

## The Study of Shivapuri Water-shed Environment: An Evaluation of Socio-Economic Impact

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### INTRODUCTION

Deforestation is recognized as a pressing problem by the concerned authorities about energy supply and demand in rural areas and in particular hill areas of Nepal. They are of the view that the heavy dependence on forests as a source of energy in the hill areas is causing severe pressure on the existing forest resources to the extent where it cannot sustain itself. In this context Nepal stands as a country where the depletion of forests has become very critical. This paper employs a micro approach concentrating on Shivapuri area to discuss the issue of deforestation from the perspective of fuelwood, fodder and manure.

Factors other than overcutting of trees for energy are considered to be responsible for deforestation, such as expansion of agricultural land, overgrazing and logging. But most of the discussions of hill energy tend to focus firewood consumption as a main reason for deforestation. We are of the view that the primary cause of deforestation in rural areas of the hill region are commercial activities, pressure to extend agricultural land to avert food deficit problem, economic hardship, need to sell firewood in the urban areas and cutting trees for firewood. Side by side the population explosion on the one hand and the rapidly increasing cattle population on the other are contributing to deforestation in one way or another. Deforestation leads not only to the shortage of energy in the hills but also creates environmental imbalances.

These issues are examined in this paper. The analysis is based on field work done in the year 1982/83 in the Shivapuri area. Field work was done in Jhor, Mahankal, and Tokha Village Panchayats. The village study approach is employed here to illustrate the diversity and complexity of the resource utilization pattern in the study area. Such micro studies, we hope, will provide information to formulate appropriate policies both at micro and macro levels.

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## INTRODUCTION OF THE STUDY AREA

Shivapuri is the second highest peak situated in the northern site of Kathmandu Valley. It lies between 85°16' to 85°30' east longitude and 27°45' to 27°50' of north latitude. It covers an area of 54 square kilometer with a circumference of 640 kilometer. The population in the panchayats under study totals 11,220.

The altitude of the study area differs at various parts and it ranges from 6,778 ft. to 8,962 ft. above the sea level. The northern half of the land slopes towards the west and according to the residents of this area, this part do not get enough sun. In order to take maximum advantage of the cultivable area houses are usually built in the higher elevations and lower elevations are used for cropping. The houses are separated from each other leaving sufficient space around the house for planting vegetables.

The study area is bounded in the north by Likhukhola of Nuwakot district. In the south it is separated from some panchayats of Kathmandu viz.; Sundarijal, Jhor, Tokha, Mahankal, Budhanilkantha etc. In the east it touches Manichure and in the west it is bounded by Kakani of Nuwakot district. Subsistence agriculture is the main livelihood of the people even among the occupational groups. Monetized activities are minimum. The main objectives of most of the households is to acquire sufficient land to support the food requirements of the family. The forests provide fuel as well as poles for the construction of the houses.

As Nepal is rich in mineral resources, granite and mica are specially found in Shivapuri. The presence of Lomy sand, sandy loam, sandy clay, loam and loam types of soils have been suspected at many places. Often there are fear of occurrences of land slides due to the acidic nature of the soil.

The main rivers and streams that originate from Shivapuri are Bagmati, Nagmati, Slamati, Vishnumati, Alle Khola, Kateri Khola, Bhandari Khola, Kolpu Khola, Bade Khola, Dhobi Khola, and Mahadeva Khola. In the Shivapuri watershed area there are six water reservoirs drained in Bagmati, Mahadeva Khola, Bhishnumati, Bhandari Khola, Kateri Khola and Kolpu Khola. Besides these there are two water falls one in Shivapuri and another in Taragoun.

The main plants of the forest of this area are Schima Wallichii (Chilaune), Castonopsis Indica Pines, Roxburghie, Alnus, Nepalensis, Quercus lanta, Quercus gealla, Lyonia and Rhododendron arborium.

## METHODOLOGY

The effect of grazing is considered here because livestock is important to the rural economy of Shivapuri not only as a support to the pattern of cultivation (bullocks for ploughing and animal dung for fertilizer) but also to provide milk and meat (mainly cows, goats, sheep, pigs etc.) as dietary supplement. Grazing of livestock in the forest is practiced.

The supply of fodder is derived from weeds growing on fields, stubbles, agricultural residues and leaf fodder exerting impact on deforestation.

The present study assumes that average consumption of wood per capita multiplied by total population equals total wood requirements, the requirements are all derived from forests and the present trend of fuelwood consumption indicated whether or not there is adverse impact on the forest of Shivapuri. To estimate the wood or energy requirements we use the fuelwood per capita consumption as estimated by Resource Conservation and Utilization Project, Nepal. To estimate the fodder requirements we use the same procedure taking into account the per live stock unit nutrition requirements.

Homestead surroundings provide Jhikra which includes usable portion of old wooden fences, dried bamboo pieces and agricultural residues such as maize stalks and coves. Though the major source of fuelwood is what is collectively known as Daura.

All the relevant information on the part of energy, fodder and manure requirements were collected through a structured pretested questionnaire. Simple random sampling method without replacement was employed to select the households to be interviewed. 90 households were selected, 30 from each panchayat, to meet the specified objectives.

#### ENERGY NEED IN SHIVAPURI AND ITS IMPACT

Energy need is determined by both the end use and the efficiency of use. As Shivapuri has a subsistence agricultural system with commercialization the fuelwood and relative ease of access to sources of fuelwood, income, education and land holding levels do not directly influence the demand for fuelwood. But instead, the demand is determined by how much can be acquired without having adverse effects on agricultural domestic schedules. Therefore, family size, access to forest and distance to fuel sources are the important factors determining the demand.

Fuelwood for cooking is required for regular meals twice a day and preparation of Khole (a warm, soupy mixture used to supplement fodder for livestock). Firewood is also needed for space heating specially during winter. Fuelwood has been the sole source of the energy in the study area.

Estimates of the fuelwood needs are revealed by the interview with ninety households. In interviewing the household, type of fuelwood (Daura and Jhikra), place of collection, time of collection and amount collected were asked. From the study we find that 1222.5 Metric Tons fuelwood were consumed by ninety households. Of that amount 23.8 percent (291.0 M.T.) is derived from Jhikra and rest from Daura. The levels of consumptions of fuelwood are treated as levels of fuelwood need in the sample panchayats.

As in the developing countries of the world, the demand for energy in Nepal is increasing at a very faster pace. Out of the total consump-

tion energy in Nepal more than 85 percent is provided by fuelwood, 6 percent by petroleum product, 1 percent by hydro-electricity and the rest by other sources. As more than 85 percent of the total energy consumed in the country is used for domestic cooking, fuelwood is used overwhelmingly for such cooking. It has been estimated that the per capita consumption of fuelwood in Nepal is 0.5202 M.T.

The per capita demand for fuelwood in the study area is found to be 1.7267 M.Ts. Which is about 3 times greater than the national per capita demand. On the contrary, the per capita demand for Daura and Jhikra are found to be 76.2 and 23.8 percent respectively. The high demand compare to the national figure is quite natural because people of the study area have not realized yet the necessity of economizing the consumption of energy. Despite the recent attempts of the concerned agencies to limit and control the movement of people in forest, the concept of free access still prevails. The need for energy has not yet been suppressed by resource constraints. People are collecting as much fuelwood as they need in such a way as not to conflict with their other activities. Fuelwood is also sold by the people of this area in the markets of Kathmandu, that is why the average per capita demand for fuelwood is quite high. The following table shows the number of dependent population in Shivapuri forest and number of livestock unit.

Table 1  
People and Livestock Unit\* Dependent on Shivapuri Forest

Population	.....	31090 <sup>1</sup>
Livestock Unit	.....	94363.69 <sup>2</sup>

1. Compiled from the population Census 1981.
2. Field Survey.

Conversion

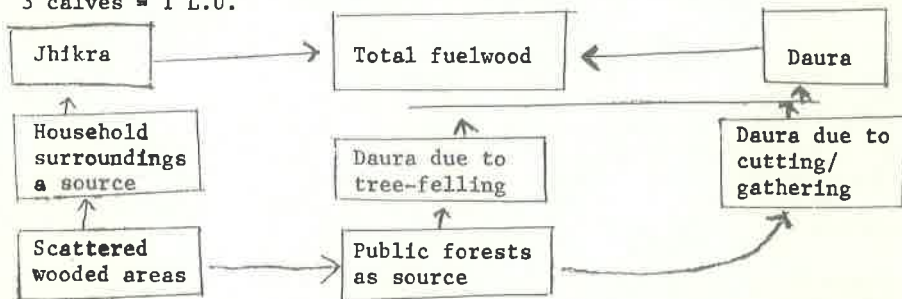
\* Sited from RCUP annex  $\frac{1b}{8}$ , Vol. III, 1979.

1 buffalo = 1 Livestock Unit (L.U.)

1 cow = 0.7 L.U.

10 sheep or goat = 1 L.U.

3 calves = 1 L.U.



The fuelwood need of the study area is met by the 89 percent public forest area of 85 sq. km. of the Shivapuri. The availability of forest resources to the communities is found to be variable. The general tendency of the villagers is to go from the settlement area to the nearest section of the Shivapuri forest. Different households indicate different areas of Shivapuri where they go more frequently than others, and people from different clusters go to more than one area of the forest.

In the study area almost 99 percent household were found using forest as the sole source of energy. The use of coal was found non-existent. Dung was found being used to prepare compost manure only. As electricity is not sufficiently available in the study area, each household was found using about 3.07 litre kerosene oil to meet the light demand in the night. The trees that are usually cut down for fuelwood were found to be Quercus, Seme Carpifolia, Lycnia and Rhododendion etc. During the winter each household reported the collection of ten bharies dry leaves both for the purpose of compost and firing. Mostly the gathering of fuelwood is during January to April and the consumption of fuelwood relatively higher during winter.

Table 2  
Population and Energy Requirement

Interviewed households	.....	90
Total Population	.....	708
Energy requirements	.....	1222.5 M.T.

Source: Field Survey.

The above table reveals that the energy requirements of the study area is quite high compared to the national average. It is quite obvious that people of this area supply firewood in Kathmandu. But the above estimates focus only on the collection of fuelwood per household from Shivapuri and it was not identified how much they collect for home consumption and how much for sale.

#### FODDER DEMAND AND ITS IMPACT

Crop residues contain a substantial portion of fodder supply in the study area. Maize and millet straw supplies a significant amount of total roughages and is fed to livestock mainly buffalo and cattle. Wheat straw is usually not fed in this area and is mainly used for roofing.

Farmers collect annual grass and weeds from crop field, bunds terrace slopes and road sides during the main crop season of 120 to 150 days. Usually, such collected green matter is fed only to productive animals such as milking and draft animals. It is the major contributor and provides more total digestible nutrition (TDN) than crop residues.

Contribution of leaf fodder from crop-land zone is negligible in Shivapuri area. Farmers generally have fodder trees around homestead and on the bunds of upland field lopped from the middle of November to April and the major portion of this is fed to goats and buffalo. Forest and open pasture land in Shivapuri area shares about 60 to 90 percent of the total available total digestible nutrients depending upon forest condition and nearness to village. There seems to be positive correlation between the number of livestock unit per household increases the dependence on forest grazing. Average livestock per household in Shivapuri is found to be 2.67 oxes; 6.73 cows; 2.2 calves; 7.17 buffalo; 8.63 poultry, 8.6 sheep and 5.6 goats. The following table shows the total cattle population of Shivapuri area which solely depend on Shivapuri forest.

Table 3  
Total Cattle Population of Shivapuri

Cattle	Per Household	Sample* Households	Shivapuri* Area	Livestock Unit*
Ox	2.67	240.30	14754.42	10328.09
Cow	6.73	605.70	37189.98	26032.86
Calf	2.20	198.00	12157.20	4052.40
Buffalow (Female)	7.17	645.30	39621.42	39621.42
Buffalow (Male)	1.17	105.30	6465.42	6465.42
Coat	5.63	506.70	31111.38	3111.14
Sheep	8.60	774.00	47523.60	4752.36
Total				94363.69

\*Estimated with the knowledge of per household cattle population and number of households.

Farmers collect grass and weeds from forests and open grazing land depending upon nearness to the village. Farmers collect as much fodder from Shivapuri as much they require. The table of total digestible nutrients (TDN) availability in the green grass and leaf fodder is as follows:

Table 4  
TDN Availability in Green Grass

1 kg. Green Grass = 0.52 kg. TDN

1 kg. Leaf Fodder = 0.905 kg. TDN.

For one livestock unit 1.58 M.T. TDN is required per annum. Therefore, as a whole Shivapuri area TDN requirement is 149094.63 M.T. for 94363.69 livestock units. As evident from the above analysis total livestock units dependent on Shivapuri forest is 94363.69. To meet the per livestock TDN requirements leaf fodder has been a significant unit. Major portion of the leaf fodder comes from Shivapuri forest. These are lopped haphazardly and continuous lopping given no chance for regrowth. In general leaf fodder production in forests is four/fifth of the total fodder leaves consumed.

Grazing in open barren land and forest land in the Shivapuri provides nearly 90 percent of the TDN depending upon the accessibility in the forest. The daily green matter availability per livestock unit from grazing land is estimated to be 15 kg. per day from May to October and 8 kg. per day from November to April. During the non-milking time cattle are left free to the Shivapuri forest for grazing. Sheep and goats get their nutrient by grazing during both Summer and Winter. For the cattle about 24 Bhari (about 1080 kg.) green grass are required to each household daily. This is clear from the following table:

Table 5  
Green Grass Requirement Per Day

Cattle	Average per Household		Green Grass Required in Bhari* (Summer)
Buffalo	7.17	7	14
Cow	6.70	7	6
Ox	2,60	3	4

Source: Field Survey.

\*According to local people one Bhari green grass contains 45 kg.

In general, the source of green grass is Shivapuri forest. Fodder is also used to prepare compost manure. The per household demand for fodder from Shivapuri forest is eight bhari per day during summer.

Thus, it is clear that for 5526 households of the Shivapuri area solely depend for fodder, green grass and grazing land and livestock seems to be the major occupation as per hectare crop yield is very low.

#### LAND PRODUCTIVITY AND ITS IMPACT

Maize, millet and wheat are the main agricultural production of this area. Maize is the major staple crop and rice is virtually non-existent. Yields per hectare of maize, millet and wheat are estimated from interview responses. Results show that factors such as soil quality irrigation facility and organic manure input influence the yield. It is assumed that among the households in the same general area, the uniformity in yield is greater. The following table shows the average grain yields per hectare of the study area.



Table 6  
Average Grain Yields

Crop	Yield (kg/ha)	
	Shivapuri	Nepal (1982/1983)
Maize	590.65	1406.19
Millet	279.28	937.73
Wheat	383.07	1369.14

Source: Field Survey and Economic Survey (1982/1983).

The average grain yields are very low compared to national figure. As the per hectare grain yield is very low, it can hardly provide subsistence to the people of this area. Therefore, animal husbandary has been a prominent occupation. The Shivapuri forest facilitates for the animal husbandary of this area. The food needs created by low productivity of the land exerts negative impact on the existing forest. The mean level of the grain consumption in the Shivapuri area are reported to be very low compare to the national level. The National Planning Commission Study estimates about 220 kg/year to derive 2256 cal./day. But in contrast to this generalization the per capita consumption in this area is very low. Another important thing we found is that the diet of the people of that area do not contain rice. Maize and millet constitute almost 85 percent of their diet. The composition containing greater proportion maize and millet may be seen as an indication of forced reliance on land of low quality. In producing maize, millet, wheat and other vegetables only compost manure is used. The existence of chemical fertilizer is virtually nil either by ignorance or by the income constraint. As only compost manure is used the demand for leaves from the forest is very high. The following table shows the use of manure for different crops:

Table 7  
Use of Compost for Different Crops

Crops	Compost	No. of Responses	Leaf for Compost (in Bhari)
Maize	707.28	90	2829.09
Millet	471.51	90	1886.04
Wheat	589.38	75	2357.52

Source: Field Survey.

N.B.: 1 Bhari of compost manure requires 4 Bhares of green leaves.



All the dung from the livestock are used as manure not as energy. Thus dung constitutes a substantial portion of manure supply in the study area. According to one estimate per kg. manure produces 0.175 cereals.

#### CONCLUSIONS

Fuelwood is the need for the growing population in the Shivapuri area as no substitute fuel for them has been provided. There is an increasing pressure on these forests, due to this increasing need, and as a consequence deforestation is increasing. Grazing is a problem. The cattle population of the surrounding communities has access to the forest grazing land but the increasing number of cattle population is affecting the grazing schedule and has adversely affected the afforestation and regeneration programme.

The pressure of increasing food problem has led to a situation when people are clearing forests land to expand agricultural land. With the increase in population, there is a continuous increase in the demand for fuelwood. The demand for fuelwood is alarming during winter. To have more forest produce, the economic condition of the community depending on the Shivapuri forest have to be materially changed and the dependence on forests is to be reduced. If villages are provided alternative means of livelihood through small scale industries, the proper utilization of forests can be stepped up considerably.

For the surrounding communities as well as for environmental protection there is need of integrated development of the communities in this region which means equal emphasis on agriculture, livestock as well as forests. The changes brought about by population growth and some physical development in this area may affect the ecological system in various parts of Kathmandu and Sindhupalchok. There is a serious need to protect the natural environment of the surrounding area of Shivapuri. But it has so many dimensions that its protection always requires strong and wide ranging administrative actions. More important and crucial may be the assessment of individual and collective requirements of the people living in this area, which may bring change in the environment of the Shivapuri region. As revealed by the study, the prospect of afforestation are bright because when the villagers were asked what they would do if the forest extincts, the answer from 94.5 percent households was uniform that they would plant trees for fuelwood and reduce the number of cattle instead of buying fuel, grass fodder and other requirements from the market. It should be well realized that natural vegetation once destroyed, is very difficult to bring back.

We found in Shivapuri that the pressure from extraction of fuelwood, by cutting down trees has much greater influence on deforestation. Conservation of forests will be impractical as long as basic needs are not met.

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