Econometric Analysis of the Causes of the Deforestation in Nepal

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ROSHANI DANGI

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Roy Gene Boyd

Professor of Economics

Benjamin M. Ogles

Dean, College of Arts and Sciences

ABSTRACT

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This research investigated the effects of social, economic and other factors contributing to the forestry sector of Nepal. Based on literature and socio-economic conditions of Nepal, various variables are included as main cause of deforestation in Nepal. The concept of econometrics and regression model is used. The results indicated a significant link between the several included variables and the changes in forest land in Nepal. The results also suggest that increased productions of forest products and social unrest in the country are the main negative contributors to the forestry sector of Nepal. Social Unrest is found to be the most significant variable affecting the forest land of Nepal. From this study, timber production found to be the major culprit causing more negative effect to the forest land of Nepal compared to fuelwood production. Furthermore, the various policy efforts taken indicate that Community Forestry is the best policy option available but some changes needs to be done to avoid the loopholes and improve its efficiency.

Approved: _____

Roy Gene Boyd

Professor of Economics

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

LIST OF ACRONYMS

ADB: Asian Development Bank

CBS: Central Bureau Statistics

CF: Community Forest

DFID: Department for International Development

DFO: District Forest Officer

DOF: Department of Forest

DOF: Department of Forest

FAO: Food and Agriculture organization

FINNIDA: Finnish International Development Agency

FRA: Forest Research Association

GFRA: Global Forest Resources Assessment

GoN: Government of Nepal

ICIMOD: International Centre for Integrated Mountain Development

MFSC: Ministry of Forest and Soil Conservation

MPFS: Master Plan for Forestry Sector

NOC: Nepal Oil Corporation

NPC: National Planning Commission

PF: Panchayat Forest

PPF: Panchayat Protected Forest

TCN: Timber Corporation of Nepal

UNCED: United Nations Conference on Environment and Development

UNDP: United Nation Development Programme

UNEP: United Nation Environmental Programme

WB: The World Bank

WEC: Water and Energy Commission

CHAPTER 1: INTRODUCTION

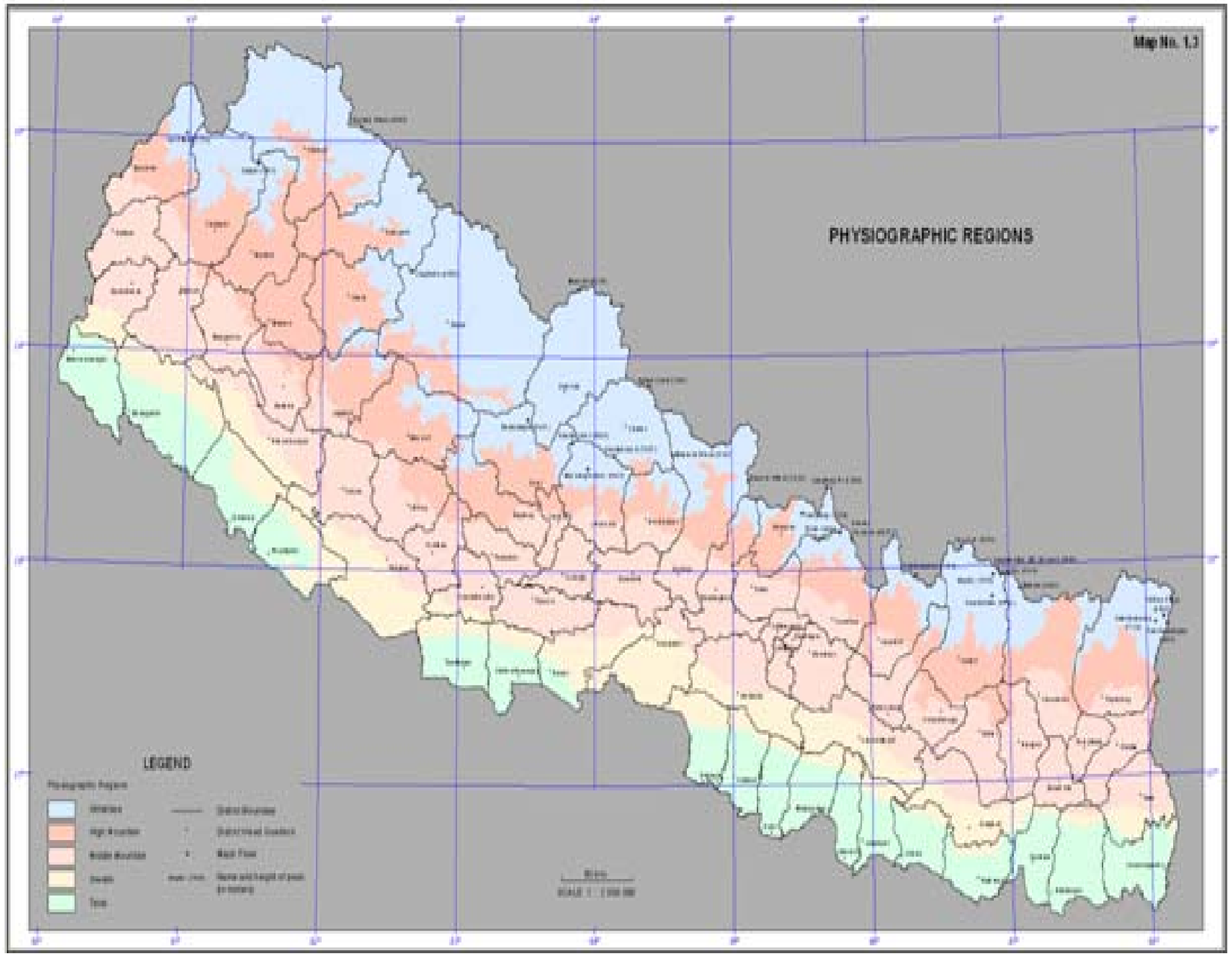
Of the total physical area of about 147,181 square kilometers of Nepal, about 39.6 percent is covered with forest land (DFRS, 1999). Forestry is one of Nepal's most important natural resources. Indeed, forestry plays an important environmental role in addition to its role as a driver of economic growth. Both direct benefits (such as timber, fodder, fuelwood etc) and indirect benefits (such as erosion control, flood control and CO_2 sequestration etc) are derived from forest resources at a local as well as a national level. The livelihood of more than two hundred million forest dwellers and poor settlers depend directly on the food, fiber, fuel, building materials, medicinal plants, and fertilizers either taken from the forest or produced on recently cleared forest soils (Scrieciu, 2007). About 85 percent of the twenty five million people of the country live in rural areas and practice subsistence farming, and the forest is an integral part of their livelihood. Similarly, the forest sector contributes greatly to the national economy and in 2001 alone, revenue from forest products was about US $ 6.31 million (8.6 percent of Nepal's total revenue) (CBS, 2002).

Currently overexploitation and mismanagement of forest resources has become one of the major issues in Nepal due to substantial negative economic and environmental consequences. Kanel (2000) estimated the annual financial losses due to deforestation to be of US $ 154.87 million and this is a significant sum.

Deforestation, due to logging, fuelwood consumption, overgrazing, population growth and political instability is growing at an alarming rate. It is estimated that 25,000 hectares (ha) of forests (i.e. at 0.4 percent) are being degraded every year. This is causing

many serious economic and environmental problems referred to in the literature as "negative externalities". It is reported that "if the current rate of forest destruction continues, the forest of the Southern Belt of Nepal will disappear in next 25 years, and the forest of Middle hills will be gone in the next 15 years" (Joshi, 1991). The physiographic map of Nepal is presented in Figure 1.

Many policies have attempted to control Nepal's deforestation, but very little progress has been made and forest cover is still decreasing with alarming environmental consequences. The purpose of the present study is to determine those forces most responsible for Nepal's deforestation and to evaluate the best policy option now available.



Source: Government of Nepal, 2001

Figure 1. Physiographic map of Nepal.

CHAPTER 2: LITERATURE REVIEW

2.1. Concept of Deforestation:

The term deforestation has different meanings to different people. For some it's the conversion of forest land to other landuse practices, whereas for others it includes all activities that destroy forest land. Some definitions include: loss of any kind of closed forest(FAO/UNEP, 1982); conversions of forest to another land use or the long-term reduction of the tree canopy cover below a minimum 10 percent threshold (FAO, 1990); the loss of original forest for temporary or permanent clearance of forest for other use purposes (Fearnside and Grainger, 1993). Deforestation for some, describes a situation of complete long-term removal of tree cover (Kaimowitz and Angelsen, 1998), while for others it entails permanent destruction of indigenous forests and woodlands (Collin 2001).

Other definitions of deforestation include: (1) any activity that disrupts the natural ecology of the virgin forest (Timberlake, 1985); (2) an inevitable result of the current social and economic policies being carried out in the name of development (Revington, 1991); and (3) complete destruction of forest cover along with 'removal of or 'unsurvivable injury to' the great majority of trees (Myers, 1994).

Thus, the understanding of term deforestation can vary widely from a fairly simple to a relatively broad meaning. Even though different researchers have different definitions for the term, in this paper it will refer to clearing of the forestland for other purposes. This coincides with the Food and Agriculture Organization (FAO, 1993) definition of deforestation which defines it as the forest loss that are permanent in nature.

2.2. Global Deforestation:

The topic of deforestation has become one of the major global issues since the 1980s. Inspite of worldwide concern about tropical deforestation, there remains no exact estimated value of the global deforestation rate and the published values vary largely. One of the reasons behind this is the different understanding of term deforestation mentioned in section 2.1 above because researchers and organizations estimate the loss differently. Between 1923 and 1985, at least 26 different calculations of closed forestland were made and they ranged from 2400 million hectares (ha.) to 6500 million hectares (Mathews *et al.*, 2000).

According to the FAO (1992), since 1979 the total loss of forest land increased from 75,000 square kilometers to 126,000 square kilometers. This was followed in the 1980s by an annual increase of 132,000 km^2 (Myers, 1989, 1992). The World Bank (1989, 1992) estimates the overall annual rate of tropical deforestation worldwide, since the 1980s to have been 0.9 percent. According to this estimate then Africa, South-East Asia and the 14 developing countries in South America, have already lost more than 250,000 hectares of tropical forests.

In the period between 1980 and 1985, total deforestation in developing countries was about 200 million hectares. In Asia and Africa these figures stand at 60 and 55 million hectares respectively. Worldwide, however Latin American had the highest deforestation rate and over that time 85 million hectares of forestland was lost, much of it in Brazil (FAO, 1997). Indeed, between May 2000 and August 2006, Brazil lost nearly 150,000 square kilometers of forest (Butler, 2008). Both the FAO and Global Forest Resources Assessment (GFRA, 2000) estimated that the world's net loss of forests in the

1990s was 94 million hectares and project that if this rate continues, in just over 400 years all of the world's 3,869 million hectares of forest will be gone.

Goodland and Pimentel (2000), report that 20 to 30 percent of the world's forest land has already been converted to agricultural land use and this conversion accounts for about 60 percent of worldwide deforestation. The World Resources Institute (WRI) statistics indicate that once tropical forest occupied 16 million square kilometers where now only about 8-9 million square kilometers exist.

Current FAO estimates indicate that approximately 10.16 million hectares of tropical forest was lost in the period between 1990 and 2000. This increased to 10.4 million hectares in the period from 2000 to 2005. From these estimates, it is clear that, every year the rate of deforestation has been increasing and thus far we have already lost almost one-half of the earth's forest cover.

2.3. Extent of Deforestation in Nepal:

Nepal is not exempted from the global issue of deforestation. In fact, this issue has been a major concern to policymakers since the 1960s. Various reports agree that the forest cover in Nepal is decreasing rapidly. Thapa and Weber (1990) found the 4.1 percent deforestation rate in Nepal between 1950 and 1975 to be among the highest of various selected tropical countries of south and South East Asia, with more than 25percent of the total forest cover lost during this time. Between 1947 and 1980, Nepal's forest cover declined from 57percent of the national territory to just 23 percent (Myers, 1986). Barnes *et al.* (1985) and the FAO Yearbook (1980) rank Nepal as the 29th highest

country in terms of deforestation rate with an annual rate of 0.11percent. This rate has recently increased to 3.68 percent per annum and ranks second in terms of its deforestation rate in 1982 (FAO/UNEP, 1982).

Within the 15 years between 1964 and 1979 about 400,000 hectares or 7 percent of Nepal's total forest area was cleared (EPC, 1993) and of this total 380,000 hectares occurred in the Siwaliks[a] and Terai[b] areas (WEC and Neild, 1985; MPFS and GoN/ADB/FINNIDA, 1988). Between 1978 and 1991, about 90,000 hectares of tropical Sal (*Shorea robusta*) forest in the Terai was cleared with an average deforestation rate of 1.3 percent per annum, and, as a result, the total forested area has now shrunk from over 6 million hectares in 1964 to just 4.2 million hectares (Biodiversity Sector Programme in Siwalik and Terai (BISEP-ST), 2003).

The deforestation rate in Nepal is not uniform; varying in different physiographic zones. As pointed out by BISE-ST (2003), in the Terai area, forest land decreased at an annual rate of 1.3 percent between 1978 and 1991, whereas in the hill areas it decreased at an annual rate of 2.3 percent. According to WEC (1980), the forest in the Hill area had a crown cover of more than 70 percent in 1964-65, and by 1978 this area was reduced to 40 percent. Similarly in the Siwaliks and Terai regions there was significant deforestation. Indeed after the eradication of malaria deforestation became even more severe in the Terai region compared than in hills and mountains (Karkee, 2007).

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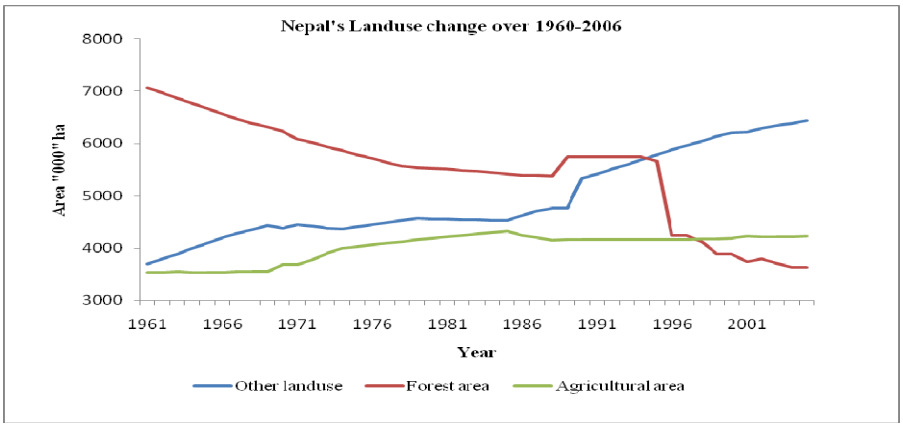
[a] Narrow strip of fragile hills in between middle hills and Terai which extends upto an altitude of 1800meters (Gautam *et al.*, 2004).

[b] This region is an extent of the Gangetic plain of India and extends at an altitude of 60 to 200 meters.

Between 1990 and 2005, Nepal lost 1.2 million hectares of forest representing about 25 percent of its total forest cover (Butler 2006). Increased demands for food and shelter has resulted huge conversion of forestland to agricultural, other income generating uses and settlements, causing massive declines in forest land but increases in other land use practices. Figure 2 clearly indicates that Nepal has already lost almost one-half of its forest land since 1960s. The downward trend was reversed briefly in the 1990s due to a new forest policy known as Community Forest (CF). After 1994, however with the social unrest in the country, the clearing of forest land resumed along the same trend line it had previously followed.



Date Source: WB and FAO, 2006

Figure 2. Land use change in Nepal.

2.4. Causes of deforestation:

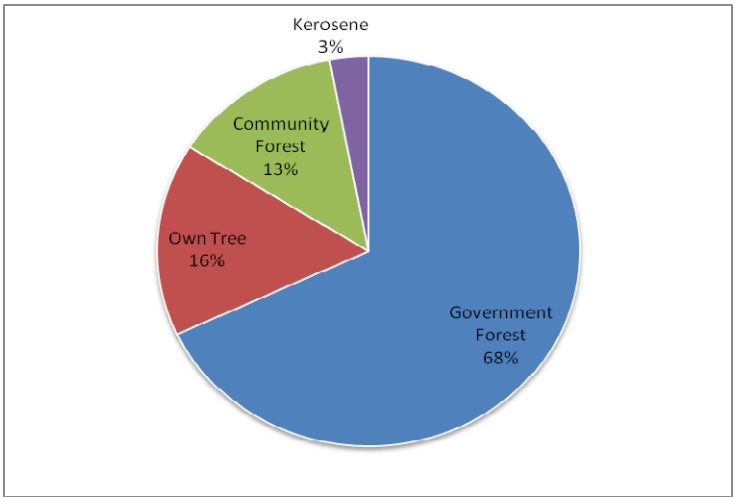
The main cause of deforestation differs between countries depending on the socio-economic, political and physical structure of the country. Based on the nature of the study; micro, regional or macro, different causes of deforestation have been identified and examined (Mahapatra, 2001). This study is done at the macro level (i.e. the regional

scale) since the whole country is considered as the unit of study. Hence, those factors considered to be the main contributors to deforestation at the macro level study are reviewed in this study.

High levels of wood production are an important cause of deforestation in developing countries (Allen and Barnes, 1985). According to Myers (1989) cattle ranching and commercial logging are the chief sources of deforestation whereas logging is a secondary source of deforestation in Southeast Asia (Panayotou and Sungsuwan 1994; Kummer and Sham, 1994; Osgood 1994; Katila 1995). The timber trade has been cited as a contributing factor to deforestation worldwide (Mystad 1995) and the commercial exploitation of forests has been identified as an important factor in the destruction of forests (Repetto and Holmes 1983, 1985; Capistrano, 1994). Commercial logging operations seriously deplete forest stocks (Duraiappah 1996; Eckholm, 1979; Powell 1978); accounting for about 20 percent of forest loss while the rest is chiefly due to fuelwood collection, and other uses such as urban development and infrastructure (Shafik, 1994; Southgate, 1994). In a separate study, Shafik (1994) considered the harvesting of timber, the removal of other forest products and the clearing of forest for livestock and agricultural production to be the chief factors leading to deforestation.

Increased fuelwood demand, burning and grazing, and weak forest protection institution (Repetto & Gillis, 1988; Brown and Pearce, 1994) contribute to deforestation, and the World Resources Institute (WRI, 1994) cited increasing human and livestock populations, poverty, the demand for fuel wood and high levels of consumption by industrialized nations to be important causes of deforestation.

Panayoutou(1994) identified excessive timber logging as the main cause of deforestation in Indonesia and Malaysia whereas in Nepal he found it to be due to excessive fuelwood consumption, overgrazing and fodder harvesting. Fuelwood and charcoal energy consumption are also considered to be one of the major causes of deforestation there (Allen, Barnes and Chakraborty). The pie chart given below in figure 2 indicates that 80 percent of the energy demand in Nepal is fulfilled by fuelwood alone.



Data Source: WECS, 1996

Figure 3. Percent of households using different sources of fuel energy in Nepal.

Duraiappah (1996) mentions logging and fuelwood collection as main sources of deforestation worldwide and the United Nation's Food and Agriculture Organization (FAO) estimates show that 1.5 billion of the 2 billion people worldwide who rely on fuelwood for cooking and heating are overcutting forests. Indeed, the demands for fuelwood by subsistence agricultural households may be the leading cause of world deforestation (Amacher, Hyde, and Joshee, 1993; Amacher, Hyde, and Kanel, 1996).

The demand for the wood energy has been augmented by the recent dramatic increase in oil prices, which have prevented the switch to non-wood based fuels (Allen and Barnes, 1985). Currently Nigerians who are in a similar socio-economic situation as the Nepalese, have had to resort to fuelwood due to the increase in price of petroleum products which has lead to massive deforestation, biodiversity and habitat loss there, including siltation of streams due to land cover clearing (Health & Science Environment, Islam and Raufu, 2003). Elsewhere farmers who account for 80 percent of the Northeast Thailand's population find it more economical to use fuelwood rather than any other source of energy and this is borne out by the negative relationship between kerosene prices and forest cover (Panayotou and Sungsuwan, 1994). The poor economic condition of Nepal provides few alternatives for fuel (Allen and Barnes, 1985).

Economic theory suggests that the aggregate energy consumption of fuelwood depends on national income, price of compliments and substitutes, and various other demographic factors (Yiridoe and Nanang, 2001). Thus, fuelwood consumption is determined by factors such as the level of income, population growth, accessibility of forest to people, the opportunity cost of labor and substitute prices. Based on this analysis, Panayoutou (1994) built a fuelwood demand function that describes fuelwood consumption:

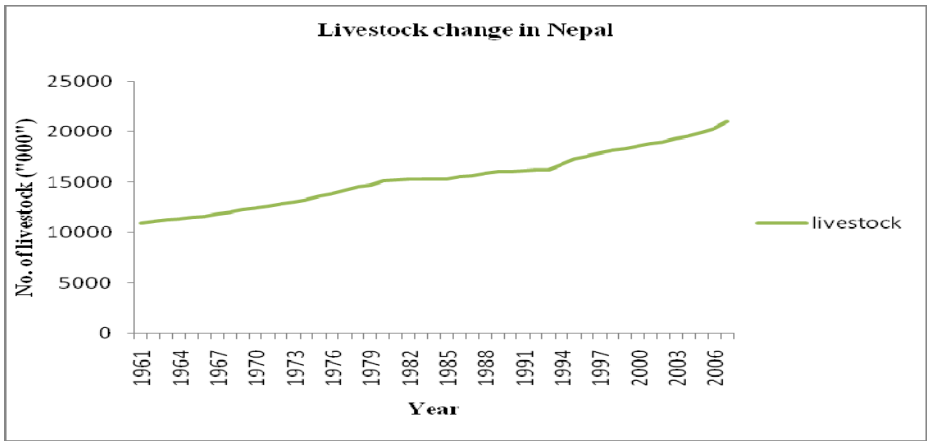
$$X_F=F(P_F(P_o), P_K;Y, N, Z)$$

Where:

$dF/dN, dF/dZ>0;$
P_f= fuelwood collection cost
N=population
P_k=price of substitute
Y=income
Z=accessibility of forest
P_o=opportunity cost of labor.

Forests are common property resources and low income/ high poverty makes more people dependent on fuelwood compared to other fuel energy choices (Pudasini, 1992). The poor economic condition of Nepal provides few alternatives for fuel use (Allen and Barnes, 1985), and thus the combination of low income, high kerosene prices, high population growth, and low fuelwood collection cost has increased fuelwood demand and exacerbated deforestation.

Increased livestock/grazing has been cited as one of the other main causes of deforestation in Nepal. About 14 million heads of livestock graze in the forests and pasturelands of Nepal putting excessive stress on its delicate ecosystem (Pudasini, 1992). Thus, the rapidly increasing population of livestock as shown in Figure 4 has created tremendous negative pressure on Nepal's forest resources.



Data Source: FAO, WB, CBS, 2006

Figure 4. Livestock population in Nepal.

Recently, due to its high poverty rate there is a larger amount of internal and international migration in Nepal. Marcoux (2000) stated that as "More and more rural house-holds see permanent out-migration of one or more family members as a way of earning cash income and diversifying risk which helps alleviate their dependence on dwindling forest resources".

2.5. Forest Policy in Nepal:

There have been various changes in Nepal's forest policies since the early 1900s, when serious concern about forest resource use first emerged. This was a shift from the past when the main focus of forest policy was general towards revenue generation from forest resources. Later the focus shifted from revenue generation to forest management and then to management through participation of people in a sustainable management process. Thus several policies were formulated to reduce the deforestation problem in

different time period. The policy formulated from 1846 to 2002 along with their effects are identified in Table 1 and discussed in more depth below:

Table 1

Comparison of forest policies in Nepal

Year	Policy/Legislation	Effect of Policy/Legislation
1846-1950	Forest administered as private property 1. Allocation of national forest to the Rana family members as Birta land; 2. Clearance of the Terai forest along the border with India for the purpose of settlement; and 3. Indigenous management system (group efforts) and traditional forest management (Talukdar) practice in the hills	1.1 Forest conversion to agriculture land 1.2.Privatization of forest by autocratic regime 2. Revenue Generation 3.1 Protection of forest land 3.2. Fulfillment of basic needs for fuelwood, fodder and construction material 3.3 Period of transition to convert forest as private property to state property
1957	Private Forest Nationalization Act	• indiscriminate cutting of forests • conversion of Private forest into farm land in Terai
1961	Forest Act	• forest categorization • forestry officials empowered
1967	Forest Protection Act , special provision	• judicial power to forestry officials, • law enforcement power reinforced
1976	National Forestry Plan	• recognition of people's participation in forest management • concept of village Panchayat forest (PF)
1977	Amendment in Forest Act	• provision of Panchayat Forest and Panchayat Protected Forest (PPF)
1978	PF and PPF Rules	• handing over of National Forest to village Panchayat (elected village body)
1978	The Leasehold Forest Rules	• leased barren or very degraded areas
1982	Decentralization Act	• authority to District and Village Panchayat • promotion of user's Committee concept

Table 1: continued

1984	Private Forest Rules	• entitled owners of private forests to free supply of planting materials • provide technical assistance from the District Forest Offices
1987	Revision of PF and PPF Rules	• provision of the User's committees for forest management
1989	Master Plan for the Forestry Sector	• incorporated the concept of Community Forest User Group (CFUG) • priority given to community forestry
1993	Forest Act	• Users as managers of forests • CFUG empowered for forest management
1995	Forest Rules	• process of community forestry detailed • Forestry staff's role changed from custodial to facilitation
1999	Revision of Forest Act	• control mechanism brought for violation of operational plan • provision for spending 25% in forestry activities
2000	Forest Policy 2000	• Management of degraded and scattered forest areas in Terai & Inner Terai • Collaborative forest management approach for national forests on the basis of the landscape planning • Conservation of Siwalik forests
2002	Leasehold Forestry Policy	• Provision of basis for the transfer of national forests to the private sector in the form of leasehold forests

Source: MFSC, 2000; Shrestha and Nepal, 2003; Kanel, 2006; Pokharel *et al.*, 2005

2.5.1. Birta and Talukdar under different rulers (Before 1957):

Prior to 1951, Nepal was divided into 22 and 24 smaller kingdoms: *baise* and *chaubise* respectively, ruled by the monarchies through a democratically constituted assembly. At that time, the ruler's main objective was to insure food production and obtain state revenue through land tax collection. Hence, they encouraged individuals to convert forestland to agriculture, which in turn resulted in a huge conversion of forest

land to agricultural land (Wallace, 1981 and Mahat *et al*. 1986). In 1846, the Rana regime was established and during this time period many of the forestlands were granted as birta's[1] to either a Ranas family member or to the officials for their service. According to Malla (2001) "by 1950, one-third of the country's agricultural and forestlands had been granted to private individuals, of which three-fourths belonged to the Ranas family" (pp 291). Very little Terai forest land was destroyed till 1920 but later with the advent of cultivated land expansion and timber export to India, there was a large amount of destruction in the forest land of the Terai area (Gautam *et al.,* 2004). After the end of Rana regime in 1951, the village headmen known as Talukdars[2] became the body responsible for the regulation of forest use, but there were hardly any restrictions on forest product extraction for subsistence (Mathema *et al.,* 1999) and the practice of converting and destroying forestland continued even after 1950 (Gautam *et al.,* 2004).

2.5.2. Nationalization Act (From 1957 to 1976):

In 1957, the government of Nepal took a major policy action (i.e. nationalization) and privatized forests through the Private Forests Nationalization Act. After the promulgation of this act, the Government of Nepal (GoN) claimed ownership over all type of forest land. This created a strong incentive on the part of individuals to destroy forests and thereby convert them to agricultural land so that they could claim the land as private property (Wallace, 1983 and Chapagain, 1984).

During the 1950s and the 1960s the government's resettlement programs and the

[1] it is tax-free land tenure granted primarily as a pension or as a reward

[2] A local government official and village tax collector

eradication of malaria in the Terai region encouraged a massive migration from the mountains and hills to the Terai region in search of fertile agricultural lands. This in turn, created strong negative pressure on the Terai forestland (Gautam *et al.*, 1994). It was reported that by the beginning of the 1950s to the mid of 1980's a total of 103,968 hectares of forest in the Siwaliks and the Terai regions were cleared under various settlement programs and an additional 100,000 hectares of forestland were illegally encroached upon. (GoN/ADB/FINIDA, 1988 and Joshi, 1993).

Then in 1961, the Forest Act was promulgated. Under this Act, the forest department was designated as the main body responsible for the management and control of forest resource use. The forest land was divided into various categories and placed under the authority of the Forest Department. In 1968, the Forest Protection Act was passed. This provided for the provision of stronger penalties for damaging or removing forest products from national forests without the permission of forest department officials who were given formal police and judicial power (Kanel, 2004).

In spite of all these efforts, the result was disappointing due to a lack of strict enforcement. Furthermore, none of these Acts dealt with sustainable management, future planning, and the consequences of the increased demand. Rather these laws were only concerned with the sale of forest products, prohibitions on forest use, punishment of unlawful activity and reorganization of the bureaucracy (Gautam *et al*., 1994). Similarly, strict enforcement and public participation were lacking in those acts. Taking all of this in view, a new working plan was prepared in 1962 for some of the Terai district, but unfortunately it was never implemented.

During this time period, the role of the forest department's staff was limited to forest protection only, and local people were considered only as potential violators rather than as potential protectors (Joshi, 1993). The combined effect of all these factors: the resettlement program, revenue generation, the nationalization act, and the policy flaws of the various laws increased the rate of deforestation.

2.5.3. Panchayat Forest Act (1976-1988):

In 1976, the Government of Nepal (GoN) again drafted a new national forestry plan and one of the major goals of this plan was the role of local communities. More specifically the participation of local communities in forest management was recognized and emphasized (Pokharel, 1997). With this in mind the Forest Act of 1961 was amended in 1977.

The operating rules for the Panchayat Forest (PF) and the Panchayat Protected Forest (PPF) were codified in 1978. This policy called for the handover of forests to local political units for the purpose of forest protection and its proper management and utilization. This Forest Act and the accompanying regulations recognized the importance of local people and their participation in both decision making and the forest management processes. Without their cooperation and participation it was recognized that the management objective would be hard to achieve, and indeed this realization led to a major shift in Nepalese forestry policy (Shrestha, 1996).

Even though there was a realization of the importance of public participation in forest management, there was not much success in forging any partnership between the Forest Department and the Panchayats (Pokharel, 1997). Some of the reasons were: (i)

during the initial stage of policy creation, emphasis of the government and donor agencies was general more toward resource creation through reforestation and afforestation[1] projects rather than people's involvement in forest management per se and (ii) public participation was limited to activities related to the government project objectives, rather than their need and demands (Collett *et al*., 1996). Some of the other reasons included that the forest was not handed to the actual user but rather they were handed to lower level political group so there was a lack of motivation among locals to protect the forest, and that the Panchayat had little incentive to properly manage and monitor forests since it was not the main user of those forests (Kanel *et al*., 2005).

2.5.4. Master Plan for the Forestry Sector (1988 onwards):

The first Master Plan for the Forestry Sector (MPFS) was prepared in 1988 and approved by the government in 1989. It detailed a 25-year plan for the forestry sector.

The long-term objectives of the MPFS (1989) were stated as:

- To meet people's basic needs for forest products on a sustained basis.
- To conserve ecosystem and genetic resources
- To protect land from degradation and other effects of ecological imbalance.
- To both conserve and use in a sustainable way biological diversity and genetic resources for the maintenance of prevailing ecosystems.
- To contribute to the local and national economic growth.

[1] "Conversion from other land uses into forest, *or* the increase of the canopy cover to above the 10% threshold" (FRA, 2000).

The main focus of this plan is to meet the local's basic demand regarding forest products. This plan recognized the importance of the community and private forestry to forest management and hence it emphasized the handover of forest management responsibility to local communities (Kanel, 2006).

The Master Plan emphasized on the establishment of Community Forest User Groups (CFUGs) as the appropriate local management bodies responsible for the protection, development, and sustainable utilization of local forests. This plan also made an operational forest management plan in which the permission of communities was required for handing over of forests for other uses. It also emphasized the need for forest service staff to act as advisors and to handover of all accessible potential forestland to local communities, rather than controlling and managing it themselves (Kanel, 2006). Thus "the formulation and implementation of the Master Plan is considered as a main turning point in the history of forestry sector policy in Nepal" (FAO, 2000).

2.5.5. Forest Act 1993 and Forest Rules 1995:

The Forest Act of 1993 incorporated the recommendations of the earlier Master Plan and gave substantial rights to local people in managing their community forests. The Forest Act of 1993 categorized national forests into five major sub-categories: (1) community forests (CF), (2) leasehold forests, (3) government-managed forests, (4) religious forests and (5) protected forests. CF was given the highest priority of all the other types of forest management, and management responsibility was placed in the hands of local user groups (Kanel, 2006). Unofficially CF has been defined as any form of forest activity undertaken by the local inhabitants to receive communal benefits from

the forest either directly or indirectly. Under this act responsibility is given to the government officer where District Forest Officer (DFO) has the right to hand over any part of the national forest to the communities that are the traditional users of those resources. Thus land ownership is maintained by the state but the land use right lies under the Community Forest User Groups (CFUG's) and all the management decisions, such as land and forest management are taken by them(Kanel, 2006)

In CF, each household in a community is recognized as a unit member and each has equal rights over the forest resources. Among the main benefits of this act are; (1) that CFUGs and forest handovers will not be affected by political boundaries, and (2) an outsider or someone who is not from that community will not be allowed to access the resources from that community's forest. Under this act there are mutually recognized user-rights and equitable benefit sharing provisions. However, in reality there have been some flaws with this legislation. As far as the management of the forest goes, the state provides technical assistance and advice to the local communities. Furthermore, there is no limitation of size of the forest tract to be handed over. Indeed, any size of forest tract with any number of household can be handed to Community Forest User Group (CFUG) (Acharya, 2002; Kanel, 1993 and Kanel *et al.,* 2005).

The Act identified a CFUG as a self-governed autonomous entity with authority to independently manage and use the forest according to an agreed management plan (Kanel, 2006). Thus, after the handover of a tract of national forest to one of the CFUGs, the user groups are recognized as independent, self-governing, autonomous and corporate bodies with management rights. This, in turn, provides strong incentives to

protect their forest as there is feeling of self-ownership and if they destroy forest they too will be affected by the consequences.

The Forest Rule of 1995 defined the user groups' responsibilities and their activities. Under these rules, for example, user groups are allowed to plant short-term cash crops like Non-Timber Forest Products (NTFPs, such as medicinal herbs). Similarly, user groups have the right to fix the prices of forestry products for their own use. They can also transport forest products under their jurisdiction anywhere in the country. They are allowed to accumulate funds received from the government or any other institutions from sale of forest products, and they can spend those funds in any community development work. An amendment to the Act in 1999, made it mandatory for a CFUG, invest at least 25 percent of its income in the development and conservation of the community forest. They can also change their operation plan after duly informing the District Forest Office (DFO). In the case of forest offences, the CFUGs have the right to punish their members according to their constitution and their operational plan. Thus this Act has more or less given absolute rights to CFUG's in managing their community forests (Kanel, 2006). Presently, community forestry is regulated by the rules derived from this act and if forest operations deviate from their operational plan (resulting in damage of the forests), then the DFO has the right to withdraw the community forests from the users. Thus, the legislation and the rules have been thought by some to be the most progressive ones in existence (Kanel, 2006).

The community forestry program has dramatically expanded in the past few years in terms of both physical areas under its jurisdiction and in number of forest lands actually handed over to local communities after its enactment (GoN, 1993 and 1995). To

date, about 1.1 million hectares of forest land or about 25 percent of the total national forest has been handed over to more than 13,000 CFUGs. This has resulted in benefits to about 1.4 million households or 35 percent of the Nepal's total population (Kanel, 2004).

2.5.5.a. Community Forest in Makawanpur District:

Over the time, the CF has been recognized as a nationally prioritized forestry program in Nepal (Khanal, 2002). The concept of the CF program had been adopted for the protection and management of forestland through local participation and many reports indicate that this program has indeed been successful in achieving its goals. According to survey records of the Forest Department (Table 2), the handover of forest land to locals has brought about a positive change in the forest condition of Makawanpur District (central part of Nepal).

Table 2

Comparison of forest conditions before and after handover of CF

Before hand over		After hand over	
Good	37 percent	Good	82 percent
Very Good	2 percent	Very good	14 percent
Worse	61 percent	Worse	4 percent

Source: Annual Report of CFUG's, District forest office, Makawanpur (2003/04)

Thus table 2 clearly indicates that handover of forest had positive effects in the forest land of Makawanpur District of Nepal. Opinions about the condition of forest improved as only 37 percent thought conditions were "good" before CF and this increased to 82 percent after handover. Those who thought forest conditions were worse decreased from 61 percent to 4 percent.

2.5.5.b. Survey Research:

For my own study in 2006, I conducted a survey in three CFs in the Makawanpur District. The sample population consisted of the households from the Community Forest groups and key people of community (i.e. the VDC chairman and the CF members). The key respondents and sample households were selected from each tole (street), which was further stratified based on socio-economic variables and then based on judgement sampling the sample units were selected from each stratum which is shown in Table 3 below.

Table 3

Information on the sample size of each CF selected for the study

Sample CF	Sample calculation	Sample Size	Total Number of toles/villages	Sample from each tole
Mahila Srijana	$n=\frac{338*1.96^2*0.98*0.02}{(338-1)*0.05^2+1.96^2*0.98*0.02}$	61	10	6
Neureni-Chisapani	$n=\frac{193*1.96^2*0.98*0.02}{(193-1)*0.05^2+1.96^2*0.98*0.02}$	26	2	13
Kalika-Hariyali	$n=\frac{201*1.96^2*0.98*0.02}{(201-1)*0.05^2+1.96^2*0.98*0.02}$	27	2	14

I interviewed community people (users); senior residents of a CF in the Makawanpur district about the change in forest condition, after its handover to the CFs and the responses were categorized into three categories i.e. Improvement, no change, and deterioration.

Table 4

Opinions about change in forest condition after hand over to CF

Condition of CF	Mahila-Srijana CF	Neureni-Chisapani CF	Kalika-Hariyali CF
	Percent respondent	Percent respondent	Percent respondent
Improvement	100	97	2
Deterioration	-	2	98
No Change	-	1	-

The result of this small survey clearly illustrates that after the handover of forestland to the local communities, people thought the forest conditions improved in all areas except the Kalika-Hariyali CF, which is likely due to the fact that it is open access. In the Kalika Hariyali CF, I must say that the forest quality is deteriorating due to institutional failure, lack of local access control, lack of effective enforcement and lack of awareness among the local community about the consequences of deforestation.

This new policy hands over land to the local communities for the management of the forest has proved to be one of the most important steps taken in the proper management of forestland. It is also true however that this policy is more effective in the hills and much less effective in the Terai region. Some of the main reasons for this are:

(1) even though the policy aims to be equitable in benefit sharing, in reality there has been a lack of equitable benefit sharing,

(2) a lack of awareness/consideration of principal causes of deforestation in the policy formulation process,

(3) sexual discrimination in the decision making process, and

(4) transparency (i.e. institutional failure due to lack of effectiveness in controlling the deforestation rate).

Hence, there is need of significant changes in various aspects of this forest policy. By the same token, people are unaware of the consequences of deforestation and thus less effort is given to the conservation process.

2.5.6. Forest Sector Policy 2000 (Recent policy initiatives):

This policy was formulated with an objective of providing a positive impact on the sustainable management of the Terai forestland. It reduces the loopholes that the earlier community forest plan had in its management system, and it provided for collaborative forestry management (Kanel, 2006). This policy is more focused than earlier plans on community empowerment and institution building for forest management and it emphasized community development rather than merely conservation. Some of the more salient features of this policy are (Kanel, *et al*., 2005, pp 72-73):

- For Sustainable Forest Management, The Terai and Inner Terai forests will be managed through Blocks formation and each block will be sub-divided into different compartments. The barren and isolated forestlands of these areas will be handover as community forests. Gradually all the open forest land and shrub land detached from large blocks of forests will be handed over to

CFUG. To avoid the loopholes in earlier policy, FUG will be formed from households residing near forests. Fuelwood and fodder will be made available to such groups at free of costs.

- The operation plan of CF will be prepared and forest production will be utilized based on annual increment and prescribed guidelines relating to the marketing of forest products. More opportunities will be provided for income generation activities.
- To improve forest and biodiversity a Collaborative Forest Management Approach would be applied.
- For program implementation, government will collect 40 percent of the earnings in the Terai, Siwaliks and Inner Terai, that is collected from the sale of surplus timber by CFUG after fulfilling the communities demand needs. At the same time more focus will be given to community and local development activities and for its implementation, 25 percent of income of the government managed forest will be provided to local governments (VDC and DDC) and the remaining 75 percent will then be collected as government revenue.

The Tenth Five-Year Plan (2002-2007):

The Tenth plan is the latest one following the Forest Sector Policy of 2000. This plan was prepared based on Millennium Development Goals, a part of the Poverty Reduction Strategy Paper (PRSP) with its chief objective to reduce poverty from 38percent to 30 percent by the year 2007 To achieve this main goal i.e. substantial, positive and sustainable change in living standard of Nepalese people, this plan basically

focused on the four main strategies : (a) sustainable and broad-based economic growth, (b) Social sector and infrastructure development, (c) create appropriate bases for the distribution of their opportunities to various sectors and classes and (d) Good governance (NPC, 2004). The main objectives of the Plan were to (Shrestha and Nepal, 2003- pp 202):

- "Manage and utilize forest resources in a sustainable manner while balancing environmental and socio-economic development;
- Promote the community and leasehold forestry development programs to generate employment for poor and disadvantaged groups;
- Increase private sector involvement in forest management;
- Stabilize the supply of various forest products in a sustainable manner and conserve or improve biodiversity; and
- Assist in the adoption of proper land-use practices."

Thus from this review, it is clear that many efforts have been taken to control the rate of deforestation but unfortunately, some of these efforts brought about further degradation. Currently CF has brought positive change to some parts of Nepal and has been recognized as one of the most successful approaches of the forestry sector. Due to institutional failure, however, there is some controversy about this policy in various part of the country. Many policies in the past have failed due to several loopholes (i.e. lack of participation and ignorance on controlling real causes of deforestation).

To resolves this issue, today new acts, 1995 seek to incorporate the local community, but forest degradation is still increasing in different parts of the country. This is primarily due to the fact that policy has been formulated without recognizing the demand for forest

products, dependency on forestland, and main causes of deforestation. As a result there is still a failure in policy, causing further deforestation. Thus in the next section of this study we attempted to identify those major real causes of deforestation in Nepal, so that policy can be formulated to control those real causes and reduce further deforestation.

CHAPTER 3: METHODOLOGY AND DATA

3.1. Variables Used and Hypotheses Assumptions:

To capture the cause and effect relationship between forest cover and the factors that contribute to its destruction, a simple linear regression model is developed.

$$y_t = \alpha + \beta_1 x_{1t} + \beta_2 x_{2t} + \beta_3 x_{3t} + \beta_4 x_{4t} + \beta_5 x_{5t} + \beta_6 x_{6t} + \beta_7 D + \varepsilon_t$$

Where,
y_t =The forest land cover in hectare.
α = Constant term
β_i = Slope of the parameters (independent variable co-efficient)
x_1 = Fuelwood production (cubic meter)
x_2 = Timber production (cubic meter)
x_3 = Price of kerosene ($/liter)
x_4 = Livestock size (no.)
x_5 = Industry (percent of GDP, US $)
x_6 = Net_migration (immigrants- émigrants in Nepal, Nos.)
x_7 = Social Unrest (Variable that controls social unrest in Nepal)
ε = Error term

The purpose of this model is to quantitatively assess the causes of deforestation in Nepal. The regression equation is estimated using Ordinary Least Squares Method (OLS) incorporating those factors that are thought to be significant in determining deforestation. Annual time series data on all dependent and independent variables cover the period from 1970 to 2006.

Dependent Variable:

As mentioned earlier this study attempts to assess the main cause of deforestation in Nepal. To assess this we used forest land cover in hectares as a dependent variable.

Forest land cover is the total land used as forest and data on forest land cover in different time periods was obtained from the World Bank (WB), Food and Agriculture Organization (FAO), Central Bureau of Statistics, Nepal (CBS) and Department of Forest (DOF). In most of these kinds of study the forest cover as a percentage of total land or the deforestation rate are used as the dependent variable, but due to the lack of availability of data, forest land cover is used as the dependent variable in this study.

Independent Variables Used and Hypotheses:

As Hill (1999) mentioned "Almost 90 percent of the people of Nepal depend on forests for fodder, fuelwood, food, building materials, medicinal plants, and fertilizers. Fuelwood provides 80 percent of the energy supplies of Nepal, and although fuelwood used in rural areas is seldom traded, there is significant demand in small urban areas that is met by traders who purchase fuelwood from rural collectors". In our study then fuelwood production is used as explanatory variable and the coefficient estimate, β_1 is expected to have negative sign since higher fuelwood production is connected to a decrease in forest cover. The fuelwood production data used for this study was obtained from the FAO and DOF. Fuelwood production rather than fuelwood consumption is used in this study. Since the Nepalese store fuelwood for future use, and hence fuelwood consumption value might not correspondent to the actual value consumed in that year.

As mentioned earlier the forestry sector makes a great contribution to the national economy. It has been argued that timber contributes billions of rupees to the national economy through its use in the national market as well as its export to the international market (India). The Government of Nepal has focused on developing the economy of the country, leading to excessive logging for purpose of increased trade. In addition to legal

logging, however illegal logging is also very common. Thus timber harvesting is one of the main causes of forest land reduction in Nepal and it is used as another explanatory variable in this study and β_2 is expected to have negative sign. The timber production data are obtained from the FAO and Timber Corporation of Nepal (TCN).

The main alternative for energy beside fuelwood in Nepal is kerosene. Almost 3 percent of fuel demand is fulfilled by kerosene alone, and an increase in income can create a shift from fuelwood use to that of better alternatives i.e. kerosene. Recently, however, oil price shocks in the international market have created a significant negative effect on the oil importing countries like Nepal which receive all of their fossil fuels and imports. This created huge scarcity and price rise in all petroleum products in Nepal. So, this has resulted in further deforestation, since for many the only affordable alternative available to fossil fuels now is fuelwood. The kerosene price shock is thus causing huge pressure in the forestland of Nepal and we include it as explanatory variable and β_3 with an expected negative sign. The kerosene price time series data is obtained from the Nepal Oil Corporation and the Department of Energy's Office of the Strategic Petroleum Reserve. The kerosene price is converted to US dollars based on the exchange rate in each period.

Locals mostly depend on forest resources for the fulfillment of their daily requirement regarding fuel wood and fodder. In the hills, livestock rearing is an integral part of their life. Excessive free grazing in the common forestland is very common, and this has created huge negative impact on forestland. The increasing population of livestock demand large quantity of grass and fodder resulting in forest degradation. Thus

the amount of livestock is negatively linked to forest cover so β_4 is expected to have a negative coefficient.

The Industrial value represents the total contribution of the industrial sector to total of GDP in the national economy. In Nepal, the main industries are: Tourism, textiles, jute, sugar, oilseed, cigarette, cement, brick production, tea, and medicinal plants. Tourism is one of the chief sources of income in Nepal. "Tourism has grown by more than 10 percent for most of 1980s. In 1985, more than US$40 million worth of foreign exchange was earned through tourism. In 1989, tourism accounted for more than 3.5 percent of GDP and about 25 percent of total foreign exchange earnings" (US library of Congress, 1991). Traditional cottage industries, including woolen carpets, garments, handicraft goods, basket-weaving as well as cotton fabrics and edible oil production account for 60 percent of the industrial output and are Nepal's largest exporting goods. Nepalese garment products and home-made material such as carpets and pashmina shawls are famous worldwide. Other important export goods are pulses, hides and skins, jute, steel utensils, cigarettes, beverages and sugar. Medicinal plants are another large export product to international markets, and exotic species such as *Yarsha Gumba* are very expensive. Thus most of these types of industries have no negative impact to the forestland as production of these goods doesn't cause clearing of forest land. Rather they have a positive impact, since the more people employed in the industrial sector the less unemployment and the less clearing of forest land for agriculture. So it is hypothesized the higher the industrial contribution to the national GDP higher is the forest land cover i.e. less deforestation and we expect that the industrial contribution coefficient β_5 will be positive. The data for this explanatory variable are obtained from the World Bank (WB).

Net migration is the difference between in-migration and out-migration of an area in a specific time period. Positive net-migration indicates that the country has more immigrants than emigrants and negative net-migration indicates vice versa. Due to various social, political and natural disasters there have been both huge in-migration (immigration) and huge out-migration (emigration) in Nepal. Only international migration however is considered for this study, which is the count of net in and out-migration from the country. Important causes of external migration from Nepal are poverty, civil unrest, an inequitable distribution of income, unemployment, difficult livelihood, and food insecurity (KC, 2003). The main reason for internal migration is business opportunities for foreign investors (mostly Indian). According to KC (2003), "Men are migrating to different countries in search of better opportunity and jobs, but leaving behind children, women and old people to take care of the agriculture land". "Of the total absent population from Nepal in the 2001 census, males comprised 89.1 per cent and females made up only 10.9 per cent" (CBS, 2002). About 70 per cent of the migrated population comes from the poverty stricken mountain and hill districts in the mid-western and far-western region of Nepal (CBS, 2002). In Nepal, women are the main user/collector of the forest resources. Left behind by the male members of their families has worsened women's living standard and created more pressure to the forest land. For them,(i.e. women, children and elders), the only source of living(income) is agricultural land, so there is always a tendency to overexploit forestland to increase agricultural productivity and claim private property. Similarly they solely depend on forest products to fulfill their fuel and fodder demand. However, the relation between the net-migration and forest cover is quite complex, and many believe that an increase in net-migration lead

to a reduction in the dependence on forest resources, less people less pressure on forest land. In Nepal, however, the situation is different, as mentioned earlier, even though with high net-migration, population reduced but the forest dependency has increased. For purpose of this study net-migration is considered to have negative effect to the forestland of Nepal, thus the sign of β_6 in this study is expected to be negative.

Civil unrest is now a major problem in Nepal which started since 1994 which is one of the major critical situations that Nepal is still going through. Since then there has been a civil war between the government and the rebel party. They were considered terrorists in the country and the army also launched a military campaign against them. The rebel group had autonomy control in the rural part of the country and they lived/hid in the forest for many years. The influence of this activity on the forestland is quite complex to answer. Since, on the one hand this rebel group might have an incentive to preserve the forestland to hide themselves, whereas on other had they might have an incentive to clear the land to use it for training camps. To control the rebel group's activities and their threat, the Nepalese Army cleared much of the forest land of Nepal, claiming that for security reasons it needed to be done. Thus the effect of the civil unrest to the forest land of Nepal is quite unclear which will be attempted to answer through this study. The social_unrest, a dummy variable, is used in this study to assess the effect of civil unrest to forest land of Nepal, as Hall and Asteriou (2007) mentioned a dummy variable "captures the qualitative effects of a situation by coding the different possible outcome with numerical value" (pp185). This is done by arbitrarily assigning the values 0 and 1 to two possible outcomes and in this study, a value of zero is assigned for the time period from 1970 to 1993 i.e. the period of no social influence of the maoist (null)

movement and the value 1 is assigned from 1994 to 2006 i.e. the period of social influence the maoist movement. So, the coefficient estimate β_7 can be either positive or negative as explained earlier.

CHAPTER 4: RESULTS AND DISCUSSIONS

The result of our regression model is presented in table 5 and discussed in this section. First, a multicollinearity test is done to check the correlation among the independent variable, which is presented in table 6. To examine the error conditions; serial correlation and heteroskedasticity test were also done and results are presented in table 7.

Table 5

Result of linear regression model

Variables	Coefficient	Std. Error	t-stat	(p-value)
Fuelwood	-0.000730	0.000244	-2.991891	**0.0057*** **
Timber	-0.001125	0.000266	-4.229175	**0.0002*** **
Kerosene Price	-0.850177	0.396481	-2.144310	**0.0408** **
Livestock	-0.000867	0.000496	-1.749471	**0.0912***
Industry	0.033589	0.017948	1.871453	**0.0718***
Net_migration	-1.237	1.801798	-0.686395	**0.4981**
Social unrest	-0.796570	0.174125	-4.574688	**0.0001*** **
No. of observation	**36**			
Degree of Freedom	**28**			
R-squared	0.956189			
Observed R-squared(*R^2)	0.945236			
F-statistics	**87.30**			**0.00000*** **

***significant at the one percent level

**significant at the five percent level

*significant at the ten percent level

4.1. Discussion:

Pindyck and Rubinfeld (1981, pp79) state that, R^2 measures "the proportion of the variation in dependent variable which is explained by the multiple regression equation, so it is often used as goodness of fit specification of the independent variable in the model". It is necessary to find out if the model is good enough to explain the causal relationship between the dependent variable and independent variables specified. So R^2 is often used to test the goodness of fit. There are, however, several problem associated with this, as it is highly sensitive to the number of independent variables added. To solve this issue the adjusted R^2 is considered rather than the simple R^2. Fortunately, the R^2 and adjusted $*R^2$ is very close in the model (Table 5), which indicates that about 95 percent of the change in the forest land is explained by the independent variables mentioned in this model. The R^2 alone however is not a complete measure of the validity of the model. To test the significance of the R^2, the F-statistics and p-value are also considered.

Pindyck and Rubinfeld (1981, pp81) state that "F-statistic with K-1 and N-K degree of freedom allows to test the hypothesis that the none of the explanatory variables helps to explain the variation of dependent variable about its mean". The high value of F-statistic (i.e. 87.3) (Table 5) compared to the tabulated F-critical (i.e. 2.36) allows us to reject the null hypothesis and conclude that the explanatory variables in fact explain the variation of dependent variable in this model. Similarly, a low p-value of the six independent variables, significant at the 1 percent, 5 percent and 10 percent level, out of seven indicates the likely significance of these variables as a whole in the model. Thus, it shows that the model accurately explains the variance for dependent variable.

Table 6

Multicollinearity test

	FUELWOD	TIMBER	KERSENE	LIVSTOCK	INDSTRY	NTMGRTN
FUELWOD	1.000000					
TIMBER	0.640500	1.000000				
KERSENE	-0.160147	0.021865	1.000000			
LIVSTOCK	0.074077	-0.344151	0.110365	1.000000		
INDSTRY	0.826010	0.415378	-0.505474	0.037777	1.000000	
NTMGRTN	-0.833218	-0.336468	0.186958	-0.409468	-0.717472	1.000000

Other independent variables might well affect the forest land of Nepal, but due to the multicollinearity issue and the unavailability of data, only the variables discussed earlier are considered for this study. The existence of multicollineraity among the independent variables makes it difficult to separate the impact of individual explanatory variables on the dependent variable. This can often cause unexpected coefficients on variable, low t-statistics (i.e. misleading high p-values) and large standard errors. So a multicollinearity test is done and only variables with less correlation among each other are considered. As we can see in the Table 6, the highest correlation coefficient (i.e. -0.83) exists between fuelwood and net-migration. Thus none of the variables have correlation coefficients of more than 0.83 percent which we believe is good for the model.

The link between forest cover, fuelwood and timber production, are each significant at the one percent level with negative coefficient sign as expected (Table 5). It was hypothesized that with an increase of forest product production there would be a decrease in forest land cover (i.e. more deforestation), so our assumption that forest land and forest product production negatively are linked are found to be significant. A one million cubic meters of production of fuelwood cause a decrease of 730 hectares of forest land whereas a one million cubic meter increase in timber production cause decrease of 1125 hectares. Thus even though, it is believed that fuelwood is the main culprit for deforestation in Nepal, our estimate result proved otherwise indicating that timber production is main culprit and has a stronger negative effect than fuelwood production.

The independent variable kerosene price is significant at the 5 percent level and the sign of β_3 is found to be negative, as expected (Table 5). This means that an increase in kerosene price leads to a decrease in forest land, in line with our hypothesis. In particular, an increase of a one dollar in the price of kerosene per liter will lead to a decrease in 0.85 hectares of forestland, implying that the current increase in kerosene price has caused a tremendous negative pressure in forestland.

There is significant link between the amount of livestock and forest land. The low p-value, significant at the ten percent level supports our hypothesis concerning the relation between livestock and forestland (i.e. that with an increase in livestock number there is decrease in forestland) (Table 5). The negative sign of β_4 indicates that with increase in livestock number there is decrease in forest land. With a one million increase in livestock number there is a decrease of 860 hectares of forest land.

The other independent variable, industry value added, is also significant at the 10 percent level (Table 5). Thus, as we hypothesized, there is a significant positive link between industry value added and forest land. The positive sign of β_5 (as expected) indicates that there is a positive link between industry value added and an increase in forest land cover.

Net-migration is another independent variable considered in this study. The high p-value of this variable, however, leads to a rejection of the hypothesis and indicates no significant link between net-migration and forestland (Table 5). As mentioned before, the relationship between net-migration and forestland is quite complex even though we initially hypothesized a negative link. The β_6 sign was thus expected to be negative. The variable was found to be insignificant but the negative sign of the coefficient is obtained as hypothesized. This indicates that there is likely to be a negative relation between net-migration and forest land though we cannot say so with any kind of statistical certainty.

To address the effect of a social factor like civil unrest on forestland we chose social_unrest variable in this study. The low p-value of the social unrest (Table 5) indicates significance at the one percent level. Furthermore, the negative sign of β_7 indicates that there is a significant negative link between civil unrest and forestland. In other words, social unrest was responsible for negative impacts on the forest land of Nepal.

Thus in this study both positive and negative variables are used. Three out of seven variables used are significant at one percent level, and the other three are significant either at five and ten percent levels. This confirms that the incorporated

explanatory variables are in fact major factors affecting forest land of Nepal, and that all the signs of the coefficient estimates are as expected.

Table 7

Serial correlation LM test and white heteroskedasticity test:

Breusch-Godfrey Serial Correlation LM Test		White Heteroskedasticity Test	
F-statistic: 1.296378	Probability : 0.2665	F-statistic: 2.762026	Probability: 0.02011
Obs*R^2: **1.814132**	Probability:**0.178**	Obs*R^2: **21.83680**	Probability:**0.05794**

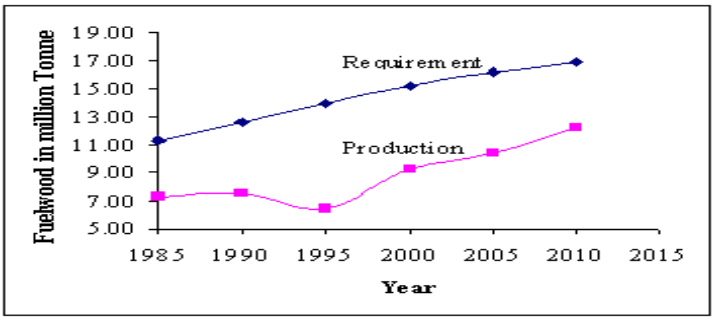
For the regression model to be accurate we assume that there is no serial correlation or heteroskedasticity in the model and that all errors are normally distributed. Violations of these assumptions lead to bias and misleading results. Hence, a serial correlation test and a heteroskedasticity test are done to assure the validity of the results. There are several methods available to test for the serial correlation. For this study, however, we used the Breusch-Godfrey LM (Lagrange Multiplier) test. The statistical Chi-Square (χ^2) is calculated to be 1.81 (Table 7) and tabulated χ^2 critical 12.59. The high tabulated χ^2 critical value compared to statistical χ^2 and high p-value of the test i.e. 0.18 (table 7) conclude that one cannot reject the null hypothesis of no serial correlation in the model. For the white heteroskedasticity test, the relevant p-value is 0.06. This value indicates that we cannot reject the null hypothesis of no heteroskedasticity, at the 5 percent significance level.

4.2. Consequences:

The most immediate consequences of deforestation in Nepal is at the local level as most people directly depend on the forest for their daily requirement regarding fuelwood, timber and fodder. Deforestation also has a significant impact on biodiversity which is of global significance and land degradation. Thus the impact of deforestation is at local, national and global level.

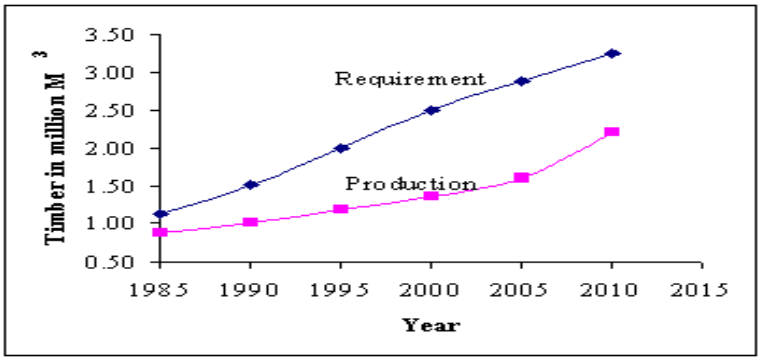
4.2.1. Decrease in fuel wood and timber productions:

The firewood and timber deficit was estimated to be 2.6 million tons and 0.25 million cubic meters per year respectively in 1988. This increased to 3.5 million tons and 1.2 million cubic meters respectively in 2000 (Master Plan, 1988). Most households in developing countries resort to freely gathered biomass fuels (World Energy Council and FAO, 1999) and this deficiency creates huge negative impacts on rural population. Furthermore, this negatively impacts mainly females as it increases women's labor time since they spend more time looking for fuel wood, fodder and grasses. The ratio of firewood demand to supply is estimated to be 2.3:1 in the Mid Hills and 4:1 in the drier Far-western Hills (Blaikie, 1988).



Source: MPFS 1988

Figure 5. Requirement and production of fuel wood.



Source: MPFS, 1998

Figure 6. Requirement and production of timber.

Nepal's increasing population has increased the demand for forest products and as this trend tends to continue in future. It is forecasted that requirement/demand will be higher than supply/production as shown in figure 5 and 6. Due to product scarcity, the resulting price increases lead to more negative effect among the poor rural population. Similarly there is likely to be increases in the illegal logging and theft causing further

deforestation since a majority of the rural poor depends on fuelwood as their main source of energy and alternate income.

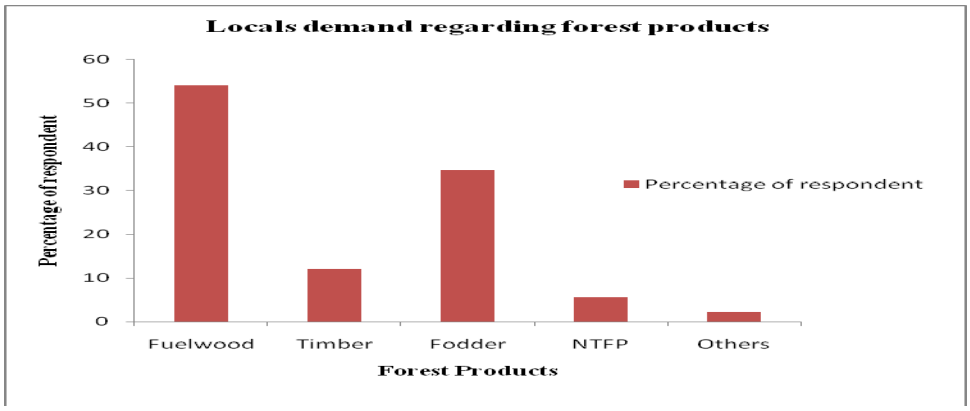
4.2.2. Decrease in agricultural productions:

Kumar and Hotchkiss (1988) analyze the consequences of deforestation in Nepal on agricultural production and nutrition in the hill areas. Agriculture still remains as a major economic activity in Nepal. It contributes about 60 percent of national GDP and is an important factor in the livelihood of more than 90 percent of its population (Gunnig, 1991). Due to the low income of the population and the low productivity of the land (except in the Terai region), a majority of people collect leaf litter from the forest and compost it for agricultural use as fertilizer. However, degrading forest resources and increasing the difficulty of obtaining fuelwood and fodder have significant negative impacts on the farming system through the reduced availability of biomass for compost. Degrading the forest also leads to the use of manure for fuel rather than organic fertilizer and results in declining soil fertility (Hill, 1999). Thus deforestation has negative impacts both on the agricultural production and on land quality as people shift to chemical fertilizers in an effort to increase production.

4.2.3. Decrease in fodder productions:

Beside fuelwood, fodder is another major product taken and consumed from the forestland of Nepal. About thirty seven percent of total fodders demands are fulfilled from the forest land of Nepal (FRA, 2000). “The major source of leaf fodder in Nepal is from the forest” (Joshi, 1992). The survey result of Mahila Srijana CF is shown in figure 7, which shows that locals depend heavily on forest to fulfill their demands regarding

fodders as livestock rearing is very common. The main source of food for these livestock is forest leaf products i.e. fodder.



Source: Field Survey, 2006

Figuire 7. Local forest products demand in Mahila Srijana CF.

Livestock make a substantial contribution to the livelihood of households and currently help to sustain an estimated 700 million rural poor living in various developing countries (Maltsoglou and Taniguchi, 2004). Livestock population is increasing at the same rate as the human population creating a huge demand for fodder. Hence, high deforestation and an increased number of animals used as livestock has created a huge scarcity of fodder. Thus deforestation has had a negative effect on the rural population of Nepal and their income, making the rural population's living standard even worse since most of their income comes from cattle grazing.

4.2.4. Natural Disaster:

Deforestation has also contributed to the natural disasters such as severe soil erosion, landslide and floods in Nepal. This occurs every year particularly in the rainy season leading to floods in the Gangetic plain of India and Bangladesh killing thousands of people. Due to andslides and floods, tens of thousands of cubic meters of topsoil are washed away by rivers and streams from Nepal and are deposited in the Bay of Bengal (Shrestha, 2004). Annual soil erosion due to over grazing alone is estimated to be 35 metric ton per hectares of land (Mathema, 2006). The survey conducted on local communities in the Kalika hariyali area and in the Mahila Srijana CF of Makawanpur District Nepal, regarding the effect of CF on natural disaster is presented in table 8. Respondents indicated that deforestation in Kalika Hariyali area has increased the intensity of erosion and river cutting whereas in Mahila Srijana area due to improved forest land condition there has been control/reduction in severity of these kinds of natural disasters. In Mahila Srijana CF, 63 and 78 percent of respondent indicated that there is control in erosion and river cutting problems respectively.

Table 8

Opinions about natural disaster control in CF

Natural Disaster Control	Mahila-Srijana CF		Kalika-Hariyali CF	
	Percent Respondent		Percent Respondent	
	Yes	*No*	*Yes*	*No*
Erosion	63	37	9.8	90.2
flooding/river cutting	78	22	14.8	85.2

Deforestation and forest degradation have resulted in significant localized erosion and led to a loss of farmland through landslides and decreased productivity (through the loss of topsoil and downstream siltation effects) (Hill, 1999). It is estimated that about 1.8 million hectares (13 percent) of the land in the Mountains is severely degraded by landslides (CBS, 1998) and flood. The total land affected by landslides and floods is shown table 9:

Table 9

Land area affected by floods and landslides in Nepal (1984-2000)

Year	Land Affected (Ha)	Year	Land Affected (Ha)
1984	1,242	1994	1143
1985	1,355	1995	41867
1986	1,315	1996	6846
1987	18,858	1997	6063
1990	1132	1998	327
1991	283	1999	182
1992	135	2000	889
1993	5584		

Source: Disaster Review, 2000 and Poudyal *et al*., 2001

In 1987, due to torrential rain for several weeks, extensive flood and landslide reported throughout the country particularly in central and Terai districts and central hills (UNDRO, 1987). Outburst of Sunkosi landslide dam and Kaligandaki glacial lake also occurred during this year (Khanal *et al.,* 2007). All these activities created huge negative

effect on large portion of land. Each year, huge amounts of land are being wastes away due to landslides and flood. Landslides and floods not only cause negative environmental impacts on the land, but they also are responsible for huge losses in terms of human life, animal life and property damage as shown in table 10:

Table 10

Loss of lives and properties by floods and landslides in Nepal (1994-2000)

Description	Unit	Years						
		1994	1995	1996	1997	1998	1999	2000
Dead/missing	Nos.	49	203	258	78	273	241	390
Injured	Nos.	35	62	73	21	80	92	162
Affected families	Nos.	3,826	28,973	37,096	5,648	33,549	9,424	24,900
Animal losses	Nos.	256	3,150	1,548	103	982	460	1,017
Houses destroyed	Nos.	894	22,251	28,432	1,790	13,990	3,807	6,886
Cattle shed destroyed	Nos.	19	252	684	137	1,244	128	540
Total estimated losses	$(millions)	13.4	27.5	208.7	1.6	29.7	5.4	1.58

Source: Poudyal, Chhetri and Bhattarai, 2001

In 1996, an outburst flood swept away Larcha River dam and bridges, causing huge financial and economic losses (Khanal *et al*, 2007). According to the Ministry of Home Affairs, in an average year, 300 lives are lost annually, 8600 homes are washed away and 12,000 to 15,000 hectares of arable lands are washed away in Nepal by landslides and floods (NPC, 1991).

4.2.5. Decrease in Biodiversity:

Nepal occupies only 0.09 percent of the total earth surface but it is ranked as having 10th richest reserves of flowering plants (BPP, 1995). In the world scale it is placed 31st (Caldcot *et al.,* 1994) and most of the species found here are globally endangered with over 500 of them cited in the Red Data Book of the Fauna of Nepal (Hill, 1999) having a high risk of local extinction. Due to deforestation there is significant harmful impact in this biodiversity and it needs to be mitigated urgently. A prediction has been made that if Nepal were to lose its remaining humid tropical forest, there would be an accompanying loss of ten species of highly valuable timber, six species of fiber, six species of edible fruit trees, four species of traditional medicinal herbs and some 50 species of little known trees and shrubs. This in turn would severely alter the habitat for 200 species of birds, 40 species of mammals and 20 species of reptiles and amphibians (HMG/IUCN, 1988). Thus, deforestation has not only affected human life and property but it has created a significant negative impact on biodiversity as well.

CHAPTER 5: CONCLUSION

The forest is one of the most important common property resources available in Nepal. It is being destroyed due to various reasons leading to many negative consequences. Nepal is a country with extreme poverty where the majority of people depend on forests for their daily needs ranging from fuel wood to food as well as a supplement of income needs. Due to the increasing demand for forest products, the rate of forest land reduction is rapidly increasing and political turmoil in the country is making the scenario even worse.

Malla (2001, pp303) mentioned for sustainable forest management "we need to reconsider the whole approach of looking at the forest, the people, the policy, and the implementation of policy on the ground" as well as to identify its major causes and incorporate these in the policy making process. Thus, for a solution of the deforestation problem in Nepal, policymakers first need to develop and understand the root causes of deforestation, as well as the various stakeholders' social, economic, and political objectives. The policy should then incorporate laws that control the real causes of deforestation without hampering the fulfillment of local demand. As Panayoutou and Sungsuwan(1994) pointed out, "unless the root cause of deforestation is known and understood, we will be treating the symptoms with little hope for sustainable improvement". Thus, in this study the effort has been taken to identify those major causes and based on the socioeconomic, physical and political situation of Nepal, the main driving force of deforestation in Nepal is found to be the increased demand for forest products combined with social unrest. The major root causes found to be timber,

fuelwood production, the kerosene price, social unrest, livestock, and industry value added that are all significant variables when evaluating the problem of forest land reduction in Nepal. Amongst all the independent variable incorporated, social unrest is found to be the most significant variable that is negatively affecting the huge forest land in Nepal. In addition, timber production is found to be major culprit in the forest land reduction compared to fuelwood production. Recent kerosene price rise and increasing population of livestock are other significant factors that are tremendously affecting the forestland. Industry value added is however making the scenario comparatively better as increase in industry value added is causing positive effect in forest land cover of Nepal. Thus, policies to control deforestation should directly target these factors if successful outcomes are to be achieved.

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Department of Forest. http://www.dof.gov.np/

Disaster Management. http://dpnetnepal.tripod.com/id12.html

Federal Reserve. http://www.federalreserve.gov/releases/

Food and Agriculture Organization. http://www.fao.org/corp/statistics/en/

Forestry Nepal. http://www.forestrynepal.org/

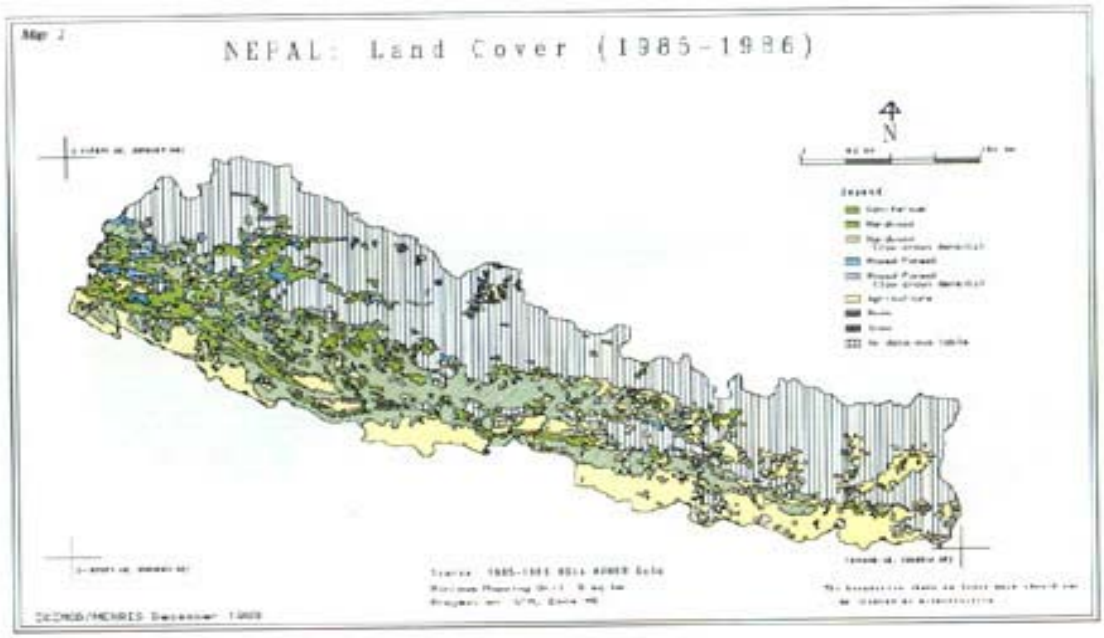
Nepal Oil Corporation Limited. http://www.nepaloil.com/

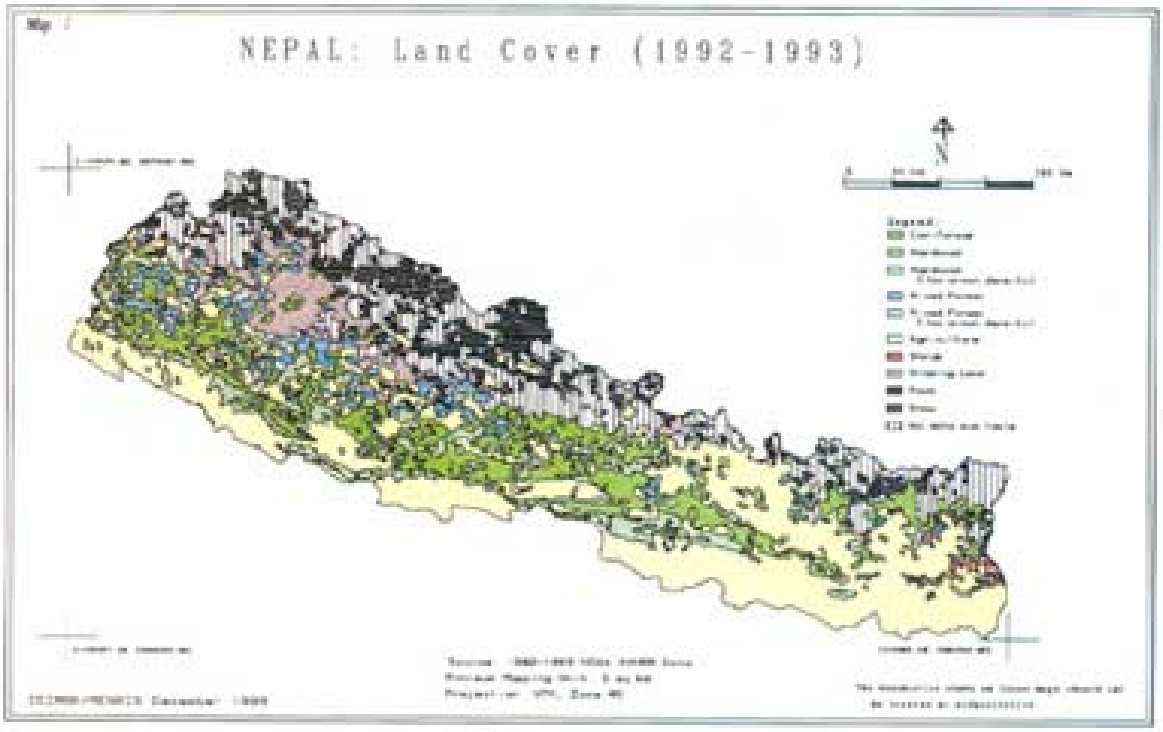
The World Bank. http://devdata.worldbank.org/dataonline/

UNEP. http://www.rrcap.unep.org/reports/soe/nepalsoe.cfm

Direct causes of deforestation.
http://www.wrm.org.uy/publications/briefings/underlying.html#direct

APPENDIX A: LAND COVER MAP OF NEPAL (1985 AND 1992)





Source: Shrestha (1994), UNEP Environment Assessment Programme - Asia Pacific

APPENDIX B: DESCRIPTIVE STATISTICS

	TIMBER (1M m^3)	FUELWOD (1M m^3)	FOREST (1M ha)	LIVESTOCK (1M nos)	Social-Unrest	INDUSTRY (Percent)	KERSENE (US $ per liter)	MIGRATION (1M nos.)
Mean	748.4444	12206.97	5.182139	72.59158	0.305556	15.70255	0.33355	-0.084971
Median	565	12353.48	5.52	38.866	0	16.20233	0.351222	-0.09827
Maximum	1260	12762.68	6.17	318.6	1	22.9161	0.659023	-0.005799
Minimum	560	11167.77	3.636	0.089	0	8.176456	0.158668	-0.163523
Std. Dev.	300.4667	465.2939	0.838585	95.85395	0.467177	4.632086	0.117075	0.046019
Skewness	1.133825	-0.736675	-0.88818	1.869286	0.84423	0.087334	0.463209	0.443528
Kurtosis	2.315806	2.383009	2.131367	4.899269	1.71272	1.878026	3.090982	1.980789
Jarque-Bera	8.41553	3.827162	5.864954	26.37621	6.76197	1.934001	1.299793	2.73849
Probability	0.01488	0.147551	0.053265	0.000002	0.03401	0.380222	0.5221	0.254299

1M=1 Million

m^3=cubic meter

Ha=Hectares

Nos.=Number

1Liter= 0.0085 barrels