CHAPTER I

INTRODUCTION AND METHODOLOGY

Introduction

Kathmandu is comprised of three districts, namely, Kathmandu, Lalitpur, and Bhaktpur. Each of these districts contains a small urban conglomerate and a large rural sector. For the purpose of the study the valley was divided into an aggregate urban area and an aggregate rural area. Various important sectors of the rural valley were integrated and analysed according to methods used for other districts of the Bagmati Zone (ICIMOD 1993).

However, the urban sector could not be analysed as exhaustively as the other districts, primarily beacuse of the lack of information and parameters. The urban sector is far more complex than the rural districts. It has large manufacturing, trade, service, and tourism sectors as well as a relatively large private sector. These sectors as well as other sectors of the urban economy interact with one another to determine the level of income and employment. However, an information base for the valley's urban area is simply not available, primarily because, so far, there has been no institution responsible for collecting data related to the urban sector on a systematic basis. As a result the modelling exercise conducted for the urban valley was limited to certain key sectors only.

This paper is divided into two chapters. The first chapter describes the methodology used. A larger part of the methodology dealing with the rural valley is described in Volume I of the Bagmati Study (ICIMOD 1993). Chapter Two presents results of the analysis of the baseline conditions of the valley. Three different sectoral studies, namely, on the manufacturing sector's energy consumption, its performance, and on tourism, have also been published as discussion papers in this series.

Variables and Linkages of Model Prices

Volume I, Chapter 2 of the Bagmati study (ICIMOD 1993) describes how agricultural commodities, livestock products, and several input prices are forecasted. These forecasted prices have been calibrated to match price trends in the Kathmandu Valley using more recent information.

Several new price series have also been forecasted to develop a model for the urban sector of the valley. These new price series include energy prices, namely, firewood, kerosene, diesel, petrol, electricity, and aviation fuel. The method of forecasting prices is also based on simple time trends, which are based on information from the Economic Survey of the Bagmati Zone (ICIMOD 1993).

Electricity prices are forecasted for the domestic and commercial sectors. The growth rates of electricity tariffs in the domestic and commercial sectors were obtained from a recent report (WECS 1992) and are 12 and 16 per cent respectively. The aviation fuel price is assumed to increase at seven per cent per year.

Population

The population of the Kathmandu Valley is divided into rural and urban population. The base data obtained are from the National Planning Commission (NPC 1992). The population forecasts were first made for each age group (5-year age intervals) by gender and later aggregated to arrive at total, school going, and active population.

Land Use and the Forestry Sector

The land use and forestry sector data reported by the Land Resources' Mapping Project (LRMP) have also been updated for the valley and the supply and demand for forest products, namely, fuelwood, timber, and fodder are also calculated in the same manner as described in Volume I of the Bagmati study (ICIMOD 1993).

Agriculture

Agriculture as an economic activity is assumed to be confined primarily to rural areas in the present exercise. Due to the paucity of information on crops that have become important in the more recent history of the Kathmandu Valley, we have included six crops in our examination of the agricultural sector of the valley. These crops are paddy, maize, wheat, millet, oilseed, and potatoes. The area cultivated with these crops, their yields, cultivation costs, and gross margins are projected using similar methods to those described in Volume I of the Bagmati study (ICIMOD 1993).

Livestock

Livestock raising is assumed to be an entirely rural activity and the manner in which this activity is treated is akin to that reported in Volume I of the Bagmati Study (ICIMOD 1993). Inside the valley, livestock are not used for ploughing and hence this activity is not included as an input in the crop yield function.

Food Availability

Food availability is estimated using domestic production, i.e., the valley's production. The method of calculating food availability is discussed in Volume I of the Bagmati study (ICIMOD 1993). Milling rates, seed losses, and other allowances are assumed to be the same rates as discussed for the other districts covered in the Bagmati study. Note that we have not been able to include the food production from agricultural land inside the urban enclave. However, the food supply from urban agricultural lands may not have a significant impact on the valley's food supply, especially cereals.

Food Demand

Food demand includes demand for cereals, milk, meats, oils, fats, and vegetables, and this is assumed to be influenced by relative prices and incomes. Urban households are assumed to face a different demand structure than that of rural households. The demand system parameters estimated for high income households by Mudhbery (1988) are used in the case of urban households.

Imports

Food import in the valley is determined endogenously by the model described in Volume I of the Bagmati study (ICIMOD 1993). Estimates of the magnitude of imports into the valley are also made. For food, an aggregate (rural + urban) estimate is made. As in other districts of the Bagmati Zone, food imports into the valley are assumed to be determined by the volume of food deficit (i.e., difference between projected rural and urban food demand and total food production within the valley).

In addition, the values of non-food imports are also derived. Two types of non-food estimate are made, namely, non-food imports that originate from India and those which originate from the Rest of the World (ROW). The non-food import structure is assumed to differ in the rural and urban areas. This fact is

reflected in the different assumptions of income elasticity of demand for non-food and the population growth in the regions. The demand for non-food product imports in both rural and urban areas is assumed to be elastic. Engel's law states that income elasticity of demand for a luxury is generally elastic, i.e., the demand for a luxury is very sensitive to changes in income. Thus, we assume that non-food imports are luxuries and, further, that imports originating from the ROW are relatively more luxurious than imports originating from India. Further, the sensitivity of imports is assumed to be greater in urban areas than in rural areas following Engel's law.

The values assumed for the import elasticities for Nepal are not available to our knowledge. We have assumed different values for non-food demand elasticities originating from India and the ROW and separate values for rural and urban Kathmandu. These are reported in Table 1.1. The rationale for assuming these values is guided by estimates of such values derived for India and Pakistan.

The base year values for imports from India and the ROW for rural and urban areas are based on the NRB estimates reported in the Multi-Purpose Household Budget Survey (NRB 1988). The survey reports monthly expenditure per household on imports from India and the ROW for food as well as non-food items. For rural areas, the estimates for the rural hills are scaled upwards by a factor of 1.25. Similarly, for the valley's urban areas, expenditure on imports reported for the Urban Hills has been scaled upwards by a factor of 1.40 to reflect the higher levels of expenditure in the Kathmandu Valley; this is also reflected in the Multi-Purpose Household Survey estimates. Since the estimates reported in the Survey are for 1984, the resulting values are further scaled upwards by a factor of 1.1449 to take into account the inflation rate for 1985 and 1986. These adjustments give the base year estimates (1986) on per household annual imports (Table 1.2).

Table 1.1: Income Elasticity of Demand for Non-food Imports: Kathmandu Valley

Elasticity	India	ROW
Rural	1.15	1.10
Urban	1.50	2.00

Table 1. 2: Expenditure per Household on Non-food Imports: Kathmandu Valley

Rs/Household	India	ROW
Rural	1,436	8,870
Urban	1,931	2,562

Energy Demand in the Kathmandu Valley

In the Kathmandu Valley, energy is assumed to be demanded by urban households and by the manufacturing and transport sectors. The energy demand for rural households is primarily fuelwood and is discussed separately.

The types of energy demanded by urban households are fuelwood, kerosene, and electricity. The manufacturing sector demands fuelwood, coal, diesel, kerosene, and electricity. The transport sector demands petrol, diesel, electricity, and aviation fuel.

Energy Demand: Household Sector

Rural

Firewood is the chief energy source used by rural households for domestic purposes. The demand for firewood in rural areas is assumed to be driven by the population. Firewood demand projections in rural areas are based on the method described in Volume 1 of the Bagmati study (ICIMOD 1993). As with firewood demand projection, timber and fodder demands are projected using methods similar to those described in Volume 1 of the Bagmati study (ICIMOD 1993).

Urban

Urban households primarily consume three different types of energy, namely, firewood, kerosene, and electricity. Demand for these three different types of fuel is assumed to be influenced by the population growth, population elasticity, income growth, and income elasticity of demand for each energy type.

Firewood demand in the base year is assumed to be 220 kg/person in urban areas (APROSC 1983). The demand parameters used in projecting firewood demand are based on a study conducted by APROSC in 1983. In this study, six urban areas are considered. These include Kathmandu, Lalitpur, and Bhaktapur. The estimated demand parameters of the three districts of the valley indicate that the demand parameters for Lalitpur are about at average for the three districts. We have, therefore, used Lalitpur's firewood demand parameters to represent the valley's urban firewood demand. The functional relationship used is:

$$Demand = Demand\ in\ base\ year * \{(1 + UPG)^n * (1 + UIG)^e\}$$

where,

Demand	=	per capita demand
UPG	=	urban population growth
UIG	=	urban income growth
n	=	firewood demand elasticity with respect to population growth, and
e	=	income elasticity of firewood demand.

The resulting figure is then multiplied by the population figures to arrive at the total firewood demand. Similar methods were used to project demands for kerosene and electricity. The income elasticity of demand for firewood (0.2) is based on the APROSC (1983) study. Income elasticities for kerosene and electricity are estimated from the information reported in Sharma's study (1988, Table 2.4) and are 0.309 and 0.688 respectively. The population elasticity is assumed to be the same for all three fuel types and is assumed to be 0.0397 (APROSC 1983). Thus, over time, as urban population growth and income growth change the demand for energy by urban households also changes, depending upon the strength of income and population elasticity.

It is reasonable to assume that, over time, as per capita or household incomes increase, households will substitute other types of fuel for firewood. Also, not all households consume all three energy types in the urban area and this fact has to be accounted for in evaluating energy demands. To capture this fact we have used APROSC (1983) and Sharma's (1988) estimates of the percentage of population in the urban area consuming electricity, kerosene, and firewood and changes that have occurred between this period. Annual growth rates are then derived and incorporated into the projections in order to capture changes in energy demand by households over time. It should be noted that, in the Kathmandu Valley, especially in the urban area, cooking gas is also becoming an increasingly important source of household energy, albeit for a small sector of the population. We have not taken this energy type into account.

Energy Demand: Manufacturing Sector

A detailed study of the manufacturing sector's energy demand was conducted for this present study and is available in Volume I of the Bagmati study (ICIMOD 1993). The data reported in the 1986/87 Census of Manufacturing were used to estimate the energy demand parameters of the manufacturing sector. The model employed to estimate the energy demand parameters was the translog cost function. The model assumes that energy cost is separable from other input costs. This assumption allows for estimation of the energy demand by energy sub-types. The different energy sub-types considered are diesel, kerosene, coal, firewood, and electricity as reported in the Census.

Based on the estimated national level, factor demand elasticities' parameters, as reported in Table 1.3, the energy demand in the valley by the manufacturing sector was forecasted. Price projections for different energy types have already been discussed above.

Table 1. 3: Energy Demand Elasticities by Energy Types in the Nepalese Manufacturing Sector

	Wood	Diesel	Coal	Electricity	Kerosene
Wood	0.542	-0.816	0.034	0.644	-0.219
Diesel	-0.705	-0.728	0.349	1.596	0.009
Coal	0.071	0.837	1.981	-2.572	0.703
Electricity	0,241	0.689	-0.464	-0.490	0.001
Kerosene	-2.774	0.136	4.295	0.032	-1.691

The Census results of 1986/87 provide the base line values of energy consumption by the manufacturing establishments for the nation as a whole. To arrive at the base line consumption values of the valley, we first obtained energy consumption values per firm in each establishment for the NSIC group. The values calculated were then multiplied by the number of firms inside the valley (Kathmandu, Lalitpur and Bhaktapur) also based on the same Nepal Standard Industrial Classification (NSIC) group (Table 1.4). This gave us the value of each type of energy consumed by each manufacturing establishment according to the NSIC group. The base consumption values of each of the energy types obtained were as follows: wood 74,168 MT; diesel 6735 kl; kerosene 195 kl; electricity 146,050 mwhr, and coal 12,577 MT. Based on the estimated results on factor demand elasticities, the energy demand in the Kathmandu Valley is projected using the following equation.

$$Energy\ Demand_t = \{Demand^{*}(1 + [P_{it}/P_{it-1}]^{n_{ij}})\}$$

where,

P_e = to the unit price of energy;
i,j = wood, diesel, kerosene, coal, and electricity;
n_{ij} = price elasticity between energy types; and,
t = time (1987).

Table 1.4: Number of Manufacturing Establishments in the Kathmandu Valley by NSIC and Percentage of Total

NISC	Establishment Type	No. inside Valley %	Valley %	Energy bias by Energy-type
31	Food, beverage & tobacco	125	2	Electricity/wood
32	Textile & leather	351	>90	Electricity/wood
33	Wood products	279	44	Electricity/diesel
34	Paper and printing	131	52	Electricity/diesel
35/36	Chemical, rubber & printing	41	43	Electricity/diesel
38	Fabricated machinery	108	50	Electricity/coal

Note: The percentages reported are approximate, since industries included in the national level figures are not all present inside the valley and, also for reasons discussed in the text, some industries have not been accounted for.

Energy Demand: Transport Sector

The transport sector demands petrol, diesel, aviation fuel, and electricity (trolley and ropeway). Detailed consumption patterns of these energy types are reported in the Energy Demand Analysis of the Transport and Agriculture Sector, Water and Energy Commission Secretariat (WECS 1989). To project the energy demand of the transport sector the base consumption values have been derived as described below.

Petrol: We first estimated the city roads in Central Development Region (CDR) as a percentage of total city roads in Nepal. This factor was multiplied by the petrol consumption by the transport sector in Nepal in 1986 to arrive at petrol consumption in the valley.

Diesel: The percentage of total roads in the Central Development Region (CDR) as a percentage of total roads in Nepal was first derived, and the quantity of diesel consumption by the transport sector was multiplied to this factor to obtain the base consumption of diesel in the valley.

Electricity: Electricity is consumed by the ropeway linking Kathmandu with Hetauda and by the trolley bus. The WECS (1989) provides the necessary base consumption values of electricity consumed by the ropeway and trolley bus. It should be noted here that we have assumed that all the electricity consumed by the ropeway occurs in the valley. In the case of the trolley bus, this is definitely the case.

The base consumption values of the different types of energy consumed in the transport sector are reported in Table 1.5.

Table 1.5: Energy Consumption by Energy Type in the Transport Sector (Base Values (1986)

Petrol (klit)	Diesel (klit)	Aviation (klit)	Electricity (mwhr)	
			Trolley	Ropeway
11,185	20,199	41,745	1334	331
Growth Assumptions (%):				
4.97	4.86	2.62	2.00	0

Source: Growth assumptions were derived from WECS, Part I, Transport Sector, Table 7.8A (1992).

The estimated base consumption values of the different types of energy consumed by the transport sector obtained have been projected then over time using the national consumption growth rates of the energy types reported by WECS (1989, Table 16).

Energy Demand: Total Valley

The total energy demand for the valley consists of the energy demands of urban households, manufacturing establishments, and the transport sector only in this study. The demand for energy by other sectors could not be included due to lack of information. All energy demanded is converted into metric tonnes using conversion factors reported by WECS (1992).

Employment

Rural Sector

Employment in the traditional sectors, namely agricultural and livestock, depends on the area cultivated and labour used per hectare for the six different crops and for LSU holdings per household. Besides the traditional sources, rural populations also work as professionals, office workers, traders, and in the manufacturing (production) and construction sectors. In addition large numbers of the rural labour force as general labourers. The 1984 estimates of the engagement of rural labour in the above categories are found in the NRB-Multi Purpose Household Budget Survey for the Rural Hills (1988). The recently conducted 1991 census (10 % sample estimates) also provides more recent estimates of the rural employment. Surprisingly, the 1984 and 1991 estimates did not vary in any significant way and hence we used the NRB estimates. While the employment situation in agriculture is determined from the model, rural employment in the non-agricultural sector has been projected using the proportion of the active population in rural areas engaged in activities such as those reported by the Nepal Rastra Bank (NRB, 1988, Table 58, p.210).

Urban Sector

Urban employment has been estimated on the basis of industry and occupation. The 1984 NRB and the 1991 census sample estimates have been used to estimate changes in the population engaged in different activities. An average proportion of population engagement during the different periods is then used to obtain the base population engagement by industry. After obtaining the base population, the growth rates in employment for the broad categories of workers are assumed to depend on a combination of historical performances (growth rate) of the sectoral GDP. In the absence of historical data on employment by sector, it is customary to use sectoral GDP growth as a proxy variable (World Bank 1991, p. 182).

First, the nominal sectoral GDPs were projected using time trends based on data from 1974 to 1989. The nominal sectoral, GDPs were then converted to real GDP by dividing the agricultural GDP by the agricultural GDP deflator, and the non-agricultural GDP deflator was used to convert other nominal GDPs to real GDP.

These sectoral, real GDP growth rates were then used to project urban employment by sectors. These employment figures were calibrated to reflect the more recent, i.e., 1991 estimates. The sectoral growth rates derived to project population are presented in Table 1.6.

Table 1.6: Sectoral Growth Rates Assumed to Project Employment in Urban Areas

Sector	Growth (% per annum)
Agriculture	-2.90
Manufacturing	1
Electricity	11.80
Construction and Transport	6.20
Trade, Hotel, Real Est etc	4.3
Public sector	6.3
Private sector	1.0

Source: Based on sectoral growth rates of real GDP reported in the Ministry of Finance, Economic Survey, 1991

In addition, estimates of employment by occupation are also made. The method that is used to obtain these estimates is as follows. The 1991 census (10 per cent sample estimate) provides population engagement by industrial and occupational sector for all urban areas of the country. The percentage of population by sector of industry for a given occupation has been derived from the results. This percentage is then used as a multiplier to obtain population engagement by occupation from engagement by industry. The multipliers derived by industry and occupation are reported in Table 1.7.

It is to be noted that agricultural employment by sector and occupation reported for urban areas is not the same. This arises because of the differences in the definition of 'agriculture' in the two cases. For example, in the sectoral definition, agriculture consists of agriculture, forestry and fisheries, whereas, in the other definition, agriculture includes farming and fishing.

Income Sector

Income estimates are made seperately for the rural and urban sectors. For the rural sector, incomes are estimated on a sectoral basis, whereas, for urban areas, besides sectoral income we have attempted to estimate incomes by occupation.

Rural Income

The sectoral incomes accruing in the rural area of the valley are agriculture (crops), livestock, professional, office workers, sales and services, production, construction, and general labourers. Rural sector income assessments have been carried out on a basis similar to those carried out for rural districts of the Bagmati Zone as reported in Volume I of the Bagmati study (ICIMOD 1993). The rural household incomes have been scaled by a factor of 1.25 to reflect the CDR's higher levels of income.

It is to be noted that rural income assessments generated by the model do not take into account household earnings from miscellaneous sources, e.g., property income, pensions and remittances, and others as covered in the NRB estimates. These other sources in the NRB estimate account for about 21 per cent of the total household income in rural Nepal (see NRB 1988, p.82). While it is possible to scale the

income derived in the model by the appropriate factor to account for the miscellaneous income, we have not done so. This is because there is no information to develop this class of income and link it with the rest of the model. Hence the estimated incomes in the present case are underestimated by about 20 per cent in rural areas.

Urban Income

To derive base year incomes we have relied on the Multi-Purpose Household Budget Survey (NRB 1988) information which reports incomes for 1984. The per household incomes have been scaled first to 1986 values by seven, per cent annually for two years. According to the Survey information, the Central Development Region's urban households had 1.25 times higher household incomes than urban hills' households. The valley's urban income has been assumed to be 15 per cent higher than that of CDR urban income, based on our subjective judgement. From this perspective the per capita base income in the urban area (Table 1.8) works out to be 40 per cent higher than in the urban hills as reported by NRB (1988). This factor was also taken into account in projecting income and base .

Table 1.7: Multipliers Used in Converting Employment from Sector of Industry to Occupational Status

Sector	Total	Proff	Admin	Clerical	Sales	Service	Agri	Manu	Others
Agriculture	0.228	0.001	0.001	0.001	0.001	0.003	0.987	0.002	0.004
Manufacturing	0.082	0.010	0.011	0.020	0.010	0.065	0.000	0.824	0.060
Electricity	0.005	0.174	0.065	0.306	0.004	0.095	0.000	0.193	0.162
Const & Trans	0.057	0.021	0.094	0.042	0.010	0.042	0.000	0.760	0.031
Trade etc	0.214	0.010	0.024	0.048	0.743	0.104	0.000	0.037	0.034
Public & private	0.364	0.141	0.045	0.139	0.014	0.312	0.000	0.164	0.184
General Labour	0.049	0.020	0.018	0.037	0.012	0.063	0.000	0.73	0.777
Total	1.00	0.058	0.029	0.068	0.167	0.148	0.225	0.184	0.121

Source: Derived from the results of the 1991 Sample Census results (CBS, 1986, Vol I, Table 63).

Table 1.8: Base Year Per Capita Urban Income by Occupation (1986)

Occupational Group	Per Capita Income (Rs/year)
Professional	11,214
Administrative	15,930
Clerical	6,930
Sales	7,866
Service	7,848
Agricultural	4,932
Manufacturing	5,346
Others	3,690