil. Conifer forests commonly found associated with quartzite	1000-2500	Temperate	20°C
Chure	Testing mudstone, siltstone, sandstone. Steep slopes and weakly consolidated bedrock. Tends to promote surface erosion despite thick vegetation	200-1500	Moist subtropical	25°C
Bhabar	Boulder region of high recharge zone	150	Humid tropical	> 25°C
Upper Tarai	Sloping, recently deposited alluvium	100	Humid tropical	> 25°C
Lower Tarai	Very gently sloping, recently deposited alluvium	< 100	Humid tropical	> 25°C

Some section of the districts of Mustang and Manang are located in the Tibetan plateau. The district of Nawalparasi straddles the middle hills, the dun and Tarai while ten districts are wholly within the middle hills. Rupandehi and Kapilbastu are the Tarai districts. The Chure (also called Siwalik) runs in an east west direction as the boundary between the district of Kapilbastu and Rupandehi with Arghakhanchi and Palpa districts. The Chure also divides Nawalparasi District. The overlap of physical geography and administrative boundaries of districts are compared in Table 2.

Table 2: Geography and administrative boundary overlaps

Physiographic zone	Trans Himalaya	High Himalaya	Mid hills	Chure	(Bhabar)	Tarai
	Nepal					India
Districts	Mustang	Baglung, Gulmi, Tahanu, Syangja, Parbat, Palpa		Kapilbastu, Rupandehi, Nawalparasi		Maharajgunj, Siddhartha Nagar, Basti, Santa Kabir Nagar
	Manang	Argakhanchi				
		Lamjung, Maygdi				
		Kaski				

Nautanua in Uttar Pradesh is the gateway for Nepalis living in the hinterland districts to the outside world. Since historical time people have used this route to travel to India for trade, employment, medical treatment and pilgrimage. The central part of the corridor was the tradition trade route between Nepal and Tibet.

The economics of the corridor is embedded in larger economy of Nepal and in the South of that of Uttar Pradesh. The contribution of agriculture to Nepal's GDP, however, has declined from 52 percent in 1990 to 42 percent in 2000 and to about 32 percent in 2007. Yet, agriculture continues to provide livelihood to almost 81 percent of the labor force. At the same time, contribution from remittance has increased from less than 1 million US \$ in 1994 to more than 65 million US \$ in 2003. Tourism provides significant foreign exchange earning. In fact with the world class mountain range, the Annapurna trekking circuit and Lumbini the birth place of Lord Buddha is located in this corridor. Both are major tourist attraction. The region houses Nepal's industrial town of Butwal.

In 2000 receipts from tourism amounted to 15 percent of exports but have not increased as did remittance. Declining contribution of agriculture to national economy and rising income from remittance

demonstrate that the country's natural resource base especially ecosystem services for basic services will not be able to support growing population. Those hardest hit by this incongruity will be the poorest section of the population. The five districts in eastern Uttar Pradesh is typical of the region socio and economic context. Large numbers of farming families engaged in both formal as well as informal activities.

## Emerging *Desakota* System

Migration has been a historical process along the corridor. Young and able bodied men from villages along the corridor joined the British army in Colonial India. This trend continues even today as young Nepali men serve in both the Indian and British armies. In the aftermath of 1950 when Nepal began a path to modernization the region saw spurt of investments in development infrastructure; highways, irrigation canal and local water supply systems. Integrated development programmes were implemented in some of the districts in the 1970s and 1980s.

The physical and social contexts of the corridor are undergoing changes as new roads are opening its remote parts including the henceforth secluded region such as Mustang. In Nepal a road connecting Pokhara with Mustang is being built. The district of Mustang is also being connected to Tibet by a motorable road. Road building has increased along the middle hills too and has received boost due to availability of jeeps (Tata Sumo, Trax, Bolero, mini trucks and Chinese micro vans.) is affordable to local investors. The transfer of financial resources by the government to the districts and local governments has also increased local funding basket. Both processes have fuelled incentives for building roads through local initiatives. These interventions will have implications for the region and its ecosystem. Poorly laid and excavated, the roads are sources of erosion, disruption of micro hydrology and increased downstream sedimentation.

Roads have improved mobility while urban centers have emerged as markets for local vegetables and other produces. In some places, farmers have organized themselves in cooperatives to sell the produce. The flip side is unregulated use of chemical fertilizers and pesticides. In many towns and cities disposal of solid and liquid waste is an emerging problem and has implications on the local ecosystem. Disposal of wastewater from towns and expanding settlement is another problem. The problem is serious in the dry season when natural low flow has limited dilution capacity. In addition in the *bhabar* and Tarai of Nepal, river sand mining is a source of revenue for the government as well as livelihood for those in the lower economic rung.

## Existing and Emerging Ecosystems Trends in Region

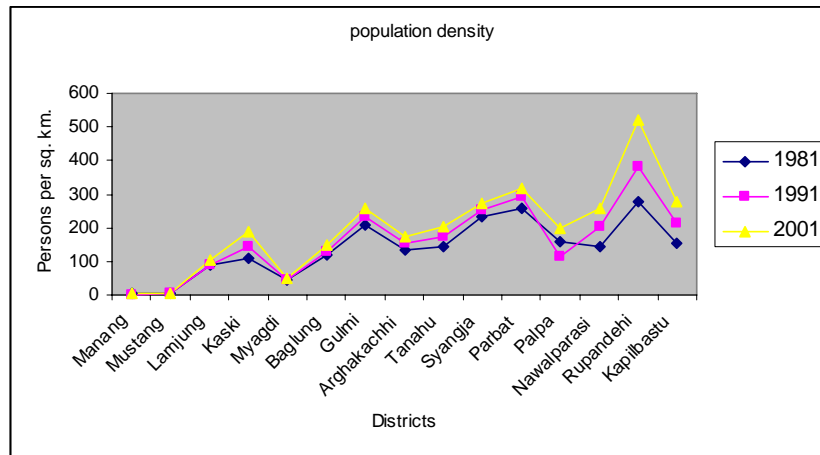
The corridor sustains diverse biotic conditions and multiple ecosystems that nurture about more than 100 ecosystems, 75 vegetations and 35 forest types. These ecosystems support globally known 635 species of butterflies (4.2%), 185 species of fresh water fish (2.2%), 43 species of amphibians (11%), 100 species of reptile (1.5%), 860 species of birds (8.5%) and 181 species of mammals (4.2%) (Bhuju *et al.*, 2007).

## Population and Density

Nepal has one of the highest population growth rates in South Asia and the population of the corridor is a reflection of this trends. In 2001, districts along the corridor had a population 4.3 million growing at a rate of 2.25 percent. The population almost doubled from 2.3 million in 1981 to 4.3 in 2001. The growth rate of population varied between census periods. In most of the districts population growth rate was higher in the 1980s than that in the 1990s. The district of Manang witnessed a negative growth implying that out migration was higher. The districts of the Tarai witnessed a high growth rate in the 1980s. The increase was due to high migration from the hills. Most of the migrants were small holders unable to sustain. Pull factor was important too. This trend declined in the 1990s in all districts, though Manang witnessed a higher increase. One factor contributing to the high growth was due to the return of those involved in foreign trade in the 1980s.

Population density increases as ones move from north to south. Runapdehi district which lies at the center of the corridor in the south has the highest population density of 521 persons per square kilometers. Except in Palpa District in the hills, where the density declined in the 1980s, all other districts show a high rate of increase in population density after 1981. The districts of Kaski, Gulmi, Syangja and Parbat have more than 200 persons per square kilometers. The population density varied from 4 to 521 persons per square kilometers.

## Population Density



## Pressure on cultivated land

Population density is a useful indicator of pressure on agriculture land and by extension to ecosystem services. In the hills land available for cultivation is limited. The pressure population on cultivated land in the central section of the corridor is higher. This region also has major cities and towns. The pressure on cultivated land reduces toward the Tarai plain where vast tract of land is under cultivation. However, while discussing population density, two points need to be considered. First, pressure of population provides a rough indicator of dependency on land. This means the hills have a high population pressure on cultivated land. From this perspective Kaski District has highest pressure on cultivated land. The pressure in the Tarai is comparatively less. Skewed land distribution changes this logic. More than 50% of the household posses less than 0.5 hectares of cultivated land and such population pressure is higher than that indicated by the general figure.

## Livestock population

The cattle population in the last two decades has declined significantly. Much less cattle manure is available since which is no longer an integral part of local livelihood. But buffalo population has increased. This increase implies emergence of dairy as a source of livelihood and selling milk fetches higher income than cows. Similarly, the population of sheep has declined while that of goat has increased goat, which put pressure on forage and grassland but less pressure on water sources, is reared as a source of income.

## Landuse

Landuse is categorized into agriculture, forest, grassland and others. About 25 percent of the area of the districts is occupied by agriculture while almost 30 percent is under forest. Grassland and other types such as rivers, flood plains, settlements, wetlands, and eroded areas occupy about 14 percent. Landuse distribution within the corridor is listed in Table 3.

Table 3 Landuse in the districts

Landuse	Forest	Agriculture		Dry land	Grazing	Others
		Cultivated	Non-cultivated			
Area (km <sup>2</sup> )	8895	5401	2034	3864	4927	4104
Percentage	30%	18.5%	6.9	13%	16%	14%

### **Trend in crop coverage**

The land under maize in the area has increased marginally by about 2% between 1990 and 2003, whereas the production has increased by about 20% and so is the yield (19%). The increasing trend began from 1996 and continued until 2003. In case of rice the area under rice has increased by 9 percent between 1990 and 2003. The production of rice has increased by 21 percent whereas its yield has increased by only 13 percent.

### **Food sufficiency**

There is a distinct food deficiency trend from north to south. High mountains does not experience a remarkable difference between people with high (>50% hhs) and medium (<50% hhs) food deficit, but in the districts of mid mountains where temperature change is between 0.06 to <0.09 degrees centigrade, a large number of households face food shortage for about 6 months but the number of households with longer food deficit are lesser. The trend in the Tarai does not show such a difference, which means number of people with high and medium food deficiency is almost same in Tarai.

The disparity between households having food deficit for 6 months of a year and more than 6 months of a year is substantial in many districts. But there are some districts where the disparity is less. The districts of Maygdi, Tanahu, Parbat and Palpa do not show wide variation but Lamjung, Baglung, Gulmi, Argakhanchi, Syangja, Nawalparasi, Rupandeshi, and Kapilbastu districts have higher disparity. This means in these districts, a large number of households need to look for alternative source of income to survive and as such different sets of economic activities are done.

### **Coping with food deficit**

Households with food deficit use various methods cope with the shortage. They burrow food, or earn income within district, or outside district, or go abroad. The coping method shows a variation according to the location of the district (north, south or middle). People in all districts cope with food shortage by wage earning within district. This trend is followed by people working outside Nepal. Working outside Nepal is high in the middle hills than in the Tarai or high Himal. Very few households tend to work within Nepal but outside their district of abode. Burrowing is common in all districts but the number is higher than those working within Nepal.

### **Conflicts and Poverty**

Conflicts are manifestations of the stress which exists in a given society and reflect the fact that injustice prevails and that the weak and the marginalised suffer. They also reveal differences in the aspirations, hopes, and expectations of two or more people or communities. Conflict highlights the existing power balance and the authority to exercise power, both of which can undermine social relationships in times of stress. In most disputes, there is a feeling that one group has been deprived of rights, dominated by others or lost properties. Disputes over the utilisation of natural resources have been especially prominent as parties with different needs, perception and goals clash. Since the condition of land, forests and water resources and the level of people's access to them govern the livelihoods of many families, the result is disputes of many types. Whether it is in the use or distribution of natural resources, it is the powerful segment of a society with access to knowledge and technologies which benefits at the cost of the weaker segments, which absorb the risks.

There are four main causes of disputes. The first is over data: debates resulting from a lack of information, misinformation, different interpretations or different views of what are relevant. The second cause is called a 'conflict of interest,' in which dispute develop over seemingly incompatible interests. Interests are defined as tangible needs that are satisfied through a resource-sharing process. Value differences generate a third type of dispute which arises when disputants use different criteria for evaluating conflicting outcomes; espouse different lifestyles or goals; or profess different ideologies, religious beliefs or worldviews. The fourth source is the relationship issues which often result from the build up of derogatory expressions, strong emotions, stereotyping, poor communication skills and consistent negative behaviour. Nepal's natural resource system consists of conflicts which are outcome of all four. An in fact the third type, ideological factors was the main factor that intertwined with the context of poverty that gave rise to rural revolt in Nepal in the form of Maoist Violence

Even according to conservative estimate more than 42 percent of the rural households in Nepal live in poverty, which is associated with the changing structure of relations between classes of production, surplus appropriation and domination, economic and political struggle. Poverty and social deprivation in its broader sense - is regarded as a product of underlying social relationships associated with particular form of class struggle (Blaikie, Cameron and Seddon, 1979). The combination of and contradictions among these groups was the driving force of the Nepalese political economy which has resulted in a complex arrangement of diverse social classes and class fractions. The structure of inequality among and within these classes gives rise to oppressive and discriminative relationship among them often resulting in exploitation and conflicts.

Throughout the country's development history, growth rates in both of the agricultural and non-agricultural sectors have remained low, erratic and without a base for sustained growth at a satisfactory rate. The growth rates decelerated rapidly in 1995 due to political instability and bad governance. The neo-classical development approach pursued in the aftermath of 1990s led to the uneven distribution of income and wealth. Inherited property rights kept the society divided between the poor and the rich who enjoyed most of the opportunities and facilities as the economy worked in favor of the urban and rural rich who controlled businesses and industrial activities.

The governmental agencies and their representatives are involved in the distribution of goods and expertise, aimed at the enhancement of production and consumption.<sup>1</sup> But local district offices deliberately create scarcities or delays in provision, deliberately create a gap between state and society though they act as mediators. In most parts of Nepal, the option of acquiring goods and services through market mechanism is lacking. Though Nepal is in the institutionalizing peace process poverty has worsened following the insurgency as access resources and services are still distant as infrastructures have been destroyed during the insurgency.

Seeking job outside the country is the preferred option for the rural youth. Remittance forms the major source of Nepal's income. There are fewer men in the villages engaged in farming. The emerging trend is to invest in real state in the urban areas. Once they leave villages, very few seem to go back to village to operate farming. These dynamics have major implication for poverty alleviation task.

## **RAINFALL DYNAMICS**

Rainfall in the corridor varies from 5,000 mm (south of Annapurna Dhaulagiri range) to 250 mm in Mustang (north of the range). This rainfall is one the highest records in the country. There are more than 50 met stations within the corridor which are mostly concentrated in the central areas. Very few stations are located in the high Himalaya area. Annual rainfall in the last 15 years shows both increasing and decreasing trend. In the eastern part of the corridor rains have generally increased while in the western part of the corridor it has decreased. The record of some stations shows 'no change' in annual rainfall (Map 2).

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<sup>1</sup> For centuries, the state had been extracting goods and money from its subjects through different kinds of revenue collection (Regmi, 1972, 1978).

Map 2 Rainfall in the region



The Kali Gandaki River valley stretches along the North-South while monsoon winds flow from the east to west. The changed rainfall trend somehow follows the Kali Gandaki Valley. But south of the Annapurna range rainfall between altitude 2000-3000 meters has not changed. A similar effect is seen in along Narayani River in Nawalparasi District. This behavior is probably due the effects of the Chure range. The intensity of rainfall corresponds with overall rainfall amount: intensity has increased where annual rainfall shows increasing trend and vice a versa (Table 4).

Table 4: Changes in Rainfall

Station	Rainfall trend (1980-1995)										Annual trend	Intensity trend
	Winter rain					Summer rain						
	Jan	Feb	Mar	Apr	Jul	Aug	Sept	Oct	Nov			
Mustang	+	+	-	-	-	0	-	-	-	0	-	-
Kaski	+	+	+	0	-	-	-	-	-	+	+	+
Il Gurja	+	+	-	0	-	-	-	-	-	+	-	-
Baglung	+	+	+	-	-	+	-	-	-	+	0	0
Tanahu	+	+	-	+	+	+	+	+	-	+	+	+
Syanja	+	-	-	+	+	+	+	+	-	-	+	+
Tatopani	-	+	0	+	-	+	-	-	+	+	0	-

+ = Increased, - = Decreased, 0 = No Change

The local rainfall is highly variable. The precipitation in Kaski, Tanahu, and Syangja districts has increased in a period of 15 years. Baglung and lower parts of Maygdi (Tatopani) district it has remained the same. In upper part of Myagdi (Gurja Khani) rainfall has decreased. Generally rainfall at higher altitudes shows an increasing trend. Irrespective of whether the annual rainfall has increased or decreased, the winter rainfall of January and February in most stations has increased. The pre-monsoon rainfall of March shows a declining trend, whereas rainfall shows mixed trend in April. Wherever, the March and April rain has declined the maize crop in the high altitudes has decreased. Increased rainfall in August results in higher instances of flood and landslides.

## River Systems

The corridor is drained by three types of rivers. The Kali Gandaki, Marsyangdi and Seti rivers, which originate in the high mountains, are snow fed. Their Tributary Rivers originate in the middle mountains and are rain-fed. The snow fed rivers after draining the region flow as Sapta Gandaki River and flow towards the east of the corridor. The lower part of the basin is drained by the Rohani, Tinau and Banaganga and System (RTB). The Tinau originates in the middle mountains, fed by rainfall and has sustained low base flow. Many

smaller ephemeral rivers also flow from the Chure and drain southern part of the corridor in Nepal and India.

Table 5: River Systems

Origin	River	Catchment area (sq. km)	Average Annual Discharge ( m <sup>3</sup> /s)
Trans-Himalaya	Kali Gandaki	11,400	471
High Himal	Marshyangdi	3,850	210
	Seti	582	52
Mahabharat	Tinau	745	
Chure	Banganga		
	Rohini		

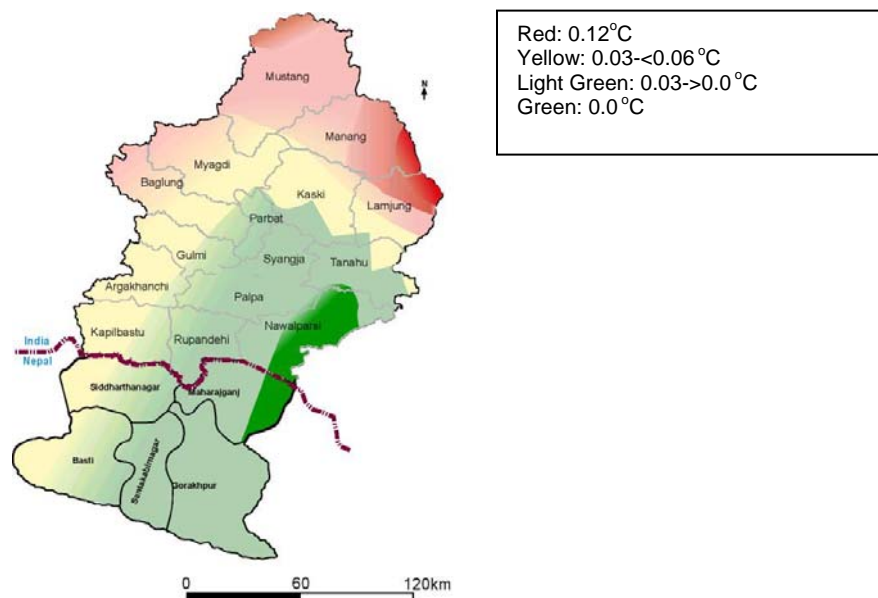
The run off volume in July is less than that in August though the amount of rainfall in July is greater. As a result during these months almost the entire rain turns into surface run off, which in turn lead to higher discharges. Landslides, mass wasting and debris flow are major sources of sediment, as is the erosion of the beds and banks of rivers. Many times cloudbursts trigger landslides, which is common in the Chure hills. Coarser sediments derived from the landslides are deposited in the upper sections of the rivers and their tributaries. Finer sediments like sand and silt are washed further downstream along the river. In the forested areas of Chure hills in eastern Tarai, annual rate of erosion is 780-3,680 t/km<sup>2</sup>/year. In the far western Chure, the rate is higher which is estimated at 2,000 to 20,000 t/km<sup>2</sup>/year. Several factors determine amount of sediment supplied to a river and precise quantification is difficult. The Himalayan rivers transport high suspended sediment load.

Lower regions of the RTB basin face waterlogging. And pollution is an emerging problem, too. Because of the low discharge in dry seasons the extent of pollution is high till monsoon rains augment flow and flush the wastes. People suggest that due to pollution they cannot use water to fulfill many of their domestic needs. Migration and urbanisation have introduced new challenges adding to the stress by pollution.

### Changes in Temperature

The average temperature recorded in the corridor between early 1980s and 1990s shows an increasing trend. At higher altitudes temperature has increased by about 0.12 degrees. In the Tarai it has remained the same. The changed pattern shows that rise in temperature has been noted throughout the hills and mountains. In parts of Tarai there are some pockets where the temperature has not changed while in others it has changed marginally (Map 3).

Map 3 Changes in Temperature between 1980 and 1993





## Landholding

Landholding is one of the indicators of peoples' access to natural resource and their reliance on ecosystems. In the study corridor the overall land holding is as follows. Nearly 50 percent ( 0.33 million HH) of the households own less than 0.5 hectares of land. Another 28 percent households own between 0.5 and 1.0 hectares. In most cases this size of land is not sufficient to feed the families especially when there no irrigation facility is present to grow winter crops. 20 percent households have between 1.0 and 5 hectares of land. Since they own large piece of land the pressure to grow more is not very high. The households having no land or more than 5 hectares constitute 0.5% each.

Table 5 Landholding Situation

Holding size (ha)	Number of households	Percent
Landless	4078	0.6
< 0.5	322637	48.8
0.5 – 1.0	186649	28.2
1.0 - 5	144427	21.8
> 5.0	3376	0.5
Total	661167	

Disintegrating the above data provided extreme disparity within the corridor. For example, the district of Kaski has the highest number of households with less than 0.5 hectare of land indicating a significant pressure on natural resources. Only a tenth of the households have 1-5 hectares. Kapilbastu district has only 32 percent people with 0.5 or less hectares of land to produce food. About a third of the households have between 1 and 5 hectares. Land distribution is a result of a combination of factors, but population growth and internal migration are two important dynamics of the corridor. In the last 40 years, migration from the hills to the Tarai was high as the hills could not produce enough for the growing population. Incidentally, it was during this period in Tarai was eradicated malaria and the region became favorable for settlement. Figure 1 indicated population growth of the 1980s, when the rate of migration was at its peak. In the Tarai the growth rate was high (>3 percent). Similarly Kaski District, which attracted people from Mustang, Myagdi and Baglung recorded higher growth. Manang District recorded a negative growth because of out migration.

## Food sufficiency

Table 6 shows that only 33 percent of the people grow enough food from their farms. About 66 percent of the households have food deficiency. Of those having food shortage, 19 percent face shortage for 1-3 months, 45 percent for 4-6 months, 18 percent face shortage for 7-9 months, and about 15 percent of the households (nearly 70,000 households) face shortage for almost 10-12 months, though they own some cultivated land.

Table 6 Food Sufficiency

Food balance	Number of households				
	Sufficient	218350 (33%)			
Not sufficient	442819 (67%)	87195	203465	81887	69426
		(19%)	(46%)	(18%)	(15%)
Total	661169				

## Economic activities

The primary economic activity is farming can be categorised as those having land, livestock and poultry (LLP), and others in the nonagricultural categories. About 81 percent of the households are engaged in agriculture alone and earn their living using LLP. About 14% of the households have no access to LLP and make their living by working as labour, providing services, or are involved in trade. About 6 percent of the households have both agriculture and other sources of income. This breakdown shows that people are engaged in non-farm based economic activities, those engaged in both agriculture and other activities. Generally no LLP houses are engaged in non-farm-based activities.

### Desakota phenomenon

Households engaged in farming as well as other economic activities are an indication of the limitation of ecosystem services to meet local needs. When food produced from agriculture is insufficient, families pursue other economic activities. The districts have been ranked according to the number of households engaged in both farming and other economic activities (Table 9). Though in the Tarai Rupandehi District has the lowest percent of households conducting farming as well as other economic activities. This trend is followed by Manang, Tanahu and so on. All districts in the mid-hill have 3 to 9 percent of the households fall in this category.

Other economic activities include, manufacturing, trade and business, transport and service sector. Service dominates these activities followed by trade and business. In the middle hills economic centers such as Pokhara large number of households are engaged in different economic activities, which decline towards south of the mid-hill region. In the Tarai trade and business dominate, but nevertheless a large number of households are engaged in other categories of economic activities also

### Other economic activities

There is no economic survey carried out for the corridor, however, general economic context of the country reflects the conditions of the corridor as well. According to the economic survey of 2001 the contribution of different sectors to national GDP is as follows.

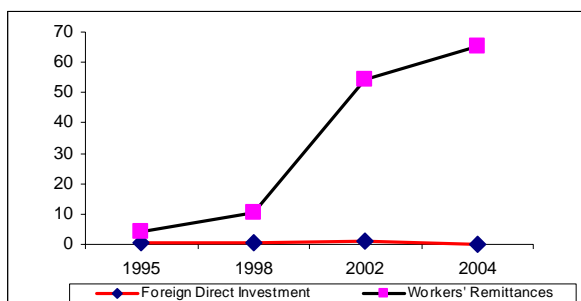
Agriculture	38%,
Industry	21%, and
Services	41%.

The population below poverty line constitutes about 38%, of which the lowest 10% of the households consume about 3.2% and the highest 10%. Of the total labor force of 9.828 million the division by occupation is as follows: agriculture 66%, services 21%, industry 3% (Census 2001). The unemployment rate has been categorized as 3.3% unemployed; and 43.3% underemployed.

Nepal's export import balance has been negative. Nepal's foreign debts began increasing in the 1980s. In the late 1980s, the value of merchandise imports was more than three times that of merchandise exports. This situation has created problems in the balance of payments. In 2001 the total import was worth \$1.15 billion whereas its export was about \$704 million. The export commodities primarily consisted of carpet, clothing, leather goods, jute goods, and grain. The major import commodities were gold, machinery and equipment, petroleum products, fertilizer. The external debt stood in 2000/01 at \$2.6 billion (Economic Survey 2001/02, Ministry of Finance).

Evaluation of Nepalese rupees in the early 1990s attracted labor force to opt for employment abroad. The exchange rates were 51.89 (1995), 56.69 (1996), 58.01 (1997), 65.98 (1998), 68.25 (1999), 68.78 (January 2000), 73.95 (January 2001), 76.30 (January 2002). Remittance became a major source of income. However, the exchange rate declines sharply from 78 to 63 in the last 5 years.

### Contribution of Remittance



### **Drinking water source**

Drinking water is supplied mainly by tap water, which covers about 70-90 percent of the households. Wells are used by small number of households in all districts but the households using wells are about 20% in Argakhanchi and Tanahu. Tubewells are mostly used in Tarai. Water supply coverage has increased between 1997 and 2004.

### **Sanitation coverage**

Access to sanitation and infant mortality are well related. Infant mortality is high in the High Himal districts such as Manang and Mustang. It is also high in Palpa, Nawalparasi and Kapilvastu. Access to sanitation is relatively better in the middle hills where infant mortality is comparatively lower.

### **Irrigation**

Information about access to irrigation water is only available where there is irrigation canal built. The change in the command area is compared to examine if there is sharp rise in irrigation facilities in the last decade. It was seen that irrigated area has increased in the between 1997 and 2004. In Kaski the irrigated area has reduced, which could be due to flood damage. The rise in percent of irrigated area is less in Tarai and high in the mid-hills.

### **Implications**

The mid-hill districts of Tanahu, Syangja and Kaski have the highest number of households with < 0.5 hectares of cultivated land. Food balance is negative in Tanahu and Kaski where a very high percentage of households face food shortages for more than 6 months. Therefore a large number of households have gone to foreign jobs for income. Syangja has positive food balance and yet people going outside Nepal are high because households with food shortages for 6 months are also high. Rainfall has been increasing in these districts, therefore rice and maize production has increased.

Food deficit is a reason for these districts to increase area under irrigation. Population density is medium. But Kaski has lost some of the irrigated area in the last 7 years. Increase in rainfall is seen in all these districts, which probably is a reason for increased area under rice and maize. Syangja District is a clear case where rice and maize area is decreased but production has marginally increased. What this means probably is that farmers have used more fertilizer due to access to road and market.

Gulmi is another area the rainfall has decreased or remained same in some pockets. The area under rice, maize, and millet has decreased but rice production has increased. Maize production has decreased. Food deficit is severely negative. Majority of the households hold more than 0.5 hectares of cultivated land. Household with food deficit for 6 months is about 50 percent and more than 6 months is about 25 percent. Here large number of households goes abroad for income.

In the adjoining district of Argakhanchi, maize and millet yield has declined. Rainfall has reduced. Though population density is medium (100-300) a very high percentage of population have food deficit for more than 6 months. A large number of households go abroad for income.

In Tarai Nawalparasi, Rupandehi and Kapilbastu districts which are in the Tarai food balance is positive. The rainfall in Kapilbastu District is decreasing whereas in other two districts it is increasing. Temperature regime in all districts has marginally changed. The area under Millet has decreased in all districts. Maize has decreased in Rupandehi and Kapilbastu but has increased in Nawalparasi. Rice cultivation has increased significantly in Nawalparasi but only marginally in Rupandehi. In Kapilbastu there is no change the number of small landholders in between 45-55 percent in Nawalparasi but is <45% in the other two districts. Therefore the land distribution for food production is better. Population density in Rupandehi is high (300-500) due to two major cities here, but in other two districts it is between 100-300. Irrigated area has not increased significantly. It is only about 5-15%, which means the stress on water resource has not increased so much. The area under irrigation increased very low in Kapilbastu. The striking feature of the districts despite the positive food balance is that about 50% of those reporting food deficit lack food for about 6 months. About 25% of that percentage reported that they faced food shortage for more than 6 months. Few people from Nawalparasi go for jobs in foreign but this rate is medium (11-20% of the households) in Rupandehi

and Kapilbastu districts. However, people doing wage labour within districts are high in all districts. (They do sand collection, stone mining, and aggregate making).

The inference is that even in fertile plains of Tarai there is a significant portion of poor people that cannot sustain from their own land due to its size and may be due to reduced rain, farmers have not been able to plant maize and millet. Since irrigation has increased only marginally it is unlikely that people have shifted from maize to rice in large areas. These people depend on outside sources for sustenance.

High mountain districts of Manang and Mustang are more guided by other economic activities than the ecosystem based systems normally evident in the middle hills. In Mustang land under maize has reduced but in Manang it has increased. Rainfall in Mustang has reduced but increased in Manang. The number of poor landholders is less in Manang than in Mustang. Food balance in both district are negative. Population density is low. Nearly 50% of that reporting food shortage in both district lack food for 6 months. Mustangies have gone abroad for income where most of the Managies have opted to work within district for additional income.

In Palpa the rainfall has increased but all major crop yield have declined though the land under crops have increased. This probably means that the stress on land has increased to sustain increased population. And yet the food balance is negative. Population density is only 100-300. Many people go outside Nepal as well as work within the district for additional income.

In Lajung maize and millet yield has declined and 45-55% of the households own <0.5 hectares. Food balance is positive (from the rice production?) and has increased irrigated area in the last 10 years by about 15%. Rainfall also has increased. Though food balance is positive households with food shortage is very high. They make living by working in the district and few go abroad.

Parbat, Baglung and Myagdi district fall in area where rainfall is either reduced or has remained same. Area under rice and its yield has increased in all districts. Food balance is negative in all places and Baglung has acute food shortage. There are more households with food shortage in the area. They all go outside Nepal for income with higher number of households in Parbat and Baglung than Myagdi. People who prefer to work within the district [what do they do?] is about 50-60% of those with food shortage. But in Baglung maize area has reduced but millet has increased substantially though its yield has reduced. Millet in Parbat and Myagdi has reduced in area and yield.

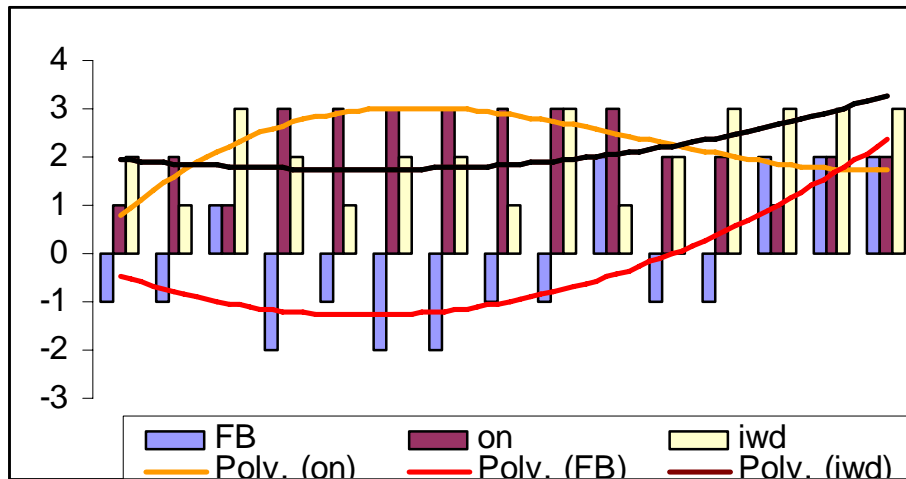
## **Inter-linkages**

Population density is directly related to the land holding. From north to the south the corridor has a character that shows that the population density increases as one moves from north to the south. Though there are pockets of high population density in the middle hills, most of the midhills have average population density of between 100 and 300 persons per square kilometres. The southern areas have more than 300 persons per square kilometres.

The land holding with less than 0.5 hectares of cultivated land was examined and it is found that a large number of households have less than 0.5 hectares of land. The percent of households having less than 0.5 hectares of land decreases to the south. Though food balance is a result of combination of factors, 0.5 hectare of landholding is not sufficient to meet the food requirement of any farmer family even in a very favourable land and climatic condition. Now let us check land holding and food balance. It shows that food balance in the corridor is severely negative in the hills and mountains but gradually becomes positive towards the south and in the Tarai the food balance is very positive.

People go for alternative source of income to respond to the food deficit. The alternatives depend on length of food deficit period. If the shortage is only for few months families burrow the food from neighbors. Burrowing does not help if the food deficit is for longer period. In such a situation families choose one of several option including wage labour within or outside the district, work in transport sector, carry out trade and business, and go to foreign countries for employment.

Food balance situation in the corridor can be related to people doing other jobs within the districts and going to foreign countries. Working within the district is a phenomenon which is done by people even in areas with food surplus. These people are mostly small and holders. The deeper the food deficit more people seem to be heading to foreign countries, which is high in the hill districts. In Tarai few people go to foreign countries for income.



Number of households sending its members to foreign countries for income has also been compared with the population density. It appears that density is not a primary factor as long as the resource is available for meeting food requirements. In the Tarai the population density is very high but the number of people going to foreign countries is small compared to the hills where population density is small.

Those who could not send their family members to jobs outside the country have also been affected by the changing socioeconomic situation largely impacted by *desakota* phenomenon. They need to earn cash income which has become a symbol of prosperity and a means to meet other requirements. Selling local alcohol has become an easy and accessible means to many families in this category. This is indicated by the fact that millet area in Baglung has increased from 4000 hectares in 1990 to 20,000 hectares in 2003. This change draws attention and could lead to very important processes of changes taking place in the area. Millet is not a preferred crop for food. It is primarily used for making alcohol, which is consumed widely in the area. There is a strong but illegal market of millet alcohol. Why such a big increase in area when its productivity has declined? The reason probably is that the summer rain in Gurja in Myagdi has reduced. Rainfall in September in Baglung is also reduced. Millet is grown as a relay crop to Maize using the rainfall of late August and September. Another factor is that the road to Baglung and Myagdi has opened up access to Raksi market as far away as Pokhara. Perhaps Millet has provided a reliable source of income to a vast number of households. If this is true, then the wood required to brew millet alcohol will have a huge negative impact on the forests of the region.

Increasing area under irrigation is one of the aims of the households to increase food production. Faced with such an objective irrigation is a necessity when the rainfall reduces or its pattern is changed. The rainfall in the stations of the corridor indicates that half of the corridor received more rain than the western half in the last decade. We compared increase in area under irrigation with respect to the annual rainfall amount. Generally, there is an increase in irrigated land in all districts except in Kaski where it has reduced. The reason could be increasing urbanization, land degradation, etc. In some districts irrigated area has increased more than the others. In fact, the pattern follows the trend in rainfall. When rainfall is on the decline increases in irrigated area is higher. This shows increased climate change stress on existing water resources.

### Climate change

Both temperature and rainfall seem to be changing over the last few years. It is no longer easy to predict when the monsoon rains will come and how long they will last. In 2006, farmers had to replant their rice crop, as the rains started at the expected time, but then stopped abruptly. And the second planting ended badly, as heavy rains fell during the harvest, damaging the crops. The majority of Nepalis population is dependent on agriculture for their livelihoods, and such events cause damage to poor farmers, through both income loss and food shortages.

None of these are proof of climate change, but point towards changing weather patterns, with increasing unpredictability of rainfall, and increased severity of both drought and flooding. One key impact is the retreat of the Himalayan glaciers which is faster than in any other region. The immediate risk this shift

poses is that of glacial lake outburst flooding, as glacial lakes are fed by rapidly melting glaciers, and burst beyond the basins that contain them. The alteration in the regional hydrological cycle is another major threat but its extent needs much deeper assessment.

Though they cannot explain climate change, local communities experience the effects. Their wherewithal is stretched as they respond to meet immediate needs. At the same time capacity to plan long-term responses is limited.

### **Key insights and research questions**

There is no divide between the urban and the rural. Desakota phenomenon is seen in remote villages. In the region economic activities have changed from farm-based to more non-farm activities and future development requires a better understanding of the role agriculture has in supporting local population.

Existing data on ecological properties in the mountains and vegetation types will not be relevant in the river valleys whose environment is sensitive to changes in temperature. Insect pests (citrus), diseases (fungal) are major problems where they were nonexistent in the past. Evidence of plant migration is clear. Appearance of new species (poisonous) and new diseases in cash crops have impacted economic base of those who relied on development initiatives that promoted horticulture. As a result more and more families are pushed into non-farm economic activities. New knowledge systems are required to understand the extent of changes and sensitivity of the area in general and river valleys in particular to such changes.

Shift in rainfall pattern in the monsoon has affected local farming practices. The winters are more warmers and discourage farmers to grow peas.

Livestock is kept for cash income rather than for manure in the traditional farming system. Existing practices of nutrient recycling have been replaced by chemical fertilizer, but its supply is dependent on volatility of the market. We need to understand its implication on agriculture policies.

Demand for irrigation water to grow more food is increasing overall but more so in areas where rainfall has reduced in the past decade.

People are gradually shifting from farm based livelihoods to other types because incentive for farming has reduced. Food is imported from Tarai and India. In the changing circumstances marginalized families are being further marginalized. This trend needs much greater investigations.

In many communities people resort to brewing finger millet to make cash income. This practice is made possible since roads have increased mobility and access to market has increased. Widespread this activity is the livelihood of the poorest families. The implication on environment and society is poorly understood, however.

## Annex 1: Relationship of Desakota Criteria to Water-Based Ecosystem Services and Poverty along Mustang-Gorakhpur corridor

Desakota Criteria	Water-based Ecosystem Services	Poverty
Greater Connectivity—physical, electronic and cultural.	<ul style="list-style-type: none"> <li>Pressure on local water sources has increased. Disposal of untreated wastes on the rise and degrades water sources.</li> <li>Solid water disposal and leachate flow source of pollution.</li> <li>Desakota phenomenon sustained expansion Maoist conflict wreaking the both formal and informal systems of ecosystem management.</li> </ul>	<ul style="list-style-type: none"> <li>Pushed the poor and marginal further down. Also provides diverse income sources.</li> <li>In many places those with capacity to organise are able to mobilise resources to investment in transportation.</li> <li>The marginalised are further pushed into the margin. Coercion from those earning from remittance resulted in forced displacement.</li> </ul>
Greater penetration of cash economy, with remnants of exchange and reciprocity mechanisms on the decline.	<ul style="list-style-type: none"> <li>Money receiving centres have proliferated and traditional practices of <i>perma</i> are depleting.</li> <li>Quasi formal organisations such as WUAs and forest users groups manage water and forest while government agencies have depleting presence.</li> </ul>	<ul style="list-style-type: none"> <li>Decline in the traditional relation in some way perpetuated the caste hierarchy but in absence of alternative the poor, uneducated are at the receiving end.</li> <li>Readymade garments and agricultural tools have displaced occupational castes form traditional income sources.</li> </ul>
Mixed livelihoods drawing upon local as well as non-local service, and manufacturing sector opportunities.	<ul style="list-style-type: none"> <li>More people depend on mixed livelihood and dependence on local ecosystem for food is on the decline.</li> </ul>	<ul style="list-style-type: none"> <li>Lack of commensurate options and limited degree of freedom means that the incentive for migration is sustained.</li> </ul>
Greater diffusion of modern production and resource extractive technologies.	<ul style="list-style-type: none"> <li>Promotion through state sanctioned policies is taking ecosystem based services such as water flow away from traditional irrigation and for meeting ecosystem, cultural and religion.</li> <li>Electric pumps and inter basin transfer of water impinge upon traditional water allocation</li> </ul>	<ul style="list-style-type: none"> <li>Extractive and modern technologies are technology aim for transferring benefits of ecosystem based services to metropolis.</li> <li>New initiative such as community electricity shows potential of promoting non-farm based local enterprises</li> </ul>
Greater penetration of formal institutions existing in a transformational tension with traditional informal institutions.	WUAs increasingly face capacity limitation to manage as new constraints such as pollution, groundwater overdraft and market penetration have emerged.	On a spatial scale the <i>desakota</i> region fall in the fuzzy area where the rural and the urban. Lack of institutional oversight further debilitates the ecosystem and hurts the poor.