Doctoral Dissertation

Contribution of Farming on Rural Livelihood in Nepal: Focusing on Dairy Farming in Chitwan

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DEDICATION

Dedicated to Fond Memory of My Late Father

Mr. Bishnu Lal Singh

And to My Mother

Mrs. Saraswoti Singh

ABSTRACT

Nepal is a mountainous country, and agriculture is its economic mainstay. Due to the inadequate support of agricultural infrastructure service, and lack of agriculture inputs, agriculture has remained almost stagnant or experienced slow growth. Thus, crop production alone is unable to meet the ever-increasing food needs of the growing population. On the other hand, over use of fuelwood to meet the energy demand in household sector causes high pressure on forest and cropland, which adversely affects farming. And also the use of traditional energy source in traditional mud stove creates lots of indoor smoke that negatively affects the health of the people. Under these circumstances, there is a need of viable alternative, which requires comparatively low cost resources and have short income generating span, and can minimize the over use of fuelwood. Dairy farming could be one of the most appropriate and viable alternatives, which can provide food in terms of milk and meat, income earning and energy generation in terms of biogas at the household level. Considering this background, the general objective of the study is to assess the contribution of dairy farming on rural livelihood. The specific objectives are:

1. To examine the situation of crop and dairy farming in Nepal, focusing on Chitwan.
2. To analyze the crop and dairy production and income earning at household level.
3. To analyze milk yield of an individual dairy cow.
4. To examine the role of Cooperative dairying in dairy production at the household level.
5. To analyze the role of dairy animal as a source of energy in terms of biogas generation, and its implication in rural livelihood.
6. To analyze household's livelihood strategies being practiced by the farmers in order to maintain their livelihood.

This study uses both primary and secondary sources of information to support each other. A detailed field survey was conducted to collect information mostly on different farming components. The primary data was collected mainly during the two field trips during October 2001 to October 2002. Two Village Development Committees (VDCs) from Chitwan District, Tarai region of Nepal, were selected for the study. And one VDC from Kavre District, Hill region of Nepal, was also selected to make a comparative study between the biogas users in two regions. A total sample of 139 households was selected and orally interviewed using pre-tested semi-structured questionnaires. Data analysis was done both quantitatively and qualitatively. The income from crop farming, dairy farming, and other non-farm jobs were calculated for each individual household. Contribution of dairy farming in terms of milk, as food, was analyzed by calculating milk production, milk sale and self-consumption. And the contribution of dairy farming in terms of energy generation i.e. biogas generation was analyzed by using comparative study approach among the biogas users in the Hills and Tarai regions. Implications of the use of biogas gas in various aspects such as reduction in fuelwood use, minimize smoke born diseases, minimizing time spent in household activities, and additional income earning were also examined.

National level study shows that the government of Nepal seems to have accorded top priority to agriculture, and have been allocating good share of national budget since the Forth Five Year Plan (1956-61) to Tenth Five Year Plan (2002-2007). In spite of this effort, most of the targets set for agriculture growth were not achieved. The Plan efforts reveal that the livestock sector received due importance as one of the main sectors of agriculture development, and was taken into consideration only with the implementation of the Fifth Five Year Plan. In 1991, Nepal launched Livestock Master Plan to foster livestock sector

development. Livestock units and stocking rate (LU/Ha) is increasing after the launch of LMP, but there is no significant change in livestock products. After the implementation of First Livestock Development Project (FLDP), it was realized that in order to develop over all dairy sectors, the dairy services has to reach individual household. The need of collective action with local milk producing household's participation was felt after the project. So the idea of Cooperative was introduced as a result. Hence, Milk Producers Associations (MPAs) was introduced at village level after the implementation of FLDP. Milk Producers Associations then converted in to Milk Producer Cooperative MPC, which is a registered legal body as per the Cooperative Act (NDDB, 2001). After being MPCs, farmers can sell milk in decided price and can receive various facilities and dairy infrastructure provided by Cooperatives.

In order to over come the problem of overuse of fuelwood and minimize burning of animal dung, biogas technology was proved to be one of the appropriate energy technologies produced by animal dung. Initially, it was only a matter of rural energy, and a few individuals were involved in it. After the World Energy crisis of 1973, it became a matter of environmental issue, which then triggered a global interest in this sector. Thus, it was promoted vigorously with the provision of subsidy, active involvement of private sectors and international donor agencies. As a result, the number of biogas plants has been increasing steadily to date.

A finding regarding milk production shows that the annual milk production is higher in small and medium farmers as compared to large farmers. More than 80% of the total milk production is sold by small and medium farmer where as, large farmers sell only 58%. Per capita milk consumption is higher in small and medium farmer. The overall per capita consumption in this area is much higher compared to the national per capita milk consumption.

Findings of the study show that the contribution of dairy income in the total household income is higher in case of small and medium farmers where as, the contribution from non-farm job is higher in case of large farmers. This implies that small and medium farmers, who have less land resources, have to depend on dairy farming. They are using more efforts and inputs, which translating to higher income. Most of the household members of large farmers are engaging in non-farm jobs because they have higher education, which give them more opportunity to get such jobs in urban areas.

Findings in use of biogas show that, at the village level, it is popular among the farmers, especially with livestock. It helps in saving time spent in fuelwood collection, cooking, and cleaning. This spent time is used in other income generating activities or in domestic activities. The cost of installation of the plant can be easily covered within four to five years. Biogas also lessens fuelwood consumed, and reduces burning of biomass that can be used in farms to generate more yield and income. It also improves health and hygiene of individuals, household and community, and contributes in saving money used for purchasing fuelwood and soap. Availability of fuel reduces the pressure on forest, which leads to reduction in deforestation and natural hazards. Thus, this provides environmentally friendly energy, which promotes good health. All these finally lead to well being of the rural people.

This study concludes that dairy development could help to generate large amount of income for small and medium farmers who are the most target group in any development program. Dairy contributes significantly in improvement of rural livelihoods by providing food, income, energy for household purpose, and improved health and sanitation. Thus, dairy activity can be a one intervention, designed to improve broader environment that affect household livelihoods.

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ABBREVIATIONS

ADB/N	Agricultural Development Bank of Nepal
AEPC	Alternative Energy Promotion Center
AFPRO	Action for Food Production
AGDP	Agricultural Gross Domestic Product
APP	Agricultural Perspective Plan
AREP	Agricultural Research and Extension Project
AsDB	Asian Development Bank
BMSS	Biratnagar Milk Supply Scheme
BSP	Biogas Support Program
BSPP	Biratnagar Skimmed Powder Plant
BYS	Balaju Yantra Shala
CBS	Central Bureau of Statistics
CDO	Chief District Officer
CMPCU	Central Milk Cooperative Union Ltd
CMS	Consolidated Management Service
CPSS	Cheese Production and Supply Scheme
DADO	District Agricultural Development Office
DANIDA	Danish International Development Agency
DCS	Development of Consulting Services
DDC	Dairy Development Corporation
DFID	Department for International Development
DoA	Department of Agriculture
DOC	Department of Cooperatives
DTD	Danish Turkey Dairies
FAO	Food and Agricultural Organization
FLDP	First Livestock Development Project
GDP	Gross Domestic Product
GGC	Gober Gas Company
GTZ	German Technical Cooperation

HMG/N	His Majesty's Government of Nepal
HMSS	Hetauda Milk Supply Scheme
IAAS	Institute for Agricultural and Animal Science
ICIMOD	International Center for Integrated Mountain Development
IDS	International Development Studies
JICA	Japan International Cooperation Agency
KFW	Kreditanstalt fur Weideraufbau
KVIC	Khadi and Village Industries Committee
LDLHD	Livestock Development and Livestock Health Departmen
LMSS	Lumbini Milk Supply Scheme
LRFGs	Livestock Rearing Farmers Groups
LSD	Livestock Service Division
MOAC	Ministry of Agriculture and Cooperative
MPAs	Milk Producers' Associations
MPCs	Milk Producers' Cooperatives
MPCUs	Milk Producers' Cooperative Unions
NBGP	Nepal Biogas Promotion Group
NCDB	National Cooperative Development Board
NDDB	National Dairy Development Board
NFC	Nepal Fuel Corporation
NPC	National Planning Commission
PMSS	Pokhara Milk Supply Scheme
SFDP	Small Farmer Development Program
SLDP	Second Livestock Development Project
TLDP	Third Livestock Development Project
UMN	United Mission Nepal
UNCDF	United Nation Capital Development Fund
UNDP	United Nation Development Program
UNICEF	United Nations' International Children's Emergency Fund
USAID	United State Agency for International Development
WECD	World Commission on Environment and Development

Chapter 1: Introduction

1.1 Background

Nepal is a landlocked mountainous country bordered by China to the north and India to the east, west and south. With 38 percent population living below the poverty line, Nepal is one of the least developed countries in the world. It is a home to 22.5 million people, of whom 86% live in rural areas, and are struggling hard for their livelihood (CBS, 2001). Agriculture dominates the economy of Nepal, accounting for about 40% of its total Gross Domestic Product (GDP). The cultivated land is very limited (about 20%) due to the mountainous nature of the country. Large number of farmers is characterized as small farmers (having less than 0.5 hectare of land), and medium farmers (having more than 0.5 and less than 2 hectares of land). Nepalese agriculture is predominantly subsistence in nature. The major food crops being cultivated in Nepal are paddy, maize, wheat, millet, barley, buckwheat, Dal/beans, potato, spices, vegetables, and fruits. Agriculture also provides raw materials such as jute, tobacco, sugarcane, oilseed and cotton, for domestic agro based industries and for export in some extent. In Nepal, the rural farming households throughout history have followed multiple survival strategies to maintain their livelihood. Farming has been the main source of livelihood for them. More agro based non-farm activities are food and agro processing and marketing activities, such as, processing of paddy, wheat, edible oil, milk, meat and other agricultural products, their marketing and transporting. Other non-farm activities are physical construction work, relating to irrigation, roads, cottage industries, tailoring, governmental and non-governmental work, tourism, and laboring. Non-farm activities beyond rural areas are many and diverse. Few of them are: government work, small and large entrepreneur, shop keeping,

factory working, transporting, laboring, and migratory laboring (Maharjan, 2003). Farmers in Nepal have been following the integrated type of farming, from time immemorial. It essentially consists of crop, livestock and forest. All these three components of farming together supply food, fuel, medicine, shelter, and clothing through the management of land, labor and capital (Figure 1.1). Thus, the farm products are consumed directly or indirectly through exchange system, such as, by exchange of food or by borrowing food to meet their welfare needs (Maharjan, 2003).

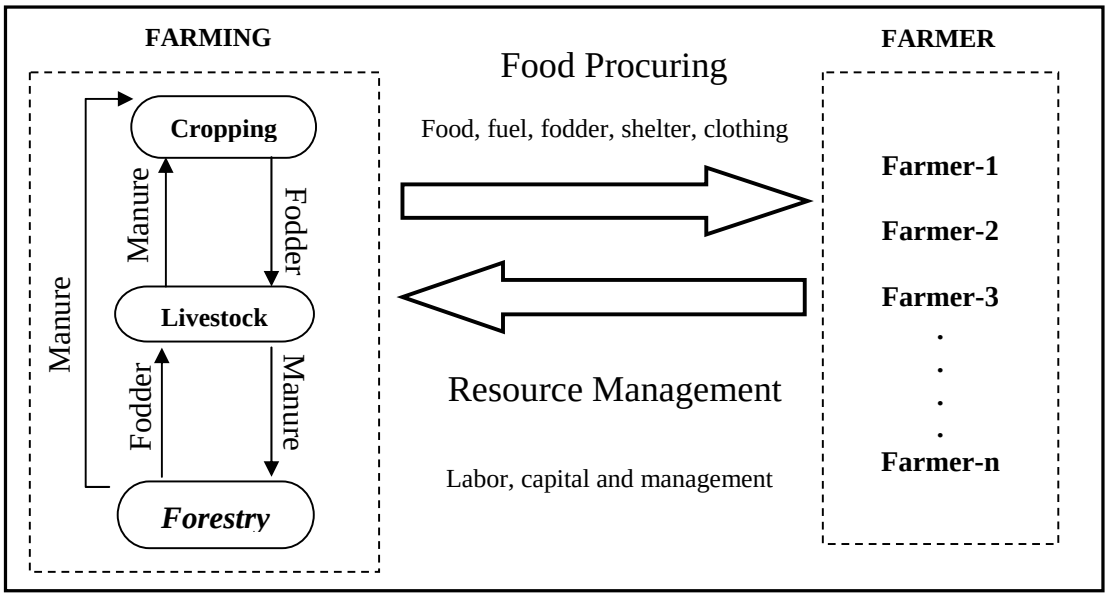


Figure 1.1: Traditional process of securing Livelihood
Source: Adopted from Maharjan, 2003

Agriculture has remained almost stagnant since 1950s due to inadequate support services and infrastructure, such as, roads, irrigation, and marketing and storage facilities. The increase in the production amount of some crops like cereals is basically due to the expansion of the areas under cultivation, mainly by clearing forest and using grazing land, other marginal lands, and also following multiple cropping systems in feasible areas. However, the share of agriculture in the total GDP has been decreasing. As majority of rural households are unable to

earn sufficient livelihoods from own production due to poor resource base, rapid population growth, and degradation of the resource base. It has resulted into shifting of their emphasis from subsistence farming to other sources of income to maintain their livelihoods (Adhikari & Bohle, 1999). They are turning to non-farm activities, agro based and or non-agro based in nature within the rural regions and beyond creating a new paradigm of livelihood inducing dynamism through which the needs of people are met by both farming and non-farming sectors (Figure 1.2).

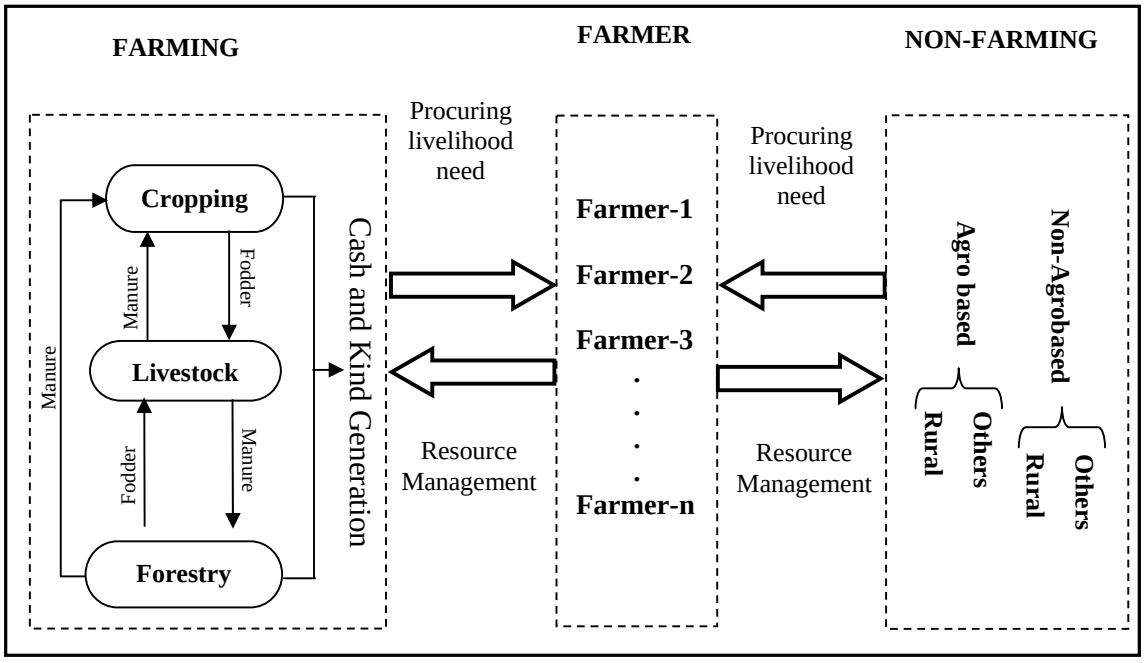


Figure 1.2: Recent dynamism in process of securing Livelihood
Source: Adopted from Maharjan, 2003

The problems of Nepalese farming system are complex. In order to have better idea, it needs to have better understanding of the present farming system and their interrelation in all three agro ecological zones the Mountain, the Hill and the Tarai. Although the nature of the problems of farming system in Tarai is different from those in the Hills and the Mountain, they are no less severe. The main problems are; firstly, migration. Tarai region is highly

influenced by migration from the Mountains, the Hills and outside of the country. The phenomenon of migration has been the most striking reason for the rapid population growth in the Tarai region. The National Census of 1991 reported that the population in Tarai is increasing at a rate of 4.2% per annum contrasting with that of 1.6% in the Hills and a national average of 2.1%. Such a rapid increase in population density in Tarai has considerably increased population pressure on the existing land and forest resources; consequently, the surpluses of food grains have been rapidly declining since last few decades. The yield of various crops in Tarai region, which is even considered as high production area in the country as a whole, is also low. Thus, the increase in production of cereal crops alone seems unable to meet the ever-increasing food needs of the people. Over the last 20 years, the country has changed from a net exporter to a net importer of food. Thus, there is a need to promote other viable alternatives, which require comparatively low cost resources and have a short income-generating span.

Dairy farming could be one of the most appropriate and viable alternatives, which is a major component of farming system in Nepal and contributes 31% of Agricultural Gross Domestic Products (AGDP) (CBS, 2001). Among the various sub sectors of livestock, the highest contribution (78%) comes from dairy farming. The dairy animals in Nepal are basically constituted of cattle and buffalo. More specifically, 30% of AGDP comes from cow and 48% from buffalo (CBS, 2004). Dairy farming is presently in a transitional phase from subsistence to commercial dairy farming in the Tarai region since demand for milk is increasing and dairy is starting to take roots as an agro based industry. Alongside, some improvements in dairy technologies and cooperatives have been contributing in the process of commercialization of dairy farming. Dairy farming helps farmers in many respects, such as,

vital sources of cash income, sources of family nutrients, sources of manure for their agricultural land, source of biogas, and source of animal draft power. To take full advantage of dairy farming, farmers need to have access to good species of animal, extension services along with the provision of dairy infrastructure such as chilling centers, milk processing centers, and credit facilities in order to avail the necessary seed money particularly by the resource poor farmers to start their small enterprises.

The dairy sector can play a key role in improving the socio-economic status of the rural population. The four very important aspects of dairy farming can be considered from the perspective of source of food, source of manure, source of household income and source of household energy.

Milk and its products constitute a main source of animal nutrients for the people. An increase in milk and meat production reduces hunger, malnutrition and food insecurity in both rural and urban areas, and at both household and national levels. The protein and micronutrients of milk and meat can increase the nutrients of food, particularly, for women and children. The total milk production in Nepal was estimated to be 379,637 ton of cow milk and 894,591 ton of buffalo milk in 2004/05. This amount of milk was said to be insufficient for the domestic consumption. Hence, Nepal imports milk in the form of powder milk, mostly from India, Australia, and Bangladesh. It was estimated that the total imports of powdered milk in 2001 was 696,978 ton (DDC, 2004).

Dairy animals play central role in maintaining the soil nutrients. Use of manure in crop farming enhances soil fertility and production efficiency. Animals that consume crop residues after harvesting also help to make the nutrients recycling in crop-livestock related farming system, thereby stabilizing the food production. Livestock manure is a critical

component of farming system. Farmers indicate that two adult buffaloes give enough manure to fertilize approximately 0.25 hectares of land. According to them, the application of manure is mandatory for the maintenance of crop yield. The production of manure differs between cows and buffaloes. Generally, buffaloes produce more manure than cows (Tulachan, 1999). In the rural areas, majority of people keep at least one or two head of cow productive/unproductive to meet manure demand for crop farming. This is especially true for the Tarai region, where generally people have large land holdings, and they need more manure.

Livestock have been playing an important role in farm economy of rural households. It alone contribute 47.3%, 35.7% and 20% of the total agricultural income in the Mountains, Hills and the Tarai, respectively (Tulachan & Nuepane, 1999).

Nepalese energy situation is highly dominated by the use of traditional energy, such as, fuelwood, agricultural residue and animal dung for household purposes, which is the biggest energy consumer. Overuse of fuelwood causes deforestation, resulting in soil erosion, and natural hazards that make rural life harder. Biogas technology is regarded as an appropriate technology to generate energy from animal dung. Rural household can use animal dung to generate biogas to meet their household energy need. On the other hand, the use of biogas can also minimize the smoke in the household and reduce CO_2 level in the environment. The national biogas program has helped to reduce 4,896 ton of carbon production annually, assuming that a total of 33,960 ton of fuelwood is saved annually. Similarly, it is calculated that installation of biogas plants in the program districts have saved about 869,000 living trees of different species annually, which makes important impact to retain greenery[1]. Thus, there

[1] It is calculated on the basis that about three tons of fuelwood is received from one tree.

is a need to develop livestock sector to meet domestic demand for milk, increase farmers' income and agricultural production, employment generation, and energy generation.

1.2 Statement of Problem

In the Hill and Mountain regions of Nepal, population pressure was low until the first quarter of the 20th centuries. Whenever population pressure was felt, people would migrate mostly to Tarai region for better livelihood. Not only from the Hill and Mountain, but also people from outside the country, particularly, from India migrated to the Tarai region (Pradhan and Routray, 1992). Consequently, the population growth rate was extremely high for Tarai at 4.2% and 2.8% during the 1970s and 1980s, respectively (Table 1.1). The percentage of land area is one of the smallest among the three geographical regions (23%). On the other hand, the percentage of population of Tarai is one of the highest with the growth rate of 2.7 (CBS, 2001). This implies that Tarai is experiencing high population growth among the regions. Such a rapid increase in population density in this region has considerably increased the pressure on the existing land and forest resources. Consequently, the surplus of food grains has been rapidly declining.

Table 1.1: General Population Figures for Nepal (1971-2001)

Population	Nepal	Mountain	Hill	Tarai
1971	11,555,983	1,138,610	6,071,407	4,345,966
1981	15,022,839	1,302,896	7,163,115	6,556,828
1991	18,491,097	1,443,130	8,419,889	8,628,078
2001	23,214,681	1,690,263	10,271,506	11,252,912
% (2001)	100.0	7.3	44.2	48.5
Growth Rate				
1971-1981	2.7	1.4	1.7	4.2
1981-1991	2.1	1.0	1.6	2.8
1991-2001	2.3	1.6	2.0	2.7
Population Density				
1971	78.5	22.0	99.0	127.8
1981	102.1	25.1	116.8	192.7
1991	125.6	27.9	137.3	253.6
2001	157.7	32.6	167.4	330.8
Land Area (Sq km)	147,181	51,817	61,345	34,019
%	100	35.21	41.68	23.11

Source: Takashi Takahatake, 2002 (Note: Population figures for 2001 are preliminary)

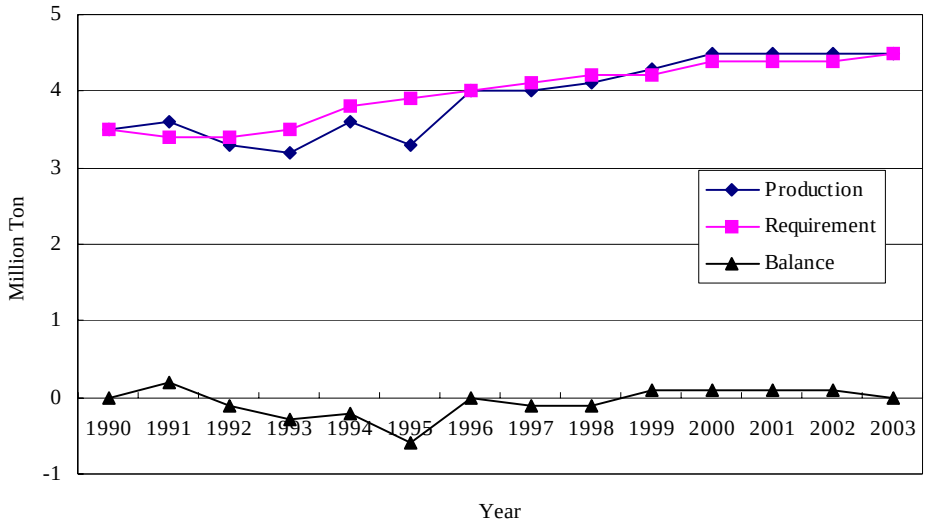


Figure 1.3: Production, Requirement and Balance of Cereal Crops in Nepal (1990-2003)
Source: MOAC, 2003

The aggregate food grain production, requirement and balance at the national level are shown in Figure 1.3 for the last 14 years. From 1990 to 1999, food grain balance was negative and requirement has been constantly increasing. The production is slightly higher than

requirement in 2000 to 2003. However, the surplus remained below 2 per cent of the requirements in all years.

The exceedingly large number of unproductive animals, scarcity of fodder, lack of quality feed, lack of adequate animal health services, and low milk yield of dairy animals are livestock related problems. In 1991, Nepal had implemented Livestock Master Plan (LMP) to foster livestock sector development. Livestock units and stocking rate (LU/Ha) increased after LMP, but there is no significant increase in milk yield. Therefore, in order to meet the demand of the increasing population for animal products through domestic product, and also to gradually promote the export of some potential products, it has become necessary to accelerate livestock production and productivity without exploiting the environment.

There is also a lack of effective organization in supporting dairy sector development at the local level in the rural areas of Nepal. Cooperative Dairy could be the key strategy for supporting dairy in local level by providing dairy infrastructure, saving and credit program, health, and extension services.

Nepalese energy situation is highly dominated by the use of traditional energy, such as, fuelwood, agricultural residue, and cow dung. The heavy dependence on fuelwood has caused high pressure on forest depletion and environmental degradation. The annual fuelwood consumption was estimated at about 11 million ton and annual sustainable yield of fuelwood was estimated at 7 to 8 million tones. Nepal is losing her forest at the rate of 1.7% annually (CES, 2000). Due to the scarcity of fuelwood, rural people are forced to burn large quantities of animal dung and agricultural residues for cooking fuel, therefore, depriving the soil of valuable nutrients and organic matter, thus adversely affecting farming. Due to the loss of forest in the vicinity, people travel long distances for the collection of fuelwood. This has led

to an increase in time for fuelwood collection, which can be otherwise used in other activities. On the other hand, the use of traditional energy resources in traditional mud stove for cooking creates lots of indoor smoke that negatively affects the health of the people. Under these circumstances, biogas, produced by cow dung, can be one such effort that directly contributes in providing household energy, which can minimize the overuse of fuelwood, and can produce high nutrient value manure in terms of slurry.

Since the past few decades, rural household with subsistence farming, have been facing greater hardships in earning their livelihood from crop production alone due to rapid population growth, and degradation of natural resource base, mainly land and forest. As a result, they have to look for other alternatives to make their living. Rural household has been practicing different household strategies in both household and individual levels. Hence, multifarious strategy is taken by rural farmers need due consideration. Considering this, three hypotheses were set, as a base for this research, which are as follows;

1. Dairy farming can improve livelihood of the rural people.
2. Cooperative dairying can play a key role in improving dairy farming.
3. Biogas technology can improve rural livelihood by providing energy, manure and income earning.

1.3 Concept of Sustainable Livelihood

The concept of livelihood is widely used in different studies on rural development and poverty reduction. Livelihood systems comprise a complex and diverse set of economic, social, and physical strategies. These strategies are realized through activities, assets, and entitlements by which individual household make a living. Sustainable livelihoods are derived from

people's capacities to exercise choice, and to access opportunities and resources, and use them for their livelihoods in ways that do not foreclose options for others to make their living either now, or in the future. But sustainable livelihoods are not just about what happens in a given locality. It begins with how people living in poverty, rather than experts, perceive their own reality, and extends to understanding how this reality is related to what happens in the rest of the society, to forming new relationships within and outside the locality. It stresses the need to support and protect people's capacity to act and produce. Yet people's productive lives are not reduced in narrow economic terms. The broad goal of poverty eradication is to develop individual, family, and community capacities to improve their livelihood systems.

In the report of an Advisory Panel of the World Commission on Environment and Development in 1987, in the publication of Food 2000 (WCED, 1987), the idea of sustainable livelihood began as an approach to maintain or enhance resource productivity, secure ownership of, and access to assets, resources and income-earning activities, as well as, to ensure adequate stocks and flows of food and cash to meet basic needs. It was a reflection of the growing recognition that food security was not merely a problem of agricultural productivity, but was a problem of poverty in all its multi faceted dimensions. United Nations Conference on Environment and Development (UNCED, 1992) moved the concept towards an action agenda especially in the context of Agenda 21, and advocated for the achievement of sustainable livelihood as a broad goal for poverty eradication focused on the poor who live in marginalized areas. Agenda 21 stated:

> Sustainable livelihood could serve as an integrating factor that allows policies to address development, sustainable resource management and poverty eradication simultaneously.

Most of the discussion on sustainable livelihood so far, has focused on rural areas and situations where people are farmers or make a living from some kind of primary self-managed production. In 1992, Robert Chembers and Gorden Conway proposed the composite definition of sustainable rural livelihood as follows:

> A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation: and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term. (Chember & Conway, 1992)

The International Development Studies (IDS) researcher, Ian Scoones, (1998) has further modified the definition given by Chamber and Conway as:

> A livelihood comprises the capabilities, assets (including both material and social resource) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base. (Scoones, 1998)

The main difference between this definition and the earlier one by Chambers and Conway is that, it does not include the requirement that for livelihoods to be considered sustainable they should also '…contribute net benefits to other livelihoods'. In this sense, the IDS version is less demanding but, presumably, more realistic. Ellis (2000) in his definition of a livelihood has placed more emphasis on the access to assets and activities that is influenced by social relations (gender, class, kin, belief, systems) and institutions. He has excluded any reference to

capabilities or sustainability.

One of the important characteristics of the definition given by Chambers and Conway is that, it looks at the connections between assets and activities, which result from options people have. This idea of 'activities as a result of options' looks at people as active beings that make decisions on their livelihood strategies. Rural livelihood strategy, which is based on the livelihood definition by Chambers and Conway, does not only look at farmer's adoption of a particular innovation option, but also considers other options as a livelihood strategy in a given context. This can provide greater potential to focus on "farmer's realities" (Basnyat, 1995:37) than the study of adoption of innovations.

Several similar analytical frameworks have been developed to set out the factors in a sustainable livelihood system, and to represent relationships between these factors. The most well-known sustainable livelihood framework has been documented by the Department for International Development (DFID). This framework draws heavily on IDS work (Scoones 1998) although it has been adapted to accommodate DFID's concerns and objectives. A useful analytical framework provided by Ellis (2000), who adapted it from Carney and Scoones (1998) is given in Table 1.2. This is an assets-institutions-activities framework, which regards the asset status of individual or household as fundamental to understanding the options open to them, the strategies for their survival, and their vulnerability to outside factors. The assets which consist of human, natural, physical, social, and financial capitals are translated into a livelihood strategy for a set of income earning activities by a number of conditioning factors, leaving effects on livelihood security and environmental sustainability. Scoones divides these institution and organization. Carney categorized these as in context of vulnerability and transforming processes.

Table 1.2: A Framework For Micro Policy Analysis of Rural Livelihoods[2]

A	Livelihood Platform	**Assets:** Human, Natural, Physical, Social, and Financial Capitals		
B	Access modified by	**Social Relations:** Gender, Class, Age and Ethnicity	**Institutions:** Rules an customs, land tenure, and markets in practice	**Organization:** Associations, NGOs, local administration, and state agencies.
C	In context of	**Trends:** Population, migration, technological change, relative prices, macro policy, nation economic trends, and world economic trends		**Shocks:** Drought, floods, pests, diseases, and civil war
D	Resulting in	**Livelihood Strategies**		
E	Composed of	**Natural Resource (NR)-based activities:** Collection, cultivation (food), cultivation non-food, livestock, and non-farm NR		**Non-Natural Resource-based activities:** Rural trade, other services, rural manufacture, remittances, and other transfers
F	With effects on	**Livelihood Security:** Income level, income stability, seasonality, and degrees of risk		**Environmental sustainability:** Soil and land quality, water, rangeland, forests, and biodiversity

Source: Ellis (2000:30), (Originally adopted from Scoones (1998:5) and Carney (1998:5))

The analysis of access to these assets is modified by social relations (gender, class, age and ethnicity), institutions (rules and customs, land tenure, and markets in practices), and organizations (associations, NGOs, local administration, and state agencies). These are important mediating factors for livelihood because they encompass the agencies, which promote or discourage the actions of capabilities and options by individuals or household. The relationship between assets, mediating processes, and livelihood activities is a process, which occurs over time. The way of this occurrence is influenced by context, such as, trends and shocks, which occur outside a household. Trends include population pressure, technological change, relative prices, macro policy, and national and world economic trends. Shocks include drought, floods, pest, diseases, and civil wars. The asset status of household, which is

[2] As shown in this Table 1.2, a livelihood is defined as what comprises the assets (human, natural, physical, social, and financial capitals), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household (Ellis, 2000).

mediated by social factors in the context of trends and shocks results in the adoption of livelihood strategies, with effects on livelihood security and environmental sustainability. Livelihood strategies consist of activities, which generate means of living. These activities can be divided into natural resource (NR) and non-natural resource (non-NR) based activities. The NR include; collection, cultivation of food and non-food, livestock. The non-NR includes rural trade, other services, rural manufacture, remittances, and other transfers. The activities also have effects on livelihood security in terms of income level, income stability, seasonality and degrees of risk, and on environmental sustainability in terms of soil and land quality, forest and bio-diversity.

1.4 Conceptual Framework

The conceptual framework developed for this study was based on the review of the concept of sustainable livelihood discussed above. The framework articulates the relationship between household's assets and the household's welfare. The theoretical background of the conceptual framework was derived from the concept of livelihood approach given by Ellis in 2000. He defines all capitals as assets that form a household's endowment of resources with which to gain a living. In this definition, the conventional meaning of assets is expanded to include, besides material and financial resources, household member's education and skill (human capital) and their relations within wider communities (social capital). The discussion on conceptual framework for this study starts from the assets.

Assets

The first and foremost concern of livelihood analysis is the people. Therefore, the starting point of the framework are the asset owned, controlled, claimed and accessed by the

household. These assets are the basic building blocks upon which household are able to make their living. Assets are also described as stocks of capital that can be tangible or intangible and utilized to generate means of survival, or to sustain its material well being at different levels above survival. The fundamental feature of asset is that they either exist as a stock giving rise to flow of output, or they can be created when a surplus is generated between production and consumption thereby, enabling the investment in future productive capacity to be made. Assets in the livelihood analysis framework include; human capital, natural capital, financial capital, physical capital and social capital.

Human Capital

The principal asset possessed by the poor is their own labor. Human capital, therefore, refers to the labor available to household combined by its education, skills, knowledge and health (DFID, 1999). Households as 'grouping' of human capital are not static in composition. Human capital composition of a household changes constantly due to internal demographic reasons (birth, death, marriage, divorce, migration and so on), and external crisis, such as, housing and employment problem (Moser, 1998). Human capital varies at the household level according to household size, skill levels, leadership potential, and health status. Human capital being of intrinsic value is required in order to make use of any of the four other types of assets. Therefore, we have to see it as a supportive factor for the other assets (DFID, 1999).

Social capital

Social capital means the social resources upon which people draw in pursuit of their livelihoods objectives. Social capital generally rests in the structure of relations among people in society, such as, networks and connectedness, membership of more formalized groups and

relations of trust, reciprocity and exchanges (DFID, 1999; and Coleman, 1990). Moser (1998) defined social capital as 'reciprocity within communities and between households based on trust deriving from social ties'. Birth, age gender, or caste, which differ within a household, most often determine access and amount of social capital.

Ethnic/caste groups (*Kul, Guthi, Gaun kiduk*), farming networks (*Parma*, membership in co-operatives, saving credit groups), *afno manche* (one's own people-nepotism) and kinship network are the four types of local social network found in Nepal.

Social capital may have direct impact on other capitals. It helps in improving the efficiency of economic relations, in reducing 'free rider' problems associated with public goods and natural resources through the mutual trust and obligations it poses onto the community. Social capital represents a place of refuge in mitigating the effects of shock or lacks in other capital through informal networks for the most deprived. Together with positive impact, social capital may also cause effects that can be restrictive for development. Social exclusion is the possible threat, since the membership in groups always entails excluding its stakeholders, especially when the social affiliation to a certain caste may be positive or negative depending on the person's hierarchical position within the system (Ellis, 2000; DFID, 1999). Together with the number of groups of community, examining the nature and quality of group is important aspect of assessing social capital

Natural capital

Natural capital simply denotes the natural resource stocks from which resource flows and services (such as land, water, forests, air quality, erosion protection and biological resources) useful for livelihoods are derived. Natural capitals are not static and nor is its

utilization for survival purpose. Human control or intervention that increase its productivity can enhance or augment the natural capital. In rural development context, depletion of renewable resource, such as, forest, land and water is in the center of interest. These capitals are very important to those who derive all or part of their livelihoods from such recourse-based activities like farming, fishing, and gathering of forest products. Within the framework, a close relationship exists between natural capital, and shocks and seasonality (parts of mediating process). Many of the devastating shocks for livelihoods are natural processes that destroy natural capital (e.g. floods, landslides). Seasonality is mainly due to changes in the value or productivity of natural capital over the year. Existence of various types of natural assets and their use, access, quality and changes in those natural capital both in terms of productivity and value is important to understand the framework more precisely.

Physical capital

Physical assets that are created by economic production processes comprise physical capital. Those are infrastructure and producer goods (equipments) needed to support livelihoods. Irrigation canals, roads, tools, machines, communication are physical assets. In economics, physical capitals are those producer goods that create a flow of outputs into the future. The physical capital, which can also be regarded as man made capital can substitute natural capital in many circumstances. In the long term, physical capital cumulatively substitutes natural capital over time, which helps to take the pressure off on natural resources that is being depleted. It is well documented that lack of particular types of infrastructure is a core dimension of poverty. For instance, lack of transport infrastructure inhibits the effective distribution of essential fertilizer resulting in low agricultural yields, and also limit market

access. Even if market is accessed, the increased cost of production and transport makes producers to operate at a comparative disadvantage in the market. Similarly, the provision of piped water has multiple beneficial effects resulting in time being saved in transporting water, and avoidance of illness and disease. Access to these physical capitals, as well as, several possible benefits the local can derive from those capital remains important issues.

Financial capital

Financial capital simply refers to stocks of money to which the household has access. Cash in hand, saving, liquid asset, such as, livestock and access to credit in the form of loan are the fundamental financial capital for rural household including pensions and other transfers from the state and remittances. Financial capital is the most versatile among the five capitals as it can be converted into other types of capital, or it can also be used to achieve livelihood outcome directly. Financial asset tends to be the least available to the poor, thus emphasize the importance of other capitals as substitute.

Evolution of financial services organization, their operations, and access by the households are the important area to be dealt with under financial capital study. In addition, the importance of remittance is also well realized by DFID, 1999.

Livelihood Strategies

Specialization in dairy farming from comparative advantage is a livelihood strategy, which aims to generate cash income in the area. This strategy involves extension services in order to increase quality and quantity of crop and milk production. Second strategy involves provision of dairy infrastructure, such as, cooling/chilling centers, processing center and

market facility. In the areas with good market access, however, farmers may adopt a strategy aiming at more or complete dependence on dairy for farm income.

Livelihood diversification is defined as "the process by which rural households construct an increasingly diverse portfolio of activities and assets in order to survive and to improve their standard of living" (Ellis, 2000). It usually refers as diversification away from agriculture, and often includes non-farm activities. The reason for diversification have been argued from several points of view, such as, necessity versus choice, seasonal nature of agriculture, risk strategies, labor markets, credit market failure, and investment in future (Ellis, 2000). The seasonal nature of agriculture and availability of wage labor also encourages livelihood diversification to non-farm/off-farm income sources. Labor requirement for farming is not constant all the year, but fluctuates with different seasons. There is a high off-farm employment opportunities in the periods of harvesting food crops and transplanting paddy. There is often excess labor availability in winter, especially high altitude areas, and this can lead to farmers' engagement in non-farm activities.

Outcomes of Dairy farming

The end result of the livelihood strategies described in the conceptual framework is different kinds of livelihood security. Dairy farming can lead to higher income levels. With the unpredictable market and national/international demand situation of dairy products, it is difficult to foresee income stability, seasonally, and degree of risk associated with dairy production. These depend on the contextual factors, such as, trends and shocks. Dairy farming leads to security of food, in terms of milk consumption, as well as, income earning through milk and animal selling. Since dairy farming is one of the labor-intensive activities, it can generate more employment. More and more family labor, both male, and female, can be used.

Environment sustainability refers to change in the resilience and stability of natural resources, such as, soil and land quality, water, forest and biodiversity (Ellis, 2000). It is often argued that manure from dairy animals is better for soil management than the chemical fertilizer. In the area where lack/unaffordable of chemical fertilizer, fresh dung plays an important role in increasing the quality of soil/land, which is the traditional and common soil management practice in most parts of the country. These outcomes of livelihood strategies lead to difference in asset status, which describes the socio-economic consequences to the community.

The different livelihood strategies that have been adopted by the rural households in Nepalese society are the results of growing difficulties in acquiring better livelihood. From historical time, rural households with little or no access to natural resources have been following various survival strategies. However, agriculture is the main strategy for acquiring livelihood in the country as a whole, and a large number of rural people depend on it for living.

In the recent years, rural households have been facing greater hardship in acquiring their food self-sufficiency due to rapid growth and degradation of the resources base, mainly land and forest. As a result, they are shifting their emphasis from subsistence crop farming to other sources of income to maintain their livelihood. Generally, in Nepalese context, single livelihood strategy sometimes cannot be enough to fulfill their basic needs. So, people are used to engage in multiple income sources even within the same household or same person. In the past, the proportion of households depending on multiple sources of income for survival was comparatively low as their farming could fulfill all household needs. Nowadays, the majority of rural households depend on multiple survival strategies for mere survival. The survival strategies have been changing depending upon the geographical location, access to

resources and infrastructure facilities. The three different categories of survival strategies are crop/forestry, livestock and non-farm activities can be considered for sustainable livelihood. In the Tarai region, people are mostly attracted towards dairy farming due to the growing potential in milk marketing, and income security. In order to analyze this survival strategy for sustainable livelihood, the sustainable livelihood approach is used, based on the concept of sustainable livelihood mentioned above.

The sustainable livelihood approach to link dairy farming and rural livelihood concentrates on the ability of the people to give continuity in the dairy production and their utilization through the legal means for the economic security in terms of income level and stability, employment generation and food security. The ability to give continuity in dairy production depends on the rights and resources that people have. In each society, there are rules governing these rights and resources. These rules are instituted in the society. The livelihood outcomes are the security of milk consumption, employment opportunity, income earning, food production, energy generation, and increase in crop productivity, which helps people for their living. The conceptual framework for the better livelihood is summarized in Figure 1.4.

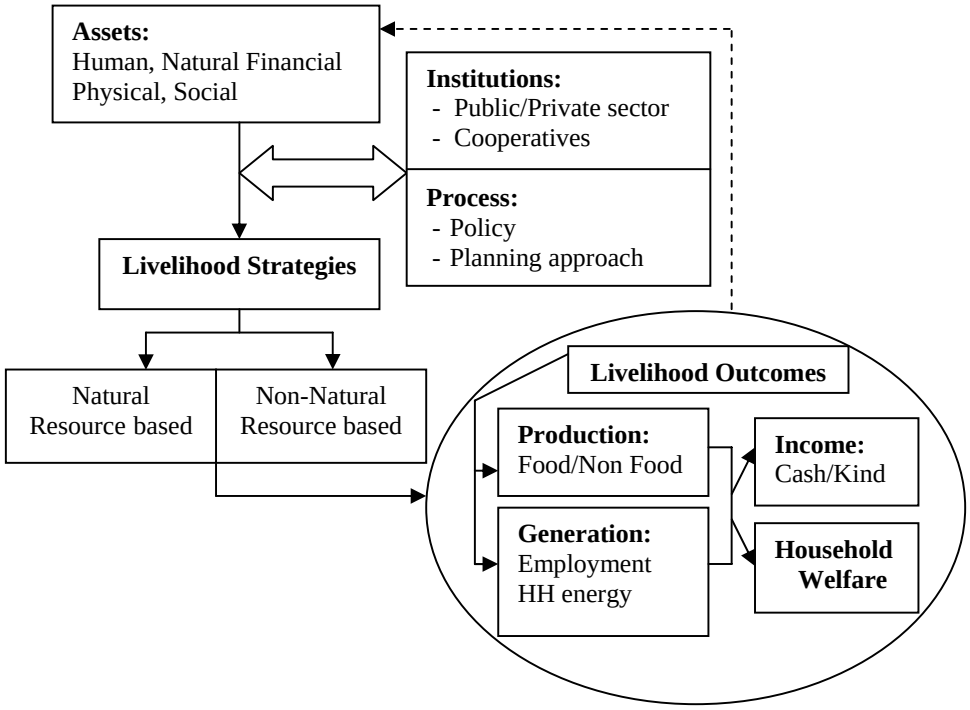


Figure 1.4: Conceptual Framework for Better Livelihood

Source: Adopted from Ellis (2000), Scoones (1998) and Carney (1998)

This conceptual framework is based on concept of sustainable livelihood approach framework as discussed above. It is an assets-institutions-activities framework, which regards the status of individual or household to understanding the options open to them and strategy for their livelihood. In this framework, dairy farming in the study area is an activity as a part of their livelihood strategies, which is again based on their household asset status. This employs detailed analysis of socio-economic status, production and consumption of milk, milk marketing, and income from dairy and crop enterprises, manure production and energy generation. Five types of assets that is human, natural, physical, social, and financial assets translated into a livelihood strategy for a set of income earning activities in presence of

transforming process, which are institutions[3] and policies and planning approach acting in the community, facilitate the household or individual to change their initial assets bundle to food and income. Household assets consist of human, natural, financial, physical, and social assets. In this study context, human asset refers to the self-labor engaging in dairy farming. Natural asset refers to the land and livestock. Financial asset refers to livestock, as they can sell in emergency and make cash, and savings. Physical asset refers to the chilling center, processing center and feed industries. Social capital refers to the formation of farmers group.

The interaction between households' assets and institutions and process determine the livelihood strategies or activities set by the particular household. In broader terms, the household livelihood strategies are based on farming (Natural Resource based) and non-farm (non-Natural Resource based) activities. The ultimate aim of an individual household is to maximize welfare through livelihood outcomes in terms of production, generation and income earning. These livelihood outcomes can further enhance the initial assets that people have.

1.5 Research Objective

Due to inadequate support of agricultural infrastructure service and marketing and storage facilities, agriculture has remained almost stagnant or slow growth. Thus, crop production alone is unable to meet the ever-increasing food needs of the growing population. On the other hand, over use of fuelwood to meet the energy demand in household sector is causing high pressure on forest and cropland, which adversely affects farming. And also, the use of traditional energy source in traditional mud stove creates lots of indoor smoke that negatively affects the health of the people. Under these circumstances, there is a need of viable

[3] Here DDC and its activities in supporting dairy activity in national level are treated as major institution or mediating factor in transferring the people's assets into livelihood outcomes.

alternatives, which require comparatively low cost resources and have short income generating span, and can minimize the over use of fuelwood.

Thus, dairy farming could be one of the most appropriate and viable alternatives, which can provide food in terms of milk and meat, income earning and energy generation in terms of biogas at the household level. Considering this background, the general objective of the study is to assess the contribution of dairy farming on rural livelihood. The specific objectives are:

1. To examine the situation of crop and dairy farming in Nepal, focusing on Chitwan.
2. To analyze the crop and dairy production and income earning from it at household level.
3. To analyze the milk yield of an individual dairy cow at household level.
4. To examine the role of cooperative dairy in supporting dairy production at the household level.
5. To analyze the role of dairy animal as a source of energy in terms of biogas generation and its implication in rural livelihood.
6. To analyze household's livelihood strategies being practiced by the farmers.

1.6 Research Methodology

Both primary, as well as, secondary data was used in this study. Secondary sources are used to evaluate the general agricultural scenario, its production situation and different aspects of dairy farming. Primary data was used to evaluate the contribution of farming at household level. In order to meet the first objective, an in depth review of secondary sources was done to assess the farming situation and policy towards farming. Growth trend of area under

cultivation, production and yield of major crops was examined by using census data from the year 1976 to 2005. Similarly, for objective two, detailed analysis of input and output of the crop and dairy farming was done. It was done on the basis of primary data to examine the implication of crop and dairy faming in the total household income of the sampled household in order to provide economic feasibility of the dairy farming. The production and consumption pattern in household level was also analyzed.

For the third objective, the focus was to analyze milk yield of individual cow on the basis of the primary data recorded by a particular household for one lactation period. And discussed the socio-economic status of the five dairy farmers through five case studies. And summarizes the problem perceived by dairy farmers in milk production and milk marketing.

For the forth objective, the focus was given to cooperative dairying, which could be an effective strategy in supporting dairy farmers at household level. In order to examine the role of cooperative dairying, comparative analysis was done between dairy cooperative member and non-member in the issue of milk collection, production, and marketing on the basis of primary data. Secondary data was used to assess the relations between cooperative dairying in different level household, village, district and national level.

In order to fulfill the fifth objective, the role of dairy livestock in household level energy generation was assessed through a case study of biogas users (who are also dairy farmers) of two geographical regions, Tarai in Chitwan and Hills in Kavre.

In order to meet the sixth objective, a theoretical and conceptual framework was created through a detailed review of relevant literature. The various livelihood strategies that are under taken by farmers were examined thoroughly in order to establish the relationship

between socioeconomic status of the farmers and livelihood strategies. Primary data was analyzed to provide share from different livelihood strategies.

1.6.1 Site Selection

Chitwan district, which lies in the Tarai, Central Development Region of Nepal, was selected purposively (Figure 1.5). Chitwan district is one of the most advanced areas in dairy farming as compared to other districts of the country, and farmers in the district are highly motivated. Considering this fact, the government has emphasized the development of dairy farming by developing livestock pocket areas in various villages of the district. This is further supported by the Institute of Agriculture and Animal Science, Tribhuvan University, which plays a key role in development of livestock in the area. Thus, this area is the most productive area. Two livestock pocket areas of Chitwan district were selected for this study considering large numbers of dairy animal holders, with high milk production (Figure 1.6). One VDC in Kavre district (Figure: 1.7) was also selected to look at the comparative situation of biogas users in Hill and Tarai.

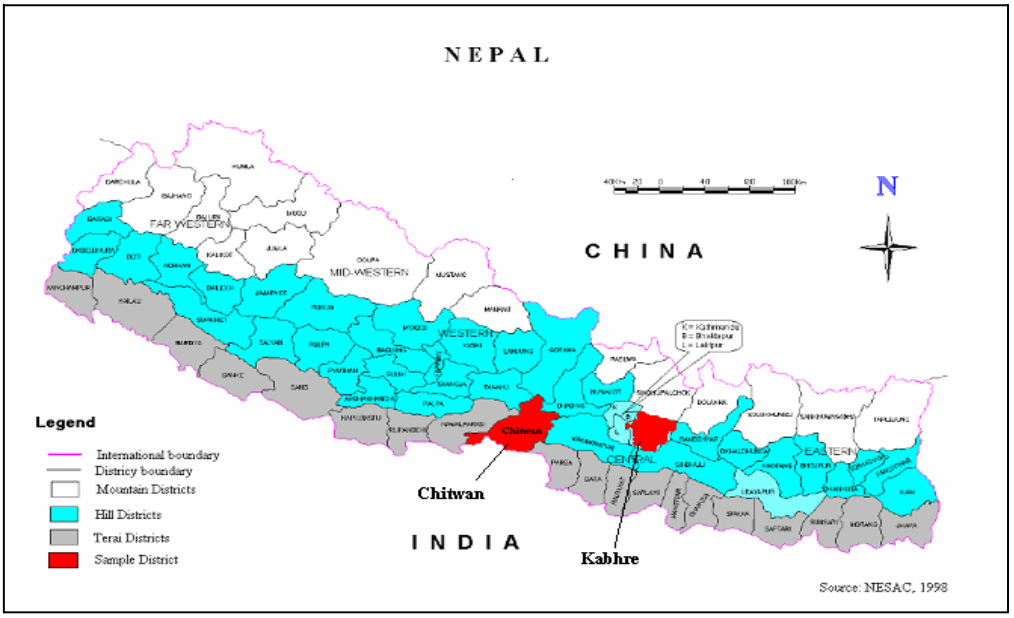


Figure 1.5 Map of Nepal with Study District

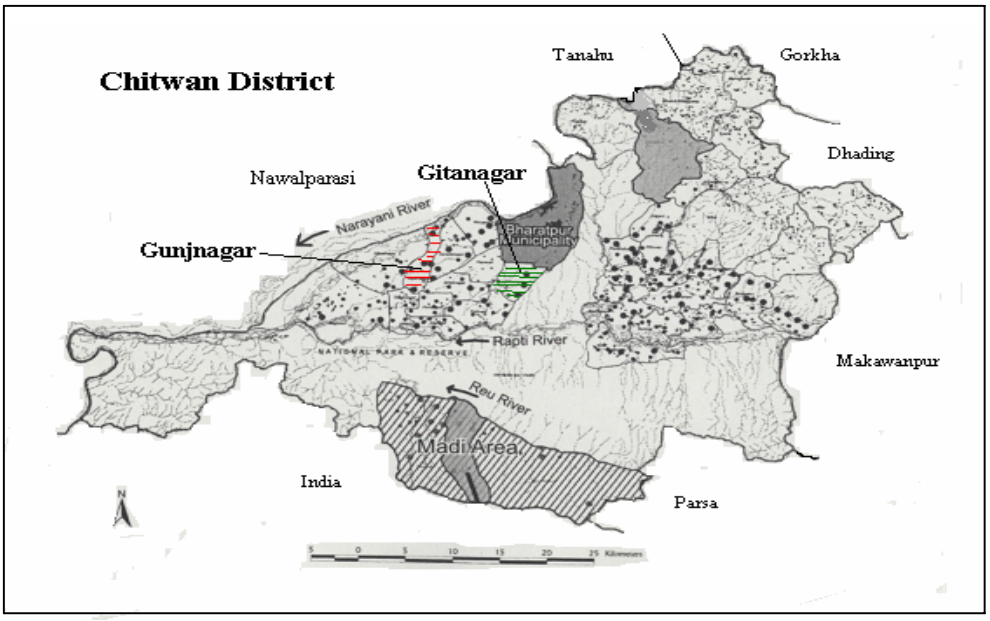


Figure 1.6: Map of Study Districts with VDCs

Figure 1.7: Map of Kavre District and Study VDC

1.6.2 Sampling Procedure

Purposive and multistage sampling techiniques were used to select district, Village Development Committee (VDC) and households. District and VDC were selected by using purposive sampling techniques, whereas, households were selected by simple random sampling techniques among the dairy farmers. To collect primary data, a detailed survey was conducted in 104 households (about ten percent of total dairy farmers) from two VDCs named Gunjanagar and Gitanagar in Chitwan district. A semi-structured interview approach was used to collect primary data. Information on agriultural land distribution, livestock operations, ethnic distribution, educational status, and income from different economic activities were collected and analysed to evaluate significance of different household economic activities. Six cows owned by five different households were selected for the analysis of milk yield of individual cow. Ten Milk Producers Cooperatives (MPCs) were selected randomly from the

same study area in order to examine its role in supporting dairy activities. Forty-one biogas users were randomly selected among the 104 dairy farmers. Thirty-five households were also selected randomly among the biogas users in Kavre district, a Hill district in order to make a comparative analysis of biogas users in Hill and Tarai. In the Hill village, the selected households were also dairy farmers.

1.6.3 Data Collection & Analysis

A detailed survey was conducted to collect information mostly on different farming components. The primary data was collected mainly during the two field trips on October 2001 to October 2002. Subsequent enquiries through short field visit and Internet were made as per need to supplement the data. General surveys were conducted for all households to find out the socioeconomic status of the dairy farmers. The sample households were selected according to dairy animal holdings. Non-dairy animal holders were not included in this study. All the information about land ownership, land use, production and production cost, labor use during each of the farming operations, income earned from various crops and fertilizer used were collected. For the livestock, data includes animal holding, labor use, production costs, and income earned from dairy animals. In addition to this, a detailed data was collected for the dairy animals, such as, types of dairy animal and their composition, feeding, milk production, milk marketing and annual income earned from dairy animals. Besides this, data was also collected about the different income sources. Data analyses were done by using appropriate statistical tool.

Chapter 2: Agricultural Development in Nepal

2.1 General Background of Nepal

Nepal is a small mountainous country located between the latitude 26^{o} 22' to 30^{o} 27' North and longitude 80^{o} 4' to 88^{o} 12' East. The topography of Nepal varied and diverse, and its altitude ranges from 60 to 8,848 meters above sea level. The average length of the country is 885 km and 193 km in width with an area of 147, 181 sq. km. Country is ecologically divided into three regions, running east to west. They are the Mountain, the Hill, and the Tarai (Plains). The mountain region covers one-third (35%) of total area of which only two percent is suitable for cultivation, ranging in altitude from 4877 m to 8848m. The region accommodates only 7.3% population of the country, who depend mostly on livestock farming for their livelihood. Raising of sheep, goat and yaks is common, which provide milk, hides, and wool. This region can support only one crop of buckwheat, barley, or potato a year or once every two years.

The Hill region constitutes 42% of the total land area of Nepal, but only about 10% of this is suitable for cultivation on tars (river basins) and steep terraces. It lies between the altitudes of 610 m to 4877 m above sea level. About 46% of the population lives in this area, of which 96% are small farmers[4]. Generally, two basic cropping systems, namely, paddy based and maize based are predominant in this region. The paddy based is generally practiced in wetlands and maize based on dry land. The main occupation of people living in higher altitudes of this region is animal grazing, cottage industry, and high altitude cereals. Whereas people living in lower altitude have main occupation as cereal crops and cash crops farmers.

[4] Farmers having less than 0.5 ha of land.

The Tarai, a part of Indo-Gangetic Plain, is a tract of low, flat land, ranging in altitude from 22m, to 600m above, sea level. This region ranges from 25 to 32 km in width. It stretches along the southern border of the country, and forms almost the entire border with India. The climate in the area is subtropical and monsoonal with annual rainfall ranging between 1000 and 2700mm. It comprises 23 percent of the total land area. Agriculturally, this region is very important, the soil in this region is alluvial and fertile in comparison with the rest of Nepal. They are often deep and have good water holding capacity. A higher proportion of land is cultivable in this region. There is much better irrigation potential, as well as, relatively better social and economic infrastructure development in this region. Thus, the Tarai becomes a major producer of cereal crops, cash crops, tropical fruits and vegetables, and is capable of producing a marketable surplus. The major contribution of food grains in the overall agricultural GDP, 42 percent, comes from this region.

Table 2.1 provides major features of three ecological regions, and presents how Tarai differs in terms of agricultural performances with the other two regions of the country.

Table 2.1 Major Features of the Three Ecological Regions

Items	Ecological Regions			Nepal
	Mountains	Hills	Tarai	
Total area in sq km[a]	51,817 (35%)	61,345 (42%)	34,019 (23%)	147,181 (100%)
Population in thousands of hectares[b]	1565.7 (7%)	10,288.8 (46%)	10,512.5 (47%)	22,367 (100%)
Cultivated land in thousands of hectares	208 (9%)	904 (37%)	1,299 (54%)	2,441 (100%)
Forest Area, in thousand of hectares[d]	1,408 (22.7%)	3,251 (52.4%)	1,542 (24.9%)	6,201 (100%)
Grazing land in thousands of hectares	1137 (64.7%)	546 (31.1%)	74 (4.2%)	1,757 (100%)
Population density/hectare of cultivated land	6.94	9.3	6.62	7.56
Forest area per hectare of cultivated land	6.77	3.6	1.19	2.54
Cultivated land per capita, in hectares	0.13	0.08	0.12	0.11
Forest per capita, in hectares	0.9	0.32	0.14	0.27
Dominant farming systems	Livestock	Horticulture	Cereal	-
Nature of farming	Subsistence		Partly market	-

Sources: APSD, 2001; CBS, 2001; adopted from Basnyat, 1995

Administratively, Nepal is divided into five development regions, 14 zones and 75 districts. Each district is composed of Village Development Committees (VDC), which is the smallest political unit at the local level. At the district level, the District Development Committee (DDC) is the main political unit. The VDCs and DDCs are responsible for planning and development activities. From the administrative point of view, there is a provision of a Chief District Officer (CDO) in each district. The CDO is mainly responsible for maintaining law and order in the district, and also to co-ordinate developmental works conducted by different ministries and local agency at the district level.

Nepal is a culturally rich country with a variety of distinct ethnic groups. Traditionally, the main resources of the country are the land and the people, and these have given rise to a rapid increase in tourism, with thousands of people visiting each year to experience at first

hand, the cultural and scenic diversity (Gilmour, 1984). Nepal is predominated by Hindus, although the majority practices a mixture of Hinduism and Buddhism. Nepali is the official language. However, every distinct ethnic group has their own languages, cultures, and traditions.

2.2 Agriculture Scenario

Agriculture in Nepal is subsistence-based, and very complex, characterized by a mutual interdependency of crops, livestock, and forest resources. The continuous increasing population has resulted in pressure on limited agricultural land. The distribution of agricultural land becomes fragmented and uneven where 70 % of households are holding less than 1 hectare of land and about 50 % of households are holding less than 0.5 hectare of land (NLSS, 1996). This land distribution pattern has limited production, thus, resulting into low crop productivity and most households are not able to produce enough food grains for their consumption.

In the late 1980s, agriculture was the main source of livelihood for more than 90 percent of the country's population. In an average, it contributed more than 60 percent of the GDP and about 75 percent of exports. Recently, it has been estimated that agriculture contributes about 38 percent of the country's total GDP and its share declined at about 61 percent in 1980; 47 percent in 1991; and 40 percent in 2001 (CBS, 2001). In the Fifth Five-Year Plan (1975-80), agriculture has been given the highest priority because economic growth was dependent on both increasing the productivity of existing crops, and diversifying the agricultural base for the use of industrial inputs. Although agricultural production grew at an average annual rate of 2.4 percent from 1974-1989 and 2.7 percent from 1900-2000, it did not

fulfill the food demand and the nation was started experiencing a food deficit situation in the eighties, and has now turned into a regular food importer. The productivity of agriculture sector is very low as compared to other South Asian countries, and this is mainly due to the low use of chemical fertilizers, lack of irrigation facilities and improved technology, and unfavorable weather conditions. The productivity of paddy is as low as 2 ton per hectare. The provision of irrigation, which plays a key role in the development of the agricultural sector, however, has been less then expected. The agricultural sector still has to rely heavily on rainfall. In Nepal, only about 20 percent of the total cultivated area is under irrigation. Out of the total irrigated area, about 77 percent is in Tarai, about 20 percent in Hills, and 3 percent in the Mountains. The cultivation of improved varieties of crops is also low (less than 50%).

There are also regional disparities in agricultural growth. The agricultural growth rate and AGDP are 2.1, 2.1, 2.7 and 8, 45, 47 percent in Mountain, Hill and Tarai, respectively (CBS, 2002). Tarai region has higher growth rate due to fertile land, as well as, better irrigation facility, and availability of inputs. However, Mountain and Hill regions are also potential for high value crops like vegetable, cash crops, fruits, and livestock due to the presence of micro climatic niches.

The dominant farming systems in Nepal vary with the geographic region. Generally, farming system in Mountain region is dominated by mixed farming system i. e. livestock-based farming system. Integrated (crop/livestock/forest) based farming system dominates in Hills and cereal crop based farming systems in Tarai. Farming systems are generally subsistence, mixed, and dependent on the use of natural resources, particularly, use of forest.

Agriculture evolution and sustainability has been based upon human experience gained over many generation of combating the harsh prevailing agro climatic conditions. Over the

years, the need to develop a sustainable system of growing food crops to support human existence, on the steep slopes of the mountain has first led to the physical conservation of soil. It is maintained through construction of extensive networks of terraces, and second to maintenance of soil fertility through the use of organic matter both in the form of animal dung, compost mixtures, and green manure crops. The forest is the foundation upon which the whole sustainability of agriculture, especially the Hill agriculture is based. Majority of farmers depend upon a complex mix of crops, livestock, and forest products for their living. Trading of livestock and livestock products, forest resources, is the major livelihood strategy in Hill and Mountain people in Nepal as food grain production in these regions is inadequate. This is also true for most of the small farmers even in Tarai region.

The land classification system currently in use in Nepal is of two distinct land types, distinguished by either being irrigated or rain-fed. The wetland (*khetland*) refers to the land where water can remain on the surface or the upper soil layer, making it suitable for Paddy cultivation, and it is usually distributed along the river/stream banks, which is bounded for flooding under various irrigation systems. *Khetland* is usually highly productive, and has a better cropping potential compared to *bariland*. The rain-fed (*bari/pakho*) is a cultivated unbounded upland, on sloping terraces, and on non-irrigated valley bottoms. However, in total area, *bariland* far exceeds *khetlan*, and so the latter is much more valued in the regions where it is available. Where small-scale irrigation schemes can be introduced, farmers invariably convert *bariland* into *khetland* at lower altitudes.

2.2.1 Cropping Pattern

Paddy, maize and wheat are the most important food crops in Nepal grown on 1.5 million ha, 824 thousand hectares and 641thousand hectares, respectively, in 2000/01. Annual

production is 4.2 million ton of paddy, 1.4 million ton of maize, and 1.1 million ton of wheat. Paddy area declines substantially in drought years, as in 1992/93. The area under maize cultivation is stable because maize is planted in rain-fed situations. Wheat, which generally uses the residual moisture of the paddy crop for germination, is a very successful crop in Nepal. Unlike paddy, it is not damaged by flood or drought because it is grown in winter. Winter showers help the growth of wheat.

Finger millet is relayed with maize. The area is increasing as more marginal lands are coming under cultivation. When paddy cannot be established due to drought, poor farmers resort to finger millet, especially in the inner Tarai. It covers an area of 250 thousand hectares with a production of 270 thousand ton. Barley is grown on about 30 thousand hectares. In the high hills, barley is mainly rotated with potato and buckwheat. Naked barley is grown in the highlands of Nepal. Oilseed crops showed a modest area expansion from 156 thousand ha to 185 thousand ha in the last five years. Rapeseed mustard occupies nearly 90 percent of the total oilseed area. Other oilseeds are line seeds in winter, and groundnut and sesame and sunflower in summer.

Pulse crops include lentil, grass pea, chickpea, mung bean, pigeon pea, black gram, soybean, and cowpea. Virtually, all farmers in Nepal grow one or more species of grain legumes, which occupy about 308,300 ha, with a production of 202 thousand Mt. Lentil, grass pea and chickpea are mainly grown in Tarai and inner Tarai. In the Hills, summer legumes, while in the higher sub-mountainous region beans are the most important summer legumes.

The potato is the most common vegetable crop in Nepal, and is also one of the major food crops. It is grown all over the country as a winter crop in the mid-mountains and plains, and summer crop in the high mountains. In the Hills above 3,000 meter it is a staple crop. In

1994/95, potatoes occupied 98 thousand ha with a production of 839 thousand ton. Hill accounts for almost three- fourths of total potato area. In Tarai region, there is over one million hectare under paddy, and around 350,000 hectares under wheat. Paddy-wheat cropping pattern is practiced mainly in low land areas, endowed with fertile, heavier soil with low permeability. Jute is also grown in the rainy season in eastern Tarai. Other important rainy season crops, grown on well-drained soils usually with some slope, include maize, finger millet, pigeon pea, soybean, and sugarcane.

The most important cropping practices in the Hills are paddy based on irrigated *khetland* and maize-based on the non-irrigated *bariland*. Although Paddy and maize are the two major staple crops of the regions, wheat, millet, barley, potato, mustard, legumes, and some other minor crops also make important contribution to Hill agriculture. Paddy can be grown virtually everywhere below 1800 m on irrigated land and maize on rain fed land up to an altitude of 2500 m. The common cropping patterns in the Hill region according to altitude and land type are summarized in Table 2.2. Following the main season paddy crop, *khetland* is generally left to fallow in winter, but in areas where there is irrigation, wheat can be grown. Most commonly, soybean and black gram are grown on the bounds of *khetland* in summer. Chickpea, lentil, peas, and other pulses are also grown on the terrace bounds with the main crops. Soybean and millet are intercropped or relay-cropped with maize or wheat, the degree of relay cropping depend upon altitude.

Table 2.2: The Common Cropping Patterns in the Hill Region

Altitude	Land Type	Cropping Pattern
<1000m	*Khet* (Paddy land)	Paddy-Wheat-Paddy Paddy- Wheat-Maize Paddy-Wheat-Fallow Paddy-Fallow-Paddy
	Bari (Homestead)	Maize-Finger millet-Fallow Maize+Soybean-Fallow Maize+Upland Paddy-Black gram
1000m-1500m	*Khet* (Paddy land)	Paddy-Wheat-Fallow Paddy-Potato Paddy-Fallow Paddy/Lentil or Peas
	Bari (Homestead)	Maize/Finger millet-Wheat/Barley Maize/Finger millet-Fallow Maize/Finger millet-Mustard
1500m-2400m	*Khet* (Paddy land)	Paddy-Fallow Buckwheat-Wheat
	Bari (Homestead)	Maize/Finger millet-Fallow Maize/Finger millet-Wheat/Barley Maize-Naked barley-Finger millet (2yrs) Maize-Fallow Potato-Fallow

Source: Subedi, 1990

Numerous cropping patterns exist in the hills and crop combination varies greatly with altitude, climate, soil, and availability of water for irrigation. It is possible to produce three crops per year on *khetland* below1000 meters, and this system is usually based upon two crops of paddy and one of winter wheat. From 900 meters to 1800 meters, two crops per year are grown, paddy and winter crop; wheat or vegetables in *khetland*. Above 1800 meters, usually one crop is grown, and it generally depends on rain fed. However, these crop sequences are not rigidly followed and land is often left to fallow during winter. Such situations impact greatly upon the ability of farmers to meet their food security.

The common crop pattern in Tarai is in given in Table 2.3. In Tarai, Paddy occupies more than a million hectares of land in summer, mostly under rain-fed conditions. Wheat is grown in winter with partial irrigation. Thus, Paddy-wheat-fallow and Paddy-wheat-dal/beans are the main cropping patterns of the Tarai. Other important patterns are Paddy/lentil-fallow

and Paddy/lathyrus-fallow. A single crop of Paddy is taken in depressed areas. Paddy-Paddy fallow or Paddy-Paddy-wheat is the most intensive farming system, where irrigation is available. Jute-Paddy-fallow and jute-mustard or lentil or wheat also prevails in the eastern Tarai. Paddy-chickpea-fallow is an important cropping pattern in the mid-western Tarai. Paddy-mustard-fallow is also an important cropping pattern in Tarai. Paddy-mustard-wheat and Paddy-mustard+chicpea+lentil are common cropping patterns in the mid-and far-western Tarai. Paddy-vegetable is becoming one of the important crops with the increased road network in the rural areas. Ninety-six percent of the country's sugarcane area lies in Tarai. And, potato, coriander and rapeseed are generally intercropped with sugarcane.

Table 2.3: Common Cropping Pattern in Tarai Region

Regions	Land Type	Cropping
All Tarai	Wet Lowland (Ghol)	Paddy-Wheat-fallow Paddy-Wheat-Dal/beans Paddy-Lentil-Fallow Paddy-Lathyrus-Fallow Paddy-Mustard-Fallow Paddy-Vegetable
	Dry Upland (Tandi)	Maize-Mustard Mustard+Chickpea+Lentil Mustard-Leguminous crops
Central Tarai	Wet Lowland	Paddy-Paddy-Fallow Paddy-Paddy-Fallow
	Dry Upland	Maize-Mustard Mustard-Leguminous crops
Eastern Tarai	Lowland	Jute-Paddy-Fallow Jute-Mustard/Lentil/Wheat
	Dry Upland	Maize-Mustard Mustard-Vegetables
Mid-western Tarai	Lowland	Paddy-Chickpea-Fallow
Far-western Tarai	Low Land	Paddy-Mustard-Wheat
	Upland	Mustard+Chicpea+Lentil

Source: Pokhrel, 2000

Common fruits grown in Tarai are mango, guava, banana, and jackfruit. Although they are primarily grown for home consumption, small amounts are sold in the market. Mango orchards are declining in Tarai largely due to poor management. The whole farming system of

the country is still at a subsistence level, and with annual food deficits in many places. However, much effort has been made to introduce modern technologies with improved varieties of crops and other inputs such as fertilizer, agrochemicals, and credits. In addition, intensive utilization of arable land through proper management and utilization of natural resources is also encouraged.

This cropping pattern as a whole is very much influenced by the use of animal manure and chemical fertilizer, which are used very often due to lack of capital or non- availability. The traditional manuring practices for maintaining soil fertility are no longer sufficient to fulfill the nutrient demand of crops in the country. These practices need to improve to achieve sustainable crop production. In the accessible areas, farmers do use chemical fertilizer in combination with animal manure, especially when improved varieties of crops, such as, maize, wheat and paddy are grown. However, with the great variation in soil properties, general recommendations of fertilizer are not cost effective (Khadka and Chand, 1987). Therefore, there is a little scope for wide application of chemical fertilizer under present circumstances. The amount of manure application greatly varies from region to region, land to land, and crop to crop. The large quantities of manure application for sustaining arable cropping patterns are dependent upon natural resources and livestock. Because of this, the numbers of livestock per human inhabitant of Nepal is amongst the highest in the developing world. Consequently, for the farmers in the rural areas, the most important enterprise after crop production is livestock husbandry. It is the major source of food protein for people in the form of milk and meat, but also supplies manure and draught power for maintaining land fertility, and for land preparation. Roughly, 75 percent of the cultivated land is ploughed by draft animal and fertilized with compost.

The land distribution pattern in Nepal is highly skewed, as a result, the majority of people do not have access to land resources. Only about nine percent of the households control over 47 percent of the agricultural land. There is also variation in the size of agricultural land ownership by household in different geographical regions. Table 2.4 shows the distribution of agricultural land ownership by household in three different regions. This shows that the proportion of households with less than 0.5 ha is as high as 46 percent in the Hills and 42 percent in the Mountains. Furthermore, about 20 percent of the households in Tarai have a holding of more than 2 ha, compared with only 6.6 percent in the Hills. This implies that the land holding of Hills is relatively small as compared to the average size of land holding in the Mountains and Tarai. But, the agricultural land in mountains is less fertile and less productive. The smaller size of land holding in the Hills and lower fertility of the land in Mountains also manifest in the higher incidence of poverty in these regions.

Table 2.4: Size Distribution of Agricultural Land Ownership by Region

Region and Holding	<0.5 Ha	0.5-2 Ha	>2.0 Ha
Mountains	41.6%	44.3%	14.1%
Hills	45.8%	47.6%	6.6%
Tarai	33.2%	47.1%	19.7%
Nepal	40.1%	47.0%	12.8%

Source: CBS, 1997

2.2.2 Crop Production

The crop yield of various crops in Nepal is low due to lack of sufficient production inputs, and appropriate technology suitable to different agro-ecological zones. The suitable technology is crucial to fit different agro-ecological conditions the yield and growth rate of major crops in Nepal and other South Asian countries are shown in Table 2.5. The Table reveals that the annual growth rate of all major crops is one of the lowest in Nepal than the

other South Asian countries. Growth rate of sugarcane is little bit higher than India, Bangladesh, and Pakistan. However, the overall growth rate is found to be negative during the Year 1991/93.

Table 2.5: The Annual Growth Rate (%) of the Major Food Crops (1961-63 to 1991-93)

Country	All	Paddy	Wheat	Sugarcane
Nepal	-0.07	0.54	0.29	1.89
India	2.71	1.92	3.46	1.39
Bangladesh	1.59	1.55	3.59	0.27
Pakistan	3.27	1.92	2.89	0.92
Sri Lanka	1.75	1.57	-	2.45

Source: FAO, (1986 and 1993b)
Adopted from Agriculture Perspective Plan 1995

More than half of the value of the Agricultural GDP is derived from the three major crops paddy, wheat and maize. Considering this, the government of Nepal has given top priority in agricultural development for the last few decades. They all have stressed that agricultural production needs to be improved through more widespread use of better technologies and agricultural inputs. Nevertheless, the overall levels of achievement have been consistently low.

Figure 2.1 shows estimated area under cultivation and yield for the selected cereal crops in Nepal. Paddy, which is the main stable crop, the area under cultivation is higher in comparison to all other crops. There is little fluctuation in area under cultivation of paddy in the year 1978/79, 1982/83, 1986/87, and1992/93 due to the unfavorable natural climate. The noticeable area under cultivation of paddy declined in the year 1992/93 due to delay in monsoon rain. In 1993, floods and debris torrents caused a terrible disaster, which appeared to be the worst in the disaster history of Nepal, damaging lives and properties in 20th century (Bhusal, 2002). The area under cultivation of maize and wheat is gradually increasing till 2004/05.

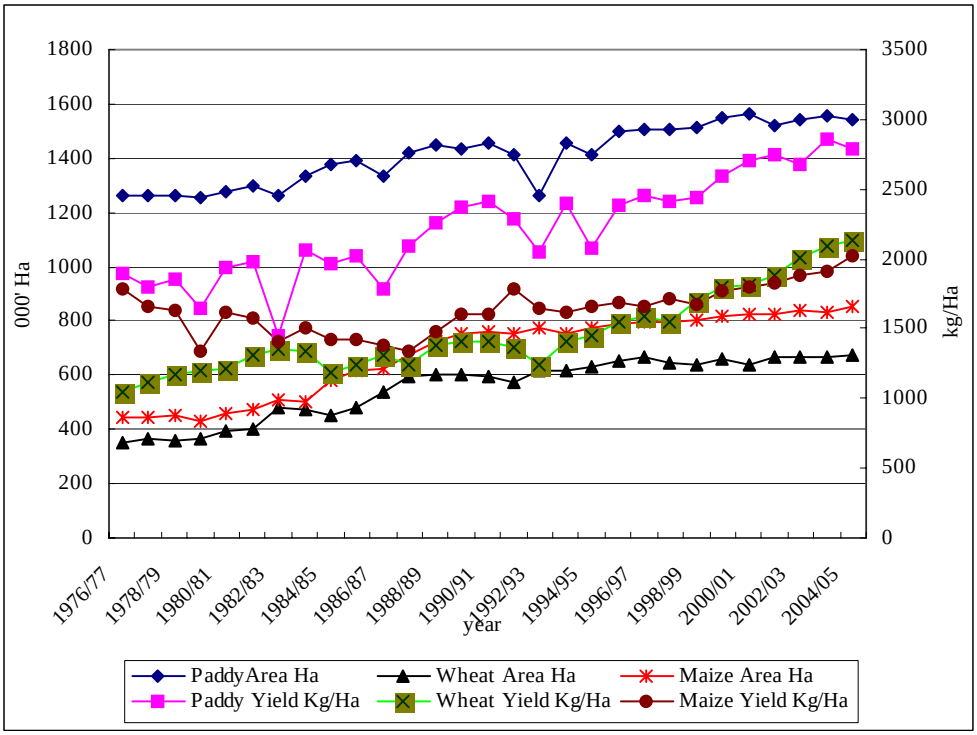


Figure 2.1: Estimated Area Under Cultivation and Yield for the Selected Cereal Crop in Nepal (1976-2005)

Source: CBS, 1987, 1997 and MOAC, 2005

Figure 2.2 shows that the area under cultivation of potato is gradually increasing. The yield of potato is also gradually increasing. However, in the year 1986/87 and 1987/89, the yield of potato suddenly declined due to the occurrence of potato disease “late blight”. After that, the yield of potato gradually increased due to the introduction of high yielding seed and “late blight” resistance. The area under cultivation of mustard is increasing, however, the yield of mustard is approximately stagnant, about 2000 kg/ha throughout the years.

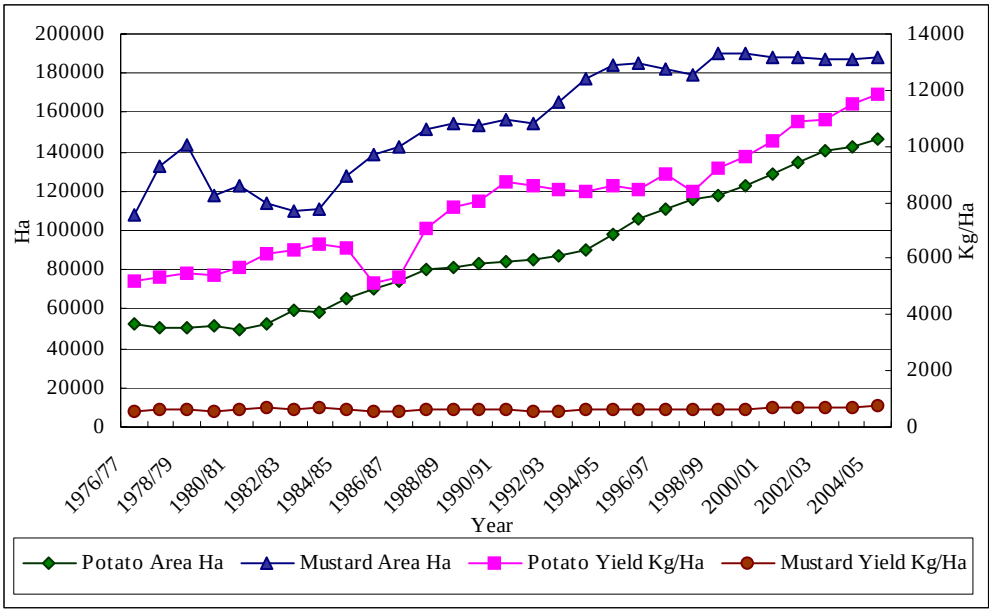


Figure 2.2: Estimated Area Under Cultivation and Yield for Selected Cash Crops in Nepal (1976-2005)

Source: CBS, 1987, 1997 and MOAC, 2005

The Forth Five-Year Plan emphasized the development of agriculture by exploiting the comparative advantages of each of the ecological regions. The agricultural development strategy endorsed and standardized a general policy for developing livestock in the Mountains, horticulture in the Hills and cereal and cash crops in Tarai. The focus on developing cereal and cash crop in Tarai is the result of agriculturally significant land as it is endowed with fertile alluvial soils. It can be seen as a major cause of the considerable migration of people out of the Hills to exploit better agricultural opportunities there, following the clearing of the forests and the eradication of malaria (Basnyat 1995, 32). Consequently, the population in Tarai is increasing at a rate of 4.2%. This is the major reason for the increased area under cultivation for cereal crops, especially paddy till 1990s (Figure 2.3).

Various policy efforts were made to increase agriculture production by improving input supply and extension services in different plan periods. As a result, the yield of paddy is

increasing from the year1998/99. In the year 1982/83, paddy yield has suddenly decreased due to the appearance of high drought in the time of paddy plantation in Tarai. In the opposite, maize yield has increased with about the same amount.

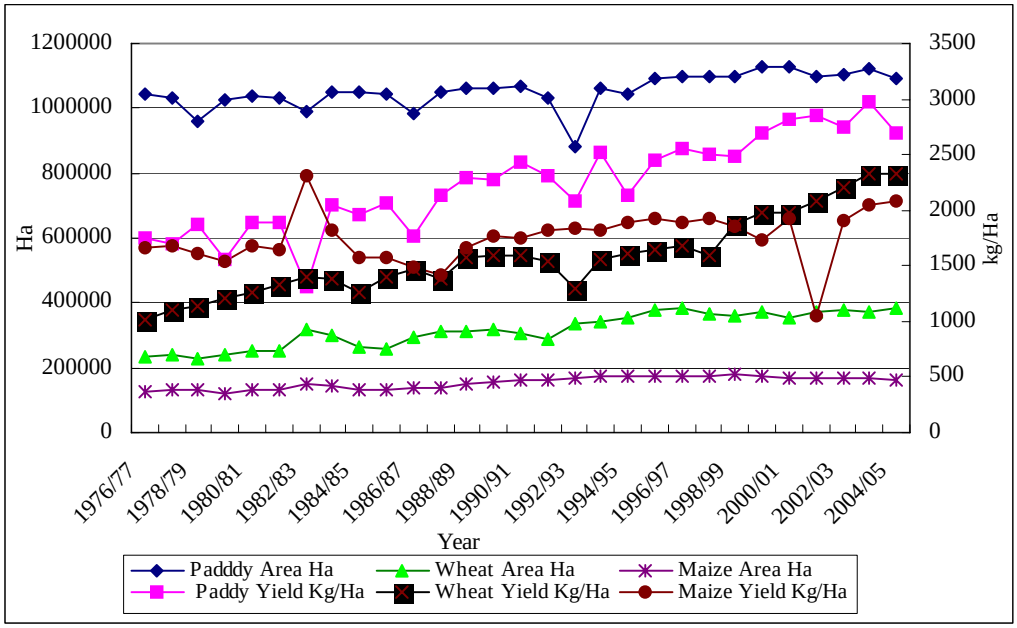


Figure 2.3: Estimated Area Under Cultivation and Yield of Selected Cereal Crop in Tarai Region (1976-2005)

Source: CBS, 1987, 1997 and MOAC, 2005

Figure 2.4 shows there is no significant change in the case of yield of mustard ranges between 500-700 kg per hectare. Though the cultivated area of potato is increasing, potato yield suddenly declined in 1986/87 and 1987/88 due to the potato disease and lack of high yielding variety seeds.

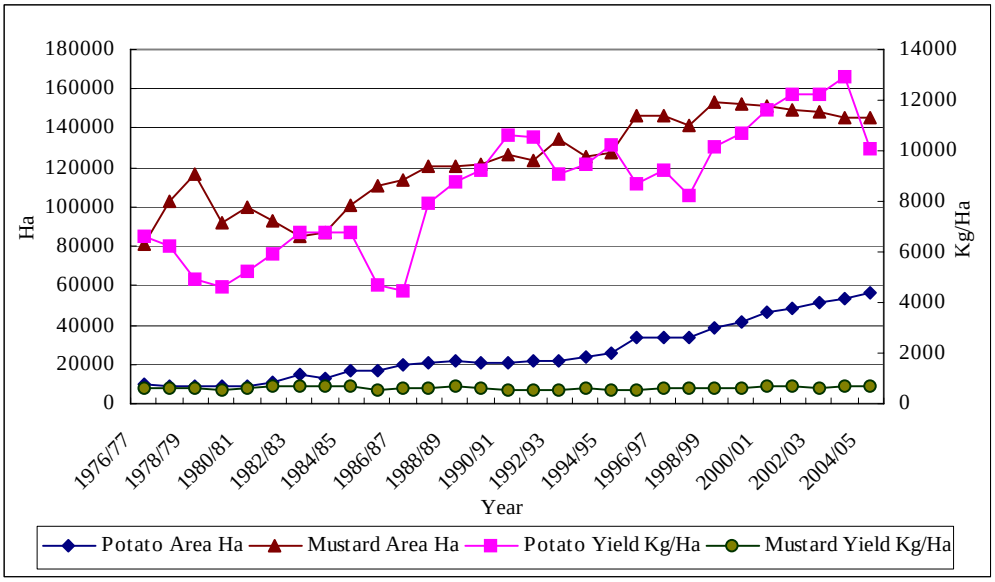


Figure 2.4: Estimated Area Under Cultivation and Yield of Selected Cash Crops in Tarai Region (1976-2005)

Source: CBS, 1987, 1997 and MOAC, 2005

2.2.3 Policy toward Crop Farming: Policy Review

During the Rana regime period till 1951, no active planning efforts were made despite development of few plan documents. In 1951, a new government was formed as a result of popular public movement. Subsequently, some new steps were taken to promote national development. A separate ministry was set-up to coordinate various development activities. A few individual projects were prepared and implemented. This marked the beginning of development activities in the country. The planning approach to development in Nepal began in 1956, with the formulation of the First Five Year Plan. Nine periodic plans have been implemented and the Tenth Plan (2002-2007) is under implementation. In this planning period, the country has made considerable efforts to increase aggregate agriculture production, but still, the country has not been successful in to meet their targets. Although this sector has been given top priority in most of the periodic plans, it is mentioned everywhere that development

planning particularly in agriculture has not been effective in bringing desired changes in the country. The agricultural sector is one of the major sectors, which is the foundation for development of the non-agricultural sectors. Thus, poverty alleviation is not possible until and unless this sector is developed. This section briefly discusses different plans implemented in Nepal, their objectives and outcomes. More discussion related to crop farming has been done.

The First Five Year Plan was started on September 1956 and ended in July 1961. The plan was prepared with very little statistical information. The top priority was given to transportation and communication with over 36 percent of budget allocation. Agriculture including village development and irrigation, received second priority with 20 percent of budget expenditures. The plan emphasized the increase of production through better extension services, and increased supply of inputs and need of expanding employment. Due to less statistical information, targets were missed by a wide margin. Only 66 percent allocated budget was spent during the period.

After the lapse of a year, a Second Plan was implemented due to the change in political system in 1960. Thus, the Second Plan was of only three years plan called the Three Year Plan, and was put into operation from the fiscal year of 1962-1965. The Second Plan also gave top priority for transportation and communication, with about 39% of budget expenditures. The Plan aimed at the creation of development of future development plan. Regarding crop production, the main aim of the Plan was to increase agricultural production. The concept of specialization in livestock, horticulture, and food crops according to geographical regions was introduced. In the Plan period, there was a little more achievement compared to the first Plan. Significant progress was made in the field of economic development. The production from agricultural sector was increased where as, the achievement from other sectors, such as,

transportation, communication, education, and irrigation were below the target level. Although the GDP growth rate increased by 13.7 percent per annum, the real per capita GDP decreased by 0.66 percent during the Plan period. The production of food grains in 1964/65 over to 1961/62 increased by 3.6 percent. This Plan also encountered various problems, such as, lack of clear programs and polices regarding objectives, lack of knowledge of choice of technology, lack of trained manpower, and lack of statistical information.

The Third Five Year Plan (1965-1970) was more specific than the previous two periodic Plans. One of the main objectives of this Plan was to increase overall food crop production to meet domestic demand. The Plan targeted to increase food grains production by 15 percent (3% per year) and cash crops by 73 percent (14.6% per year) and provision of irrigation. During third Plan, the achievement in the production of food grain increased by only 12.4 percent and cash crops by 39 percent. It was very less than targeted (Table 2.6).

Table 2.6: Targets And Achievement In Crop Production During Third Five Year Plan

Items	Targets	Achievement
Paddy	7.5%	1.8%
Maize	7.5%	-7%
Wheat	179.5%	129%
Barley & Millet	34%	39%
Sugarcane	100%	70.6%
Oilseed	150%	9.8%
Tobacco	40%	25.6%
Jute	19%	25.6
Irrigation	-	40,648 ha.

Source: NPC, 1970 (Forth Plan)

The Forth Five Year Plan (1970-1975) had also put second priority after transportation and communication receiving 26 percent of the total allocated budget. The main aim of this Plan in agriculture sector was to maximize output by increasing yields per unit land and per head of population, and the specific objectives were; to ensure raising levels of consumption,

to provide for greater exports, to supply adequate amount of industrial raw materials. For this, the government introduced the concept of corridor development and agro-climatic specialization of crops, livestock, and horticulture to reduce regional disparities. In the areas of crop production, in the Tarai region, the Plan aimed to raise food grains production by 16 percent and cash crops by 40.3 percent. However, in 1974/75 compared to 1969/70, production level at the end of the Plan was 10 percent higher each for food grains and cash crops than of the base year. Production increase was largely attributed to expansion of cultivated area rather than by an increase of crop yields. The targets and achievement in crop production is shown in Table 2.7.

Table 2.7: Targets and Achievement in Crop Farming during Forth Plan

Items	Targets	Achievements
Paddy	10.4%	9.5%
Maize	6.7%	4.0%
Wheat and Barley	95.5%	23.6%
Millet	-	14.54%
Sugarcane	50.0%	16.6%
Oilseed	11%	14.4%
Tobacco	33.0%	-28.9%
Jute	35%	-17.0%
Irrigation	184 Thousand ha.	(544 Thousand ha.) 29.6%

Source: NPC, 1975 (Fifth Plan)

The fifth Five Year Plan (1975-1980) emphasized the need to develop the agricultural sector as the “Leading Sector” of the national economy. Thus, top priority was given to agricultural development and emphasis was placed on increasing food production and cash crops, such as, sugarcane and tobacco. The Plan targeted to increase food grain production through the provision of agricultural inputs like improved seeds, use of fertilizer, irrigation, and research and extension of improved technology. Considering the increasing food demand, the Plan targeted to increase food grain production by 16.72 percent, and cash crop production

by 68.1% during the plan period. However, food grain production decreased by 13.3 and cash crop production increased with the growth rate of only 1.6 percent. The target and achievement of crop production during Fifth Plan is shown in Table 2.8. The main reason of decreasing food grain is due to the higher dependence in seasonal rainfall, low provision of irrigation facility, and inadequate distribution of fertilizer, seed, agriculture tools, and credit, according to the summary report of Fifth Plan.

Table 2.8: The Achievement and Targets of Crop Production during Fifth Plan.

Items	Targets	Achievements
Paddy	2800 Thousand Mt.	-29.8%
Maize	609 Thousand Mt.	-26.4%
Wheat and Barley	1003 Thousand Mt.	-44.8%
Millet	143 Thousand Mt.	-16.8%
Sugarcane	539 Thousand Mt.	-28.8%
Oilseed	104 Thousand Mt.	-40.4%
Tobacco	18 Thousand Mt.	-72.2%
Jute	89 Thousand Mt.	-23.6%
Irrigation		95,425 Ha.

Source: NPC, 1980 (Sixth Plan)

The Sixth Five Year Plan (1980-1985) also gave top priority to agriculture. The overall aim of the Plan was to increase production at higher rate. Intensive cultivation, multi-crop system, was introduced to raise crop production and soil productivity. With this, the target of food production was fixed to increase by 9.9 percent in the Hills and 17.6 percent in the Tarai or a total of 14.9% for the country. The achievement of food grain is more than target. It was recorded at 5.9 percent per year. The achievement in overall food grain was 6.2 percent against the targeted 2.8 percent. The achievement in cash crops was 4.3 percent against the target of 3.9 percent per annum. By the end of the Plan, irrigated land was increased to 338,672 ha, almost 13 percent total cultivated area of the country. Agricultural Research and Extension Project (AREP) was approved and was planned to provide training and extension

services to eight more Tarai districts. The achievement in this Plan was somewhat encouraging. By the end of the Plan, agricultural GDP reached 47 percent (4.7 percent/year), which is slightly higher than the target.

The Seventh Five Year Plan (1985-1990) has aimed to increase food grain production and improve consumption standard of the growing population. Twenty year Perspective Plan (1985-2005), Long Term Food Plan and Perspective Land Use Plan draft reports were submitted by Agricultural Projects Services Centers to the National Planning Commission. Farming System Division, Socio-economic and Extension Division and National Agricultural Research and Services Centre were established. The Plan targeted increasing productivity of all sectors, expanding opportunity for productive employment, and fulfilling the minimum basic needs of the people. So far, as the food grain and cash crop production concerned, the Plan targeted to increase the yearly production of food grains by 4.1%, cash crops by 5.2%, pulses by 8%, sugarcane by 60%, tea by 74%, and oilseeds, cotton, potato by 23%, 84% and 27% respectively. It included the provision of irrigation facilities to an additional 2,35,493 hectares of land during the planed period. At the end of this Plan, about 21.6% of the total cultivated area was provided with irrigation facilities.

There was a Plan Holiday in between Seventh Plan and Eight Plan (1992-1997) because of political revolution in the country in 1990. That political movement brought multiparty democracy, and New Era began in the history of Planning in Nepal. The new government implemented the Eighth Five Year Plan in July 1992 and ended at 1997. The principal objectives of the Eight Plan were sustainable economic growth, poverty alleviation and a reduction in regional imbalances. The specific objectives were; to increase agricultural production based on geographical specialty, increase production and productivity of food

grains to meet the increasing demand, and to increase production and productivity of raw materials for the growth of agro-based industries, increase productive employment opportunities for the small and marginal farmers, and to maintain balance between agriculture developmental and environment conservation. The Plan targeted annual growth in domestic production of agriculture sector at 3.7%, while the actual growth rate achieved has been estimated at 3.0% only (Ninth Plan, 1997). GDP growth rate estimated to be 4.9 percent as compared to the targeted growth rate of 4.8 percent. The targets and achievements of various crops are shown in Table 2.9.

Table 2.9: The Targets and Achievement of Eighth Plan

Items	Targets	Achievements
Paddy	5.5%	3.0%
Maize	4.7	1.8%
Wheat	8.4	7.5%
Millet	3.1	5.2%
Barley	4.4	6.4%
Sugarcane	8.6	5.2%
Oilseed	6.7	7.0%
Tobacco	8.8	-5.0%
Jute	5.4	-5.2%

Source: NPC, 1997 (Eight Plan)

In view of the principal importance of agriculture in the national economy, it became clear that the first order of priority was to formulate a plan for the sector. Hence, preparation of the Agricultural Prospective Plan (APP) was mentioned in the Eight Plan. With the realization of the decreasing trend in per capita food grain production, and increasing trend in agricultural import, the government of Nepal launched APP in 1995 with the assistance from Asian Development Bank (AsDB), and support from other cooperating agencies, such as, German Technical Cooperation Agency (GTZ) (support for a comparative analysis of groundwater development), International Irrigation Management Institute (IIMI) (support for

the aspects of irrigation management), Food and Agriculture Organization of the United Nations (FAO) (assistance in analyzing issues related to food security), U.S Agency for International Development (USAID) (supporting in high value commodity priority), Winrock International (support for gender specialization), and World Bank provided its services during an international consultation in the planning stage along with forestry. The APP mentioned that country's poor agriculture performance was due primarily to lack of a clear-cut strategy, and its failure to emphasize accelerated sectoral growth and increased farm income. Accountability for performance was made even more difficult by the lack of adequate data and monitoring systems. The greatest deficiencies in agricultural development lie in four specific areas and their improvement is the four subject of the APP. Hence, APP has four priority inputs in fertilizer, irrigation, roads infrastructure, and technology. The main aim of APP was:

1. To accelerate the growth rate in agriculture through increased factor productivity.
2. To alleviate poverty and achieve significant improvement in the standard of living through accelerated growth and expanded employment opportunities.
3. To transform the subsistence based agriculture into a commercial one through diversification and widespread realization of comparative advantage.
4. To expand opportunities for an overall economic transformation by fulfilling the precondition of agriculture development.
5. To identify immediate, short-term and long-term strategies for implementation, and to provide guidelines for preparing periodic plan and program in future.

The APP was designed to add two percent points to the county's agricultural growth, and this increase combined with a 0.5 percent decline in the rate of population growth, expand per capita agricultural growth six fold, from 0.5 percent to 3 percent per year. The Plan has set

strategy for development according to the region. The strategy for development of the Hills and Mountains was demand-led commercialization of agriculture with prioritized productivity package. Livestock farming and cultivation of high value were targeted for this region. The Tarai development strategy was an input-driven food grain strategy duce to this region has the potential and comparative advantage in producing food grain. The Plan has targeted to increase the per capita food production from 277kg in 1991/92 to 426 kg in 2014/15 (Table 2.10).

Table 2.10: APP Target: Per Capita Food Production (1991/92-2014/15)

Year/ Regions	Mountain	Hill	Tarai	Nepal
1991/92	163	233	338	277
1994/95	163	229	337	276
1999/00	178	259	379	312
2004/05	197	300	417	352
2009/10	222	347	452	393
2014/15	245	380	482	426

Source: APP, (APPROSC, JMA, 1995)

The Ninth Five Year Plan (1997-2002) has been formulated in somewhat different form from the previous Plans in the light of the implementation experience of the Eighth Plan. Basically, poverty alleviation has been taken as the main objective of the Plan; and sectoral objectives, policies and programs have been focused towards the fulfillment of this challenging objective. The Ninth Five Year Plan was implemented in 1997, and ended in 2002. The Plan targeted to increase food grain with 5.2 percent and cash crops with 6.7 percent per year. The overall GDP growth attained only 3.6 percent compared to target of 6 percent per year. The overall agricultural production grew at the rate of only 3.3 percent and non-agriculture sector compared to Plan target of 7.3 percent. Regarding the food grain and cash crops 2.5 and 5.3 percent growth was attained respectively.

With the understanding of high incidence of poverty and failure of past Plans to reduce its level, Tenth Five Year Plan (2002-2007) was set. The overall aim of Tenth Plan was to bring a remarkable reduction in the poverty level. The poverty ratio aimed to reduce from 38 percent in 2001/02 to 30 percent by 2006/07. This Plan is now under implementation phase. The major targets of the Plan include; raising literacy rate by 63 percent, drinking water for 85 percent of its population.

2.2.4 Major Observations

With the realization of importance of agriculture in the national economy, the Government of Nepal seems to have accorded top priority to agriculture and has been investing huge money in this sector since the Forth Plan. The First Five Year Plan (1956-61) was started in the absence of statistical data necessary for planning. Absence of statistical data, lack of trained manpower, and inefficiency of administrative machinery are some of the major weaknesses of the First Plan. Further mores political instability and frequent changes in government also affected it. Second and Third Five Year Plan also had similar kind of problems and achievement were far behind the targets. Inability of government to provide sufficient quantity of inputs necessary for the expansion, and in establishing an effective institutional infrastructure was major weakness of the Forth Plan. The government efforts or resources were concentrated in a few selected areas rather than covering wider areas during the plan period. Fifth Five Year Plan accorded top most priority for agriculture in the history of planned development. However, it could not achieve its target due to heavy dependence on the weather, limitation of agricultural land and unavailability of sufficient inputs. Sixth Five Year Plan made little bit success with increased overall GDP, and agriculture outputs in some

extent. Seventh Plan heavily influenced by political situation of the country, and at the end of the Plan, new multiparty system was restored. After restoration of multiparty system in the country, the new government launched Eighth Five-Year Plan. The Plan emphasized poverty alleviation and agriculture. Due to the instability of government, changing of agricultural structure, and other natural causes, such as, drought led to failure of this plan. The long-term Agriculture Perspective Plan, the 20 years long agriculture sector program adopted in 1995, was a main hope to increase food grain production in the country. Agriculture Perspective Plan Review Report 2002 states that the APP is lagging behind in its performance. Though some progress has been made, the need result so far, the APP has brought is not significantly different from that of the progress made prior to the APP. The report expresses deep concern and dissatisfaction over the 0.7% growth in the second part of 1990s as against the APP objectives of 2% contribution in GDP growth. The withdrawal of subsidies (in the fertilizer and irrigation sectors) is often indicated as cause for the low performance of agriculture in general. It clearly suggested increasing in investment in agriculture sector. On the other hand, due to the absence of regular coordination, together with frequent staff change, and the need to attend immediate priorities negatively affected the significance of APP. The evolution of Ninth Plan during the preparation of Tenth Plan indicates discouraging progress after APP implementation. Although Ninth Plan has clearly pointed out the policy of ensuring food security and improve the nutritional status of people by increasing food grain production, the lack of policy to safeguard farmers against all agricultural inputs bottlenecked the overall agriculture outputs. Now, Tenth Plan is under implementation with the emphasis on poverty alleviation.

2.3 Dairy Farming

Livestock farming is a major component of Nepalese farming system. Numerous people are involved in the production, slaughtering, processing, and trading of livestock and livestock products to maintain their livelihood. Recently, livestock production became not only an important component of farming, but also a key source of income earning activity for the rural people. Livestock farming alone accounts for approximately 31% of agricultural GDP, and about 11.5% of total GDP (ASDP, 2004). Among the 31%, 53% is derived from the Hills, 38% from the Tarai, and 9% from the Mountains (APP, 1995). Milk is by far, the most important livestock commodity, which contributes nearly half of livestock GDP. National average of per farm family dairy livestock holding is 3.6 cow, 2.4 buffaloes (Table 2.11). More than three fourth of farmers hold cow and about half hold buffaloes.

Table 2.11: Percentage of Livestock Household and Average Holding Size

Region	Cow		Buffalo	
	Household (%)	Holding Size	Household (%)	Holding Size
Mountain	85.6	4.0	44.3	2.3
Hills	75.2	3.6	58.3	2.3
Tarai	74.4	3.4	35.8	2.5
Nepal	75.8	3.6	47.7	2.4

Source: Agriculture Census, 1991

Cow and buffalo are the primary milk producing dairy animals in Nepal. Looking at Table 2.12, as a source of milk, cow is second in importance after buffalo with milk yield 851 kg/year. The yearly milk yield is, however, very low with 421 kg and 851 kg of milk per year per milking cow and buffalo respectively. This milk yield is 10 to 15 times low as compared to developed countries. Low yield is also a signal of potential because the level of inputs, such as, feeds quality and quantity used is very low and management is mostly traditional. Cow milk contributes only about 30% of the total milk production. A large share of milk production

comes from buffalo, which contributes 70% in total milk production. These figures indicate the importance of buffalo as the principal milking animal in Nepal. Buffalo has many uses including milk, meat, manure, and draft power. Thus, buffaloes are more valuable than cows in Nepal, at least from the economic point of view. In the dairy sector, there is a significant scope also for import substitution. Import of milk powder is estimated at more than Rs. 1 billion a year.

Table 2.12 : No of Milking Animal, Milk Production and Yield, 2005

Region	No of Milking cow	No of Milking Buffalo	Cow milk production (ton)	Buffalo milk production (ton)	Milk Yield (Kg)/Animal/Year	
					Cow	Buffalo
Mountain	108683	82692	34962	59114	322	715
Hills	459346	621083	184090	497598	401	801
Tarai	334257	347202	160585	337879	480	973
Nepal	902,286	1,050,977	379637	894591	421	851

Source : MOAC, 2005

The history of dairy farming in Nepal starts from the history of Kathmandu valley, which was first inhabited, and ruled by *Gopal Banshis* (offspring of cow keepers) for eight generation (about 5 hundred years) followed by *Ahirbanshis* (buffalo keepers) who ruled for 3 generations (about 120 years). The *Kirats* then took over Nepal for nearly 1600 years before *Lichivies* took over in 110 AD. Nepal made history in dairy development by producing world famous Chesses, popularly known as Yak Cheese from Nak (female Yak) milk for the first time in the world in 1953. A couple of Nepalese and Swiss pairs celebrating the first feast of fresh milk products including; pasteurized, high fat, herbal milk, and organically produced milk products, such as, Yoghurt, cream butter, and cheese supplemented with wine and oven cooked fresh brown bread and *chhang* (a local fermented product from Paddy, maize or millet) at Kyangsin Ghyang and Yala of Langtang valley of Nepal. Nepal also started exporting cheese to Calcutta and Delhi markets in the early sixties. Nepal had always been a large

exporter of Ghee to the southern, and butter and *Chhurupy* from Yak/Chauries milk to the northern, neighboring border markets.

Cows (Bos indicus) have been domesticated and raised in the Hills, as well as Tarai. In both of these areas, cows are grazed around the village grazing land and pastures. Cows are spread over different terrain and heights of Nepal. Generally, white/grey humped cow are found in Tarai. Brown/red and black cows are found in the lower and middle hills. Hump less lulu cows are found across the mountains in Mustang. Now a day, wide spread raising of crossbreed jersey and Holstein Friensian cows are found in several milk pockets.

Cows and buffaloes are raised by most of the farming household in the mixed farming system to provide necessary manure, which is used to help enrich soil fertility, the supply of animal protein (cow for milk and buffalo for milk and meat), and as draft power in the Hill region. These animals were mostly grazed around village pasture and even in the forest. Now, the forest is mostly protected and animals are not allowed to graze in them. In Tarai region, as it is flat and has most of the cultivated land, farmers owned large herds of cows for the purpose of manure and bullocks. Very often, the owner would not even know the number of cows in the herd. They were mostly grazed in village pastures and fallow agricultural land. Mostly, buffaloes were kept for milk production, as they gave more milk than cows. Practically, buffaloes were always given supplementary feed in proportion to their milk production. Bullocks were especially looked after for drawing heavy ploughs and for pulling carts used to ferry around people, agriculture commodities and inputs. The male buffalo and old unproductive buffaloes were sold for meat. Table 2.13 shows the population of cow. About 6.9 million head has decreased by –0.02% based on the year 1995/96. The share of cow in the Mountain, Hills and Tarai are about 12%, 47%, and 41% respectively. The buffalo

population is less than half that of a cow. Over the second half of the 1990s, there were about 3.4 million head of buffaloes, growing at a rate of about 1.6% per annum. The raising of buffalo occurs mainly in Hills (53.9%) and Tarai (37.5%). While the population growth rate in these ecological zones is relatively high, they currently account for only about 15% of the total herd size.

Table 2.13: Region Wise Number of Cattle and Buffalo in 2005

Region	Animals	Animal Population	Growth Rate	Share in Total (%)
Mountain	Cattle	868,523	0.53	12.4
	Buffalo	349,556	1.22	8.6
Hill	Cattle	3,266,548	-0.53	46.7
	Buffalo	2,200,495	1.54	53.9
Tarai	Cattle	2,859,392	0.43	40.9
	Buffalo	1,531,412	3.32	37.5
Nepal	Cattle	6,994,463	-0.02	100.0
	Buffalo	4,081,463	2.14	100.0

Source: MOAC, 2005

Figure 2.5 shows the trend of dairy animal population and milk production from respective animals during 1988 to 2001. The cow population has increased continuously during the year 1992/93 to 1995/96. The Eighth Five-Year Plan encouraged the participation of commercial private sector to establish animal hospitals. It also launched various programs, such as, introduction of improve breed, vaccine programs in order to maintain animal health and animal feed program. The eighth Plan, however, could achieve its targets to a large extent in the field of agriculture, forest and irrigation, but not in the livestock sector. The number of livestock units was increased, but the milk production has not significantly changed. The high numbers of animals were found to be unproductive and low productivity of productive animals. The number of buffalo is low compared to cow, but the milk production is higher than that of cow. However, the over all milk production has not increased significantly both in the case of cow and buffalo during these years.

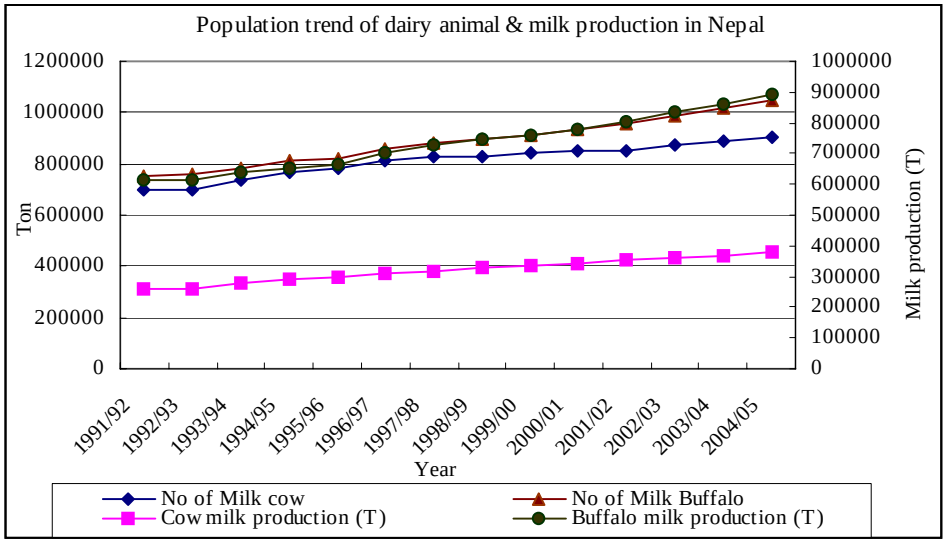


Figure 2.5: Population Trend of Animal and Milk Production in Nepal
Source: MOAC, 2005

2.3.1 Institutional Structure of Nepalese Dairy Farming

According to Livestock Service Division 1999, livestock development activity was started in Nepal around 1860 after the historical visit of Rana Prime Minister, Jang Bahadur Rana, to England. At that time, livestock rearing was started with few numbers of cows, which were bought from England. After that, few high breed animals were imported from India only to be reared inside the Rana's palace. Few numbers of those animals were shifted to the village through the workers, who were working inside the palace. The first Homeopathic System Dispensary with one foreign doctor was established in Kathmandu in order to take care of animals inside the palace. Releasing the modern animal health services, the first Yellopathic System Dispensary was established on 1940 in Kathmandu, and it was later on, changed into the Livestock Hospital in 1941. With traditional livestock production system, there was a high probability of animal diseases, and depreciation in livestock production. There was a need of extension and dissemination about high breed livestock. With this aim,

and in order to take care of the disease, which had highly affected that time, in 1958, animal hospitals were established within the ten districts of Nepal. However, due to the increasing importance of animal health, 33 hospitals, 21 dispensaries, and 18 check-posts were established till 1964 with the help from India, FAO, Oxfam, in order to provide animal health services throughout the country.

In the mean time, five livestock development farms were also established, which are currently under the agriculture department. In 1966, Livestock Development and Livestock Health Department (LDLHD) were established. Through LDLHD, from the beginning of Fifth Five-Year Plan, Co-ordinate Animal Services Programs were implemented in order to provide livestock related services to each and every farmer's door in the integrated manner i. e. animal health, animal feed, and animal breeding under the LDLHD. LDLHD has been trying to provide the animal services, such as, high breed animal, establishment of animal development farms, and to make easy access of animal health services to the local people in all geographical regions.

In order to fulfill the increasing demand of livestock farming, and realizing the lack of animal health, in 1980, LDLHD (later on, Livestock Service Department (LSD)) was re-established. As a result, animal health center, laboratory and farms, and new farms were established at local level in all 75 districts of Nepal. To support LSD program, numbers of branches were established at central level. Keeping in the mind that the villages are the main spot for livestock development because most of the households rear livestock. More than 5,000 Livestock Rearing Farmers Groups (LRFGs) were established till now through out the country to provide animal services for those households. These LRFGs have been actively working in integrated manner, animal health, pasture/grazing land, feedings, and other

livestock management, development of livestock source and extension services, which affect positively the production of livestock products and consumption.

Due to the instability of government policy towards farming system, Agriculture Development Division was established in 1992, in which all the agricultural related services were included including livestock as well. After that it started having difficulties in management sectors. Realizing this, Livestock Services Division (LSD) was re-established in 1996 separately from the agriculture division. The main aim of LSD was to develop livestock farming as commercial, diverse, income-generating means for the farmers, and lastly to contribute in national production.

The government of Nepal began dairy development activities in Nepal in 1952 with an experimental production of cheese. It led to the establishment of a Yak cheese factory in Langtang, Rasuwa district, under Food and Agriculture Organization of the United Nations (FAO) assistance in 1953. In 1954, a Dairy Development Section was established under the umbrella of Department of Agriculture (DoA), and also a small-scale milk processing plant was started on an experimental basis in Tusal, a village in the Kavreplanchok district in the Central region. A Dairy Development Commission was formed in 1955 in order to guide the dairy development activities. With the growing prospect of expanding the dairy sector, the First Five-Year Plan (1952-57) emphasized the need for developing a modern dairy industry. During the plan period in 1956, a Central Dairy Plant with average milk processing capacity of 500 lt. per day was established in Lainchaour, with the financial assistance from New Zealand and technical assistance from FAO. Around the same time, a second mini milk processing plant was established at Kharipati in Bhaktapur district. The plant started milk processing and marketing activities from 1958. In the process, prior to 1960, two additional cheese factories

were also established under DOA in other two alpine districts of the country. In 1960, a Cheese Production and Supply Scheme (CPSS) were also launched. The Dairy Development Commission was then converted into the Dairy Development Board in 1962. In order to meet the growing milk demand in Kathmandu valley, the board was again converted into the Dairy Development Corporation (DDC) in 1969 under the Corporation Act of 1964. A Board of Directors appointed by HMG/N governs DDC. A General Manager is also appointed by HMG/N. The DDC gradually established various milk supply schemes in different parts of the country to meet the growing demand for processed milk and milk products. DDC currently has seven schemes out of which five schemes are full-fledged processing plants; one is mini plant and one is currently running as a chilling centre with the prospect of converting to processing plant in future. DDC also has ten cheese production centers (six for yak cheese and four cow cheese), and one buffalo milk paneer production centre. It also owns one skim milk powder plant in the country. The schemes involved both collection of milk and processing of milk and milk products. In order to increase participation from milk producer farmers in an organized way, DDC initiated Milk Producer Associations (MPAs), which was first started in Biratnagar Milk Supply Skim (BMSS) in 1981. Later, these MPAs were transformed in to Milk Producers' Co-operatives (MPCs). In 1989, most of DDC Schemes were rehabilitated under DANIDA assistance. After rehabilitation, the plant capacities increased from about 74,000 lt. per day to about 180,000 lt. per day. DDC had supported by World Food Program, USAID and the government of New Zealand, and Denmark in different times.

The Dairy Development Board was formed in September 1989 to advise HMG on dairy development policy such as; import of dairy products and animal feed, milk prices producer and retail, legal issues affecting producer and consumer protection, support services

for dairy producer and processors, and livestock insurance. The chairman of the DDB is the Minister of Agriculture; members include; senior civil servants, industry and farmer's representatives.

In 1992, HMG established National Dairy Development Board (NDDB) for assisting dairy development in the country. It is to formulate and recommend policies and plans for dairy development in Nepal, and strengthens the dairy sector by bringing co-ordination between the private and public sectors. Besides, it is to carryout high level of studies and level of research work and management for fodder and pasture resources for dairy development. The main role of NDDB should be to facilitate the development of dairy industries in the country. A number of feasibility studies were carried out by NDDB with technical assistance from DANIDA. These included studies on animal feed industries, establishment of slaughterhouses, and establishment of SMP at Kohalpur in Banke district and milk processing plant at Butwal. The objectives of NDDB are in Box 1.

Box 1: Objectives of NDDB;

- To assist His Majesty's Government of Nepal (HMG/N) in formulation policies and plans of dairy development at the national level.
- To or cause to development dairy industries.
- To find remedies to problems in the field of livestock development and animal health sector for dairy development.
- To or cause to maintain co-ordination between all the private and public sector dairies within the country.
- To or cause to carry out high-level studies and research works for dairy development.
- To or cause to make arrangements for fodder and pasture resources.

The capital base of NDDB consists of HMG grant, Sales Proceeds Fund from DANIDA, Sales Proceed Fund from USAID, Management Fund and Danida Grant. Since April 1996, the DANIDA Support Project (DSP) under the Royal Danish Government is supporting NDDB's activities. The overall aim of the project has been to develop conditions

that allow increased milk availability and self-sufficiency of milk in the country on a sustainable basis.

The Department of Food Technology and Quality Control (Former Central Food Research Laboratory) is responsible for developing and disseminating appropriate technology for the preparation of nutritious food and preservation and storage of food, and beverages. The functions of it include; demonstrations, training, and extension services designed to improve the utilization and quality of food and agricultural products, including livestock products. It is also responsible for quality testing of foodstuffs marketed. It also fixes the minimum mandatory standards for milk and milk products in the market to meet the minimum requirement, the department can perform regular sampling and analyses.

The Department of Livestock Services (DLS) under the Ministry of Agriculture and co-operatives of HMG/N was the responsible institution for all activities pertaining to animal production and animal health in the country. It aims at developing the livestock sector by diversification and commercialization as an income generating and prosperous farming. The main objectives of DLS in dairy sector include; increasing production of milk assisting in quality improvement of milk, helping in market identification and management, encouraging livestock based industries and developing human resources.

One of the major activities of DLS regarding dairy processing is Third Livestock Development Project (TLDP), which is mainly funded by the Asian Development Bank. HMG/N has very good experience, and the livestock farmers had received benefits from the implementation of first and second livestock development project. AsDB has also recognized the importance of livestock sector in Nepal, and was satisfied with the performance of previous two livestock projects. It was therefore, decided to launch the TLDP. The main

feature of this project is to implement the livestock development activities through participation of livestock farmers in designing, planning, implementing, and monitoring and evaluating them. The focus was laid on the marketing of milk and meat. The major objective of this project is to reduce poverty in rural areas by improving nutrition, income, and employment opportunities for the farmers and resource poor rural people through improved productivity of their livestock, mainly in milk and meat production. The Project has a component of Agro-processing and Marketing, which focuses on development of milk collection centers, improvement of milk hygiene, and manpower skill in the dairy industry. It also encouraged small-scale dairy processors and increases the production of traditional dairy products.

The Department of Cooperatives (DOC) is a regulatory body assigned by the Cooperative Act, 2048. It is headed by the registrar of cooperative. The functions of DOC include; the promotion and registration of cooperatives and, as well as, supervision and monitoring of their activities. All the MPCs are registered at the DOC and they abide by the cooperative regulations. However, not all MPCs are working as cooperatives in real sense. Some of them are running even under informal contract due to unawareness of cooperative principals and functioning. The registrar of DOC has a right to dissolve a cooperative if it has not functioned for two consecutive years or acted against its objectives.

The National Cooperative Development Board (NCDB) was initially formed in 1991, as an advisory and coordinating body. It has now been established under National Cooperative Department Board Act of 1992 as a specialized agency in order to link between HMG and cooperative movement. The role of board is to promote and develop cooperatives. The board is also responsible for mobilizing funds, entering into joint venture agreements, extending

technical support, and coordinating the functions of non-government institutions involved in cooperatives. The board consists of 23 members, who are representatives of HMG, private sector, and professionals.

2.3.2 Government Policy towards Dairy Farming

For many years, Nepalese people used to rear local breed livestock only as there was no source for the entry of improved breed livestock. The improved breed livestock enter in Nepal in 1952, imported from the United Kingdom. Since then, there was a gradual inflow of improved breed livestock in Nepal from different countries. However, this is very low in proportion. On the other hand, there was no or very little livestock rearing facilities, such as, veterinary services, extension services, artificial breeding, and trained personal. Considering this, the First Five Year Plan (1965-1961) had targeted some objective in order to develop dairy sector, which is shown in Box 2.

Box 2: Targets of First Five Year Plan in dairy sector development;

1. Survey on livestock resources in terms of numbers, breeds, and feeding condition and make selections by testing progeny in each division of livestock.
2. Introduce Indian and other breeds for use in upgrading.
3. Develop artificial breeding
4. Establish a central breeding farm for dairy livestock.
5. Develop local source of vaccines, preventive and control and other necessary medicines
6. Establish veterinary hospitals and dispensaries for in all the districts
7. Introduce and cultivate improved legumes and grasses

The Plan had also separately made programs to expand and develop dairy sector during the Plan period. It had planned to establish various dairy centers in three ecological regions, such as, milk collecting and processing centers in hill areas mostly in Kathmandu, cheese making plants, using yak milk in mountain areas and ghee purification centers in Tarai regions.

In addition, the Plan had also given attention in developing trained manpower dairy livestock sector through the establishment of agricultural school inside the country. It had a program to send personnel to study abroad, and trained village worker, at village level.

In the First Five Year Plan not much progress could be achieved because of various limitations, such as, lack of proper knowledge of planned development, lack of current and basic information, and lack of statistical information on almost all the sectors. Very less progress in the field of road facilities could be visible. However, it could be the base plan for future Plans.

The Second Five Year Plan (1962-1965)

In the First Five Year Plan, basically no effort was made for the formulation and implementation of Plan. Therefore, the basic data was not available for formulation of the second Plan. Hence, the Second Five Year Plan had aimed to continue with nearly about similar objectives as targeted by previous Plans. However, some of the main aims of the Second Plan in dairy sector are listed in Box 3.

Box 3: Aims of Second Five Year Plan.

1. Import improved breed of bull, buffalo and cow in order to improve animal breed.
2. Establishment of various programs such as artificial insemination, mixed insemination.
3. Establishment of livestock centers and sub-center in different parts of the country to provide services in all places as much as possible.
4. Attention is given in the livestock feed and grazing fields to produce quality feed.
5. Establishment of milk collection centers, cooling centers, milk and cheese processing centers in different parts of the country.
6. Establishment of veterinary hospitals at the zonal and district level and Central Veterinary Clinic (CVC) to produce different vaccines for different diseases.

The second Plan also stated with certain limitation as in the previous Plan, the absence

of statistical data and proper knowledge of economic condition. The second Plan, however, could achieve in the livestock sector. It was somehow possible to establish 33 animal hospitals, 21 dispensaries, 18 veterinary check-posts, and Veterinary Sections during the Plan period with the help from India, Food and Agriculture Organization (FAO), in order to provide animal health services throughout the country.

The Third Five Year Plan (1965-1970)

The Third Five Year Plan followed first and second Plan. The first target of the Plan was production and improvement of livestock breed, and increase in milk production in Kathmandu, and also to collect milk from outside the valley. In order to improve livestock breed, the Plan had a target to arrange artificial insemination programs in the districts, as well as villages. Management of technical and financial assistance was planned to be made available. More veterinary facilities made available by opening dispensaries in less accessible regions of the country. Besides, the Plan targeted establishment of cow farms. Pasture, Fodder and Livestock Development Project was implemented in Nuwakot and Rasuwa district during the Plan period. The artificial insemination program with warm semen was initiated. And, to improve the native cow warm semen of jersey, red Sindhi, Holstein and Brown Swiss were used during the plan period. Artificial Insemination Project was established in Kathmandu to keep up with the improved breed livestock and strengthen the national cow-breeding program. Due to this, a number of artificial insemination was increased up to about 13,038 at the end of the Plan period.

The Forth Five Year Plan (1970-75)

The Forth Plan aimed to implement livestock development programs in those districts where livestock farms and other services were available. The Forth Plan gave more emphasis in production of milk and meat. Similarly, the Plan had also targeted to meet the livestock feed. In order to achieve these targets, various programs had been set to establish pasture development centers in different parts of the country. Research and experiment was undertaken with improved grass to produce quality feed for livestock, which is one of the important parts of livestock farming. The Plan had targeted to provide veterinary services, such, as artificial insemination, practical training, health services in an extensive way through existing centers, and to setup livestock development farms and veterinary hospitals.

In dairy sector, the Plan had a target to develop the capacity of Dairy Development Corporation to meet the demand of processed milk and milk products. In order to achieve this, the Plan had a target to establish cheese factories and butter producing centers in different parts of the country.

The First Livestock Development Project (FLDP) was implemented in the Plan period with the aim of improve the animal health and production. In order to achieve its aim, the project provided diagnostic facilities, livestock centers, veterinary check-posts, vaccine production, and improved communications and disease reporting. The project also aimed to provide livestock production with the establishment of Resources Centers, Fodder Production and Investigation Facilities, Livestock Extension and Training Services an Improved Livestock and AI Services. This, in turn, benefited a large number of livestock farmers throughout the country, thereby improving nutritional intake of the population, increasing countrywide self-sufficiency in milk products and was able to distribute improved breed

buffalo to the farmers.

The Fifth Five-Year Plan (1975-1980)

After the analysis of the four successive periodic Plans, it was realized that it was necessary to gear planned effort towards building socio-economic infrastructure necessary for the development of productive sectors of the economy to attain the stated goal of national development. On the basis of the experiences and the achieved infrastructure development in the Nepalese economy, His Majesty's Government of Nepal accepted as a principle, the growth of distribution of the Nepalese planned development effort. In line with this principle, the Fifth Plan onward, aimed to achieve maximum increase of the national income and distribution of increased income to the general mass.

The Fifth Plan realized that there was less livestock with the farm household in Nepal compared to other countries, and, further more, the consumption of livestock product was also very low. The farmer used livestock, as draft animal and, as such, there were a lot of scopes of livestock development in the country. As there was less production of livestock products, the demand for livestock products had to be met by import. Considering this, the Plan sets targets to increase the production of milk, and meat. For this the plan set several program, such as, establishment of multi-purpose livestock development farms, breed improvement, research farms in different parts of the country to produce and thereby, sell improved breed livestock to the farmers.

In the beginning of the Fifth Plan, as for dairy livestock development, there was a target to distribute improved breed buffalo, and yak in various parts of the country. Furthermore, there was a program made available for the provision of credit for buying dairy animals to the farmers as well. The main aim of the Plan was to improve the living standards

of the farmers by increasing dairy animal productivity, and employment opportunity through dairy, mainly by increasing production of milk. In the fifth Plan, the targets in different fields of livestock sector had been achieved to some extent.

The Sixth Five-Year Plan (1980-1985)

The main aim of Sixth Plan is to uplift the financial status of the rural household to provide nutrious food for the consumers and to develop livestock products of export quality. The other specific aims are summarized in Box 4.

Box 4: Objectives of Sixth Five Year Plan;

1. To improve breed by artificial insemination, selection of foreign breed livestock and encourage private sector for the production of improved breed livestock, improve grass seed and balanced feed by giving the necessary facilities to the farmers.
2. Research was done to reduce the unproductive livestock and to increase the number of improved breed livestock such as cow, buffalo in hill and Tarai yak and chauri in mountain.
3. Various livestock development program were to be launched under special program in different feasible districts.
4. Program for the development of grazing fields and grass and for the production of balance feed.
5. Increase production of milk and milk products by launching the programs to develop chilling centers, collection and milk distributing centers.

With this, the number of AI increased up to 47,581 by the beginning of the sixth Plan. The Liquid Nitrogen Plan was established in the beginning of this Plan period. After establishing this, AI received momentum when frozen semen, together with warm semen was used for artificial breeding. In order to add to the improved breed livestock, there was the establishment of Animal Breeding and AI program at the end of the Plan period. Furthermore, Infection Disease and Parasite Control Division was established in 1981 in order to provide animal health services to the farmers. The Plan exceeded the target in the distribution of different spices of improved breed livestock during the Plan period.

The Seventh Five-Year Plan (1985-1990)

The Seventh Plan had also followed the similar objectives of the previous Plans, However, the Plan was more specific on the livestock development, with the aim to attain self-reliance on meat, milk and milk products. The objectives of the Seventh Plan are summarized in Box 5.

Box 5: Objectives of Seventh Five Year Plan:

1. The livestock development program was to be classified into four categories; high, medium, primary and low-level priority area according to the accessibility of market, transport facilities and other infrastructures and population density.
2. Programs were implemented to increase milk production and milk product production
3. Program to establish milk collection centers, milk power plants, and milk processing centers. Facilities, such as, technical service, veterinary service and credit facilities were to be made available.
4. Animal feed program was to be taken up by solving the grazing problem by developing the grazing land and the production of fodder and grass.
5. Animal health care assistants and village animal health worker were to be assigned.

The Seventh Plan was able to achieve most of the objectives through increase in productivity. The target in the field of developing model villages based on livestock farming, extending breeder farms, encouraging farmers towards increased milk production could not be achieved. During the Seventh Plan, A proposal for Second Livestock Development Project (SLDP) prepared with the technical assistance approved by the Asian Development Bank on 1984. The primary purpose of the SLDP was to increase livestock production through improved productivity. The project also aimed to;

1. Improve disease control programs to reduce livestock mortality and improve animal health,
2. Introduce better management of livestock feed resources and animal nutrition
3. Increase on-farm availability of high protein foods derived from livestock products.

4. Enhance smallholder farm income from the sale of livestock and related products through intensive livestock development
5. Reduce the imports of livestock and livestock products by increasing the supply of locally produced meat and milk.

The SLDP has achieved some of its objective. A notable increase in the production of high protein livestock products, such as, milk and meat, was achieved through increased unit productivity rather than increasing numbers of livestock. There were some changes in population as a result of SLDP.

Livestock Master Plan (1991-2010)

In spite of the importance of livestock sector in the country, animal husbandry standards and animal productivity remain low. The government investment in the livestock sector began in the 1950s with FAO study, and since then, more than 50 projects with implications for livestock have been undertaken (LMP, 1993). Direct assistance for livestock production through 15 projects has amounted to almost US$ 50 millions over the past 20 years. The Asian Development Bank has been the largest single source of fund for livestock development in Nepal. Despite the substantial allocation of resources to livestock development, overall improvement in performance has been unimpressive, and an increase in production has arisen from an expansion of numbers (and grazing area) rather than an increase in productivity. Only in localized areas close to markets, there have been significant improvements in livestock productivity. The welfare of livestock farmers has not improved, and because of the pressures of an increasing population, may have worsened as more fall below the poverty line. On the other hand, former development Plans for livestock have generally not achieved their targets. The NPC has identified a number of factors, which have contributed to weaknesses in

the planning process. There is an excessively narrow focus on the sub sector, which does not take into account the linkage and complementarities between sectors. There is an emphasis on donor driven planning process, with lack of participation of Nepalese professional and others, and focus on the meeting of domestic targets which has ignored external market. There was a lack of understanding of the producer's farming system and lack of appropriately focused research on this subject. It has resulted in Plans that do not respond to farmers need or develop farmers' capabilities.

In order to address these issues, the government has under taken preparation of a Livestock Master Plan, a 20 years Plan, to undertake coordinated and successful livestock development in the country. The major objectives of the master Plan are summarized in Box 6.

Box 6: Objectives of Livestock Master Plan

1. To provide a basis from which to increase income and employment for livestock farmers through increased production and productivity in the sector over the twenty years period from 1991 to 2010.
2. To improve livestock production, formulate a national strategy for livestock development based on cost-effective, sustainable, environmentally suitable production systems, which take into account the needs of the people and the interaction with activities in other sectors.
3. To provide guidance to the government and other institutions and individuals concerned with livestock development for effective and rational phasing of development activities for the livestock sector of Nepal.
4. To identify programs and projects suitable for implementation during the Plan period according to priority and the phased strengthening of institutional capability.
5. To estimate the resource requirement necessary to implement the strategy over a 20 year period and the likely benefits and beneficiaries.
6. To define the requirements for management of Plan implementation, including the coordination of the various parties involved, establish procedures for planning, monitoring, evaluation and review, and the mobilization of domestic and external development resources.

The Eight Five-Year Plan (1992-1997)

The Eight Plan had given due priority for livestock development and animal production program in both areas; accessible[5], as well as, non-accessible areas at district and central level. The targets of the Eight Plan regarding dairy livestock development are given in Box 7.

Box 7: Targets of Eighth Plan

1. There was a target to produce milk, with the participation of the farmers and private commercial enterprises.
2. To implement Livestock Service Program with different activities such as Livestock Extension Program, Animal Health Program, Improved Livestock Production and Breeding Program, Animal Feed Marketing Management and Training Program and program to add and strengthen livestock services centers.
3. To improve animal health, the plan had program for arrangement for producing vaccines for infection diseases within the country, encouragement to private sector to establish veterinary hospitals and implementation of guaranteed services.
4. Training programs to the rural animal health worker, group leader farmers as well as training to produce middle level manpower through Central Training Center.
5. Program to increase production, management and quality animal feed.
6. Emphasis was given on marketing management to promote production and distribution of livestock and livestock product. For this diary development program was to be made to expand of Dairy Development Corporation mobilize Dairy Development Bank, establishment of milk collection, processing center and other related factories, commercial and scientific slaughterhouses in the urban areas.

The Eight Plan could achieve its targets to a large extent in the field of agriculture, forest and irrigation. During the Plan period, Agriculture Perspective Plan was implemented.

Agricultural Perspective Plan (APP)

During the Eight Plan, HMG/N has implemented 10 years Livestock Sector Master Plan (LSMP). APP (a 20 year Plan) has built its livestock sector strategy in line with the LSMP. Livestock sector strategy under APP emphasized on milk and meat production, animal nutrition (specially nutritional fodder supply), health and marketing. Dairy was given a top

[5] Urban areas and for areas with developed road infrastructure and marketing facilities

priority by APP. Under animal nutrition, fodder based production has been emphasized for reducing cost of production. Animal nutrition is considered as a serious problem at present. Animals are believed to be underfed by about on third of their nutritional requirement (APP, 1995). APP has considered livestock sector as one of the key contributors to poverty alleviation and employment generation, especially for women.

Dairy and dairy products have been considered as demand driven under APP. That is, these products will be greatly influenced by two factors; increase in per capita income and population growth. The national milk production growth target under APP is between 5 to 6 percent per year. The annual GDP growth target under APP is shown in Table 2.14.

Table 2.14: Annual GDP Growth Target under APP

Fiscal Year	Overall Agriculture Growth (%)	Livestock Growth (%)	Growth in Milk Production (%)	End of Period Milk Production as per APP Growth ('000 T)
1992-95	2.96	2.89	3.08	941
1996-00	4.45	4.17	4.66	1,182
2001-05	4.87	5.31	5.81	1,568
2006-10	4.88	5.68	6.02	2,100
2011-15	4.76	6.10	8.45	3,150

Source: APP, 1995

Other broader policy framework for the APP livestock component is; enhancement of the private sector, expansion of road and electrification network, improvement of the present extension programs focusing on women, and expansion of credit facilities. APP has also emphasized privatization of Dairy Development Corporation (DDC) and removal of all subsidies for livestock processing and marketing.

The Ninth Five-Year Plan (1997-2002)

The Plan has target to meet the domestic demand of milk, and meat. The main objective of ninth Plan is to increase the income level of people at rural, sub-urban and urban

areas, and to support poverty alleviation through conducting various programs. The target of Ninth Plan regarding dairy sector is given in Box 8.

Box 8: Targets of Ninth Plan

1. To conduct programs in Milk Collection and Processing, Breed Improvement, Animal Feed Development, Animal Health and Training and Manpower Development, Livestock Market Development and others.
2. To establish Central Asian Diagnostic Laboratory for the implementation of animal health service program to standardize the quality of medicine and vaccine produced in the country and to examine the imported medicine.
3. to extend other veterinary services by establishing health practice centers, animal disease identification laboratories and to produce semi-skilled and skilled manpower in the different level; grass root, district and central levels.

Ninth Plan document has fully accepted the privatization of public corporations, which is a key way to reducing HMG/N subsidy and increased private sector participation. About 30 companies were enlisted for privatization and DDC is one of them.

The Tenth Five-Year Plan (2002-2007)

The Tenth Plan is a policy continuation of the Eighth and the Ninth Plan. It has envisaged expedite poverty alleviation by giving priority to high economic growth, good governance, and social justice. Based on the experiences of the Ninth Plan programs promoting poverty alleviation and social justice, these will be implemented more effectively in the Tenth Plan.

2.3.3 Major Observation and Need of Dairy Cooperative

As the dairy sector was accorded due priority in different consecutive Five-Year Plans of the country, it has not been possible to maintain an adequate supply of necessary dairy products for the growing population. It is due to the exceedingly large number of unproductive

animals, scarcity of fodder, lack of adequate animal health services and poor development in the marketing system for animal products. The Plan efforts reveal that the livestock sector received due importance as one of the main sectors of agriculture development. However, it was taken into consideration only with the implementation of the Fifth Five Year Plan. It is the Seventh Plan that has given clear objectives and policies, which supported comprehensive program for livestock development. In 1991, Nepal launched Livestock Master Plan to foster livestock sector development. Livestock units and stocking rate (LU/Ha) is increasing after LMP, but there is no significant change in livestock products. During the planning process, household level socio-economic information were not considered in LMP. Master Plan had identified and recommended various projects, which were likely to be supported by different agencies. Therefore, in order to meet the demand of the increasing population for animal products through domestic product, and also to gradually promote the export of some potential products, it has become necessary to accelerate the livestock production and productivity without exploiting the environment. Considering the importance of livestock in Nepal, the development of livestock sector to support the development of Nepalese economy as a whole has to be looked after in the future Plans, and target programs has to be set accordingly.

After the implementation of First Livestock Development Project (FLDP), it was realized that in order to develop over all dairy sectors, the dairy services has to reach individual household. Especially AI, quality feed production and breeding is not possible to provide through the project to each and every household. The need of collective action with local milk producing household's participation was felt after the project. Dairy farming is a continuous process in which milk collection, milk processing and milk marketing need to be done day-to-day. Thus, there was a need for collective action at village level. So, the idea of

cooperative was introduced as a result. Hence, Milk Producers Associations (MPAs), which is the farmer's group loosely working as groups, which were not registered at the Department of Co-operative under the Co-operative Act (NDDB, 2001), were introduced at village level after the implementation of FLDP. Milk Producers Associations were then converted in to Milk Producer Cooperative MPC, which is registered legal body as per the Cooperative Act (NDDB, 2001), at village level. After being MPCs, they can get opportunities, such as, dairy training and extension program provided by Dairy Livestock Services. They can sell milk in decided price and can receive various facilities provided by cooperative, such as, vacillated loan, procurement of the inputs. MPAs are the farmers group formed spontaneously to get the training services, which cannot be received individually.

The concept of MPAs/MPCs first started in the milk shed areas of Biratnagar Milk Supply Scheme (BMSS) in 1981. Its success gave momentum to similar pattern in other milk collection areas of the DDC. These MPAs were facilitated by the Dairy Development Corporation (DDC) based on the cooperative principle. The main aim of this program was to link the milk producers with DDC by providing well-managed technical inputs and financial help. After the amendment of the Cooperative Act in 1992, Milk Producers Cooperative Union (MPCU) at district level was organized in order to guide the MPCs on their managerial, promotional and business affairs. The representatives of MPCs and MPCUs voluntarily and jointly organized a Central Milk Cooperative Union Ltd. (CMPCU) at national level in 1993.

2.3.4 General Constrains in Livestock Development

Some of the general constrains in livestock development in Nepal are inadequate delivery of animal health services, lack of long-term appropriate livestock policy, poor livestock farm management, lack of exotic livestock/ breeding stock, inadequate fodder

resources, lack of capital among the smallholder, poor marketing facilities, and influence of socio-cultural values on livestock raising. Besides this, the following points could be the major issues are that farmers currently facing in milk production and milk marketing.

- Milk holiday is a major issue for smallholder dairy farmers. Milk supply to the formal sector increases during the flush season, but this sector does not have the capacity to purchase all the milk that is produced by smallholder dairy farmers, and because of this, milk holiday exists. The flush season starts around September and ends in February. The monthly collection is highest during January and lowest during April. Milk collection during the flush season (six months) represents 55% of the total annual collection, while collection during the lean season represents about 45% of the total.
- Although in Eighth Five Year Plan, the government has made the Plan to encourage the private sector, the environment is not conducive for private sector investment. It could be that the government is not making transparent policy, or that policy guidelines are not strictly followed. As a result, the private sector is unsure about making investment. On the other hand, the private sector lacks manpower and technology for productive diversification. Whatever has been done is based on experience rather than on the basis of formal technical training. Productivity diversification needs investment and high quality raw materials; accordingly, many dairies find it a problem. Development of human resource and training is an essential factor of the development of the dairy sector.
- Farmers are not as aware of co-operatives, which are registered under the cooperative Act. About 80% are agriculture and rural credit based cooperatives, about 28% of these

are milk cooperatives. One of the critical issues is that there is a lot of confusion in operating the co-operatives at local level.

- Access to the livestock insurance policy is very much limited to the rich dairy farmers. Smallholder farmers have very little access to this policy, due to lack of capital to show the loan taken from the Agricultural Development Bank and other commercial Banking agencies in the country.

Chapter 3: Farming in Chitwan District

3.1 General Features of Chitwan District

The study villages, Gunjnagar and Gitanagar lie in the Chitwan district of Nepal. Chitwan district lies on Tarai region, which is often called "Grain Basket" as it has more capacity to grow crops and other farm products. The district is agriculturally significant as it is endowed with fertile alluvial soils derived from the *Rapti* River. The district is one of the biggest districts in the Central Inner Tarai[6], which is an important part of the country both from the settlement and from the economic point of view. The economy of the district mostly depends on agriculture. About 73% of the workforce derives their income from this activity.

Although Chitwan district is one of the most fertile districts in Nepal, it is hard for all farmers to meet their food self-sufficiency. It is mainly due to the increasing population pressure and low level of farming technology. This is especially true for the peripheral region of northern ridges and southern frontiers. Thus, the farmers of peripheral regions are forced to clear forest to produce more crops, which directly lead to deforestation. Realizing this fact, the government established District Agricultural Development Office (DADO) in 1967 with an aim to improve food self-sufficiency level by transferring modern farming technology to the farmers through commercialization and diversification of farming, and implementing bottom-up approach planning. However, most of the peripheral regions of the district could not be influenced by the activities of DADO due to lack of proper transportation and management.

[6]Tarai region in Nepal is divided into two parts Inner Tarai and Outer Tarai. Inner Tarai is the river valley between Mahabharat Hills (Southern Hill-2000m) and Siwalik Hills (Tarai Hills-600m). Inner Tarai is also divided into three regions. Eastern Inner Tarai which includes Udaypur and Sindhuli Districts, Central Inner Tarai, which includes Chitwan and Makwanpur District and the western Inner Tarai that includes Dang Duekhuri districts.

Before 1950, Chitwan district was covered with dense subtropical forest prone with malaria and was known as *Kalapani* i. e. the Death Valley. Only the Tharus with natural immunity to malaria lived here then. During the Rana period (1855-1951), when the Rana government had to punish an individual, they would send him/her to the Death Valley. This implies that when a person enters into the Chitwan valley he/she would surely not return. This area was also used by the then rulers for hunting tigers, and other wild animals, often as a state event with foreign dignitaries, such as, royal families of British Empire and Maharajas of Indian subcontinent. At that time, people were not attracted to go to the area for settlement. However, after launching of simultaneous program of planned settlement, and malaria eradication in late 1950s, people started going there for settlement. To encourage the *Pahadis* (hill people) to permanently settle in Chitwan, the government had offered plentiful land and free tractor service to them. Chitwan then became an attractive place for the *pahadis,* as the soil is fertile. There after, people from all over the country composing of different caste and ethnic groups, culture and religions started migrating to the district. Not only overall country, but also from the neighboring country, especially India because of no restrictions whatsoever in crossing the inter-national boundary between India and Nepal. During the harvest season, many Indian labors came to work and finally settled in the district in most cases. Many of the returnees from Burma (Myanmar) and northeastern states of India; Assam, and Meghalaya were also systematically settled here. However, still some forests are secured along *Char koshe Jhadi* (8-mile long dense subtropical forest between the plains and Siwalik Hills), and most of the Chitwan National Park and its buffer zone.

The district is located 146 kilometers south of Kathmandu, the capital of Nepal, covering an area of 2218 km^2 in the Central Development Region. It lies at 27 degrees 27

minutes to 27 degrees 46 minutes latitude toward north and 83 degrees 55 minutes to 84 degrees 48 minutes longitude east. It is surrounded by Makawanpur and Parsa districts in the east, Nawalparasi and Tanahu districts in the west, Dhading and Gorkha districts in the north, and Bihar (India) in the south.

The district elevation ranges from about 200 meters in the south to 2000 meters in the north. The highest hill of the district is Upperdangi, which is about 1900 meters above sea level. The average temperature of this district ranges from 18 degrees Celsius to 31 degrees Celsius. According to the record prepared by Rampur Station in 1994, the minimum temperature of the district recorded was 2 degree Celsius in December and maximum temperature recorded is 38.2 degree Celsius in May. The average annual rainfall is 2133 milliliters. The climatic condition of the district is subtropical and temperate type depending upon the topography of the district.

From geographical point of view, the district consists of three major topographic divisions; Mahabharat Hills in the north, Siwalik Hills in the south, and inner Tarai region in the center and the west. The northern mountainous parts of the district, about 2000m in height are inaccessible due to the steep elevation and dense forest. The southern part of the district in the foothills of Siwalik (600 m), bordering India and cut off from the plains by *Reu* and few other rivers. The central and southern part of the district is the basin along the *Rapti* River known as Chitwan valley. Between the plains and Siwalik lies the dense subtropical forest, rich with flora and fauna. World famous Chitwan National Park, the first one in Nepal, covers much of this forest area. The district as the home place of rhinoceros, wild elephants and other animals, has been famous for tourism since the period of Rana regime. Major River of the

district includes Narayani River, which covers 84 km of the district. The second major rivers include; Rapti, Lothar, and Rigdi. The third include Reu River.

Administratively, the district is divided into 36 Village Development Committees (VDCs) and two municipalities (Ratnanagar and Bharatpur). The district headquarter is Bharatpur, which is located at the Central Western part of the district near Narayani River bank.

According to the preliminary result of the 2001 census, Chitwan district has the total population of 470,713 with 94,319 households having an average household size of 5.0. The total population includes 233,044 male and 237,669 female population providing sex ratio of 98 male per 100 female. The annual population growth rate is 2.91%, which is slightly higher than the national average 2.2%. The urban population is 27.7% in the district, while population density is 214 per Sq. Km.

Due to the high influence of migration, the population of the district was increasing sharply after the 1950s. Table 3.1 shows the number of population and population growth within the given time. The maximum percentage of growth was after eradication of malaria in 1954, 250% during 1954-1961. Then after, the percentage growth during each decade has been decreasing gradually compared to the 1950s. However, the average growth rate is about 3.5% annually in each decade, greater than the regional average growth of 2.9%, and national average growth of 2.7%.

Table 3.1 Population and Percentage Growth in Chitwan District (1954-1991)

Year	Total Population	Total Percentage Population Growth from the Year	
1954	42,822		
1961	107,394	1954-1961	250
1971	183,644	1961-1971	171
1981	259,571	1971-1981	141
1991	354,488	1981-1991	137
2001	470,713	1991-2001	132

Source: Based on Pradhan & Routray, 1992

In terms of ethnic composition, the total population of Chitwan district comprise of wide diversity of ethnic groups of the Pahadis origin of Bahun, Chhetri, Newar, Gurung, Magar, and Tarai castes derived from the successive waves of migrants from Hills, Tarai itself, and northern part of India. This has resulted in language accumulation among different ethnic groups. Each of these nationalities has its own language, while Nepali is the national language. Most of the people can speak this language. A distinct territory can be found within Chitwan district due to the highly influence of migration. The west Chitwan settlement had migrants from west-central Hills. The Newar, a traditional business caste group from the Hills, and people from India and Burma were mainly concentrated in the major market settlements. The real indigenous people in the Inner Tarai are the Tharus, who also comprise the biggest group in the district. They stay in the plain areas. The Kumals stay at the bottom of the hills, and the Chepangs and Darais stay in the hills of the district. Although the indigenous inhabitants of the district are Tharus, their numbers in the district is decreasing because of migration to other places, such as, Nawalparasi near by the district, and India. Presently, people moved from the densely populated western part to the eastern part of Chitwan. The district is primarily rural area. Bharatpur is the only incorporated town, which is the main market place with concentrated dwellers. The village settlements were generally formed by groups of concentrated dwellings, and enclosed by open farms. The villages are small with varying

household ranging from 50 to 100. The morphology of market settlements located along the highways and roads is compact.

Compared to other parts of the Tarai region, Chitwan District is relatively more accessible. Markets, hospitals, and educational centers are within accessible distance and the transportation facilities are easily available. It has two main national highways and two airports. The 78km long Hetauda-Narayanghat highway, a part of east-west highway and the 61 km long Muglin- Narayanghat highway connects Chitwan with all other districts of the Tarai and some districts of the central and western Hills, and forms the main junction of the national highway system of Nepal. It can be reached from Kathmandu by highway route bus in about four hours, and connects Kathmandu and Pokhara to other major towns of Nepal. The airports are located at Bharatpur and Meghauli and linked to Kathmandu. The flight is less than an hour by small planes like beach craft and twin otter. Southern Chitwan is more accessible by roads having numbers of dirt roads linked with major settlements and National Park. However, the roads do not reach *madi* region. The northern montane area, on the other hand, is accessed only by cart and foot tracks. All the district level line agencies of the ministries concerned with forest, education, health, and banking are situated in the district headquarter, Bharatpur.

Having an adequate number of educational institutions, the district literacy rate is 58.3% (male 65.7% and female 49.2%), according to the preliminary results of the 2001 census. The Institute of Agriculture and Animal Science at Rampur and the horticulture farm at Yagyapuri are directly related to agricultural development in the district. Other institutions, provide services to agricultural development and agricultural service centers, cooperative

(*Sajhas*), division of women development and financial institutions, such as, Agricultural Development Bank, Nepal Bank and Commercial Bank.

The total arable land area of Chitwan district is 46,894 ha, of which 44,391 ha of land is cultivated. There are 142,422 ha of forestland, 18,882 ha of pastureland, and 13,602 ha of lands covered by rivers, mountains, and settlements. Among cultivated land, only 28% is irrigated throughout the year, while rest of the cultivated land is irrigated only partially. Since the district has more capacity to grow crops, it exports food grains to India and other parts of Nepal. Table 3.2 shows the cultivated area, production, and yield of major crops in Chitwan comparing to the country as a whole.

Table 3.2: Cultivation Area, Production and Yield of different Crops in the Nepal, Chitwan District 2004/05

Crops	Nepal			Chitwan District		
	Cultivation Area (ha)	Production (Kg)	Yield Kg/ha.	Cultivation Area (ha)	Production (Kg)	Yield (Kg/ha)
Paddy	1,541,729	4,289,827	2,782	33,465	93,702	2,800
Maize	849,892	1,716,042	2,019	20,450	52,147	2,550
Wheat	675,807	1,442,442	2134	8,450	22,000	2604
Millet	258,839	289,838	1120	1,990	1,990	1,000
Barley	26,428	29,341	1,110	259	364	1,405
Potato	146,789	1,738,840	11,846	1,790	26,850	15,000
Oilseeds	187,823	141,989	756	14,000	7,700	550
Sugarcane	59,082	2,376,103	40,217	15	300	20,000

Source: MOAC, 2005

This data shows that the yield per hectare of oilseed, maize and potato is higher in the district than the national yield. The yield of major cereal crops such as, paddy, wheat, and barley are not significantly different when compared to national yield. The soil, in the other hand is also equally favorable for agricultural products. The soil in the district can be classified into four groups; brown sub-tropical soils, alluvial soils, intergrades to brown sub-tropical soils, and hydromorphic soil. All these soils have good natural drainage and more

fertile than the soil in other parts of the country (ADB, 1972). The major crops grown in the district are paddy, maize, oilseed, potato, and wheat. Besides, millet, barley, and sugarcane are also grown. The trend of major cereal crop cultivated area and respective crop yield is shown in the Figure 3.1. However, there are several ups and down in the cultivated area and crop yield, the general trend shows very slow growth in all the three major cereal crops. It is due to the lack of proper management, irrigation system, and some natural causes such as, flood and drought.

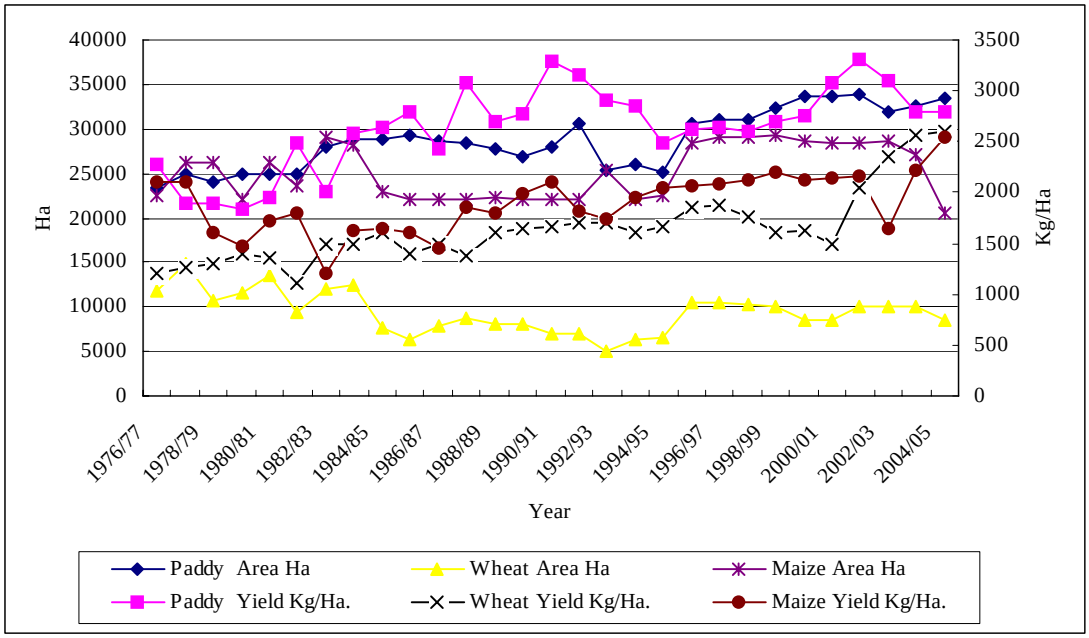


Figure 3.1: Estimated Area Under Cultivation and Yield for the Selected Cereal in Chitwan District (1976-2005)

Source: CBS, 1987, 1997 and MOAC, 2005

Figure 3.2 shows the trend of estimated area under cultivation, and yield of major cash crops; potato and oilseed. It also shows that the cultivation area has been gradually increasing. The yield of potato was declining from the year 1982/83 to the fiscal year 1985/86 due to the flood and potato disease. As already mentioned, the potato yield was decreasing in the same

year in the all over Tarai region. Chitwan district is one of the districts, which is highly affected by potato disease. After the completion of the Sixth Five Year Plan, government introduced disease resistance programs, especially in Tarai region, and introduction of high yielding varieties of potato seeds and additional provision of irrigation helped to increase the yield of potato thereafter. Again in 1991, the yield of potato has gradually decreased till 1997/98. It was due to the flood in the beginning of 1991 and failure of the Seventh Five Year Plan. After implementation of APP in 1995, which increased irrigation services and provided high yield variety potato seed, yield of potato is increasing. The yield of mustard shows no significant difference during the past years. However, it shows slight decreasing trend after 1997/98.

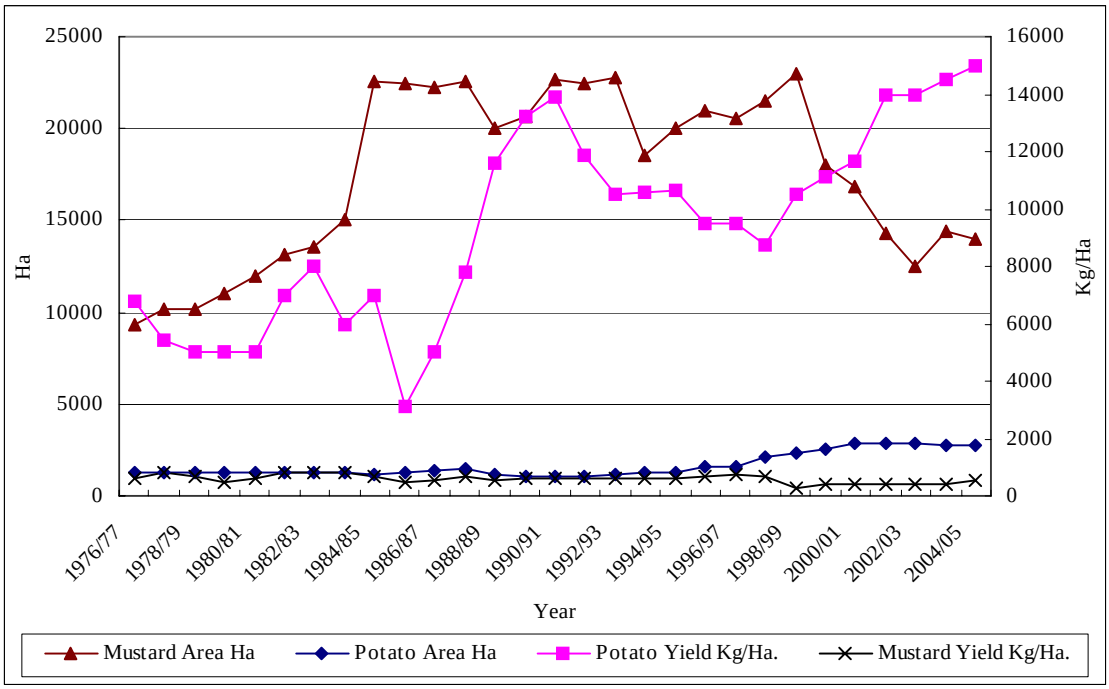


Figure 3.2: Estimated Area Under Cultivation and Yield for the Selected Cash Crop in Chitwan District (1976-2005)

Source: CBS, 1987, 1997 and MOAC, 2005

The farming system, however, still remains traditional, and based on human labor and animal power, and depends mostly upon the rain for irrigation. Since the landholding is small, mechanized farming is not favorable. Farmers in the district mainly use compost manure i.e. mostly animal dung. This encourages them to raise dairy animals, which is the main source of manure. The use of chemical fertilizer is very low in the district. The amount of manure and chemical fertilizer used in the district is shown in Table 3.3. It shows that the amount of manure used is higher in maize and mustard crops. However, the amount of compost manure used is higher than chemical fertilizer used in the case of all the crops. The average amount of manure used is more than 19 times greater than that of the amount of chemical fertilizer used.

Table 3.3: Amount of Manure and Fertilizer Used For Major Crops in Chitwan District

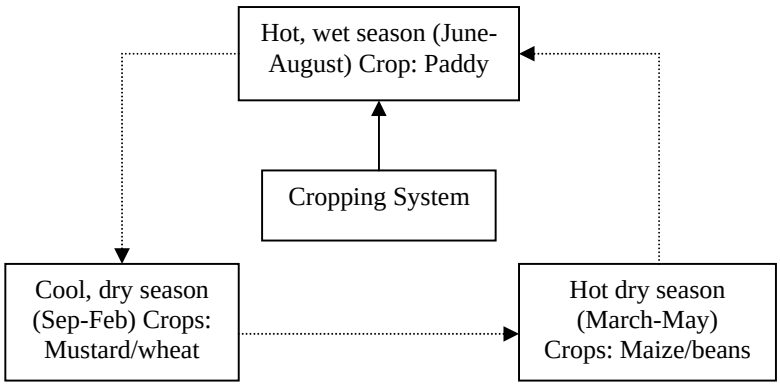
Crops	Compost Manure (Kg/Ha)	Chemical Fertilizer (Kg/Ha)
Paddy	490	33
Maize	4,570	60
Wheat	420	148
Mustard	2,767	133
Average	2,062	106

Source: Pradhan & Routray, 1992

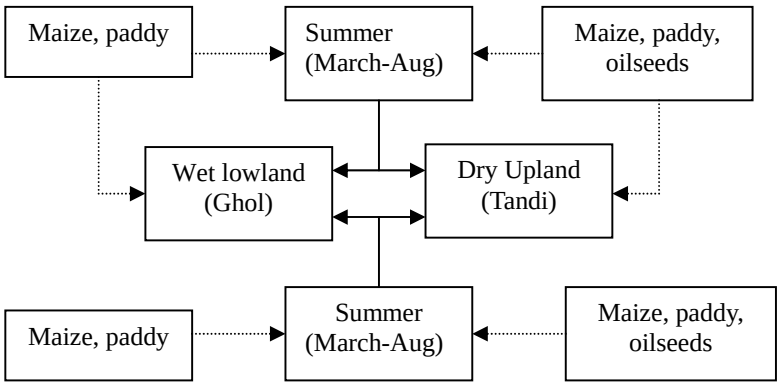
Multiple cropping is practiced in the district. The general cropping pattern of the district is shown in Figure 3.3. The general cropping pattern differs according to rain fall and irrigation facility. Generally, paddy is grown during rainy season, mustard and wheat in winter, and maize in dry season. Cropping pattern is also associated with the types of land within the district. Paddy and wheat are grown in the *ghol*,[7] and maize and mustard in the *Tandi*.[8] Mustard is the most important cash crop in the district and followed by paddy, vegetables, and fruits. The varieties of fruits and vegetables are mainly grown for local

[7] Basin or low terrace is called Ghol (Blon and Shah, 1962).
[8] An ancient higher terrace is called Tandi or tar (Blon and Shah, 1962).

consumption. However, small but rapidly expanding commercial vegetable farming along the main road of national highway, and in and around large market centers is emerging recently. Leguminous crops are grown and consumed either as food or fodder. The integration of crop farming and livestock is another important characteristic of the farming system in the district.



a. Cropping Pattern by Season



b. Cropping Pattern by Land Type

Figure 3.3: The Cropping Pattern in Chitwan District

Source: Pradhan & Routray, 1992

3.2 General Features of Study Area

3.2.1 Background

As mentioned earlier, the two VDCs, dairy pocket area, with about similar characteristics were chosen for detail study. Both VDCs (Gitanagar and Gunjnagar) are located in the central part of Chitwan district. Both the villages are located in the southwest side of Bharatpur Municipality; headquarter of Chitwan district where Gitanagar is adjoining to it. This village is surrounded by dense forest in East, Pathani VDC in the south, Shivnagar and Phulbari VDCs in the west. The total area of the VDC is 16 square km. It has milk potentiality for income generation. If the area is addressed and strengthened in terms of milk production with modern inputs, milk production will be sustainable. Gunjnagar another study village, is about 162 km southwest from Kathmandu, and 16 km from Bharatpur. It covers an area of 16 sq. km. Gunjnagar is delineated by Dibyanagar VDC in the west, Nawalparasi district in the North, Saradanagar VDC in the east and Sukranagar VDC in the south. It can be reached easily by public bus with the bus charge of Rs. 30 (Rs. 76= $1) from Bharatpur. Both the villages are located in plain area in the average altitude of 200 meters and can be considered as strong and developed VDCs based on various attributes, such as, presence of numbers of institutions (banks, NGOs, cooperatives facilities) and other infrastructure (communication, transportation) health facility, electricity more than 80% and more than 50% of the total population has food self-sufficiency.

According to the preliminary census of 2001, total population of Gitanagar is 10244 living under 2012 households making an average household size 5.1. This includes 4905 males and 5339 females. The male to female sex ratio is 0.91, which is slightly less than the

national average of 0.99. The total population in Gunjnagar is 12868 living under 2499 households with family size of 5.1. The male to female sex ratio is 0.93.

Table 3.4 shows the population distribution according to the farm size and sex of the sampled household among the dairy farmers in the study area. The total population of sampled household is 650 living under 104 households. The majority of sampled household belongs to medium size, holding less than two hectare of land. The average household size is 6 with male and female population being approximately equally distributed.

Table 3.4: Population Distribution of the Sampled Household According to Farm Size

Farm Size	Male	Female	Total	%	No of HH	Av. HH Size
Small	57	57	114	17.5	22	5
Medium	233	220	453	69.7	74	6
Large	45	38	83	12.8	8	10
Total	335	315	650	100.0	104	6

Source: Field Survey, 2002

The settlement in the village is compact among each other with individual houses lined along the road or pathways, and surrounded by the agricultural field and accompanied by cowshed and toilet nearby house. Generally, cowshed, kitchen, and toilet are made separate around the house. Sometimes kitchen can be adjoined with the house, however kitchen is separately made from the house in most cases. Cowshed has mostly thatched roof. The houses are one or two-story, ground floor are used for storage of agricultural products, and others purpose and the second floor is for sleeping, and worshipping purposes.

The structure of the house represents the economic status of the dairy farmers. Cement roof houses also can be seen everywhere in the district. However, among the sampled household, two types of houses can be seen *kaccha* and *pakka*. *Pakka* houses are, wall made up of stone mud plaster, galvanized iron roof. *Kaccha* houses are mostly made up of wood with galvanized iron roof. Small farmers have mostly (70%) *kaccha* house while 75% of large

farmers have *pakka* house representing higher financial assets status than that of small and medium farmers (Table 3.5). Most of the sampled households have separate toilet due to the influence of introduction of biogas plant in the area. More than 50% of the farmers have biogas plant with various volume ranges from 6 to 8 cubic meter, and are using biogas for cooking purpose (Table 3.6). Before introduction of biogas plant, generally people were not practicing toilet, they used free space for defection.

Table 3.5 House Type of the Sampled Household According to Farm Size

Farm size and house type	Small		Medium		Large	
	No	%	No	%	No	%
Kaccha	16	69.6	45	61.6	3	37.5
Pakka	11	47.8	51	69.9	6	75.0
Both	4	17.4	23	31.5	1	12.5
Total HH	23	100.0	73	100.0	8	100.0
Stable	17	73.9	51	69.9	8	100.0
With Toilet	18	78.3	67	91.8	8	100.0

Note: multiple numbers of houses are included. Cu. M= Cubic meter
Source: Field Survey, 2002

Table 3.6 Number of Sampled Household Having Biogas Plant

Farm Size & Biogas Plant Size	Av. Animal Holding	6 cu. m	8 cu. m	10 cu. m	Total	%
Small	4	5	4	1	10	43.5
Medium	5	12	19	11	42	57.5
Large	6		3	2	5	62.5
Total	15	17	26	14	57	54.8

Source: Field Survey, 2002 (Unit: cu. m=cubic meter)

3.2.2 Socio-economic Characteristics of Sampled Household

The study area is composed of various caste/ethnic groups, including Bahun, Chhetri, Tamang, Magar, and other occupational caste groups such as, Damai, and Kami. However, the dairy farmers in the study area are highly dominated by Bahun. Bahun (priest caste) are the highest caste in the caste hierarchy of Nepal. It comprised 82.9% of the total sampled

household. Chhetri is ranked second in the hierarchy and occupying 7.7% of the total respondents. In the study area, the dairy farmers belonging to Magar and others, which includes Tamang, Newar, Mahato, and kamali were very as few shown in Table 3.7**.** For this study, caste/ethnicity is not an important issue as sampled household were dominated by Bahuns. Thus, now onwards, cast/ethnicity will not be considered in this study.

Table 3.7 Caste/Ethnic Distribution of the Sampled Household

Caste/ethnicity	Male	Female	Total	%
Bahun	277	262	539	82.9
Chhetri	22	28	50	7.7
Magar	10	9	19	2.9
Others	26	16	42	6.5
Total	335	315	650	100.0

Source: Field Survey, 2002
Others: Tamang (1HH), Newar (2HH), Mahato (1HH), Kamali (1HH)

Education sector plays a strategic role in the attainment of the country's multifarious economic development. The performance of this sector reflects the true development of the country. Education is co-related with different development variables. Indeed, it is considered essential to have sufficient number of educated, conscious, responsible, and skilled manpower to accelerate development effort. It is one of the important human capitals, which plays important role in determining household status in the society. In the village areas, it is one of the major service sectors for the livelihood. In the research area, there are ten primary, five secondary, and four higher secondary schools distributed within the various wards. Most of the schools are privately funded. With the presence of a number of educational institutions, the literacy rate is as high as 88.5% among the sampled household, including those who are just literate with no schooling (Table 3.8). However, there are very few high-educated people. The large percentage of the sampled household is in the range of primary to intermediate level. The highest percentage of graduate people belongs to large farmer (13%). This implies that better

educated people are generally not involved in dairy farming, due to the fact that better education provides more opportunity to access the services provided by different sectors. However, the average education status is not significantly different among the three groups of farmers.

Table 3.8 Educational Status of Sampled Household According to Farm Size

Educational Level & Farm Size	Small	Medium	Large	Total
Illiterate (No Schooling)	15	46	9	70
Literate (No Schooling)	8	51	6	65
Primary (1-5)	33	90	19	142
Secondary (6-10)	19	90	12	121
SLC (School Leaving Certificate)	11	31	10	52
Intermediate (10+2)	16	77	12	105
Graduate	6	36	10	52
Total	108	421	78	607
Literacy Rate (%)	86.1	89.0	88.5	88.5

Source: Field Survey, 2002
Note: Under 6 (43) is not included

Table 3.9 shows different trends in the diversity of income sources between small, medium, and larger farmers. All three groups of farmers have approximately similar range of income sources (4 activities) for income generation. The most important occupations are farm based that includes crop and livestock production called farming. It provides income to about 77.3% of them, which is far greater figure than the second largest clerical job (13.1%), professional (7.1%), and business (2.5%). The given economic activities are the main livelihood strategies of sampled household that represent the district. If we see the occupational structure according to farm size, all the large farmers are engaging in farming including dairy as they endowed higher proportion of natural assets with annual food self-sufficiency and surplus. As the small and medium farmers, having small proportion of land, though they have annual food self-sufficiency, they need to depend on other activities to

manage other non-food items. However, the majority of households have farm-based activities; crop and dairy farming as their main strategy for living.

Table 3.9 Occupational Structure of Sampled Household According to Farm Size

Occupation Category	Small	Medium	Large	Total	%
Farming	44	168	31	243	77.3
Business	1	7		8	2.5
Clerical Job	10	24	7	41	13.1
Professional Job	2	18	2	22	7.1
Total	57	217	40	314	100.0

Source: Field Survey, 2002
Note: Above 60 (22), under 6 (43), Student (279) is not included
Salaried Job: Government/non government service, Officer
Farming: Crop & livestock, Business: Shopkeeper, Trade; Clerical Job: Service, Officer, computer operator
Professional: Teacher, Politician, Writer, Driver, Nurse, Police, Army, and Overseer
Small: 0.2 to under 0.5 ha; Medium: 0.5 and under 2 ha; Large: 2 ha and above

The ownership of equipment and facilities measure a physical asset status of the respondents. The comparison of ownership of selected equipment suggests that the large farmers have higher physical status than other two farmers' groups. Mostly in case of agricultural tools, the percentage of ownership of large farmer is higher. More than two-third of large farmers own plough (63%), more than double large farmers own irrigation pump (88%), than other groups. Hundred percent of large farmer owns well/hand pump/motor and axe and sickle (75%). In case of the tools, which are mostly used in dairy farming, such as, milk can, bucket, and straw cutter, the ownership of these tools is higher or equal among all the farmers. This also shows that the involvement of medium and small farmers in dairy activities is higher than involvement in crop farming (Table 3.10, Figure 3.4).

Table 3.10 Ownership of Selected Equipment and Facilities

Physical Assets	Small (n=22)		Medium (n=74)		Large (n=8)		Total (n=104)	
	N	%	N	%	N	%	N	%
Equipment								
Plough	3	14	15	20	5	63	23	22
Irrigation Pump	3	14	23	31	7	88	27	26
Well/hand pump/motor	20	91	55	74	8	100	83	80
Gas/kerosene stove	3	14	42	56	6	75	10	10
Milk can	19	86	67	91	7	88	93	89
Pipe	4	18	18	24	6	75	22	21
Bucket	19	86	60	81	7	88	86	83
Straw cutter	5	22	15	20	1	13	5	5
Knife	9	41	20	27	2	25	31	30
Axe	16	73	50	68	8	100	74	71
Sickle	20	91	55	74	6	75	31	30
Facilities								
Electricity	18	82	58	78	8	100	83	80
Radio	10	45	44	59	7	88	61	59
TV	13	59	52	70	7	88	72	69
Motorbike	1	5	6	8	5	50	10	10
Bicycle	18	82	65	88	8	100	89	86
Bullock cart			2	3	3	38	5	5

Source: Field Survey, 2002

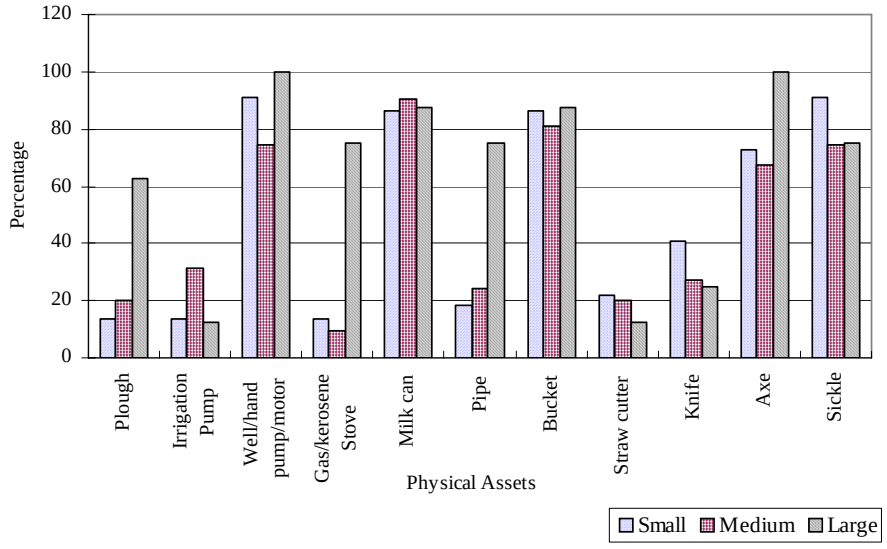


Figure 3.4: Ownership of Selected Equipments

The comparison of physical facilities for communication, however, does not suggest large farmers' higher physical asset status. Not much difference could be found in the percentage of small, medium, and large farmers, who have access to electricity. It is about 82%, 78% and 100% among small, medium and large respectively. The comparison for transportation asset such as, motorbike and bullock cart suggest large farmers' higher physical asset status, while similar percentage of small, medium and large farmer have access to bicycle (82%, 88%, 86% respectively). (Table 3.10, Figure 3.5)

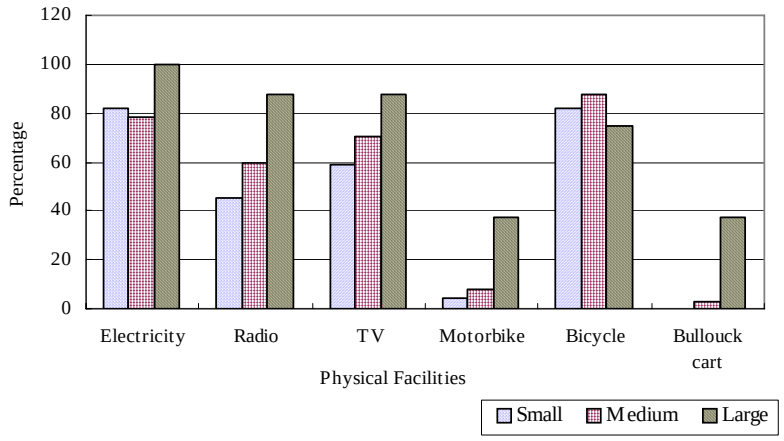


Figure 3.5: Ownership of Selected Physical Facilities

3.3 Analysis of Crop Farming

3.3.1 Crop Farming

The main crops cultivated in the study area are paddy, maize, and wheat as in the district as a whole. These accounts for about 86.09 hectare, 82% of the total land of sampled household, which includes 84.9 Ha, 61.4 hectare and 13.3 hectare was covered by paddy, maize, and wheat respectively in 2002. The crops such as, buckwheat, dal/beans, and vegetables followed this. Potato and mustard are the main cash crops in the area as in the

district. The nature and share of these crops varies from season to season due to the difference in water condition, land type, and farm management. The main eight types of cropping patterns of the study area are shown in Table 3.11.

Table 3.11: Cropping pattern according to Farm size in Irrigated Lowland

Pattern No.	Cropping Patterns (Summer-Rainy-Winter)	Small	Medium	Large	Total Cases	Area (Ha)
1	Maize-Paddy-Wheat	4	35	1	40	9.52
2	Maize-Paddy-Fallow	5	16	3	24	13.52
3	Fallow-Paddy-Fallow	1	18	1	20	5.23
4	Maize-Paddy-Buckwheat	6	11		17	3.83
5	Maize-Paddy-Dal/beans	2	13	2	17	3.38
6	Maize-Paddy-Mustard	2	13		15	3.68
7	Maize-Paddy-Potato	4	11		15	0.53
8	Maize-Paddy-Green vegetables	3	11		14	1.37

Source: Field Survey, 2002

Of these cropping patterns, forty cases of first pattern “maize-paddy-wheat” are found to be highest among the other patterns, covering area of about 10 hectors of total irrigated low land within the sampled household. This cropping pattern is practiced in most of the farmland in the village and district. This is followed by second, third pattern. In 2002, Paddy was grown in most of the irrigated lowland in rainy season within the sampled household covering more than 90% of irrigated lowland. In both rainy and summer season, most of the land was covered with similar crops i.e. paddy in rainy and maize in summer. However, mixed cropping including mustard, potato, green vegetables, dal/ban, and buckwheat is practiced in winter.

Table 3.12 shows three main cropping patterns found in non-irrigated lowland in the study area. In non-irrigated lowland, most of the land was covered by paddy in rainy season as in irrigated lowland. Wheat, dal/beans, potato, mustard are grown in non-irrigated lowland in winter season. Fifteen cases of second pattern “maize-paddy-fallow” are found covering the area of about 11 hectors.

Table 3.12: Cropping Pattern in non-irrigated lowland

Pattern No.	Cropping Pattern (Summer-Rainy-Winter)	Small	Medium	Large	Total	Area (ha)
1	Maize-Paddy-Wheat	3	12	6	21	4.95
2	Maize-Paddy-Fallow	1	10	4	15	11.20
3	Maize-Paddy-Dal/beans	2	4	4	10	1.52

Source: Field Survey, 2002

In irrigated upland paddy is also the main crop in rainy season, where as non-irrigated upland mostly remains fallow in rainy as well as summer season. Few cases are found in winter season that major winter crops including mustard, wheat, and buckwheat are grown. Diversity of cropping pattern among small, medium, and large farmers are not much difference in all types of land.

In order to find out the crop pressure on the land, Cropping Intensity (CI) is calculated as the total cultivated land divided by net cultivable land multiplied by 100 i. e.

$$\text{Cropping Intensity (CI)} = \frac{\text{Total cultivated land}}{\text{Net cultivable land}} * 1000$$

Table 3.13 shows that the cropping intensity is one of the highest in irrigated lowland. The cropping intensity is one of the lowest in non-irrigated upland, as most of the non-irrigated upland remained fallow in 2002.

Table 3.13: Cropping Intensity according to Land Type

Land Type	Net Cultivable Land (Ha)	Total Cultivated Land (Ha)	Cropping Intensity (%)
Irrigated lowland	0.69	1.65	245
Non-irrigated lowland	0.80	1.78	218
Irrigated upland	0.69	1.65	245
Non-irrigated upland	0.28	0.59	163

Source: Field Survey, 2002

3.3.2 Land Holding

Land ownership within the agrarian economy of the study area provides a major source of income, which is an important natural assets that farmers have. The inequity in land distribution translates to economic disparity among the farmers. The land size of the holding and type of land available in the study area can have a large impact on the ability of farmers to earn a living. Table 3.14 shows the land distribution of the sampled household according to land type and farm size. It shows that, in sampled households, the average land holding of small, medium, and large farmers is 0.3, 1.0 and 2.4 hectare respectively. The large farmers are endowed with higher natural asset status than medium and small farmers. Mainly, the land in the study area is categorized in two types *Ghol* and *Tandi*. *Ghol* refers to the wet field in which water is available from irrigation or rivers for at least several months during the monsoon season, and paddy is the main crop cultivated or it can also be understood as paddy land. Mainly maize and mustard are grown in *Tandi,* or can be understood as terrace land. It can be seen that average *Ghol* (paddy irrigated land) owned by large farmers (1 hectare) is almost twice as large as that of medium farmers and four times higher than that of small farmers. Larger size of *Ghol* owned by large farmer mean that they have higher potential to grow crops such as, modern variety Paddy and other crops. It is considered that they have utilized this in higher potential for commercial crop farming. It can also be proved from the income earning from various sources, in which the maximum income comes from crop farming in case of large farmers. It seems they have more tendency to engage in crop farming.

Table 3.14: Land Distribution of the Sampled Household by Farm Size and Land Type

Land Type	Farm Size	HH	Total Land Holding (Ha)	Total Land Holding (Ha)/HH
Ghol (Paddy Irrigated Land)	Small	22	4.2	0.19
	Medium	74	44.8	0.61
	Large	8	8.33	1.04
Ghol Paddy Non-irrigated Land	Small	22	1.07	0.05
	Medium	74	15.75	0.21
	Large	8	7.79	0.97
Tandi (Terrace Irrigated Land)	Small	22	0.51	0.02
	Medium	74	1.66	0.02
	Large	8	0	0.00
Tandi Terrace Non-irrigated Land	Small	22	0.64	0.03
	Medium	74	6.72	0.09
	Large	8	2.34	0.29
Homestead, Animal Shed and others	Small	22	1.13	0.05
	Medium	74	4.72	0.06
	Large	8	1.1	0.14
Total Land	Small	22	7.55	0.34
	Medium	74	73.65	1.00
	Large	8	19.56	2.45

Source: Field Survey, 2002
Small: 0.2 & under 0.5 hectare land, medium: 0.5 & under 2 hectare land, Large: above 2 hectare land
Note: Land Unit in Ha, Others include few cases of holding of fodder/forest land.

Tandi, a terrace land, homestead, forestland, and fodder are not significantly different between the all three farmers groups, small, medium, and large. *Tandi* is a dry field which usually does not have irrigation facility, and is used for the cultivation of maize, millet and wheat, while other lands is not suitable for cultivation, but can produce fodder, grasses, and trees. This implies that small and medium farmers utilized the natural asset in dairy farming. It is also supported by the income earning from dairy, which is higher in these groups of farmers than in the large.

3.3.3 Crop Production and Self-sufficiency

Farming is not only the main industry of Chitwan district, but also the mainstay of life and most of the people are engaged in it as their main occupation. Farming includes all land-based activities such as, crop farming, livestock farming, vegetable farming, horticulture, and

forestry, which are organically interlinked with each other. The farming system and production differs according to the geographical condition, quality of land, and availability of irrigation facility. Paddy, maize, wheat and buckwheat are the main staple crops while potato and mustard being the main cash crops grown in the study sites. Table 3.15 shows the area coverage, annual food crop production and yield of major crops per household. Food crop includes paddy, maize, wheat, and buckwheat. The large farmers have higher paddy production as they hold higher amount of paddy-irrigated land (48%). On average, the entire farmers cultivate food crops on a larger area. This implies that the farmers have adopted a strategy to use greater proportion of their land for farming activities. This strategy has resulted in greater crop production and food self-sufficiency.

Table 3.15 Area, Production and Yield of Major Crops per HH

Crop		Paddy	Maize	Wheat	Buckwheat	Mustard	Potato	Dal/Beans
Small	Area (ha)	0.331	0.185	0.03	0.068	0.028	0.002	0.017
	Area coverage (%)	50.08	27.99	4.54	10.29	4.24	0.30	2.57
	Production (Kg)	1177	369	55	76	17	3	25
	Yield (Kg/ha)	3556	1995	1833	1118	607	1500	1471
Medium	Area (ha)	0.824	0.603	0.175	0.096	0.119	0.015	0.073
	Area coverage (%)	43.25	31.65	9.19	5.04	6.25	0.79	3.83
	Production (Kg)	2544	899	310	91	66	161	19
	Yield (Kg/ha)	3087	1491	1771	948	555	10733	260
Large	Area (ha)	2.145	1.766	0.075	0.233	0.087	0.004	0.170
	Area coverage (%)	47.88	39.42	1.67	5.20	1.94	0.09	3.79
	Production (Kg)	5158	1569	115	200	35	13	34
	Yield (Kg/ha)	2405	888	1533	858	402	3250	200

Source: Field Survey, 2002

Regarding food self-sufficiency, about 90% of small farmers produce food crops enough for 12 months while in the case of medium farmers, about 92% of them produce enough food crop for 12 months, where as, 100% of large household produce enough food crops for 12 months of period. Own food crop production is sufficient to maintain their

household for 12 months food self-sufficiency. However, Only one household belonging to small farmers have 3-6 months and 7-10 months sufficiency (Table 3.16).

Table 3.16 Annual Self sufficiency of the Sampled Household

Months	Small	Medium	Large
3-6 Months Self sufficiency	1	3	
7-10 Months Self sufficiency	1	3	
12 month Self sufficiency	20	68	8
No of Household	22	74	8

Source: Field Survey, 2002

3.3.4 Crop Production Costs

In order to assess the contribution of crop farming in maintaining the livelihood, an examination of the production cost associated with growing them is required. It is important to have an understanding of the scale of cash, as well as, kind of investment required to grow crops and profits that can be made on certain amount of land cultivated in order to see what kind of benefit can be accrued.

When growing a crop, there are wide variety of costs that farmer will incur. These include costs for seeds, manure, fertilizer, pesticide, irrigation, and labor costs. In each item two types of cost; self and purchased can be found. The gross production cost for individual household is computed by summing the expenditure on self and purchased cost for seed, fertilizer, pesticide, self and purchased manure, irrigation and labor cost, which were reported by farmers themselves. Self-cost are estimated on the basis of the market price during the survey. The labor used in crop production was family labor, exchange labor, and hired labor. The utilization of exchanged and hired labor is high mostly for paddy planting and harvesting. Family labor value was calculated on the basis of the value of agricultural labor found in agricultural labor market. Table 3.17 shows the annual crop production cost per household. It

shows the difference in various items cost among the three farmers group. The self-seed cost for small farmer is one of the lowest, as they owned small size of land holding. It can be seen in case of self-manure, machinery, and hired labor used by large farmers is more than double compared to other two farmers' groups, as their natural assets status is higher. A maximum use of self-manure by large farmers is the result of having largest number of dairy animal holdings. The overall crop production cost is increasing with the increasing farm size. Also farm income is increasing according to increasing in farm size. Net return to farm is highest in large farmers, and followed by medium and small farmers.

Table 3.17: Annual Crop Production Cost per Household

Description		Small	Medium	Large
Seed Cost	Self	601	3,091	2,612
	Purchased	1,190	2,543	2,000
Fertilizer Cost	Self manure	3,415	5,177	10,581
	Purchased manure		464	
	Chemical Fertilizer	1,403	5,110	2,290
Other Cost	Pesticide	1,410	2,279	1,500
	Irrigation	874	1,280	1,160
	Machinery	1,662	3,528	7,283
Labor Cost	Self & Exchanged	3,500	6,210	11,970
	Hired	420	3,510	6,030
Total Production Cost		14,475	33,192	45,426

Source: Field Survey, 2002 (Unit: Nepali Rupees; 1 $=NRs.77)

3.3.5 Labor Utilization

Labor is one of the human capitals which people have. The labor that is utilized in the study area for crop farming was found to be self-labor, exchange labor, hired labor, and animal labor. The self-labor is calculated on the basis of market labor value during the survey period. The value for one manday (An adult working for 8hours per day) working is different for man, women, and child in the study area. One manday labor cost for man, woman, and child is NRs 100, 80 and 50 respectively. In the study area, exchange labor is locally called *Parma Jane.* It

literally means ‘turn’ ‘by turn’ in Nepali. It is a reciprocal labor exchange among a group of neighboring farming households for many farming activities, which need large amount of labor such as, paddy planting, weeding, harvesting, threshing, and sowing of wheat and maize. Table 3.18 shows the annual labor use in crop production per household. It shows that the total human labor utilization in main crop (paddy, wheat, maize) is increasing according to increasing in farm size. In the opposite, animal labor utilization is decreasing according to increasing farm size. Most animal labor was found to be hired animal. The self-animal labor utilization is negligible. Very little self-animal labor utilization can be seen in case of large farmers. Mostly, self and exchange labor is utilized for paddy production as mentioned earlier that paddy production needs large amount of labor for its various stages. More hired labor are used for wheat and maize production. Very few about 1person per household labor are used for dal/beans production. It does not need more labor because it is direct seeded after harvesting main crops.

Table 3.18: Annual Labor Utilization (AEU) in Crop Production per HH

Crop	Small				Medium				Large			
	S & E	H L	Total	H A	S & E	H L	Total	H A	S & E	H L	Total	H A
Paddy	24	1	25	73	25	1	26	185	79		79	40
Wheat	9	4	13		14	10	24		8	8	16	
Maize	9	6	15	1	15	19	43	1	35	58	93	12
Buckwheat	1		1		1		1		1	1	2	
Mustard	2		2		4	1	5					
Potato	2	1	3		3	2	5					
Vegetable	3		3		7	6	13		10		10	
Dal/beans	1		1		1		1		2		2	
Total	51	12	63	74	70	39	109	186	135	67	202	52

Source: Field Survey, 2002
Small: having 0.2 & under 0.5 ha land, Medium: 0.5 & under 2 ha, Large: above 2 ha
S & E = Self & Exchange Labor; HL: Hired Labor; HA: Hired Animal
Unit: Manday= Working an adult 8 hrs/day; AEU=Adult Equivalent Unit.
A working child counted as a half of an adult.

3.3.6 Income Earning From Crop Farming

Since the district is one of the most fertile districts in Nepal, most of the sampled households produce surplus food crops and the income earning from food crop selling is one of the main strategies to maintain livelihood in the study area. Table 3.19 shows that, the net crop income per year is directly proportional to the farm size. The net income earning from crop farming is much more higher in large farmers as compared to small and medium farmer as they own more land. It implies that medium and small farmer has to depend on other economic activities, which is dairy, finally translated the higher net income earning among medium and small farmers

Table 3.19: Annual Income Earning from Crop Farming per HH

Crop	Small	Medium	Large
Paddy	10,593	22,900	46420
Maize	2,820	6,866	12403
Wheat	436	2,481	921
Buckwheat	1,134	1338	3000
Mustard	383	1496	840
Potato	27	1142	88
Dal/Beans	804	604	1090
Gross Income	16,198	36,828	64,762
Total Production Cost	14,475	33,192	45,426
Net Income	1,723	3,636	19,336
Net return to farm	9,239	18,578	44,499

Source: Field Survey, 2002 (Unit: Nepali Rupees; 1 $=NRs.77)

3.4 Summary

Chitwan district is one of the agriculturally significant districts. It is often known as “Grain Basket” as the district has more capacity to grow crops. The district is highly influenced by migration from several parts of the country, and beyond. Thus, the population of the district is comprised of wide diversity of ethnic groups. Compared to other parts of the Tarai regions, this district is relatively more accessible with developed infrastructure. Having

an adequate number of educational institutions, the district literacy rate is as higher as the national literacy rate. Farming is the main occupation of the majority of the population. However, the general trend of yield of various crops shows slow growth since the past 25 years.

Two VDCs, dairy pocket areas, from Chitwan district were selected for this study. One hundred and four households (dairy farmers) were selected from two VDCs. Sample population are dominated by Bahun caste as the villages are dominated by Bahans. The average literacy rate is far higher than the district literacy rate with more than 80% population being literate, including those who are just literate without going to school. Mixed farming crop and dairy livestock is the major livelihood activities for the entire sampled household. The sampled households are dominated by Medium sized farmers, having less than two hectare of land. The average land holding is one hectare of land. Large farmers owned more irrigated low land, which is considered as good for crop farming. Consequently, large farmers produce food crops for 12 months. About 90% small and medium household produces enough food crops for 12 months. Mostly household and exchanged labor was used for doing farming activities. The income from crop farming is higher in case of large farmers as they own comparatively more land. Where as small and medium farmers have very less income earning from crop farming. This implies that large farmers have higher tendency to engage in farming compared to small and medium farmers. Due to the less land resource, small and medium farmers could not earn much from crop farming.

Chapter 4: Dairy Farming in Chitwan

4.1 Background

The history of dairy farming in the district started with the resettlement of the district in the 1950s. During the resettlement process, people migrated from different places of the country as well as, neighboring country such, as Burma, India, and Bhutan. Milk production, its utilization and processing have been the main occupation of the early settlers who came from Burma along with their herds consisting of cows and buffaloes. After that, gradually transferring to other dwellers in the district. These days, dairy farming is becoming an important economic activity in Chitwan district. Cow, and buffaloes are the main dairy livestock. Cows, oxen, and buffaloes are commonly kept as domestic animals for dung, draft, milk, and meat in the district. They are generally grazed in the open spaces, farm roads and nearby forests wherever feasible. Dairy livestock are also given cut fodder plants, straw and at times, grains and oilcakes. Milk selling is one of the major income generating activities for the local people. Besides, renting oxen for ploughing and pulling carts to transport farm goods is also an income-generating source in the district, where one pair of oxen can earn NRs. 210 per day for ploughing a field. Manure selling is also one of the other option for income earning for small holder farmers who have high numbers of dairy livestock, and less land holding. Table 4.1 shows dairy livestock trend, which include productive as well as unproductive animal, found in the district. It shows slightly increasing trend in number of cow as well as, buffalo except in few years. The ratio of cow and buffalo is not significantly different.

Table 4.1: Trend of Dairy Livestock in Chitwan district

Year	Cow	Buffalo
1991/92	88038	69752
1992/93	88416	70115
1993/94	110100	79000
1994/95	110193	59566
1995/96	116600	87810
1996/97	105742	83724
1997/98	103530	86711
1998/99	99679	86348
1999/00	97716	87897
2000/01	95791	89474
2001/02	88934	98300
2002/03	80936	107460
2003/04	65270	93213
2004/05	97251	93200

Source: MOAC, 2005

In order to fulfill the need of milk for self-consumption, income earning and manure, people raise dairy animal. Before 1954, there was no any formal sector that can buy milk regularly from the farmers in the country. Thus, farmers used to sell their milk by visiting door by door and few informal sector such as, teashop and sweet shop. While selling in these informal places, farmers were suffering several problems regarding price and payment of the milk. Due to the highly perishable nature of milk, and the absence of chilling centers, farmers have to use milk as soon as possible. The majority of dairy farmers are small and medium holder farmers. Thus, the majority of farmers depend on loan for buying dairy animals through merchant even in higher interest rate. In order to support dairy farmers at the village level, dairy cooperative emerged in the district. In 1992, the first dairy cooperative was established in the district with 199 shareholders. It has aimed to support dairy farmers in milk collection and sale. And also providing various services such as, chilling facility, feed supplies, extension and training services, saving and credit. After that, other dairy cooperatives and private dairies also emerged in the district. Presently, there are 76 Milk Producers

Cooperatives (MPCs) and six registered private dairies in the district. There are altogether eleven chilling centers including private sector and cooperatives chilling centers with capacity varying from 1000 to 6000 liters per day. Due to presence of numbers of dairy institutions and infrastructure, dairy buffalo and buffalo milk production in the district is gradually increasing since 1990 except in the fiscal year 1993/95 and 2003/04 in the case of buffalo. Where as the number of cow has .not significantly changed except in the fiscal year 2003/04, the number of cow decreased. The reason behind decreasing is due to the animal disease (Figure 4.1).

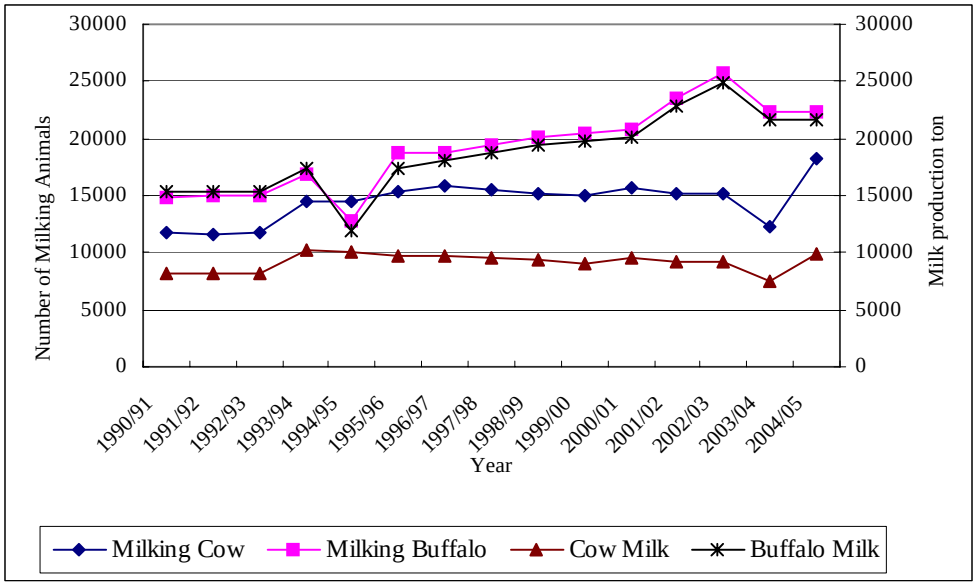


Figure 4.1: Milk Animal and Milk Production in Chitwan District

Source: MOAC, 2005

4.2 Analysis of Dairy Farming

4.2.1 Animal Holding

Livestock ownership is one of the other major financial assets that people have. The production of manure through livestock is a major contributor to traditional soil management practices, and through dairy, provides an important source of income. In the study area, the

sampled households also have non-dairy animals such as goat, sheep and chicken. The average dairy cow and dairy buffalo holding per household is about 3 and 2 respectively. Small animals such as, sheep and goat and poultry (chicken) were found to be very less in the area (Table 4.2).

Table 4.2: Livestock Holding among the Sample Household According to Farm Size

Farm Size	HH	Cow		Buffalo		Small Animal		Poultry	
		Pop	No/ HH	Pop	No/ HH	Pop	No/ HH	Poultry	No/ HH
Small	22	54	2.4	32	1.4	37	1.7	22	1
Medium	74	234	3.1	127	1.7	165	2.2	144	1.9
Large	8	22	2.7	29	3.6	14	1.7	300	37.5
Total	104	310	2.9	188	1.8	216	2.1	466	4.5

Source: Field Survey, 2002

Table 4.3 shows the distribution of dairy animals, and its composition in the study area. The average number of dairy cows and buffaloes in small, medium and large farmers are 4, 5 and 6 respectively. Large farmers have one of the large mean numbers of dairy animal. Generally in Tarai region, large farmer has large number of dairy animals mainly for the farmyard manure to maintain the soil productivity, which tends to be more easily degraded by pest, disease and nutrition deprivation as they won large land. Medium and small farmers owned less numbers of dairy animals compared to that of large farmer. Large farmers owned only 21% milking animals where as small and medium farmers owned more than 30% milking animal. This implies small and medium farmers have high tendency to engage in dairy farming as they have less land resources compared to large farmers.

Table 4.3: Dairy Animal Holding of Sampled Household

Description	Small (22)	Medium (74))	Large (8)	Total (104)
Milking Cow	25	92	7	124
Dry Cow	9	28	4	41
Heifer	6	42	2	50
She Calf	10	29	3	42
He Calf	3	14	2	19
Bull	5	37	4	46
Milking Buffalo	14	46	4	64
Dry Buffalo	1	16	10	27
Heifer	7	26	6	39
She Calf	2	17	2	21
He Calf	4	14	7	25
Total Animals	86	361	51	498
Holding/HH	4	5	6	5
Milking Cow Holding/HH	1.1	1.2	.9	1.2
Milking Buffalo Holding/HH	0.6	0.6	0.5	0.6
Milking Animal Holding/HH	2	2	1	2

Source: Field Survey, 2002
Small: having 0.2 & under 0.5 ha land, medium: 0.5 & under 2 ha land, Large: above 2 ha land
Milking animal: cow, producing milk
Dry animal: a cow usually in the latest part of pregnancy, whose lactation has been terminated and who is being prepared for the next lactation. Or stop milking
Heifer: young female bovine from birth up to the time she gives to a calf
Calf: young male or female animal
Bull: adult male animal

4.2.2 Milk Production and Consumption Pattern and Sale

Dairy farming in the study area is an activity as a part of their livelihood strategies. Milk production is the major income-generating source for the dairy farmers. Fluid milk consumption among household is common practice in the area as other parts of the country. Majority of sample household member drink fluid milk regularly. Children and old family member has given more priority to drinking milk. The use of milk for tea is popular in the study area.

Table 4.4 shows the annual milk production and consumption per household according to farm size. The average amount of milk production among the small and medium farmer is more than double that of large farmer. Similarly, small and medium farmers sell more than

80% of total milk production while large farmers sell only 58% of total milk production per household. This implies that small and medium farmers have high tendency to engage in dairy farming as they have less land resource. Milk consumption is higher 42% among the large farmers where as, small and medium farmers consume only 16% and 20% respectively from their total milk production. The consumption pattern among large farmers is high. However, per capita milk consumption is one of the lowest among the large farmer with the maximum family size compared to medium and small farmers. Since the study area is dairy pocket area, the overall per capita milk consumption is much higher than that of national average.

Table 4.4: Milk Production and Consumption per Household

Farm Size	Milk Production (Kg)	Milk Sale (Kg)	Milk Consumption (Kg)	Per Capita Milk Consumption (Kg/head)
Small	3117.5	2609.8 (84%)	507.7 (16%)	101.3
Medium	3145.1	2521.4 (80%)	623.7 (20%)	106.5
Large	1743.8	1004.6 (58%)	739.1 (42%)	76.2
Average	3037.8	2423.4 (80%)	614.4 (20%)	103.1
National Per Capita Milk Consumption in 1991 (Kg/Head)*				47.3
Basic Need Level Recommended by WHO (Kg/Head)				57.8

Source: Field Survey, 2002 *LMP, 1993

4.2.3 Dairy Animal Production Cost

Production costs generally varies, based on scale of production. In this study, different variable costs[9] were considered to calculate the net household income from dairy. The variable cost for individual households in dairy production were computed by summing the expenditures on self and purchased feed, dairy animal health, electricity and cost for labor,

[9] Fixed cost such as depreciation cost for animal, animal shed and equipment used were excluded in the study. It is difficult to evaluate animal depreciation cost due to the various matters such as animal type, size, age and calving stage. In the case of animal shed and equipment, it is also difficult to evaluate the depreciation cost. Because majority of farmers are using same animal shed for dairy animals and other small animals and using same equipment for dairy as well as crop farming.

which were reported by farmers. The average purchased feed value is very high due to the high market value of ready made feed produced by private industry. The labor used in dairy production was household labor. The household labor value was calculated based on the value of agricultural labor found in agricultural labor market. One-man day value is different for man, woman, and child in the study area. One-man day labor costs for man, woman and child is NRs 100, 80 and 50 respectively.

Table 4.5: Annual Dairy Production Cost per Household according to Farm Size

Description	Small	Medium	Large
Self Feed (Concentrate/maize/oilcake)	123	655	2,100
Self Feed (Fodder/grass/straw)	741	1,682	3,480
Purchased (Concentrate/maize/oilcake)	22,395	22,884	10,463
Purchased Feed (Fodder/grass/straw)	3,691	2,869	
Total Feed Cost	26,950	28,090	16,043
Health Cost	1,476	1,496	2,120
Electricity Cost	39	61	100
Labor Cost (Estimated)	27,748	30,252	27,318
Total Dairy Production Cost	56,213	59,899	45,581
Total Cost per Animal	14,054	11,980	7,597

Source: Field Survey, 2002, Unit: Nepali Rupees (NRs.), $1 = NRs. 77.00

Table 4.5 shows the types of variable costs included and respective average cost. Finding shows that the mean value for self-feed is one of the lowest in small and medium farmer. These two groups of farmers used more than double amount of purchased feed compared to self-feed. While large farmers used approximately equal amount for self and purchased feed. This coincides with the low natural assets status of small farmers than large farmesr. Mean value for electricity used and health is very minimal in all the cases. The total production cost is not significantly different in small and medium group farmers with NRs 56,213 and NRs. 56,899 respectively. Large farmers have one of the least production costs (NRs. 45,581). The major reason for less production cost of large farmers is due to the less expense in feed and labor. Large farmers hold less milking animal than the small and medium

farmers. Generally, milking animal need quality feed to increase milk production. It implies that large farmers are using less effort in dairy farming as they have sufficient amount of food grains from their own production.

4.2.4 Labor Utilization

Labor available to the household is another important human asset, and one of the important inputs in dairy enterprise. Both quantity and quality of labor are important human assets. The knowledge of dairy animal management, and the requisite skills needed in dairy farming determine the quality of labor, and input to enhance the productivity of dairy animal. But in a low productivity framework, non-professionals do the work maintained and rearing of dairy animals, as their opportunity cost is lower. The dairy enterprise provides a gainful employment to the rural households. The number of household members available in dairy farming is an important factor for adopting labor-intensive livelihood strategies. Table 4.6 shows the annual labor use in various dairy activities per household in study area. In the study area, almost labor found is family labor among all the three groups of farmers. Participation of female labor is also encouraging. The average number of days, which was spend for dairy activities per year are calculated according to farm size. It shows that the average number of days, spent by small (310), medium (334) farmers is higher than large (306) farmer while the average animal holding is higher in large farmers. This implies that small and medium farmers are using more dairy inputs in terms of labor.

Table 4.6: Annual Labor (AEU) Utilization in Dairy Activities per Household

Activities	Small			Medium			Large		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Fodder Collection	32	60	92	39	56	95	33	56	89
Feeding	35	37	73	35	33	68	40	48	88
Cleaning Animal	10	7	18	14	8	22	7	10	17
Cleaning Animal Shed	17	33	50	22	23	46	17	29	46
Milking	25	16	40	33	24	57	26	14	40
Milk Delivery	28	10	38	37	8	45	20	6	26
Total	147	163	310	180	154	334	142	163	306
Labor use/animal	37	41	78	36	31	67	27	30	58

Source: Field Survey, 2002
Small: having 0.2 & under 0.5 ha land, Medium: 0.5 & under 2 ha, Large: above 2 ha
Unit: Manday= Working an adult 8 hrs/day; AEU=Adult Equivalent Unit.

4.2.5 Income Earning From Dairy Farming

Income from dairy in total household income is given in Table 4.7. The net income is one of the highest in medium farmers and followed by small farmers. The main reason for it is that, small and medium farmers are using more dairy inputs in terms of labor and expense. As already discussed in previous section, small and medium farmers have been more diary inputs compare to large farmers, which finally translating to higher income. Besides, small and medium farmers own more milking animals than large farmers.

Table 4.7: Income from Dairy Production according to Farm Size

Description	Small	Medium	Large
Selling Milking Cow	1,681.82	4756.76	
Heifer (cow)		739.72	
Cow Milk	43,363.09	44,980.33	17,793.75
Milking Buffalo		2,122.97	
Dry Buffalo	328.18	378.37	
Heifer (Buffalo)		216.21	
She calf		14.46	
He calf	100	277.92	
Bullock		56.75	
Buffalo Milk	19,045.90	20,137.33	20,394.37
Ghee		199.32	
Manure Selling	1,909.09	113.51	
Milk Self Consumption	7,615.50	9,346.50	11,086.50
Manure Self Use	3,415.00	5,177.00	10,581.00
Gross Income	77,458.58	88,517.15	59,855.50
Net Income	21,245.58	28,618.15	14,274.12
Net Income/Animal	5,311.00	5,724.00	2,379.00
Net Return to Farm	49,857.58	61,207.15	47,172.57

Source: Field Survey, 2002
Unit Nepali Rupees, $1= NRs 77.00

4.3 Case Studies of Milk Yield of Individual Cow

This section analyzes the milk yield performance of individual cow in different calving stages. The data for this analysis were collected from six cows in different calving stages, which were owned by five different dairy farmers in Gitanagar VDC. The selection of household was done on the basis of duration involved in dairy activities. The farmers were asked to keep everyday record for milk production during one lactation period of a cow. The dairy farmers were asked to keep record for about fifteen cows. Since most of the data recorded was not complete due to the selling and buying process. Few cows dead. Thus, six cows among those, who have complete data for one lactation period, were selected for this analysis. The main aim for these case studies is to examine the milk yield performance of an individual cow in different calving stages, and its impact on dairy farmer's livelihood.

4.3.1 Basic Information of the Dairy farmers

The five households were defined as case 1 to case 5. The dairy farmers have experience in dairy farming for16 to 20 years. The main people involved in dairy activity are mostly two (husband and wife) in all the cases. The initial capital used in dairy farming varies from NRs. 15,000 to NRs. 50,000, which was used to buy dairy cows in all the cases. Dairy farmers are belonging to Bahun caste with Hindu religion, and have migrated to Chitwan district around 20 to 47 years ago, from different Hill districts, such as, Lamjung, Parpat, Syanja and Tanahu districts for the betterment of their livelihood. The age of the farmers varies from 36 to 55 years old. The family size varies from 5 to 7 members per household (Table 4.8).

Table 4.8: Basic Information of the Dairy Farmers

	Age of the Farmer	Family Size	Experience in Dairy (Years)	Initial Capital (NRs)
Case 1	36	5	19	30,000
Case 2	55	7	15	15,000
Case 3	55	4	20	15,000
Case 4	50	5	20	20,000
Case 5	46	6	16	50,000

Source: Field Survey, 2002

Table 4.9 shows some of the socio-economic characteristics of the farmers. The education status of the farmers varies from literate to SLC (School Leaving Certificate) level. In all the cases, farmers have main occupation as farming, which include crop and dairy. Among the farmers, four are medium holder farmers and one belongs to smallholder having land holding varying from 0.4 ha. - 1.9 ha. The animal holding changed during 2001 and 2003 in case 1 and case 2. For the other farmers, they have little change in milking animal holding. ing is increased by 1 to 8 head except in case 4, milking animal decreased by 1 head, he sold out one milking cow (Table 4.10).

Table 4.9: Socio-economic Characteristics of The Farmers

Cases	Education	Occupation	Farm Size (Land Holding Ha.)
Case 1	SLC	Farming	Medium (0.7)
Case 2	Primary	Farming	Medium (1.9)
Case 3	Literate	Farming	Medium (0.9)
Case 4	Secondary	Farming	Small (0.4)
Case 5	Literate	Farming	Medium (0.9)

Source: Field Survey, 2001

Table 4.10: Number of Cow Holding in two Different Year

Cases	2001		2003	
	Total Cow Holding	Milking Cow Holding*	Total Cow Holding	Milking Cow Holding*
Case 1	11	5	14	9
Case 2	12	3	15	6
Case 3	6	2	6	3
Case 4	6	4	6	3
Case 5	10	5	10	6

Source: Field Survey, 2003

*Milking cow indicates only those who are producing milk during the survey.

4.3.2 Dairy Farming by Individual Dairy Farm Households

For all the cases, farmers were asked to keep records of daily milk yield of their one or two cows, according to availability of cows in different calving state in their farm. The characteristics of individual cow in different calving period are shown in Table 4.11.

Table 4.11: Characteristic of Individual Cow in Different Calving Stage

Cases	Jersey Cows	Calving stage/age		Milk Production	Milk Yield Morning (Lt.)	Milk Yield Evening (Lt.)	Total Milk Yield (Lt.)	Lactation Days
Case 1	C1	1st	2	2897.8	4.4	3.8	8.2	351
Case 2	C2	2nd	3	2627.2	4.5	3.7	8.2	320
	C4	4th	6	3479.3	5.7	4.9	10.6	326
Case 3	C3	3rd	5	2772.0	4.9	3.9	8.8	315
Case 4	C5	5th	7	2360.6	3.9	3.8	7.6	309
Case 5	C6	6th	10	2522.6	4.1	3.6	7.7	326

Source: Field Survey, 2003

Case 1

This is the case of a 36 years old dairy farmer in Gitanagar VDC. He started engaging in dairy activities since1983, when he was 13 years old. Initially, he was helping his father in doing dairy activities. After his marriage, he started his own dairy farming with an initial capital of NRs. 30,000, which was used to buy 2 heifers from local market. Before establishment of the cooperative, he sold fresh milk to the villagers in the same village as well as near by villages door by door. Some of the neighbors came to buy milk in his house too. After he became member of Annapurna dairy cooperative, he started selling milk to the cooperative.

At present, he has two small houses; *pakka*[10] and *kachha*[11] with 0.7 ha of cultivated land. He lives with his 32 years old wife, one 14 years old son, and two daughters of 12 and 11 years old respectively. He and his wife have SLC level education and can read and write Nepali very well. His son has secondary education, while two daughters have primary education. His main occupation is farming. They produce crops and raise dairy animals in an integrated manner. They grow mostly paddy, maize, wheat, and little vegetables for their home consumption. They have just enough food for 12 months from their own production. However, they have no other sources of income to fulfill their non-food needs basically education of children, heath, and festival. So, they had decided to raise dairy cows in commercial way.

Presently, he has nine milking cows, and milk yield was about 8–10 liters per day. Dairy cows were fed fodder, mainly from agriculture by-product, such as, Paddy straw, grass and grazing in the fallow land. He was asked to keep record of one milking cow (C1) in its first lactation period. C1 is a Jersey cow born in his own farm in 1999. C1 was 24 months old.

[10] House made by bricks and galvanized roof.
[11] House made by wood and roof made up of straw.

The lactation days of C1 was 351 days, which is the longest milking days among the other sampled cows, and milk yield was 8.2 liters per day (Table 4.11). The total milk production by C1 was 2897.8 liters of milk in 351 lactation days, which is bit higher than the study carried out by New Era team (1990) in Tarai with the objective to compare varieties of crossbred cows, which is 2760 liters of milk in 264 days of lactation period. The lactation period is also longer. The daily milk production trend of C1 is shown in Figure 4.2. The highest monthly milk yield is around second and third months of lactation as the general trend of milk yield. Lane and Larry (2002) also give the statement that the highest yield is during the 2nd and 3rd month of the lactation period.

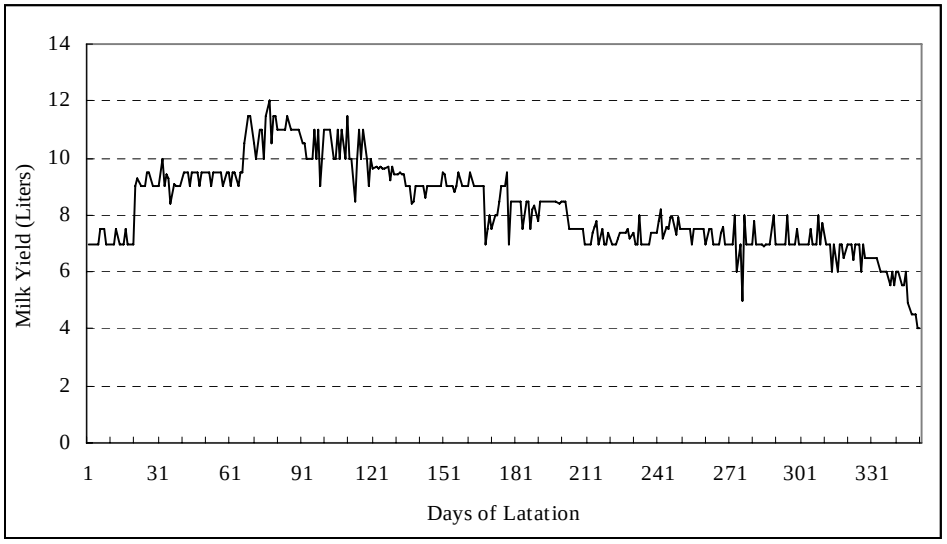


Figure 4.2: Daily Milk Yield of C1 in 1st Calving Period
Source: Field Survey, 2002

Table 4.12: Expense and Income From Individual Cow in Different Calving Stages

Expense	Case 1	Case 2		Case 3	Case 4	Case 5
	C1	C2	C4	C3	C5	C6
Concentrate	6,000	4,131	4,131	4,975	4,866	4,100
Fodder	1,153	1,483	1,483	1,053	1,250	900
Labor	5,972	2,851	2,851	5,855	3,359	4,516
Others	100	400	540	200	500	300
Total expense	13,225	8,865	9,005	12,083	8,975	9,816
Gross Income	40,569	36,920	48,710	38,808	43,048	35,316
Net Income	27,344	28,055	39,705	26,725	34,073	25,500

Source: Field Study, 2002
(Case 1= C1 1st calving cow, Case 2= C2 2nd calving cow, C4 4th calving cow, Case 3= C3 3rd calving cow, Case 4= C4 4th calving cow, Case 5= C6 6th calving cow)
Others include expense for health, electricity use etc.
Unit: NRs. 1$=77

The net income earn from C1 in its first calving period was NRs. 27,344 (Table 4.12). He and his wife are responsible for all dairy activities such as, feeding, cleaning animal and animal shed and milking. They usually spend seven to eight hours in dairy activities. As he is the member of Annapurna Dairy Co-operative, he sells 71% of the total milk production to the co-operative. He consumes the rest of (29%) of the milk at home in the form of curd, whey, butter etc. Milk value is paid by co-operative to him every 15 days on the basis of fats and solids not fat (SNF) content.

Income from selling milk and selling of surplus crop (which was fertilized by biogas slurry) constitute his total household income. The share of dairy income is 89% in his total income and the rest of income is from crop selling. He uses this income to purchase daily needs, and mainly education of his children, health and festival. He also has biogas plant in his house, which has been helping him to fulfill energy needs and need of manure in his crop field. He mentioned that after using biogas slurry, his production became approximately double than before. Therefore, he is able to make some income from crop by selling surplus crop though it is low. They have no other non-farm job. Thus, dairy became a main strategy for fulfilling non-food needs such as, festival, clothing, education, and other facilities.

Table 4.13: Total Household Income And Expense Per Annum

Items	Case 1	Case 2	Case 3	Case 4	Case 5
Total dairy animal holding	13	12	7	11	10
Income from Dairy	182,080	191,075	116,800	112,900	215,875
Income from Crop	33,400	65,100	14,900	73,320	35,316
Income from non farm				60,000	
Total Income	215,480	256,175	131,700	246,220	251,191
Total Milk Sale (Kg)	12,855	9,720	5,913	6,480	9,297

Milk Consumption (Kg)	5,289	1,777	657	90	3,514
HH expense in Food	26,500	27,600	26,630	22,672	20,200
Non-food	31,700	82,400	29,752	18,332	82,800
HH total expense	58,200	110,000	56,382	41,004	103,000

Source: Field Study, 2002

He has mainly animal feed problem in his dairy farming, such as, expensive concentrate, unavailability of fodder. He feeds concentrate only to lactating cow in order to minimize the cost of concentrate. He feeds his milking cows at the rate of 4 kg per day per milking cow along with crop residues, salt, fodder grass and *khundo* (locally home made ration). He mentioned that a major problem in milk selling is milk holiday. He has also infertility problem, and lack of knowledge in dairy farming. He wishes that infertility checking should be easy available. He also wished to have some kind of training in dairy activity so that he can improve his dairy business. He also mentioned that after establishment of feed mill by cooperative, the feed value has been reduced a bit. And due to the provision of various services provided by the cooperative, it became more convenient in milk selling than before. He is getting opportunities in involving training programs and dairy education programs, which encourage him to do dairy farming.

In the end he said, “I am grateful to God, because with dairy business, I am better off than before.” He was able to make *pakka* house amounted about NRs 300,000 with separate toilet. Before, he had only a *kaccha* house. He was able to install biogas plant without taking loan and able to buy Television (Table 4.14). He was able to send his son and two daughters to school. He wished his children do well in school and be elite people in future. Besides, he was also able to make savings in Bank amounting to NRs. 50,000.

Table 4.14: Ownership of Equipment and Facilities and House type

Items	Case 1	Case 2	Case 3	Case 4	Case 5
Pakka house	1	1	1	1	
Kaccha house	1				1
Stable		1	1	1	1
Toilet	1	1	1	1	1
Irrigation pump	1	1			1
Hand pump	1	1	1	1	
Milk can	3	7	1	3	
Bucket	5		2	8	
Knife/sickles	3		6	9	2
Radio		1		1	
TV	1	1	1	1	1
Bicycle	2	2	1	1	1
Motorbike		1			
Biogas	1	1	1	1	1
Savings/Loan (NRs.)	50, 000	50,000	50,000	*40,000	17,000

Source: Field Study, 2002

* Indicates loan

Case 2

This is the case of a medium farmer, who migrated from Syanja district about 24 years ago for the betterment of his livelihood. He lives with his 40 years old wife and three sons, 22, 19 and 17 years old respectively. He and his wife have primary level education. His elder son has a bachelor level, and two younger sons have Intermediate level in engineering and intermediate level in commerce respectively. His main occupation is farming. He and his wife generally grow crops such as, paddy, maize and wheat. They have enough food for 12 months. However, they have no other sources of income to fulfill their other food and non-food needs basically education of children, heath and festival. In order to fulfill these needs, he has been raising cows commercially, which is becoming a main job for him and his wife. He was asked to keep record for daily milk yield of C2 and C4 cows, which were in 2nd and 4th calving stage. The daily milk production trend of C2 and C4 in 2nd and 4th calving period is shown in Figure 4.3. The highest monthly milk yield is around second and third months of lactation period in Case 2 of calving cow C2. In case of C4, the highest milk yield per month is around 3rd and 4th

months of lactation period. However, milk yield of C2 (8.2 lit/day) and C4 (10.6lt/day) both the cows were much higher than that of national average cow milk yield i.e. 2.34 liter/day (MoA, 2004) (Table 3.30).

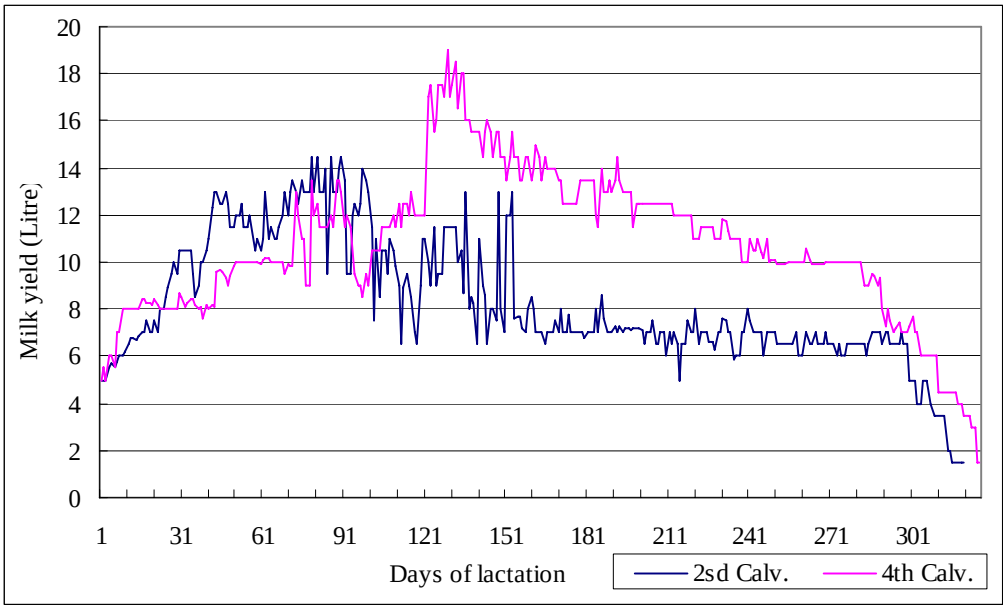


Figure 4.3: Daily Milk Yield of C2 and C4 in 2nd and 4th Calving Period
Source: Field Survey, 2002

He feeds concentrate about 2 to 3 kg and 10 to 15 kg of green fodder daily per head of diary animals. He received concentrates from Annapurna Dairy Cooperative, which provides feed with bit lower than the local market price for its members. He also feeds *khundo* to the cows. He wished to have quality breed to improve daily milk production. Milk holiday is the main problem in his dairy farming. He has been bearing loss during milk holidays. So, he wished to stop milk holiday in the near future. To solve this problem, he processes milk himself, and produced locally some dairy products such as, ghee, card, and whey.

The net income earning from C2 and C4 was NRs. 28,055 and NRs. 39,705 respectively (Table 4.12). He and his wife are responsible for all dairy activities such as, feeding, cleaning animal and animal shed and milking. They spend about 4-5 hours per day in

dairy activities. The share of dairy income is 84% in his total income (Table 4.13). He uses this income to purchase daily needs and for his sons education. He also has biogas plant in his house with 10^3 m capacity, which has been helping him to fulfill energy and manure needs. He also does not have other non-farm income sources as in case 1. Thus, dairy became a main strategy for fulfilling food and non-food needs such as, festival, clothing, education, and other facilities. He also spent more in education of his children. Since he has only primary level education, he wished to have higher education for his children. He mentioned that he somehow succeed to give intermediate level education to his sons and this was only possible because of dairy business.

Thus, he was happy with the dairy business, which improves his life standard than before. He was able to make *pakka* house amounting to about NRs 200,000. He was also able to install biogas plant without taking loan, which made clean and healthy cooking environment that reduces occurrences of sickness and make available manure. By 2003, he could also make some fixed assets and cash savings amounting to about 50,000 in cooperative (Table 4.14). His sons have no jobs yet. He has been bearing all the expenses in their education. He wished his children to do well of their studies and something that he never had the opportunity to experience.

Case 3

This is the case study of a 46 years old dairy farmer. He is also characterized as medium farmer having 0.9 ha. of land. He started dairy business, when he was 30 years old. He and his wife have the main occupation as dairy and crop production. They grow mainly paddy, maize and wheatm, and few amount of lentil. He produces about 900 kg of straw,

which is sufficient for 4 months fodder for the dairy animals. They have also 12 months food self-sufficiency with their own production.

He feeds about 4 kg of concentrate per head of milking cow and 2 kg per head of calf for buffalo 1 kg concentrate and about 15 kg of fodder. He used to own bull for breeding purposes. He was asked to keep daily milk production record of C3 cow with 3rd calving stage. C3 produces 2772 liters of milk with daily milk yield of 8.8 in 315 lactation days (Table 3.30). The milk production is however higher in comparison to national average milk production with daily milk of 2.34 liters, which is 702.92 liters based on 300 days lactation period (MoA, 2004). The daily milk yield trend of C3 is shown in Figure 4.4. It shows that the highest milk production is during 3rd and 4th month of the milking stage.

The net income earning from C3 was NRs. 26,725. He and his wife do all the dairy activities. They also have largest share of income from dairy farming. About 90% share comes from dairy farming in his total household income (Table 4.13). He spends in food item such as, beaten rice, paddy, potato, meat, green vegetables, and fruits. In non-food items, mostly he used his income on children education and festival. He has also biogas plant in his house for cooking.

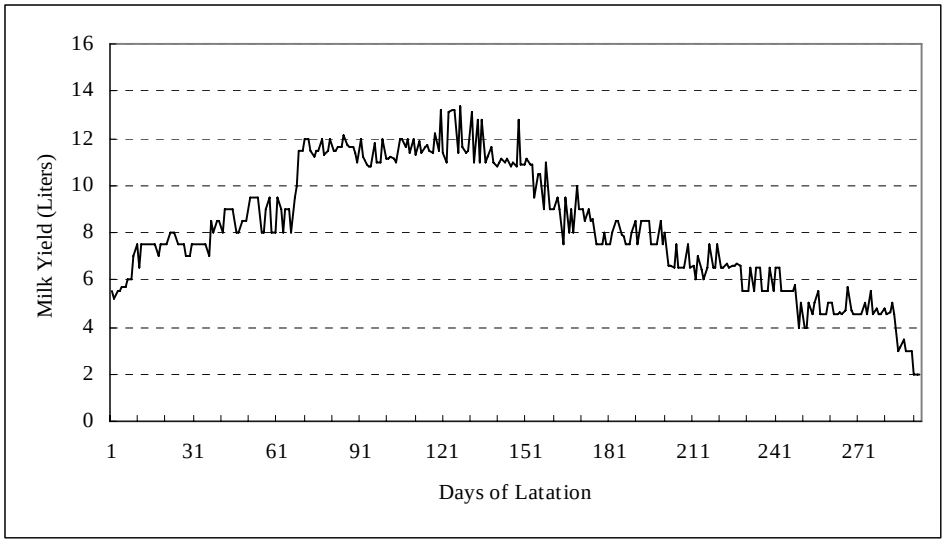


Figure 4.4: Daily Milk Yield of C3 in 3rd Calving Period

Source: Field Survey, 2002

Case 4

This is the case study of a farmer who has 15 years experience as a farmer in dairy farming. He started his dairy farming with initial capital of NRs. 15,000. The main people engaging in dairy farming are two, he and his wife. His elder son, who is 27 years old, has intermediate level education and has job in Bharatapur municipality with average income of NRs. 60,000 per year. They mainly grow paddy, maize and wheat and few vegetables. They produce fodder (Paddy straw), which is sufficient only for about 5 months for their dairy animals.

He was asked to keep daily milk yield record for C5 cow in 5th calving stage. C5 produces 2360.6 liters of milk 309 days lactation period (Table 4.11). The milk yield trend of C5 in its 5th calving stage is given in Figure 4.5. The milk yield of the C5 is lower than the other cases. The milk yield of C5 is approximately equal during second month to sixth month of lactating stage. He and his wife spent 5-6 hours in dairy activities per day. He feeds 3-4 kg

of concentrates and fodder produced in own field. The net income earning from C5 cow was NRs. 34,073 (Table 4.12).

Earning from dairy, crop production and his son's income constitutes a total household income. The share of dairy is 46 %, crop is 36% and his non-farm income is 24% (Table 4.13). Currently, he has one *pakka* house and well managed separate stable for dairy animals and toilet. The numbers of dairy tools are more compared to all other cases. He has also biogas for cooking purpose, which saved time especially for his wife in cooking, cleaning and fuelwood collection. Thus, his wife can spend more time in dairy. He took loan from the cooperative amounting to NRs. 40,000 for buying cow. Due to the various problems such as low milk production, costly feedings, infertility problem, milk holiday, he could not earn much benefits from dairy as compare to other cases. However, he agreed that after being cooperative member, some of the above problems were solved and improve his dairy farming to some extent.

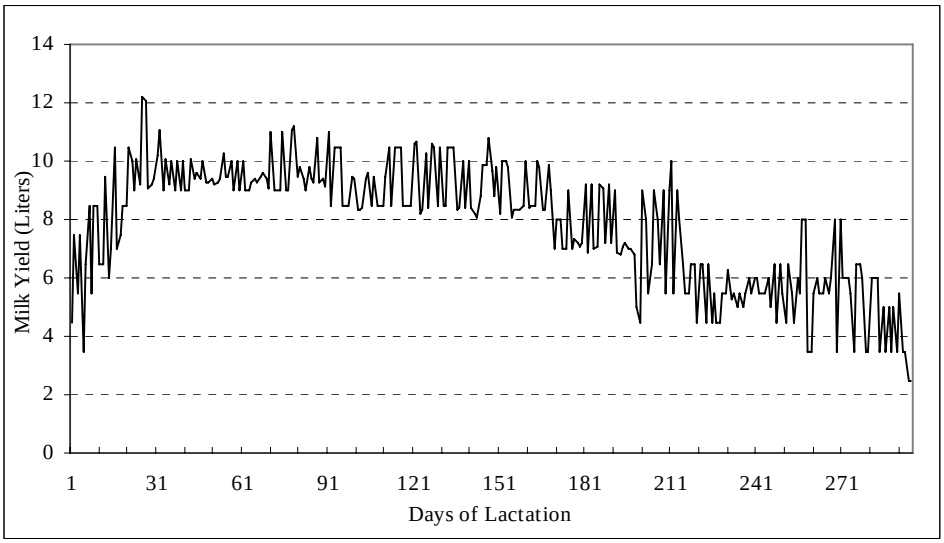


Figure 4.5: Daily Milk Yield of C5 in 5th Calving Period
Source: Field Survey, 2002

Case 5

This is the case of 55 years old dairy farmer. He has 20 years long experience in dairy farming. His family size is 4, including his wife and two sons. His main occupation is farming. He grows paddy, maize, wheat, and vegetables at subsistence level. He has also 12 months food self-sufficiency from crop that he grows. He started his dairy farming with initial capital of NRs. 15,000. He had kept milk yield record for C6 cow in its 6th calving period. The milk yield trend of C6 is shown in Figure 4.6. C6 produces 2522.6 liters of milk in 326 days lactation period. He feeds 3 kg of concentrate and 10 kg of fodder per head. Since he produces 28 liters of milk per day in total, milk holiday is becoming a major problem in his dairy business. Dairy contributes the highest percentage of about 75% in his total household income. The rest is covered by crop. He also does not have any other non-farm job. He has one *kaccha* house with animal shed separately. He is also using biogas plant for cooking. He was able to made biogas plant without having loan. He has one bicycle and television, irrigation pump. He spent his income especially in his children's education. He has some savings in cooperative and lends some amount to relatives.

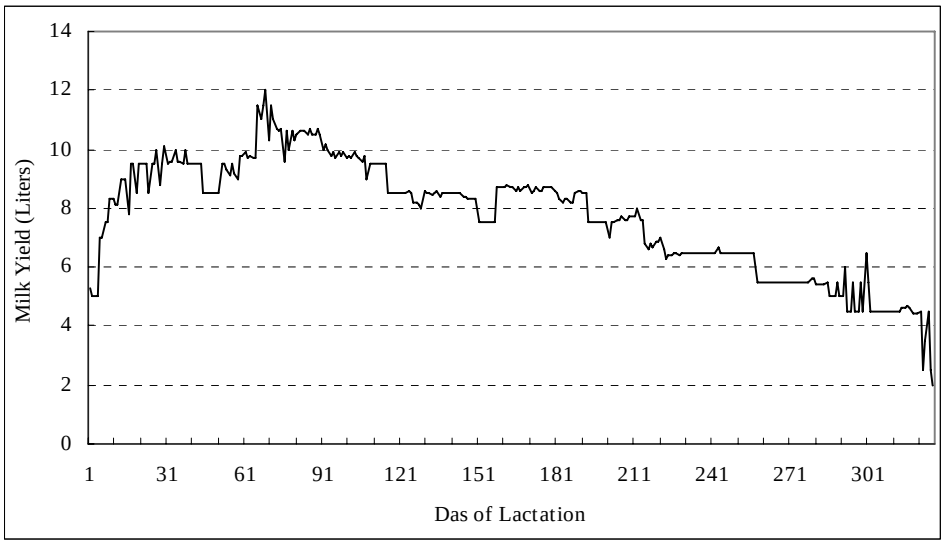


Figure 4.6: Daily Milk Yield of C6 in 6th Calving Period

Source: Field Survey, 2002

4.4 Constraints in Dairy Production and Marketing Perceived by Dairy Farmers

In Nepal, small farmers in rural areas produce milk, whereas much is consumed in the major urban areas, in particular Kathmandu Valley. In the absence of an assured market, the producers do not have an incentive to invest in good breeding stock, feeds, veterinary medicines, and services. On the other hand, inadequate delivery of animal health services, lack of long-term appropriate livestock policy, poor livestock farm management, lack of exotic livestock/ breeding stock, inadequate fodder resources, and lack of capital among the small holder are the general constraints in development of dairy production in Nepal. To understand the problem perceived by dairy farmers in the study area, it would be better to have knowledge about the dairy production system in the area. Table 4.15 summarizes the characteristics of the dairy production system in the study area. The holding ratio of Cow and buffalo is 2:1. Animal herd size is 3 and 2 heads of cow and buffalo per household respectively. Stall-feeding of dairy animals is common practice through out the year in the area. Important breed is Jersey and Holstein cross for cow and Murrah cross for buffalo. Generally, farmers feed concentrate, oilcake, *chokar*, Paddy straw, maize crop and green fodder (only in rainy season).

Table 4.15: Characteristics of Dairy Production System in the Study Area

Description	Study Area (Gitanagar/Gunjnagar) (Dairy Pocket Area)
Important species	Cow, Buffalo (2:1)
Important breeds	Jersey/Holstein Cross, Murrah Cross
Average herd size	3, 2
Normal feed (daily per head of dairy animal)	2-5 kg concentrate, 12-15 kg dry fodder, 32 kg green fodder (rainy season)
Feeding system	Stall feeding, Individual feeding system
<u>Reproductive performance</u> Age at first calving Milk yield (Jersey cross Cow) Milk yield (Murrah cross Buffalo)	 2-3 yrs for cow, 3-4 yrs for buffalo. 9.31lt. /day, 3660 lt./lactation, 6.2 lt./day, (1943-2205) lt./lactation for

Calving interval	13 months for cow, 14-15 for buffalo
Lactation period	322 days for cow, 315 days for buffalo

Field Survey, 2002

Poor Feed Base

Scarcity of fodder, especially in winter is a crucial problem in raising dairy animals in Nepal. The storage of animal feed is acute during the dry period and winter and animals are generally underfed by one-third of the amount required (Tulachan and Nuepane, 1999). This has resulted in late maturity, high calf and adult mortality, poor lifetime performance, and infertility in dairy animals (Sherchan and Pradhan, 1997). The primary reasons for the shortage of fodder and grass are the shrinking per capita landholdings and loss of forestland, which have reduced the resources base per head of livestock. On one hand, lack of availability of good quality forage is a major problem among the smallholder dairy farmers. This has made the dairy farming become more concentrated-based than forage-based. On the other hand, commercially produced concentrates are very expensive and their use increases the cost of milk production and reduces profits.

In the study area, findings are that adequate amounts of fodder and grass are becoming a problem. More than 45% of the respondents mentioned that the fodder/grass availability is not adequate or not available due to the significant decrease in the forest resources. Until a few decades ago, the area was covered with tropical rain forest and the vegetation was in abundance. The villagers used to practice unrestricted collection of firewood, which they would sell for their daily income. But now, this resource has significantly decreased. The remaining forest has been protected by the Government as Royal Chitwan National Park, and farmers are prohibited to collect fodder/grass from there. Such restrictions contributed to the

farmer's problem with fodder collection. Another reason is that of fertile land in which people prefered to grow crops rather than the growing fodder/grass in the study area. Separate grass farming is not significant in the area. Some people plant improved grass like Ipil-ipil (Leucaena leucocephala), Budahar (artocarpus lakoocha) and Napier on the bank of canal or on the dykes of their field and the periphery of their house. People use concentrate (mostly for milking animals), grains having main ingredients of maize and oilseed cake, chokar and straw produced from their farmland. In order to solve fodder problem, respondents were asked to give a possible solutions. About 15% of the respondents mentioned that the government is the only institution that can play key role in making fodder available in the area by arranging the fodder cultivation program and providing good species of fodder for cultivation. About 76% of respondents mentioned that the average purchased feed (concentrate) value is very high due to the high market price of ready-made feed manufactured by the industry (Table 4.16). Thus, the production cost became higher, which has been reducing benefits among the farmers. About 53% suggested that government should provide cheap feed in order to increase their profits from dairy. Few respondents have desired provision of subsidy for purchasing feed.

To overcome this issue, the government should promote more private feed industries to develop competition between each other. There is involvement of the private sector in production of livestock feed in the country. However the competition is very low. About 5 % farmers in the study area expressed dissatisfaction over the quality of feed. Relevant bodies to monitor the quality of livestock feed should be instituted. After the establishment of cooperatives, few dairy cooperatives that have been able to establish their own feed industry have been providing little bit cheap concentrate than the market value to their members. If all

the cooperatives can be able to establish their own feed mill, then the problem of concentrate may be overcome soon.

Table 4.16: Problem Faced by Dairy Farmer in Animal Feed Base

Problem	Small (n=22)	%	Medium (n=74)	%	Large (n=8)	%	Total (104)	%
Supply of Concentrate:								
No response	3	13.6	19	25.7			22	21.2
Expensive	19	86.4	52	70.3	8	100.0	79	76.0
Not available			3	4.1			3	2.9
Supply of fodder:								
No response	12	54.5	32	43.2	4	50.0	48	46.2
Not available/not adequate	10	45.5	41	55.4	4	50.0	55	52.9
Poor variety			1	1.4			1	1.0
Grass Availability:								
No response	13	59.1	36	48.6	4	50.0	53	51.0
Not available/not adequate	9	40.9	37	50.0	4	50.0	50	48.1
Poor variety			1	1.4			1	1.0

Source: Field Survey, 2001

Poor Animal Productivity

Low productivity in terms of milk is a major constraint among the dairy farmers. Poor feeding practices, local breeds, nutrition, and lack of quality feed are the primary reasons behind poor milk production. High-yielding animals are expensive. Quality animals have been promoted in the past, but the improved cow were an inappropriate choice in the country. The productivity of dairy animals presently owned by the majority of smallholder dairy farmers is very low. By knowing this fact, the government has promoted the adoption of high-yield dairy animals mainly cow through distribution and credit arrangements. However, there were several problems that hindered the optimal performance of such animals. They include nutrition and management, greater susceptibility to prevailing diseases and pests, and thinly spread veterinary services.

In the study area, the dominant breeds are Jersey cross and Murrah cross. Being a dairy pocket area, more than 50% of dairy animals are improved breed as a result of dairy

cooperatives and private clinics. The IAAS is also providing infertility check and veterinary services through infertility camp program. However, these services are not adequate to fulfill the farmer's need because of limited extension services and workers.

The present problem faced by dairy farmers in the study area in the improvement of dairy animal production is shown in Table 4.17. Regarding the issue of animal breed, about 38% of the respondents mentioned that lack of improved breed animal is the current constraint in improvement of milk production. About 17% of respondents suggested that government/ District Agricultural Office (DAO) should provide improved bull services in cheap price in order to improve animal breed. In case of infertility problem, about 27% of the respondent mentioned that they were having infertility problem. According to the farmers, in order to solve infertility problem, government/DAO should conduct regular infertility camp and should provide regular checkup. Similarly, 15 % of respondents mentioned that there is lack of AI facility and 12% of respondents mentioned that though they received AI service, the conception rate is high, due to the late heat detection, and unable to receive AI services on time. Regarding the animal health and veterinary care, most of the respondents did not respond. Only about 7% of respondents mentioned that animal health is not good and veterinary service is not easily available due to the long distance to veterinary service center. They cited that veterinary care is very expensive. This consequently leads to low production according to the dairy farmers in the study area.

Table 4.17: Problem Perceived by Dairy Farmers in Dairy Production

Problems		Small (n=22)	%	Medium (n=74)	%	Large (n=8)	%	Total (n=104)	%
Animal Breed	No response	16	72.7	54	73.0	7	87.5	77	74.0
	Lack of improved animal	5	22.7	14	18.9	1	12.5	20	19.2
	Expensive	1	4.5	4	5.4			5	4.8
	Do not Know			2	2.7			2	1.9

Infertility	No response	12	54.5	43	58.1	6	75.0	61	58.7
	Infertility problem	9	40.9	28	37.8	2	25.0	39	37.5
	No problem	1	4.5	1	1.4			2	1.9
	Do not know			2	2.7			2	1.9
Artificial insemination	No response	15	68.2	44	59.5	3	37.5	62	59.6
	No facility	4	18.2	7	9.5	5	62.5	16	15.4
	Not success	2	9.1	11	14.9			13	12.5
	Costly and distance	1	4.5	9	12.2			10	9.6
	Do not know			3	4.1			3	2.9
Animal Health	No response	19	86.4	62	83.8	7	87.5	88	84.6
	No problem	1	4.5		0.0			1	1.0
	Costly and distance	2	9.1	5	6.8			7	6.7
	Poor health			5	6.8	1	12.5	6	5.8
	Do not know			2	2.7			2	1.9
Veterinary Care	No response	13	59.1	40	54.1	3	37.5	56	53.8
	No veterinary care	1	4.5	4	5.4			5	4.8
	Costly and distance	8	36.4	28	37.8	5	62.5	41	39.4
	Do not know			2	2.7			2	1.9

Source: Field Survey, 2002

Milk Marketing

'Milk holiday' is the current emerging problem in milk marketing in the country as a whole. The term 'milk holiday' was introduced in 1991 when the Dairy Development Corporation (DDC) could not buy all the milk produced, and refers to days in the week when public or private dairy organization do not buy milk from their regular dairy farmers (Upadhaya et al. 2000). The reason may be limited consumer demand for the processed milk, and milk products or lack of processing or storage capacity of the dairy factory. The 'milk holiday' is announced in advance and can last for a day, several days or even weeks. Milk supply to the formal sector increases during the flush season, which is four times greater than in the lean season (Upadhaya et al 2000), but this sector does not have the capacity to purchase all the milk produced by the farmers, and because of this, milk holiday exists. The flush season starts around September and ends in February. The monthly collection is highest during January and lowest during April. Milk collection during the flush season (six months)

represents 55% of the total annual collection, while collection during the lean season represents about 45% of the total annual collection (Joshi, 2000). The large seasonal difference in milk production in the country is attributed to short supply of green fodder.

The import of cheap skimmed milk powder is considered as another key reason for milk holidays. The establishment of the Biratnagar Skimmed Powder Plant (BSPP) in 1994 helped to reduce the severity of the milk holiday for two years. Because of importing of skimmed milk powder at less value (ie < Rs.100/kg), far less than even the production cost in Nepal (NRs 169/kg) (Upadhya et al, 2000), BSPP was unable to sell its products to the private sector, which are believed to have made extensive use of the imported product. Consequently, there was surplus of milk production. The small scale of operation of private dairies in the country has not been able to alleviate milk holiday problem.

In the study village, the farmers are also suffering because of milk holiday and this becomes a major problem in milk marketing especially in the flush season cited by the dairy farmer. About 39% of the respondents mentioned milk holiday is major problem in milk marketing. 29% of respondent reported that low price is another problems and about 18% of respondents reported both low milk price and milk holiday as the current problem in milk marketing (Table 4.18).

Table 4.18: Problem Perceived by Dairy Farmers in Milk Marketing

Problems	Small	%	Medium	%	Large	%	Total	%
No response	3	13.6	9	12.2			12	11.5
Low milk price	5	22.7	21	28.4	4	50.0	30	28.8
Milk holiday	13	59.1	25	33.8	2	25.0	40	38.5
Low milk price/milk holiday	1	4.5	16	21.6	2	25.0	19	18.3
Don’t know			3	2.9			3	2.9
Total	22	100.0	74	100.0	8	100.0	104	100

Source: Field Survey, 2002

One possible option for the surplus milk produced during the flush season in Nepal is to export it to neighboring countries, if Nepal can provide products at cheaper price. Since the flush season in the country overlaps with that of India, this has not materialized. The only possibility for export of milk from Nepal to India is through milk producer associations, provided the public dairy milk does not set procurement value artificially high. The private dairies can also purchase such milk but it is extremely difficult for them to set a price independently (Upadhaya et al 2000). Overall, milk holidays are becoming an annual phenomenon in Nepal. The available evidence indicates that this is mainly a result of the inability of the formal dairy organizations to sell milk and milk products (Upadhaya et al, 2000). Dairy product diversification could be instrumental in increasing the demand for milk product if quality standards are maintained. A strong marketing drive, together with quality improvement could increase market uptake.

In the study area, generally, farmers have adopted a less feeding strategy in order to minimize loss during milk holidays. Generally, farmers feed less amount of feed to the animals in order to reduce milk production during the milk holiday, which may negatively impact in the total milk production.

Low milk price is another emerging issue in the study area. The present pricing policy for fresh milk favors urban consumers. More than 50% of the farmers stated that the cost of production would exceed the price they get from their milk, if they were to only feed their livestock on purchased feed. Lower milk price and increasing feed costs could jeopardize the economic viability of raising dairy livestock. Presently, cooperatives are the main customers for the farmers in the area. Cooperatives paid the fixed price according to the fat SNF contents following National Dairy Development Corporation (DDC) pricing policy. Majority of

farmers complained that the price provided is just enough margins to cover their production costs. Although private dairies pay an approximately ten percent higher price per liter of milk than DDC, because of their limited collections centers, the majority of farmers cannot sell milk to the private dairies. Majority of farmers have desired to get high price for milk.

Encouraging the Private Sector and Dairy Cooperative

Although in the Eighth Five Year Plan, the government has made a plan to encourage private sector, the environment is not very conducive to private sector investment. It is due to the fact that, the government is not making transparent policy and policy guidelines are not strictly followed. As a result, the private sector is unsure about making investment. On the other hand, the private sector lacks manpower and technology for productive diversification. Whatever has been done is based on experience rather on the basis of formal technical training. Productive diversification needs investment, and high quality raw materials. Accordingly, many dairies find it a problem. Development of human resource and training is an essential factor of the development of the dairy sector. Farmers are not as aware of co-operatives, 80% are agriculture and rural based, about 28% of these are milk cooperatives. One of the critical issues is that there is a lot of confusion in operating the co-operatives at local level. Access to the livestock insurance policy is very much limited to the rich dairy farmers. Smallholder farmers have very little access to this policy due to the lack of capital to show against the loan taken from the Agricultural Development Bank, and other commercial banking agencies in the country. There is no encouragement and facilities for livestock insurance and no one of the respondent is practicing insurance policy in the area.

Extension Services and Training

There is a significant shortage of livestock support services; extension and training. One of the reasons for farmers' reluctance to adopt improved animals is the insecurity of their investment. Animals, particularly improved breeds, are prone to diseases and cannot be sustained without readily available drugs and vaccines, and regular monitoring of their health. Veterinary services in Nepal are largely confined to the government sector. The number of skilled livestock technicians is also very small, and extension and line agencies are understaffed. In the study area, 33% of respondents expressed that there is extension and training program provided by the University and cooperatives is not adequate due to the fact that limited there is limited trained human resource (Table 4.19). Existing veterinary services are not sufficient to meet the local needs and also not centrally located. As the animals found in the area are mostly improved breeds, provision of an adequate extension services and training could improve health of the animals in the area.

Table 4.19: Problem in Extension and Training

Problems	Small	Medium	Large	Total	%
No response	11	37		48	46.2
Not available	2	14	2	18	17.3
Not adequate	9	21	4	34	32.7
Untrained		2	2	4	3.8
Total	22	74	8	104	100.0

Source: Field Survey, 2002

The current problems being perceived by dairy farmers in dairy farming seem to be the result of weak government policies. Because the existing policies and programs are week in addressing the number of problems faced by dairy farmers in different ecological settings. Having the inability of the formal dairy organization to handle the surplus milk during the flush season, the milk holiday is becoming an annual phenomenon for a large majority of small holder dairy farmers, and will continue to be so in future, unless timely measures are taken to formulate and implement both short and long-term plans and policies. In order to lessen loss in milk holiday during the flush season, diversification of dairy products with emphasis on quality and a strong marketing drive will be important, along with proper analysis of consumer demand for dairy products. In the past, most of the animals breeding development programs have been supply driven with no attention being paid to the farmer's requirements from dairy development. The present area of rangeland is inadequate to meet the feed demand of the increasing livestock population. It will require a greater use of high-quality forage and improved grassland to make dairy farming more of forage-based. Involvement of private feed industries should be encouraged to lessen the price of purchased feed. More emphasis on farming of improved breed dairy animals is also required

4.5 Summary

The history of dairy farming in the district started with the resettlement process. The Burmeli people migrated from Burma along with their dairy livestock and gradually spread over the district. Livestock farming is becoming a major component of faming as well as farmers livelihood. It plays a significant role in the farm economy in the district.

The average heads of dairy animal holding among the sampled household is 5. Dairy animal holding per household between small, medium and large farmer is 4, 5 and 6 heads respectively. Milking animal holding between small, medium and large farmer is 2, 2 and 1 head respectively. Annual milk production is higher in case of small and medium farmers as compared to large farmers. Small and medium farmers sell more than 80 percent of total milk production whereas large farmers sell only 58 percent. Per capita milk consumption is also higher in case of small and medium farmers compared to large farmers. Labor utilization and total production cost per animal is higher in case of small and medium farmers. Consequently, the annual income earning per animal is also higher among small and medium farmers compared to large farmers. The farm income is not significantly difference between small and large farmers. Farm income is one of the higher among the medium farmers compared to small and large farmers. This analysis implies that small and medium farmers have higher dependency and higher tendency to engage in dairy activity. Where as, large farmers have low tendency to engage in dairy farming, as they own more irrigated land and have higher income earning from crop farming. It seems large farmers rear livestock for self-consumption as they consume 42 percent of the total milk they produced, and for manure production.

Chapter 5: Role of Cooperative Dairying in Dairy Development

5.1 Introduction

With the advancement pace of development, people's income rises. It leads to a search for raising living standard. The first step to this is, changes in the diets over which people usually used to have. Milk being a primary item had no problem to dispose, but other items like cheese for their novelty had to wait for sometimes to be included as an important item of nutrition among the people. These days, every household of urban areas of Nepal has important bearing with milk and milk products. The rapidly rising trend of population in urban areas like Kathmandu, Biratnagar, Pokhara, and the emergence of many schools, campuses and hospitals led to the higher demand for fresh and hygienic milk and milk products. Before the establishment of dairy centers, the milk suppliers were professional and casual individual farmers. At that time, the consideration towards nutrition and hygienic value was absent. Milk supply was irregular and uncertain. The price of milk was not fixed, rather it was depended upon the bargaining power of both producers and consumers. On the other hand, milk producers have to suffer problems such as, processing and marketing. Milk being highly perishable commodity, the farmers had either to dispose it quickly or process it. In most of the places, the main milk marketing agencies were the small tea shopkeepers who offered lower price, as well as, untimely payment. In such a condition there developed a tendency to visit the nearby towns, searching for the consumers, and it was difficult to keep a uniform price. As a result two main problems developed; first in the cities and towns where there is a demand for milk scarcity was felt. And secondly, in the villages where the commodity is in plenty, there is no market for it. The producers were not in position to dispose of their commodity and turn it into cash. In order to eradicate these problems, and provide proper incentives and facilities to

both producers and consumers, the government realized the need for developing dairy program after 1950. It led to establishment of separate co-operatives dealing with milk and milk products. Hence there comes co-operative dairy in two sectors: organized and unorganized. The organized sector constitutes; Dairy Development Corporation (DDC) and other Private Dairies. The unorganized sectors include local dairy farmers and Milk Producer Associations/Milk Producer Co-operatives.

5.1.1 Dairy Development Corporation

Dairy Development Corporation (DDC) was established on 1969 under the jurisdiction of Ministry of Food and Agriculture with the aims to supply hygienic milk and standard dairy products to the consumers, and to provide guaranteed market and fair price to rural milk producers. DDC is a sole corporation dealing with milk and milk products all over the country. It is playing a key role in national economic development in the country by providing services to the local dairy farmers. It manages the market for rural milk producers and distributes processed and pasteurized milk and milk products for the consumers.

In the beginning, the dairy program was started only in Kathmandu with the establishment of Kathmandu Milk Supply Scheme (KMSS) in 1969. The increasing demand for dairy products gave an impetus to the establishment of different Milk Supply Schemes (MSSs) under DDC in order to expand network in different parts of the country. In the Fourth Plan period, it was extended to Biratnagar in 1973 and Heatuada in 1975 by establishing Heatuada Milk Supply Scheme (HMSS) and Biratnagar Milk Supply Scheme (BMSS) respectively. A couple or more of dairy plants were planned to have been started in the Fifth Plan period. At present, the DDC has six MSSs. They are located in Kathmandu, Biratnagar,

Hetauda, Pokhara, Lumbini, and Mid-western region. The general characteristics of these Milk Supply Schemes are given in Table 5.1. DDC thoughts to increase the economic growth of the rural farmers as it has been providing the facilities by home purchasing milk, and in the other hand, it aimed to promote public health by supplying standard quality of dairy products in reasonable price.

Table 5.1: Characteristics of the Milk Supply Scheme under DDC

Particular	KMSS	BMSS	HMSS	PMSS	LMSS	MPPSS	DDC
Processing Capacity L/shift*	75,000	25,000	15,000	10,000	-	-	
Milk Collection (T)	31,325	9,127	7,246	2,029	3,127	2,485	55,339
Milk Production (T)	48,244	12,393	6,935	5,680	323	-	73,575
Milk Sale (T)	46,193	3,315	2,744	5,162	260	-	57,674
Skim Milk Powder Production (T)	-	651	-	-	-	-	651
MPCs	479	144	151	58	-	-	832
Collecting Centre	469	230	200	109	84	25	1,117
Chilling Centre	14	10	8	3	8	11	54
Milk-selling Booth	965	148	175	-	-	-	1,288
Staff	149	140	135	89	39	127	679

Source: DDC, Annual Report 2004 (* Shift= 5 hours)

The establishment of dairy industry on a sound way means the betterment of the farmers economically and socially. And, at the same time, improvement in the health of consumers by supplying hygienic and valuable nutrient contain food as milk and milk products. Traditional milk supply is deficient in both quality and quantity, and hygienically unhealthy. Consumption of impure milk causes various diseases. The complete system of dairying, storing of milk, transporting and distributing, and so on, requires to be improved scientifically. For this purpose, DDC emerged as an organized agency, whose main activities are categorized in three kinds; milk collection, processing and marketing.

5.1.2 Private Dairies

The private dairy sector started getting involved in the dairy processing from the later part of the 1970s with very small-scale operations in Kathmandu. The private sector grew slowly during the 1980s. However, after the adoption of economic liberalization policy by the government after the restoration of democracy in 1990, the private sector grew rapidly. New dairies emerged, and the existing ones expanded their capacities. Presently, the private sector has been able to capture the market share of about 46% in pasteurized milk sale, which was merely about 2% in 1981. The growth of milk sale of private dairies between 1990-1999 was 15.4%. Similarly, cheese production (both yak and cow milk cheese) by private sector is growing and has exceeded the amount being produced by DDC. The available information shows that presently 131 milk processing plants of varying capacities (mostly in the Central Development Region), 21yak cheese production centers are operating in the private sector (NDDB, 2002). The Private Dairies have not only increased the number, but they have also been successful in showing their capabilities of diversifying their products. For instance, Himalayan Dairy has diversified its product line to ultra-heat-treatment (UHT) drinking yogurt in three flavors and is soon producing UHT milk. The Nepal Dairy is famous for its varieties of ND's ice cream, as well as, cheeses. However, in the private sector, there need to have some efforts for product diversification. Except for a few large-scale dairies, all private dairies are facing problems of lack of skilled manpower and technology. Whatever has been done is based on experience, rather that on formal technical training. Moreover, product diversification needs investment and high quality raw materials. The private sector needs support on manpower development and technology transfer. Some large-scale dairies are diversifying product range using foreign manpower.

Presently, there are about 80 registered Private Dairy firms in the country of which not all are in operation (NDDB, 2001). In Kathmandu valley, 22 registered Private Dairies are operating. These Private Dairies and KMSS under DDC are the main sources of milk from the organized sector in the Kathmandu valley. The milk processing capacities of Private Dairies varies from 200-130,000 liters per day, milk collection varies from 21,000 liters to 5,475,000 liters, and milk production is about 123,000 liters. The major competitors of Private Dairies are "Himalayan Dairy Product Private Ltd." and "Sitaram Gokul Milk Foods Pvt. Ltd." (NDDB, 2001).

Himalayan Dairy Product Private Ltd.

This company was established in 1981 under Danish Turkey Dairies (DTD) technology and supervision. It was the first modern milk processing plant in the private sector. For the first two years of its operation, it produced semi-hard cheese and butter only. It started processing and supplying liquid milk to consumers in Kathmandu valley since late 1983. The initial plant capacity was 1,000 liters per hour, which was upgraded to 2000 liters per hour in 1988. Currently, it stands for about 12,000 liter per hour. The holding capacity of the company is 100,000 liters of milk. It collects fresh milk from various districts of Nepal like Rupendehi, Kapilbastu, Navalparasi, and Chitwan. There is total of nine chilling centers in these areas. The milk collected from different chilling centers is then processed in the company's processing plant situated at Lalitpur. It currently sells about 35,000 liters per day of fresh milk branded as "Today milk" in Kathmandu, Bhaktapur, and Lalitpur through its 400 milk-selling booths. The sales figure of the company accounts for the second position after DDC in the liquid milk market in Kathmandu valley. It has consistently increased its market share from

15,000 liters per day in 1989 to 35,000 per liters at present. The company is in the process of establishing a UHT plant that would result in production of higher quality and tasty milk.

Sitaram Gokul Milk Food Private Ltd.

This company was established in 1996 at Champadevi VDC, Kirtipur. The milk production capacity of the company is 100,000 liters per hour, with the provision of extra 18,000 to 20,000 liters. This company markets four types of milk: standard milk, skimmed milk, pure cow milk, and pasteurized whole milk.

5.1.3 Dairy Cooperatives

After the implementation of first Livestock Development Project in 1979/80, one of the most significant contributions of it was to promote and expand the establishment of Milk Producers Associations (MPA[12]) or Milk Producers Cooperatives (MPC[13]) in the rural areas. These MPAs were initiated by the DDC, based on the cooperative principle. DDC registered them under its own rules, regulations, supervised the management and provided auditing services as well. The main aim of this program was to link the milk producers with technical inputs and financial help. DDC provide technical support, training, supply of chemicals, detergents, glassware, necessary stationary, and other required inputs on cost to these MPAs. MPAs were local organizations formed with the local milk producers with an objective of collecting, testing, selling milk to DDC, and receiving payment to distribute to their member. MPAs reduced collection cost and several irregularities. The concept of collecting milk

[12] MPA are the farmer's group loosely working as co-operatives, but are not registered at the Department of Co-operative under the Co-operative Act, hence not legal entities. (NDDB, 2001)
[13] MPC are registered legal bodies as per the Cooperative Act (NDDB, 2001).

through MPAs was started in the milk-shed areas of BMSS in 1981. Its success gave impetus to similar pattern in other milk collection areas of the DDC.

Most of the milk producer farmers are small landholders who have been organized to form MPAs, which channel milk to DDC chilling centers. Today, there are 600 MPAs assisting approximately 60,000 farmers in supplying milk to the DDC. Twenty MPAs have been structured to function as cooperatives through the initiative of the DDC, which has legally recognized them as being operated by farmer members. In order to coordinate private and public sector dairy development, the National Dairy Development Board (NDDB) has been established. The board will initiate intensive training of MPA farmers and committee members at the field level so that they fully understand their right, obligations, and management discipline. A progressive transfer of MPAs to MPCs will be encouraged through necessary activities coordinated by the NDDB, which will facilitate the participation of individual milk producing farmers in the ownership of milk-processing plants.

Dairy cooperatives, or more specifically MPAs/MPCs, are major institutions, which support dairy farmers in the study area. In the district level, District Dairy Cooperative Union is a union of local dairy cooperatives (MPAs/MPCs) in Chitwan district, which has the responsibility of policy planning, monitoring and evaluation for the local level dairy cooperatives. It was established in 1994, having twelve members, including the president, vice-president, manager and nine members, and account committee having one coordinator, and two members in its management committee. The list of sampled dairy cooperatives and their general characteristics are summarized in Table 5.2.

Annapurna Dairy Cooperative (*Annapurna Dugda Utpadak Sahakari Sanstha Ltd*) is one of the oldest dairy cooperative, and has a maximum number of shareholders. The entire

cooperative members must have at least one share amounting NRs. 100 as *Sastha ko kosh*. Two dairy cooperatives; Annapurna and Triveni have their own chilling center as they collect more than 2000 liters of milk per day. The main objectives of these dairy cooperatives are the collection and marketing of the milk produced by the local farmers. Besides, cooperatives have been providing various services on animal health, veterinary and medication, feed supply, and supplying of high breed animals, and saving and credit program. They also give training and awareness concerning the benefits of dairy to motivate farmers, and arrange tour programs to visit dairy farmers of other areas. The required qualification to be a member of Annapurna Dairy Cooperative, one should be a Nepalese citizen, and doing dairy farming under the cooperative area, and should produce milk for at least nine months. The farmer must have at least one milking cow that can produce at least 500 liters of milk per year. Table 5.3 shows the sale of total milk to the DDC and to the local sale and sale of ghee, and feed. The trend of milk selling from 1995/96 up to 1999/00 is increasing in both supplying to DDC and locally. However, the milk sale in 2000/01 decreased to about 1019912.9 liters, which covers about 4% of the total milk sale in Chitwan district.

Table 5.2: General Characteristics of Sampled Dairy Cooperative in the Study Area

SN	Name of Cooperative	Established Date	Share-holder	Objectives	Qualification to become coop. Member
1	Annapurna Dugda Utpadak Sahakari Sastha Ltd. (Chilling Center)	1992	199	- Generate income - Milk collection and sale - Feed supply - Extension and training services. - Saving & credit services	- At least 9 months milk produced per year - Economically viable - Minimum of 200 lts. Milk sell per year
2	Gunjanagar Dugda Utpadak Sahakari Sastha Ltd.	1993	170	- Milk collection and sale - Feed Supply	- Nepalese citizenship - Livestock farm - Involving group activities.
3	Kalpabriksha Multicooperative Sanstha Ltd.	1993	83	- Saving and Credit - Milk collection and sale	- Economically viable - Good social prestige
4	Chanauli Dugda Utpadak Sahakari Sastha Ltd.	1993	50	- Group formation - Increase income	- Minimum of 200 lts. Milk sell per year - Collective motive
5	Triveni Dugda Utpadak Sahakari Sastha Ltd. (Chilling Center)	1994	113	- Group formation for integrated work - Milk collection and sale	- At least 500 lt milk sell per year
6	Devnagar Dugda Utpadak Sahakari Sastha Ltd.	1995	70	- Employment generation - Milk collection and sale	- Minimum of six months milk selling
7	Shree Shanti Dugda Utpadak Sahakari Sastha Ltd.	1995	65	- Milk collection and sale - Feed sale and buy - Saving and credit	- Minimum of 500 lts milk per year sell in the locality
8	Adarsha Dugda Utpadak Sahakari Sastha Ltd.	1995	48	-Create awareness towards dairy - Saving and Credit	- Purchase share and saving
9	Shrejanshil Krishi Shamuha.	1995	30	- Provide dairy service for farmers - Milk collection and sale	- Monthly Rs. 50 saving is necessary
1	Shree Ganesh Multi Cooperative Sanstha Ltd.	1998	37	- Milk collection and sale - Income distribution - Facilitate dairy farming	- Minimum of 200 lts. Milk sell per year

Source: Field Survey, 2004

Table 5.3: Milk collection and sale under Annapurna Dairy Cooperative

Year	Milk Sale		Ghee Sale (Kg)	Feed Sale (*bora*)
	DDC (lt.)	Local (lt.)		
1995/96	454,148.5	1585.0	121.5	3,258.0
1996/97	428,998.5	287.9	161.9	2,880.0
1997/98	612,661.8	756.0	167.9	4,138.1
1998/99	897,109.3	715.5	306.0	5,741.0
1999/00	1,348,497.4	1,510.0	NA	NA
2000/01	1,019,912.9	1059.4	385.	9574.0

Source: *Annpurna* Dairy Cooperative, 1995-2001 (*bora*=50kg)

Among the 104 dairy farmers, 86 are co-operative members. Seventy-six households are receiving feed, 5 are receiving fertilizer, and 9 are receiving veterinary and medication

services from dairy cooperatives. Feed Supply is an important activity of cooperatives in the study area. Ninety percent of cooperatives supply feed to the farmers among the sampled cooperatives. The types of feed that cooperatives provide are concentrate (*dana*), bran (*choker*), and others. The cost of feed provided by cooperative is currently considered as high and becoming a serious issue among the dairy farmers in the area. At present, 90% of cooperatives are not able to provide cheap feed due to the fact that they need to depend on outside ready-made feed industry. Only one cooperative (Annapurna Dairy Cooperative), recently established its own feed mill, and started providing little bit cheaper feed compared to other cooperatives. This implies that if other cooperatives are also able to establish their own feed mill, then they can provide cheap feed to the farmers.

Extension services, which include Artificial Insemination (AI), veterinary services and other services are important factors in improvement of dairy production. Few cooperatives are providing veterinary services for epidemic diseases, warm diseases, distribution of medicine and livestock vaccination, and provide other extension services, such as, fodder planting, farmer's tour, veterinary camp, livestock health camp and group discussions on various issues related to dairy animals. Very few cooperatives provide AI services in the area. It seems cooperatives are more focused on milk collection and milk marketing produced by the farmers. Fifty percent of the sampled cooperatives provide various training programs such as, cooperative education training, livestock enterprises, milk sanitation, benefit distribution, and accounting of cooperatives, and village livestock health training for the farmers. These extension and training programs help to create awareness among the farmers in the study area.

They also have provision of saving and credit program. Farmers borrow loan mainly through three sources to meet their needs in the study area. Fifty-eight households are reported

to have at least one loan. Of them, 26 have loan from Banks, with about NRs 42,846 loan amount, the maximum and minimum amounts being NRs. 200,000 and NRs 4,000 respectively. The annual interests rate for these Bank loans vary from 16% to 18% (Table 5.4). About one forth (14 cases) of the people borrows loans from dairy cooperatives, with about NRs 21,428 average loan, the maximum and the minimum amounts being NRs 15,000 and NRs. 300,000 respectively. The interest rate is varies from 12% to 24%. In about 18 cases, people borrow loans from various sources such as, friends and relatives in which the interest rate depend upon the commitment between the lenders and borrowers. Savings are also done in the same ways as in borrowing. Deposits in Banks are the main formal method of savings among dairy farmers. Thirty-five cases of savings made by 31 people are reported that they have savings in dairy co-operative, with average saving amount of NRs. 12,306 and interest varying from 8% to 18%.

Table 5.4: Loan and Savings Saving amount by Farmers Through Different Sources

Sources of Loan and Savings		# Cases	Total Amount	Maximum	Minimum	Average	Interest Rate/Yr
Loan	Bank	26	1,114,000	200,000	4,000	42,846	16%-18%
	Dairy Cooperatives	14	300,000	15,000	1,000	21,428	12%-24%
	Others*	18	944,000	80,000	5,000	52,444	8%-36%
Savings	Bank	12	495,000	60,000	5,000	41,250	16%-18%
	Dairy Cooperatives	35	430,700	40,000	500	12,306	8%-18%
	Others*	16	497,700	125,000	700	31,106	0%-36%

*Others include friend, Mutual fund, and relatives

More than 85% of Bank loans and 66% of co-operative loans are used in productive activities such as, crop farming, dairy farming, vegetable farming, installation of biogas plant and others where as, about 70% of the loan from other sources are used in household consumption and education, health, wedding ceremony, and so on (Table 5.5).

Table 5.5: Purpose of having Loan according to Farmers

Purpose and Sources of Loan	Bank	Dairy Co-operative	Others
Crop Farming	2		1
Dairy Farming	14	4	4
Vegetable Farming	7	4	
Biogas Plant Making	2	1	
Education			2
Household use	2	1	4
Others	1	2	6
Total	28	12	17

Note: Others include health, land purchase, pay loan, wedding, house construction etc

5.2 Functioning of Dairy Cooperative

It is essential to systematize the dairy farmer's (milk producer's) participation in the dairy sector development so that milk production can be sustained for a long time in an efficient way. Figure 5.1 shows the functioning of cooperative in relation to institution in different level: village, district, and national levels.

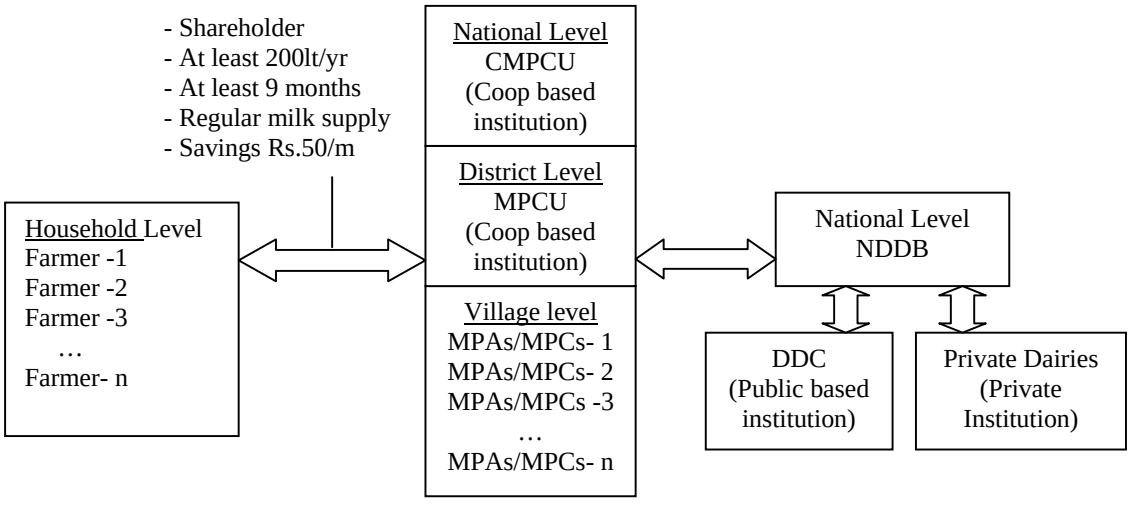


Figure 5.1 Functioning of Cooperative: Institutional Relations

Institutional Relation

At the household level, the individual milk-producing farmers spontaneously form a group known as MPAs. However, there are mainly four conditions to be met by the individual milk-producing farmers to qualify to be a member of MPAs. The first condition is that all the members should being shareholders, having at least one share so that they can feel their ownership on it, not just being a client. The second condition is that the individual milk-producing farmer has to supply 200 liters of milk per year as minimum, or at least nine months a year. The third condition is that the member should supply milk regularly. The fourth condition is that the individual member should have saving of at least NRs.50 per month. After registration, then the MPAs are eligible to be MPCs, which are the legal body registered at the Department of Cooperative under the Cooperative Act. Then, the representatives from each MPC constitute MPCU. The major responsibility of MPCU is to coordinate MPCs through providing various services such as, cooperative education program, training in auditing, financial and technical aspect, and institutional building aspects. Similarly, the representatives of each MPCU form the CMPCU, which is an apex body at the national level. The main responsibility of CMPCU is to coordinate secondary level cooperative ie MPCUs at district level in implementing policy, planning and decision-making made by NDDB.

There is a direct relation of MPCUs and CMPCU with NDDB with strong ties from the institutional perspectives. The policy formation and decision-making as well as, program planning kind of activities are the main responsibility of NDDB. Furthermore, NDDB strengthens the dairy sector by bringing coordination between both the public and the private sector dairies.

Milk Flow and Marketing Relation

The marketing channel or milk flow from the individual milk-producing farmers to consumers is also presented in Figure 5.2. The producer farmer can channel milk to MPAs/MPCs as well as, to the consumers and private dairies. Similarly, MPAs/MPCs channel their milk to DDC, consumers, and private dairies. The DDC supply processed milk to consumers through retailers/milk booths. The private dairies also supply processed milk to consumers.

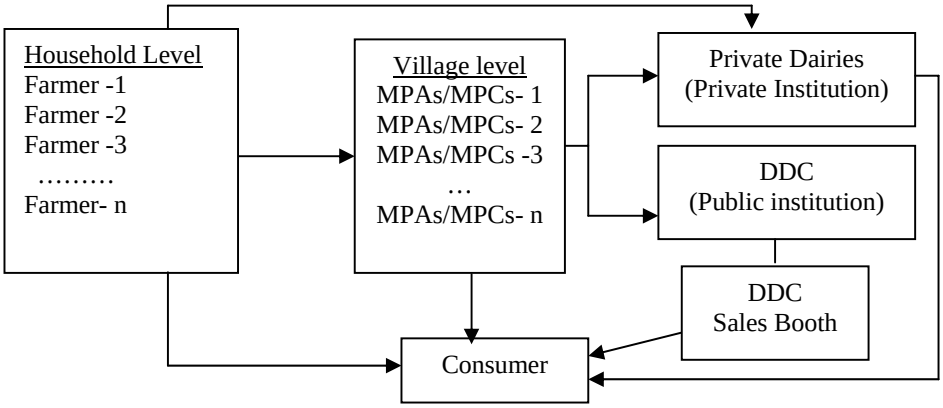


Figure 5.2: Cooperative Functioning: Milk Flow Relations

DDC pricing system is based on fat and SNF contents in the milk. DDC paid price for fluid milk containing 5% fat and 8% SNF is NRs. 16.37 per liters to the farmers. Commission to the MPCs is about 10.6% of the cost to DDC. Even if the price paid to cooperative by DDC is based on fat and SNF, the system has transmitted up to farmers level only in few cases. Most of the payment made by cooperatives to the farmers is based on only fat content by applying their own norm. Despite the DDC pricing system, the cooperative had used their own norm of paying the farmers. For example, in Kabhre district, one of the most popular milk producing districts in the Central region, farmers are paid by cooperatives at the rate of NRs.

3.15 to NRs. 3.25 per unit of fat irrespective of the fat and SNF norm introduced by DDC. In all of the districts, the system of making payment to the farmers on the basis of fat is predominant. Milk price paid by private dairies to farmers is based mainly on the price paid to farmers by DDC with small additional payment of 20 to 30 *paisa* per liters.

5.3 Relation between DDC and Dairy Cooperative in Milk Collection

The DDC collects milk from 39 districts in the country. There are 92,000 farm households supplying raw milk to DDC. At the household level, DDC collects milk from the milk producer farmers who are united as Milk Producers Cooperatives (MPC[14]) and Milk Producers Associations (MPA[15]) for supplying milk to DDC. DDC is now collecting milk from about 900 MPCs and 100 MPAs. Farmers of the surrounding area carry their milk to the MPAs and MPCs in the morning as well a, in the evening. While collecting milk from the farmers, attention is given in quality test by MPAs/MPCs. From MPAs, milk is transferred only to the DDC chilling center. From MPCs, milk is transferred to DDC chilling centers as well as, co-operative chilling centers. There are about fifty-three chilling centers of DDC spreading in different places of the country. They control and supervise the milk brought by the farmers. Milk received in chilling centers is kept in 4-6 degree celsius temperature in order to maintain milk quality. From cooperative chilling centers milk is transferred to DDC chilling centers as well as, DDC processing plant. The milk collected in the DDC chilling centers, is finally, transported to the DDC processing plants within five to six hours period with its own cost. In addition to collecting milk from its own chilling centers, DDC also

[14] MPCs are registered legal bodies as per the Cooperative Act.

[15] MPAs are the farmer's group loosely working, as co-operatives but are not registered at the Department of Co-operative under the Co-operative Act, hence not legal entities.

collects milk from chilling centers operated by MPCs. In addition to the price of milk, DDC pays an additional chilling cost to these MPCs. Some milk from MPCs nearer to the factories is also received directly without chilling. The annual milk collection trend by DDC is shown in Figure 5.3. and Figure 5.4 shows the milk collection channel of DDC.

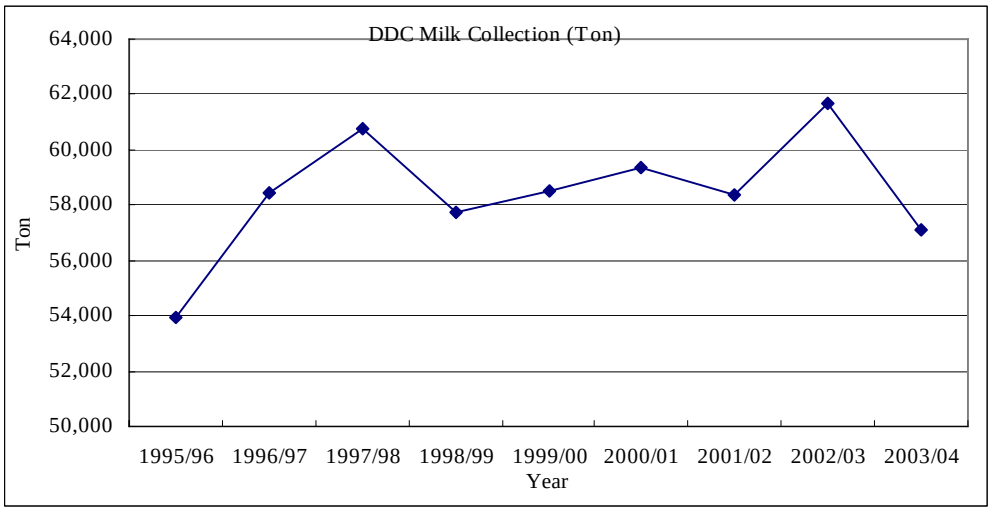


Figure 5.3: Total Annual Milk Collection under DDC

Source: DDC 2000, 2002, and 2004

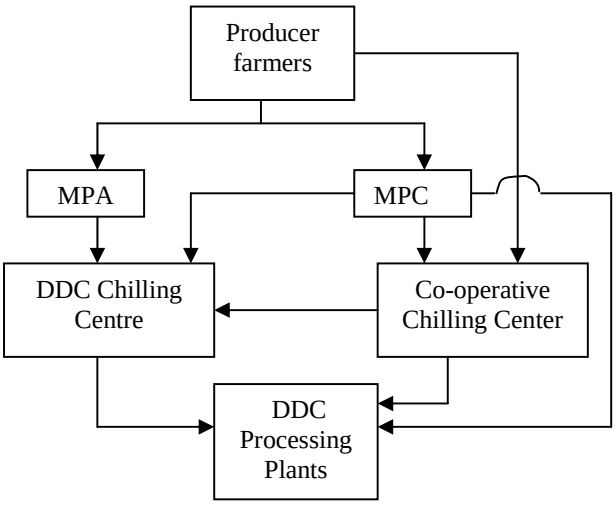


Figure 5.4: Milk Collection Channel of DDC

Table 5.6 shows the milk collection of 1998/99 by DDC and private sectors. Out of total milk collected, about 58% is collected by DDC, and private dairies collect the rest and the maximum amount (76%) of milk is collected from the central region of the country. In Nepal, generally, the farmers sell buffalo milk due to the availability of more fat compared to cow milk and consume cow milk.

Table 5.6: Milk Collection by Region (1998/99)

Region	Collection ('000 T)		
	DDC	Private*	Total
Eastern	9.3	1.3	10.6
Central	39.7	36.3	76.0
Western	7.3	3.3	10.6
Mid-western	1.5	0.9	2.4
Far-western	0.0	0.5	0.5
Nepal	57.8	42.3	100.1

Source: NDDB, 2001

*Includes co-operatives processing of 261t/y in Western and 288t/year in Mid-western regions

5.4 Relation between DDC, Private Dairies and Co-operatives in Milk Processing and Marketing

The total processing capacity of the dairy industry in the country is 581,700 lt. per day (Table 5.7). The DDC has installed total processing capacity of 1,82,500 lt. per day, which shares about one third (31%) of the total processing capacity. DDC processes 2,47,000 lt. per day in the peak season, with an average processing of 173,900 lt. per day. The processing by co-operatives is as small as 3,000 lt. per day. The Private Dairies have installed capacity of 396,200 lt. per day, more than twice of DDC. However, it has been only utilizing 172,500 lt. per day in peak season with average processing of about 1,56,000 liters per day. The private sector shares in the market have been increasing steadily as shown in Figure 5.5. In opposite, the share of DDC has been declining at about the same amount.

Table 5.7: Processing and Utilization Capacity of Various Types of Plants

Type of Plant	Running Capacity (Liters per day)	Utilization capacity (Liters per day)	%
DDC	182,500	247,000	135
Private Dairies	396,200	172,500	44
Co-operatives	3,000	1,400	47
Total	581,700	420,900	72

Source: NDDB, 2001

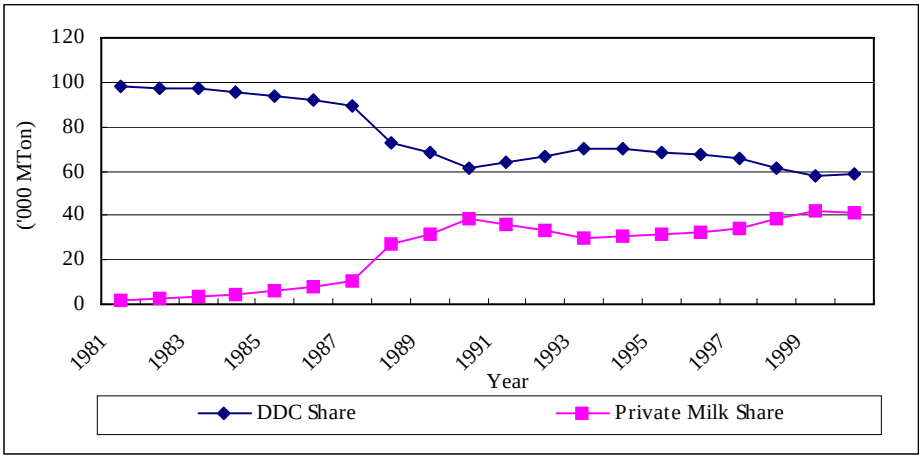


Figure 5.5: Market share of DDC and Private Sector in Pasteurized Milk

The quantity of milk collection depends on the season and weather. The collection of milk depends on mainly four variables; a) availability of milk, b) price the farmers are paid, c) the distance, the milk has to be transported to and d) other facilities granted to the farmers. Here variables a), b), and d) may bear a direct relationship with milk collection, while variable c) may bear inverse relationship with milk collection.

Adequate milk testing equipments are installed at the collection centers. Milk is brought to the collection centers twice a day. Composite milk samples are taken at the collection center, which is tested twice per month for the payment of milk. The quantity of milk collection depends on the season and weather. The annual milk collection from the fiscal year 1995/96 to 2003/04 DDC is given in the Figure 5.4. Annual milk collection, however, shows increasing trend up to the fiscal year 2002/03 except in the FY 1998/99, 2001/02 and

2003/4. Total milk collection is lowest in the fiscal year 2003/04 in comparison to preceding fiscal years. In 2003/04 the milk collection is about 7% less in compared to the previous preceding fiscal year. It may be due to poor political situation (strike, *bandha, chakkajam* etc) in the country. Farmers were not able to transport milk to the seller, and the labor also seller, and the seller also could not sell in the market. This highly affects milk business due to the fact that is highly perishable commodity. Consequently, farmers are forced to pour milk out in the cannels. A picture of farmer, who is pouring milk out in agricultural field, is given in Figure 5.6 (Kamdhenu, 2004).

Figure 5.6: Farmer is pouring milk in agricultural field
Source: *Kamdhenu* Magazine, 2004

Figure 5.7 shows the milk flow from producer farmers to consumer in the study area. Of the total produced raw milk, about 20% is kept for household consumption and 80% goes to the market. The milk for home consumption makes whey (*mohi*), *ghee* (clarified butter), and milk for drinking. Home consumption is important from the perspective of household nutrition. Milk use for making tea is famous in the study area. Farmers in the area do not

necessarily compromise the nutrition of the family and its children by selling all the milk. The farmers themselves collect milk in a group and carry it by using bicycle to the local collection/chilling centers under MPCs. From MPCs collection/chilling centers, the milk is transferred to DDC chilling centers, and some part of the milk is transported to Private Dairies. DDC transported milk via road transport to the DDC chilling centers, and then goes to DDC processing center for process. Similarly, Private Dairies also collected milk with its own vans. From these two channels, milk is transferred to the respective processing/packaging centers. Milk and milk products such as butter, ice cream and yoghurt goes to the consumer. Some of the milk and milk products go through retailer and finally to consumers.

The price for milk is fixed by the cooperative on the basis of SNF (NRs 1.05/ SNF unit) and FAT (NRs 1.47/ FAT unit). The cooperative pays the total payment for milk twice a month to the farmers. Cooperatives sell all the collected milk to the DDC and private dairy (only in the case of Annapurna Dairy Coop) in the similar basis of price. Cooperatives also received the total payment on twice a month from the DDC, as well as, private dairies. Besides, cooperatives are provided commission by the organization.

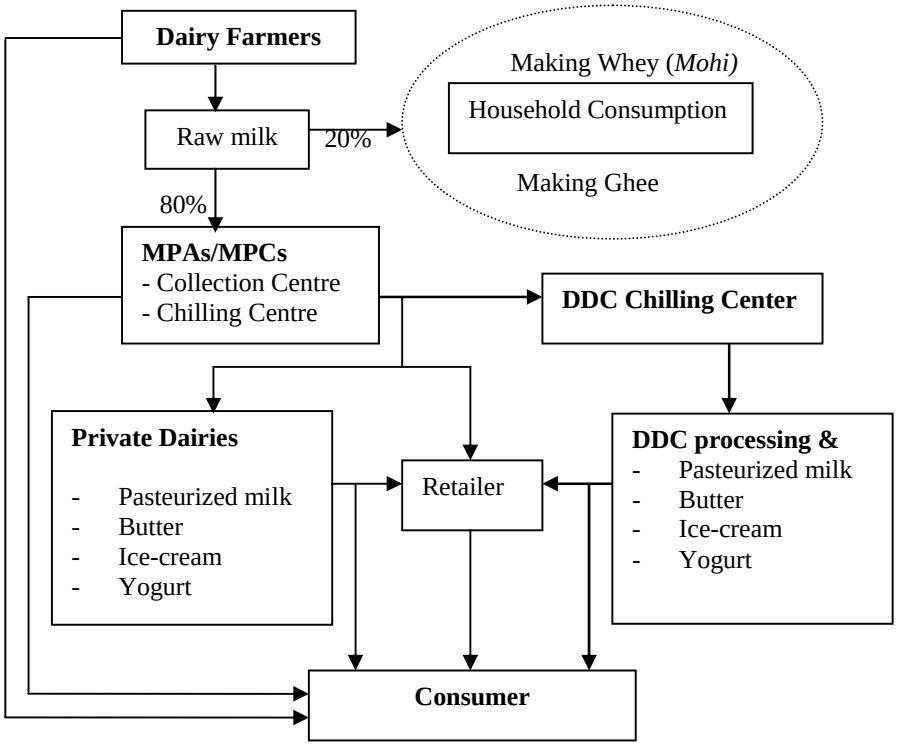


Figure 5.7: Flow of milk from producers to consumers in the study area
Source: Field Survey, 2004

5.5 Comparative Analysis between Cooperative member and Non member

In order to assess the role of cooperative in the study area, few comparative analysis have been done between coop members and non-members especially, in the issue of milk production, consumption, and income earning from dairy. Table 5.8 shows that average dairy animal holding among coop members is higher than that of non-members in all three cases; small, medium and large farmers. Milk production, milk selling and milk consumption is also higher in case of coop members compared to non-members. This implies that coop members are more effective in milk production and selling. It is due to three main reasons; firstly, coop member owned improved breed animals, where as, non-members have local animals, which make difference in milk production. Secondly, facilities are provided by cooperative to coop

members such as, quality feed, credit facility for buying animals, animal health facility and milk marketing.

Table 5.8: Annual Milk Production and Consumption per HH

Description		Small	Medium	Large
Coop member	Milk Production (Kg)	2,111.2	2,115.1	1,139.5
	Milk Sale (Kg)	1,726.2	1,601.0	789.5
	Milk Consumption (Kg)	385.0	514.1	350.0
	No of HH	15.0	56.0	3.0
	Average Animal Holding	4	5	9
Non-member	Milk Production (Kg)	1,006.3	1,030.0	604.3
	Milk Sale (Kg)	883.6	920.0	215.1
	Milk Consumption (Kg)	122.7	310.0	389.4
	No of HH	7.0	18.0	5.0
	Average Animal Holding	3	4	5
Total	Milk Production (Kg)	3,117.5	3,145.1	1,743.8
	Milk Sale (Kg)	2,609.8	2,521.0	1,004.6
	Milk Consumption (Kg)	507.7	824.1	739.4
	No of HH	22.0	74.0	8.0
	Average Animal Holding	4	5	6

Source: Field Survey, 2004

Table 5.9 shows the annual dairy production cost according to members and non-members. The total production cost per animal is slightly higher among coop members in the case of small and medium farmers. A large difference can be seen in the labor cost, and feed cost, which is much higher in case of coop members compared to non-members. This implies that coop members are using more inputs in terms of labor and feed in dairy as compared to non-members, which translated to higher milk production and higher income (Table 5.10). The major earning comes from milk selling as they produce more milk compared to non-members. In the case of large farmers, there is no significant difference whether being a coop member or not. Because, as discussed earlier chapters large farmers have less tendency in doing dairy farming as they have enough income from crop farming and other non farm jobs. They have more land resource, higher education status, and diverse income generating activities.

Table 5.9: Annual Dairy Production Cost

Description		Small	Medium	Large
Coop member	Feed cost	15,340	15,730	9,239
	Health cost	691	650	1,001
	Electricity cost	23	31	55
	Labor cost	18,398	20,132	17,230
	Sub-Total	34,452	36,543	27,525
	Total cost per animal	8,613	7,309	3,058
Non-member	Feed cost	11,610	12,360	6,804
	Health cost	785	846	1,119
	Electricity cost	16	30	45
	Labor cost	9,350	8,120	10,088
	Sub-total	21,761	21,356	18,056
	Total cost per animal	7,254	5,339	3,611

Source: Field Survey, 2004

Table 5.10: Annual Income Earning from Dairy

		Small	Medium	Large
Coop member	Selling Milk	42,004	45,851	2,4210
	Selling animal and animal products	1,000	5,062	
	Manure	3,224	3,590	7,540
	Self consumption	5,917	6,654	5,077
	Gross Income	52,145	61,157	36,828
	Net Income	17,693	24,614	9,303
	Net Income per Animal	4,423	4,923	1,034
	Net return to farm	35,535	44,036	29,413
Non-member	Selling Milk	20,405	19,260	13,977
	Selling animal and animal products	1,110	3,700	
	Manure	2,100	1,700	3,041
	Self consumption	1,699	2,700	6,009
	Gross Income	25,314	27,360	23,027
	Net Income	3,553	6,004	4,971
	Net Income per Animal	1,184	1,501	994
	Net return to farm	14,323	17,171	17,759

Source: Field Survey, 2004

Chapter 6: Dairy Livestock as a Household Energy Source: A Case Study of Biogas Technology

6.1 Introduction

The energy situation of Nepal is characterized by excessive reliance on the 'traditional energy'[16] sources such as fuelwood, agriculture residue and animal dung. Fuelwood is mainly derived from forest and shrub land. Paddy, maize and sugarcane are the major sources of agriculture residue, and animal dung of livestock, mainly dairy livestock constitute a significant source of energy especially for cooking and heating purposes. The heavy dependence on fuelwood has caused high pressure on forest depletion and environmental degradation. Due to the scarcity of fuelwood and lack of access to other options for producing 'commercial energy'[17] like (electricity, petroleum products and coal) or 'renewable energy'[18] technologies, the rural people are being forced to burn increasing quantities of animal dung and agricultural residues for cooking fuel, therefore, depriving the soil of valuable nutrients and organic matter, thus adversely affecting farming.

A large portion of population in the rural areas of Nepal is deprived of electricity. Commercial energy, such as petroleum and coal has to be imported from abroad. Due to the country's difficult geographical features, and the absence of adequate infrastructure, these energy sources are accessible to only about 15% of the total population, and just 1% in the rural areas. Installation facilities to generate other alternative energy, such as, solar, micro

[16] Those energy forms generally used in traditional or pre-industrial societies.

[17] Any energy form sold in the course of commerce or provided by a public utility. The terms are virtually synonymous with conventional energy. Wood and other traditional fuels are not included although they are widely traded.

[18] According to World Bank Report 3076, renewable energy is an energy form, the supply of which is partly or wholly regenerated in the course of annual solar cycle. It is environmentally friendly and locally available in terms of not releasing gaseous or liquid pollutants during operation

hydropower or wind energy are costly and limited to only center areas of the country, hence are not readily accessible by the subsistence farmers. They have to depend only on traditional energy sources.

People use forest for living but have not replenished it. The loss of forest in the vicinity makes people to travel long distances for the collection of fuelwood. This has led to increase in time for the fuelwood collection, which can be otherwise used in other activities. On the other hand, the use of traditional energy resources in traditional mud stove for cooking creates lots of indoor smoke that negatively affects the health of the people. Under these circumstances, biogas technology [19] can be one such effort that directly contributes in providing household energy, which can minimize the overuse of fuelwood, consequently, alleviating the problems caused by over use of fuelwood.

Biogas, the energy produced by biogas technology, is used for household purposes such as cooking, heating, and lighting. Availability of biogas for these purposes means reduction in use of fuelwood, which reduces pressure on the forest. Consequently, it reduces deforestation that ultimately lessens soil erosion, and maintains the land productivity. The use of biogas helps to reduce the increasing burning of biomass that provides manure for farmland. Animal dung and night soil that is used for producing biogas and itself converts as good manure, which is better than dung in nutrient contents (Devkota, 2001). It can be directly used in farmland, leading to increased crop yield. The use of biogas also helps to reduce time in collection of Fuelwood, and other household activities such as, cooking and cleaning. The time thus saved can be devoted to other income generating activities, which also increase the

[19] Biogas is a technology that produces energy by the decomposition of animal dung, human excreta and solid wastes to produce methane gas with calorific value of about 26,500k-kj/cubic meter, that is burnt to provide heat and light.

income of the users. Since biogas is smokeless and environmentally friendly energy technology, it can create clean cooking environment, and impact positively on the health of family members. Healthy environment and increased income may help to enhance the socio-economic status of the poor people in the society. Thus, biogas technology can play a vital role in not only providing energy, very much in need for rural households, but can also positively contribute in rural development as a whole, by enhancing the well being of the rural people, biogas users in particular, in a sustainable manner through protection of the environment.

Hence, it is important to study the implications of biogas technology in rural setting. Consequently, the main objective of this chapter is to assess the significance of biogas technology in uplifting the well being of rural people in a given setting, for instance, a village. This will be further studied by making a comparative analysis of the socio-economic conditions of biogas users in two different geographical regions of the country on the basis of in depth field survey data. The study region will be a Hill village in Kavre (Kavrepalanchwok) district and a Tarai village in Chitwan district of Nepal. Prior to that, general trend of energy consumption and available energy resources base of Nepal will be reviewed.

6.2 Energy Situation of Nepal

The energy situation of Nepal is characterized by a very low per capita primary energy consumption of 14.6 GJ in 1992/93. Out of this, traditional energy sources contribute about 91 percent in various sector. The sectorial energy consumption pattern for the year 2004/05 is shown in Figure 6.1. The figure shows that the residential sector acounts for the major share of energy consupmtion (90.28%), followed by transport (3.78%), industry (3.48%), commercial (1.45%), and then agriculture sector and others.

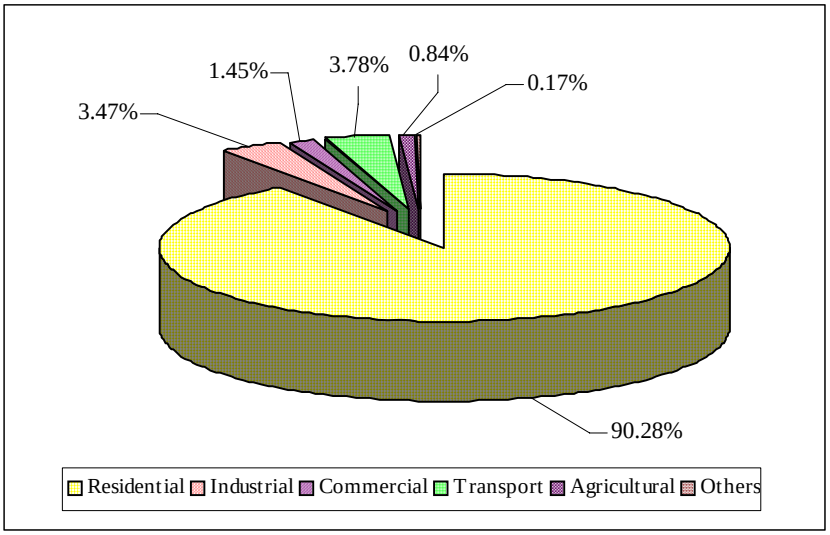


Figure 6.1 Sectorial Energy Consumption in Nepal (2004/05)
Source: WE CS, 2006

The residential sector consumed almost 90% of the total energy consumption of Nepal in 2004/05. Figure 6.2 shows the share of different fuel type in residential sector. The highest percentage, about 85% of country's energy in residential sector is met by fuelwood. It is followed by animal dung (6.32%), petroleum products (4.08%), and agricultural residue (3.7%). Contribution of electricity and coal is negligible. Recently, renewable sources like biogas and electricity from micro-hydro and solar home systems are substituting the conventional fuels used mainly for cooking and lighting. The commercial sources of fuel used is nominal in amount and is maiinly used in the urban centers.

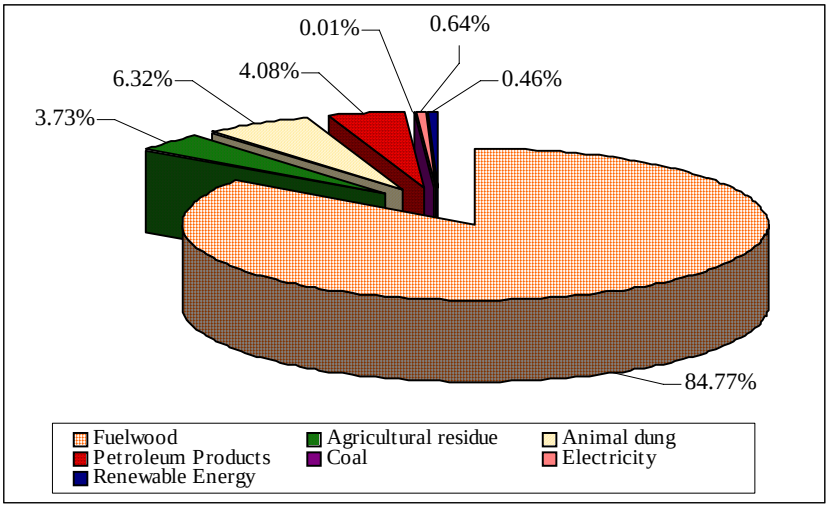


Figure 6.2 Residential Sector Energy Consumption by Fuel Type (2004/05)
Source: WE CS, 2006

6.3 Biogas Technology in Nepal

Biogas technology has proved itself to be one of the most promising and sustainable sources of alternative energy in Nepal. In the beginning, floating drum type[20] plants of Khadi and Village Industries Committee (KVIC) was used for producing biogas from animal dung. The floating drum design encountered a number of technical problems. To overcome these problems, some plants based on the Chinese Model[21] were developed. This model being durable and cheaper than KVIC plant, was popularized by Gober Gas and Agricultural Equipment Development Company commonly known as Gober Gas Company (GGC), and it

[20] The drum type consists of a two-chamber underground digester pit with a floating steel drum gasholder. Slurry is fed into the base of one chamber from the cemented inlet pipe. The gas rises and is collected inside the drum, the effluent overflows into the second chamber and the slurry is expelled through an outlet pipe that is at a lower level than the inlet pipe. The Khadi and Village Industries Commission (KVIC), India, to suit Nepalese conditions, modified the design. In the modified design the pit is designed to taper down into the ground; gas is removed through a central guide pipe; and there is a two-compartment chamber design.

[21] The fixed dome plant is introduced by GGC in Nepal, which is an adoption of a design developed originally in China. It consists of and underground digester pit with a concrete dome shaped cover for collecting gas from the slurry. The concrete dome is cast over a mud mould. The gas pipe is placed at the center of the dome and fixed with anchors and supported with turret. The digester wall, inlet and outlet wall is made with quality bricks or stone. Several air ceiling materials such as wax, coal tar and acrylic plastic emulsion paints were applied under the dome.

gradually substituted KVIC model from 1987 onwards. The fixed dome type[2] plant (Chinese Model) developed by GGC about 17 years ago and later approved by SNV/BSP has been found very effective regarding gas production and operational aspect. According to SNV/BSP, more than 90% of the GGC model plants in operation shows a very high rate of success compared to other countries. A Deen Bandhu Model plant that was established by Action for Food Production (AFPRO) as a low cost plant in India was also introduced in Nepal. However, this model of bio-digester has not gained popularity so far in Nepal because of the Chinese Model. Till now, six different sizes of biogas plants are constructed by biogas companies in Nepal; $4m^3$, $6m^3$, $8m^3$, $10m^3$, $15m^3$ and $20m^3$.

The prescribed feeding rate, animal required and average gas production for the different sizes of plants based upon the GGC model are shown in Table 6.1. After installation of plant, the equal amount of dung and water need to be fed in the plant and mixed with the help of hand mixer properly as shown in the Figure 6.3. For example, for 8 m^3 plant about 48 kg of dung and 48 litre of water is needed. To get that much of dung, one should own 4-6 animals (Cow or Buffalo). This will produce about 1.9 m^3 of gas which is sufficient for 6-7 persons for two meals in the morning and evening.

Table 6.1 Prescribed Initial Feeding Rate, Daily Feeding Rate, Animal Required, and Average Gas Production for Hill and Tarai Region.

Plant Size (m^3)	Initial dung feeding (kg)	Daily dung feeding (kg)		Daily water (lit.)		Animal required	Ave. gas Prod. (m^3/day)	Gas sufficient for persons
		Hills	Tarai	Hills	Tarai			
4	1450	24	30	24	30	2-3	1.0	3-5
6	2200	36	45	36	45	3-4	1.4	4-6
8	2900	48	60	48	60	4-6	1.9	6-7
10	3500	60	75	60	75	5-7	2.4	7-9
15	5550	90	110	90	110	9-14	3.6	9-12
20	7200	120	150	120	150	>14	4.8	12-18

Source: Silwal B.B., 1999, Devkota, 2001

Figure 6.3 Woman is mixing dung and water with hand mixer

It has been assumed that the life span of a biogas plant is 25 years. The cost for installation of the plants varies from one place to another, and also from one size to another. However, the quotation issued by Nepal Biogas Promotion Group (NBPG), which applies to most of the companies for the fiscal year 2001/02 has been shown in Table 6.2. There is a subsidy of NRs. 8,500 to 9,500 from the government to install the biogas plants. This subsidy would cover the costs of biogas appliances and their fitting costs, three years guarantee insurance of the appliance and promotion fee. This would mean that the technology itself is basically given free of charge to the villagers. Devkota (2001) had found the pay back period with subsidy and without subsidy for the 8 m^3 plant in the Hill region was four and six years respectively.

Table 6.2 Cost of Various Sizes of Plants in the Hill and the Tarai Region

Particular	Size of Plants			
	4 m^3	6 m^3	8 m^3	10 m^3
Biogas appliances and their fittings	4,842	5,399	6,251	6,601
Construction charge	4,100	4,800	5,200	5,800
3 Years guarantee	600	600	600	600
Promotion fee	525	525	525	525
Sub-total	10,067	11,324	12576	13,526
Materials & labour cost at Hills	10,194	11,944	14,628	17,135
Material & labour cost at Tarai	9,874	11,624	14,065	16,495
Total Investment in Hills	20,261	23,268	27,204	30,661
Total Investment in Tarai	19,941	22,948	26,641	30,021

Source: Devkota G.P., 2001 (US $ 1=NRs. 75)

The technical potential for biogas production in Nepal is based upon the number of cow/buffalo, or specifically on the quantity of dung that could be available for biogas, and the micro-climatic pockets in different parts of the county. Dr. Karki and Prof. Shrestha in 2004 calculated that there would be potential of 2.9 million biogas plants in Nepal (Karki & Shrestha). In 1992, based upon the potential of biogas plants in the Tarai, Hills and Mountain regions, Wim J. van Nes had calculated the potential of establishing 1.3 million of biogas plants in the country (Wim J. van Nes, 1992). On the other hand, although the assumptions on the technical potential may range between 1.3 and 2.9 million plants, the economical potential is considered to be 600,000 plants (CMS and SNV/BSP).

Thus, considering the economic potential and total number of biogas plants installed up to 2004/05, it comprises only about 20.6% of the estimated economic potential of 600,000 units. This implies that there is a long way to go as vast number of potential 87.6% still remains to be trapped. While such a huge energy potential remains unused, which otherwise could have enhanced the rate of employment and the level of rural income, the rural communities continue to face energy starvation with an estimated economic potential of 600,000 units.

6.4 Institutional Growth and Government Policy towards Biogas Development

The biogas researcher (a teacher), B. R. Saubolle, at St. Xavier's School Godawari, Kathmandu, introduced the first historical biogas plant in Nepal in 1955 with 200-liter capacity. After that, nine plants were installed on an experimental basis in various parts of the country. Only a few individuals were involved in biogas technology until the World Energy crisis of 1973, which then triggered a global interest in this sector. This crisis caused the

formation of a Biogas Development Committee (BDC) as a part of the Energy Research and Development Group (ERDG) under Tribhuvan Universtiy in 1975 (Karki and Dixit, 1984). It was only in the fiscal year 1975/76 that the real interest on biogas began, and the government decided to launch a special program on biogas technology. The main objective of this program was to control deforestation and prevent the burning of animal dung, valuable manure for farming. As a result, about 290 family size (6, and 8 cu. m) plants were installed with interest free loan from the Agricultural Development Bank (ADB/N) (BSP, 2001). All these plants were of floating drum type design based upon Khadi and Village Industries Commission (KVIC) of India. Agricultural Development Bank of Nepal has been playing an active role in the promotion of biogas technolgy since 19974/75 by disbursing loans to the interested individuals for installing biogas plants.

In 1977, Gobar Gas Company (GGC) was set up with the joint investment of the United Mission to Nepal (UMN), Agriculture Development Bank (ADB/N) and Nepal Fuel Corporation (NFC) under the Development and Consulting Services (DCS) biogas extension programmme to promote biogas technology in Nepal. GGC, as a leading biogas company, has been the only organized body responsible for the overall development and management of the biogas sector for 17 years in Nepal. Besides constructing biogas plant, it has also been involved in manufacturing biogas appliences. By 1978, the country had a total of 708 plants, and all were of floating drum type. Realizing the importance of this technology, in acheiving its target of controling deforestation and dung burning, the government set a general target to install 4,000 plants in the Seventh Five-Year Plan (1985-1990) and 3,862, about 96% plants were installed during the Plan period. It was considered an ambitious Plan and easily achieved mainly due to the effort of GGC. During this period, the government had decided to provide a

subsidy of 25% on the construction cost and 50% on the interest of loan from ADB/N. But these policy provisions were removed in 1990/91 in favor of the general policy to do away with all types of subsidies. These frequent policy changes and their inconsistency created confusion and hampered the development of biogas program. Encouraged by this achievement of Seventh Five-Year Plan, the government set up a target to install 30,000 plants in the Eighth Five-Year Plan (1992-1997) .

In 1992, the Biogas Support Program (BSP) was set up as a joint venture between private companies recognized by ADB/N, and Netherlands Development Organization, Nepal (SNV-N) to support the biogas program through subsidies, quality control and training. Ever since, BSP became responsible for the overall implementation of the biogas program in the country. The long term objective of BSP were;

- to reduce the rate of deforestation and enviromental deterioation by providing biogas as subsitute for fuelwood and dung cakes to meet the energy demands of the rural population,
- to improve the health and sanitation conditions of the population by substituting smoke stoves by smokeless biogas stoves, as well as, by reducing the time spent in collecting fuelwood and stimulation of a better management with regard to dung and night soil
- to increase the agricultural production by promoting an optimal use of slurry as organic fertiliser.

BSP has already completed its third phase, and the forth phase is under implementation. The first phase of BSP covered the period from July 1992 to July 1994, and major implementing

agencies were ADB/N, GGC and SNV/Nepal. It had mainly three objecetives; to construct 7,000 biogas plants, to make biogas more attractive to smaller farmers and farmers in the Hills, and to formulate recommendations on the privatisation of the biogas sector in Nepal. The first two objetives were met by providing a flate rate subsidy of NRs 7,000 in the Tarai, NRs. 10,000 in the Hill districts. The additional subsidy amount of NRs.3000 in the Hills was meant as a contribution to the higher transportation cost of construction materials and appliences. The objective of participation of private sector was met by instituting studies through consulting firms, which provided indepth analysis of the existing scenarios, and offered recommendations (Karki,et al 1993).

The second phase of BSP was designed to cover the period from July 1994 to July 1997 with the objectives of constructing 13,000 biogas plant, to make biogas more atractive to smaller farmers in the Hills, and to support the establishment of apex body to cordinate the different actors in the biogas sector. The major implementing agencies were the ADB/N, two banks (Nabil Bank Limited and Ratriya Banijya Bank, GGC, and other private biogas companies and SNV/N and INGOs. Maintaing the subsidy level as applied in BSP I, the first two objective were pursued.

Encouraged by the results of Phase I and II of the BSP, Phase III was designed for the period March 1997 to June 2003. The BSP III phase program plans to construct addiitonal 100,000 biogas plants in Nepal. Under the framework of SNV/BSP, a total of 101,950 biogas plants have been established in the country till 2003. BSP IV was planned from July 2003 to June 2009 with the overall objective to further develop and disseminate biogas as a mainstream Renewable Energy Technology in the rura areas of Nepal.

During the Eighth Plan, the government had policy to encourage privatization in the biogas sector. As a result, many new companies and NGOs came in to being, to participate in the program. Thus, the target set by the government to construct 30,000 biogas plants in the Eighth Five-Year Plan was fully achieved even before the end of the planned period. Encouraged by the achievement of biogas program, the government has set a target of installing 100,000 plants during the Ninth Five-Year Plan period (1998-2002) with assistance from the SNV/N and co-funding of Kreditanstalt fur Weideraufbau (KfW), a Development Bank of Germany.

The current state of development of biogas in Nepal is largely due to the incentives of His Majesty's Government of Nepal (HMG/N). It provides loans at the community level for biogas through ADB/N against collateral in the form of land (0.09-0.12 hectare in rural areas) for family size plant . Biogas development has also been promoted by the manufacturing companies like Balaju Yantra Shala (BYS), United Mission Nepal (UMN) and GGC and donors like United Nations Capital Development Fund (UNCDF), SNV-N, and United Nations International Children's Emergency Fund (UNICEF). UNICEF has provided a subsidy for the installation of family sized biogas plants with additional support and subsidies given to GGC for promoting biogas in remote districts of Nepal. SNV-N has provided capital subsidy as a grant for each plant established by GGC. Currently, 57 biogas companies have been involved in installation and maintenace of biogas plants in 66 districts of the country. Out of these installations, 48% has direct involvement of GGC, while the rest 52% is installed with the active participation of the private companies as of the fiscal year 1998/99 (BSP, 2001). The share of private companies is increasing as the number of the biogas plants increases. Although there were some incremental decreases during the 1990/91, 1994/95 and 2000/01

fiscal years, mainly due to policy discrepancies, budgetary management issues and political disturbances, the biogas plants have been increasing steadily since it took off in 1990 (Figure 6.4). This could be regarded as the outcome of proper use of government subsidy policy, active involvement of private biogas companies, and the positive attitudes of some of the donor agencies.

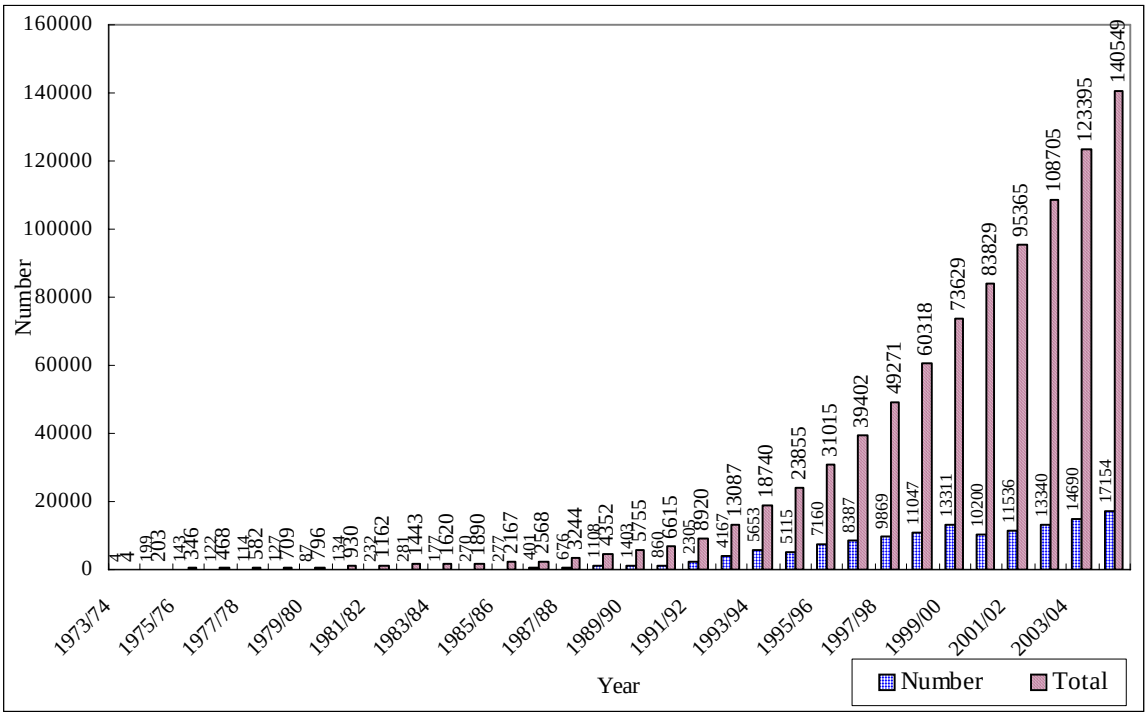


Figure 6.4: Annual Number of Biogas Plants Installation in Nepal
Source: Devkota G.P. , 2001 & BSP, 2006

6.4.1 Role of Biogas Companies in Promotion of Biogas Technology

Biogas development has also been promoted by the manufacturing companies. Through at the years, the services provided by the biogas companies have been improving. A study was done on Biogas Users Servey by Consolidated Management Services Nepal (P) Ltd. In 1998/99, It was found that around 70 percent of the users are satisfied with the after-sale-

service for their respective companies. But there is still lack of commitment from the company staff as 30 perecent of the users are dissatisfied with their follow up services. Thirty three percent of the users responded that to visit by the company at least once after installation, 29 percent responded twice and 14 percent responded thrice and more. The time required by a company to respond to maintence is directly dependent upon the distance of the plant from the nearest motorable road, as 73 percent of the sites were located at a distance of less than 30 munites walk from the motorable road. The companies have also been providing user`s training on maintenace of the plant as well as, management and utilization of slurry. In this regard, one study shows that 65 percent of the erspondents stated that they have benefited from the trainning offered by the companies, while the rest were depried of it. In general, the major problem facing biogas companies in marketing their product is the high competion. Especially in the traditional biogas areas in the Tarai region where relatively high number of biogas companies are operating in an increasingly saturated market. This has led to unhealthy practices. Another serious problem is the weak liquidity position of many biogas companies, affecting smooth and continuous operation.

There are 57 biogas companies[22] involved in installation and maintenace of biogas plants in 66 districts of the country. Out of these installations, 48% has direct involvement of GGC, while the rest 52% is installed with the active participation of the private companies as of the fiscal year 1998/99 (BSP, 2001). The share of private companies is increasing as the number of biogas plants increases.

[22] Number of biogas companies may vary every year

6.4.2 Government Subsidy Policy

In the beginning, the biogas program was primarily based on external assistance. This included community biogas plants built under Small Farmer Development Program (SFDP) of ADB/N. It was funded by UNDP, UNICEF, USAID and UMN. The government of Nepal for the first time announced a provision of subsidy in biogas plant in 1975/76 as interest free loan for biogas plant installation. In the following year, the incentive was changed to a preferential loan at six percent (subsidized) interest rate. In 1982/83, a subsidy of NRs. 5,500 was provided to each plant constructed in some specified districts only. During the Seventh Five Year Plan period, the government had decided to provide a subsidy of 25% on the construction cost and 50% on the interest of loan from Agricultural Development Bank (ADB/N). But these policy provisions were removed in 1990/91 in favor of the general policy to do away with all types of subsidies. These frequent policy changes and their inconsistency created confusion and hampered the development of biogas program. The subsidy policy after 1992, after establishment of BSP/N has been stable and fixed at NRs. 7,000 in Tarai districts and Nrs 10,000 in the hill districts, which has been quite favorable to the rapid development of biogas program in Nepal. The subsidy policy was further revised in the fiscal year 1995/96. Accordingly, the government has been disbursing subsidy amount at the rate of NRs. 7,000 in Tarai, NRs. 10,000 in Hills connected with roads and NRs. 12,000 in the remote Hills that are not connected with roads. The higher rate of subsidy resulted in a higher rate of installation of biogas plants in Hills (Rijal,1999).

The loan and subsidy program was structured in such a way that it is targeted at supporting the small and medium scale farmers. The donor agents provided fund to HMG/N which in turn sanctioned the funds through AEPC with the recommendation of BSP/N to the

implementing biogas companies. It ultimately reaches to the biogas users (see Figure 6.5). Since the subsidy is now administered through BSP instead of ADB/N, it has been possible to reduce the transaction costs to farmers willing to finance the plant themselves, since they need not go through the loan producers required by ADB/N. BSP pays the subsidy directly to construction companies upon completion of the plant.

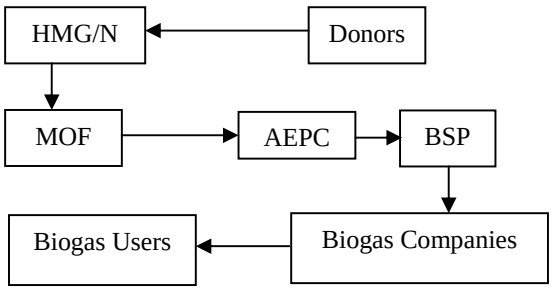


Figure 6.5: Flow of Biogas Subsidy

The impact of subsidy on increasing the number of plants has been remarkable. Even before the BSP was implemented, the subsidy showed its district role in the promotion of biogas, which shows the direct correlation between the number of plants installed and the provision of subsidy. Beside the increase in the number of plants over time, another desirable impact of the subsidy has been the tendency towards installing plnats of smaller sizes. Because of the flat rate for a particular geographical region, ie NRs. 7,000 in the Tarai, NRs. In the Hills and NRs 12,000 in the hilly districts not connected with road, the plant owners have been found to be inclined towards installing smaller plants as this reduce their costs considerably. For instance the average size of plants during 1989/90 was 13.3 cu.m., which decreased to 9.6 cu. m. during 1992/93, and further declined to 8.2 cu. m. during 1996/97 (Silwal,1999).

It is obvious that with the termination of BSP's program in 2009, the subsidy on biogas could not be provided any more (Karki et al, 2005). Unavailability of subsidy will naturally decrease the rate of biogas plant construction in the country. However, due to ever increasing price of fuel, those people who possess livestock and afford to install biogas will be interested irrespective of the fact whether subsidy is provided or not. Thus, keeping this fact into consideration, 20-Year Prospective Plan has been formulated. It is envisioned that the commercial bank will continue financing biogas, and Biogas Construction companies will continue to install the plants as per demand of the farmers. It is also expected that the government line agencies particularly AEPC will continue to play active role in launching and coordinating biogas program in Nepal. The 20-Year Prospective Plan has been emphasing to conduct appropriate Research and Development program in Nepalese context as little effort has been given to this aspect before. On the other hand, Devkota (2001) had found the pay back period with subsidy and without subsidy for the 8 m^3 plant in the Hill region was four and six years respectively.

6.4.3 Long Term Government Policy on Biogas Technology

Considering the popularity of biogas plants, its huge potentiality and its benefits, the present subsidy policy is likely to be continued with the support of other donors and potential investors, even after the closing of present BSP. The present subsidy policy is limited to less than 10 cm. m. plants of family size. However, the governmet of Nepal has a provision for feasiblity study of community biogas plants based upon biomass products and solid waste beside cow dung with the objective of supplying gas and electrictiy to neighbouring areas (AEPC, 2000).The target regarding the biogas plant in the Tenth Plan is production of 44 mw

energy by installing 200,000 biogas plants in 65 districts (NPC,2003). Out of these, 100,500 domestic biogas plants and 500 community biogas plants will be installed in the feasible areas. Priority will be given to suitable, but relatively smaller size of plants and necessary researches and cost reduction tasks will be carried out for its development in the high altitude region..

The technical potential for biogas production in Nepal is based upon the number of cow/buffalo, or specifically on the quantity of dung that could be available for biogas, and the micro-climatic pockets in different parts of the county. Dr. Karki and Prof. Shrestha in 2004 calculated that there would be potential of 2.9 million biogas plants in Nepal. In 1992, based upon the potential of biogas plants in the Plain, Hills and Mountain region, Wim J. van Nes had calculated the potential of establishing 1.3 million of biogas plants in the country (Wim J. van Nes, 1992). Although the assumptions on the technical potential may range between 1.3 and 2.9 million plants, the economical potential is considered to be 600,000 plants (CMS and SNV/BSP).

Thus, considering the economic potential and total number of biogas plants installed up to 2004/05, it comprises only about 20.6% of the estimated economic potential of 600,000 units. This implies that there is a long way to go as vast number of potential 87.6% still remains to be trapped. While such a huge energy potential remains unused, which otherwise could have enhanced the rate of employment and the level of rural income, the rural communities continue to face energy starvation with an estimated economic potential of 600,000 units.

6.5 Biogas Technology in the Hills and theTarai

A detailed field study was conducted in a village located in Kavre district, in the hilly

region. A similar survey was done in the two villages of Chitwan district, in the Tarai region of Nepal. Now onward, the village in the hills is written as “Hill village” and the village in Tarai is termed as “Tarai village”. In both, Hill village as well as the Tarai village, farming with livestock is the main strategy of livelihood, as in many villages of Nepal. Animal dung and crop residues are important by-products of this farming system, generally returned to the farming as manure, contributing in production and bio-economic environment as a whole.

6.5.1 General Features of Study Villages

Nayagaun is one of the remote VDC of Kavre district. The nearest place of the district is about 35 kilometers east from Kathmandu. The study village is 16 km away from district headquarter, having an altitude at between 900m-1500m above sea level. It can be reached by two and half hours walking from nearest road head, Kuntabesi, alternatively after walking for more than two hours from Nagarkot, a tourist area. The total population of Nayagaun VDC is 5141 with 864 households. The population in the VDC is a mixer of different ethnic groups like Tamang, Bahun, Chhetri, and so on. The average household size of the VDC is 6, which is slightly greater than the district average of 5.3, and national average of 5.38 recorded in the preliminary census of 2001 (CBS, 2001). Sample household with maximum number of family members have 16 persons whereas the minimum number was 3 persons. The settlement of Nayagaun is very much scattered and spread among the terraced fields with individual houses linked by pathways. Almost all the households are surrounded by the sloped agricultural fields with animal shed near by, or attached with the houses.

Two VDCs in Tarai region with similar characteristics were chosen for a detailed study. Gitanagar and Gunjnagar VDCs are located in the central part of the Chitwan district.

6.5.2 Socio-economic Characteristic of Biogas Users

The Hill village is composed of different caste/ethnicity, such as, Tamang, Bahun, Chhetri, Magar, Newar, and others. Although the village is dominated by Tamang, the highest biogas users (74%) come from the Bahuns ethnic group, followed by Tamangs and others. The main reason for this is that most of the Bahun/Chhetri have been rearing more cows and buffaloes that produce sufficient amount of animal dung for biogas plant. It was found that most of the Tamangs are not interested in biogas installation. The two main reasons are that; firstly, the Tamang Community has been practicing drying meat over the *chulo* (traditional mud stove) to make *sukuti* (dry meat), which can be stored for long period, and forms one of the delicious food in their food culture. But, biogas is not suitable for making *sukuti*. Secondly, they are also making *rakshi* (local alcohol) in their own houses. For this purpose, the biogas also stove is not suitable. Generally, a large sized stove is needed for making r*akshi*. The biogas stove installed at that moment is found to be relatively small in all the households. Furthermore, most of the Tamangs live in the upper part of the hill away from the water resource. They have to carry water from the lower part to feed the plant, which they feel is an additional burden.

The biogas users in Tarai village are also dominated by Bahun (73.2%), as most of the dairy farmers belong to Bahuns and Chhetri, Magar, Newar, Tharu, and Tamang in that order (Table 6.3). In Tarai region, the entire sampled household holds at least one dairy animal (cow & buffalo), since they are dairy farmers. They have enough cow dung to feed the biogas plant.

Table 6.3: Caste/ethnic Group Composition of Biogas Users in Hills and Tarai

Ethnicity	Hill Village		Tarai Village	
	No	%	No	%
Bahun	20	57.14	30	73.17
Chhetri	6	17.14	4	9.76
Magar	1	2.86	2	4.88
Newar	1	2.86	2	4.88
Tamang	7	20.00	1	2.44
Tharu			2	4.88
Total	35	100.00	41	100.00

Source: Field Survey, 2000/2004

The average literacy rate for the Hill village is 68.2, which is higher than the district literacy rate of 40% (HMG/JICA/JMA, 1997). Education status of the biogas users is classified into five categories. These are literate, primary, secondary, School Leaving Certificate (S.L.C.), signifying the end of ten years of schooling, and above SLC. Most of the Bahun/Chhetris biogas users are highly educated as compared to the Tamang, and others (Table 6.4). About 12% of them have attained above S.L.C. whereas most of the Tamangs are less educated. However, there is no visible difference in using biogas plant according to education. It is a simple technology and anybody can understand its application method with simple training after its installation. However, there could be difference in literate and illiterate people. There are no illiterate biogas users in Hill village, and the high percentage of biogas users being Bahuns coincides with their higher literacy rate.

Table 6.4: Educational Status of Biogas Users according to Caste/Ethnicity and Regions

Region	Ethnicity	Illiterate	Literate	Primary	Secondary	S.L.C.	Above SLC	Grand Total
Hill	Bahun		9		4	5	2	20
	Chhetri		1		3	1	1	6
	Magar		1					1
	Newar			1				1
	Tamang		5	2				7
	Total		16	3	7	6	3	35
Tarai	Bahun	3	11	3	2	4	7	30
	Chhetri	1				1	2	4
	Magar		2					2
	Newar		1				1	2
	Tamang	1						1
	Tharu	1			1			2
	Total	6	14	3	3	5	10	41

Source: Field Survey, 2000/2004

In the Tarai village, with the presence of number of educational institutions, the literacy rate is as high as 85.4% (slightly lower than the VDC literacy rate of 88.5%) among the biogas users, including those who are just literate with no schooling. However, there are very few high-educated people. The highest percentage of the people who reaches above S.L.C belong to Bahun. The highest number of literate people is also made up of the Bahuns (about 73%).

The land is categorized in five types in the study village. Paddy field (*khet*), homestead (*bari*), terrace land (*pakha*), private forest, animal shed, fodder land, and fallow land. In the Hill village, all the biogas users hold paddy field and homestead with an average holding size of 12.3 and 7.7 *ropani*, respectively. About 13% of biogas users owned private forest with an average size of 2.4 *ropani*. As all the biogas users owned paddy field with highest average holdings, all the households are self-sufficient in food for the whole year. In the Tarai village, about 95% of the biogas users hold paddy field and homestead with an average holding size of 20.2 and 0.8 *ropani* respectively (Table 6.5). Since all the biogas users are dairy farmers, more than 50% biogas users have animal shed with an average holding of 0.7 *ropani*, and about

10% have fodder and about 5% have fallow land. This implies that biogas users in Tarai region are giving more care to the dairy animals than in the Hills, since they are all dairy farmers.

Table 6.5: Land Holding Size of Biogas Users According to Land Type

Regions	Land Type	No HH	%	Total Land (*Ropani*)	Ave. Land Holdings (*Ropani*)
Hill Village	Low Land (*Khet*)	35	100	430.0	12.3
	Up Land (*Pakha*)	35	100	270.0	7.7
	Homestead (*Bari*)	15	43	42.0	2.8
	Forest Land	5	13	12.0	2.4
	Total	35		754.0	21.5
Tarai Village	Low Land (*Ghol*)	39	95.1	786.7	20.2
	Up Land (*Tandi*)	21	51.2	126.3	6.0
	Homestead (*Bari*)	39	95.1	33.0	0.8
	Forest Land	5	12.2	8.3	1.7
	Animal Shed	26	63.4	17.3	0.7
	Fodder Land	4	9.8	3.3	0.8
	Fallow Land	2	4.9	2.0	1.0
	Total land	41		977.0	23.8

Source: Field Survey 2000 and 2004 (1 Ha = 20 Ropani)
Note: *Bari: Bari* comes with land, which is used for household purpose such as, animal shed, store, grazing, and vegetable farming etc. Bari can be near by home or far.

Almost all the sampled biogas users were asked to indicate the size of landholding they possess. The data obtained on the basis of response made by all the users have been presented according to region in Table 6.6. It shows that in the total sample, 12% of the users consisted of small farmers, where as, 71% and 17% were of medium and large sized farmers respectively in the Hill region. In the Tarai region, most of the households (68%) were medium farmers, where as, 15% and 17% were large and small farmers. This implies that medium farmers are comparatively highly encouraging in the use of biogas.

Table 6.6: Land Holding of Biogas Users According to Farm Size

Region	Farm Size	Ethnicity							
		Bahun	Chhetri	Magar	Newar	Tamang	Tharu	Total HH	% Holding
Hill Village	Small	2	1			1		4	12
	Medium	13	4	1	1	6		25	71
	Large	5	1					6	17
	Total	20	6	1	1	7		35	100
Tarai Village	Small	3	1			1	1	6	15
	Medium	22	2	2	1		1	28	68
	Large	5	1		1			7	17
	Total	30	4	2	2	1	2	41	100

Note: (Small: 0.2 to land under 0.5 ha), (Medium: 0.5 ha and under 2 ha), (Large: 2 ha and over)
Source: Field Survey, 2000

Livestock holding is the key factor for installation of biogas plant. The average number of livestock, including buffaloes and cows, within biogas household is 5 and 6 per household[4] in both the Hills and Tarai regions respectively (Table 6.7). The average dung produced is about 14 kg per head, including both cows and buffaloes in both the regions. Generally, dung required for daily feeding in the biogas plant is 36 kg for the 6 m^3 capacity plant. Integrating cow and buffalo, 3-4 animals are sufficient for 6 cubic meter plants that can produce 1.4 cubic meter of gas, sufficient for cooking two meals a day for the households with 4-6 family members.

Table 6.7: Livestock Holding of Biogas User According to Farm Size in Two Regions

VDCs	Farm Size	Cow		Buffalo		Total		Ave Holdings	Total Dung (Kg/day)	Ave. Dung (Kg/day/ Animal)
		No	HH	No	HH	No	HH			
Hills village	Small	8	4	10	4	18	4	4.5	234	13
	Medium	46	25	76	25	122	25	4.88	1741	14.27
	Large	15	6	32	6	47	6	7.8	682	14.5
	Total	69	35	118	35	187	35	5	2657	14.2
Tarai village	Small	20	6	10	5	30	7	4.2	450	15
	Medium	118	23	57	19	175	28	6.1	2461	14.2
	Large	18	4	21	6	39	6	6.5	592	15.1
	Total	156	33	88	30	244	41	6	3503	14.4

Source: Field Survey 2000/2004

6.6 Result and Discussion

6.6.1 Fuelwood Use

In the Hills, the entire sampled households of the study area used fuelwood before the installation of biogas plant. They met their basic needs of fuelwood by using forest resource and some of the agricultural residues. According to this survey, it was found that there is a drastic reduction in fuelwood consumption among the biogas users after installation of biogas plant.

Table 6.8: Amount of Fuelwood Used Before and After Installation of Biogas Plant

Regions	Ethnicity	HH	Before Biogas Use (kg/month)	After Biogas Use (kg/month)	Difference	% Difference
Hill Village	Bahun	20	7,953	3,201	4,752	60
	Chhetri	6	2,268	900	1,368	60
	Magar	7	2,676	1,035	1,641	61
	Newar	1	306	120	186	61
	Tamang	1	300	99	201	67
	Total	35	13,503	5,355	8,148	60
	Average		386	153	233	
Tarai Village	Bahun	30	23,880	6,400	17,480	73
	Chhetri	4	3,640	580	3,060	84
	Magar	2	1,080	268	812	75
	Newar	2	1,200	160	1,040	87
	Tamang	1	840	120	720	86
	Tharu	2	1,440	200	1,240	86
	Total	41	32,080	7,728	24,352	76
	Average		782	188	594	

Source: Field Survey 2000/2004

Thus, the result in Table 6.8 shows that the demand of fuelwood has reduced from 386 kg to about 233 kg of fuelwood, a total average of about 60% after installation of biogas in the hill region. Similarly, in the Tarai region, the demand for fuelwood has reduced by 76%, which is more compared to the Hill regions. It may be because of regular and sufficient gas production. It was found that the gas production is regular and sufficient in Tarai as compared to the Hill regions. In the Hills, gas production is not regular in some cases, for example, lack of dung or water and other technical problems. At that time, they have to use fuelwood. Most

of the sampled households in Tarai region have also used fuelwood for their energy needs before installation of biogas plant. However, there were few households who used kerosene sometimes, which can be neglected due to the unavailability of data. They met their fuelwood needs from their agriculture field.

6.6.2 Domestic Labor and Time Allocation

Analysis of data in this regard reveals that there is a significant change in time required for household activities, such as, fuelwood collection, cooking and cleaning after the installation of biogas plants. Due to the availability of cooking fuel, less family time, as well as labor, is needed for fuelwood collection. Although the time required for water collection has increased, and mixing of dung and water in feeding the biogas plant is an additional work, the total time saving after the installation of biogas plant was calculated to be about four hours and 2 hours per day in the Hills and Tarai region respectively (Table 6.9). This difference in time is accrued mainly from the difference in fuelwood collection, water collection and cooking activities. Generally, women do these activities, but in the study village, except cooking, men and women equally share all other activities. The saved time in Hills is higher than in Tarai region. It may be due to the difficulty in collection of fuelwood and collection of water in Hills, whereas in Tarai, mostly sampled households collect fuelwood from their own agricultural field, and water sources are much more near by their households.

Table 6.9: Time Allocation for Household Activities

Household Activities	Hills			Tarai		
	Before Biogas Use (Mean)	After Biogas Use (Mean)	Time Saved (Mean)	Before Biogas Use (Mean)	After Biogas Use (Mean)	Time Saved (Mean)
Animal Care	1.5	1.48	+0.02	4.65	4.06	+0.59
Water Collection	0.89	1.58	-0.69	0.47	0.57	-0.10
Feeding Biogas Plant	0	0.28	-0.28	0.00	0.69	-0.69
Cooking	5.01	3.2	+1.81	1.71	0.80	+0.91
Cleaning Vessels	1.48	0.67	+0.81	1.04	0.53	+0.51
Fuelwood Collection	2.6	0.66	+1.94	1.65	0.63	+1.02
Total	11.48	7.87	+3.61	9.51	7.28	+2.23

Source: Field Survey, 2000, 2004 Note: Unit hours/day

Among the biogas users, the saved time is being used in various activities in both the regions. In Hill regions, about 43% said that they used the saved time in farming, which can lead to increase in crop yield. However, there is no exact calculation of how much crop yield is increased as a result. About 23% are not doing any productive activities. The rest are using the saved time in income generating activities, such as, labouring, livestock raising and business activities, and domestic activities, such as, child caring (Figure 6.6). In the Tarai region, the saved time is being used mostly in livestock raising since they are dairy farmers. About 20% respondents said that they have been using saved time in farming, and few said in child caring.

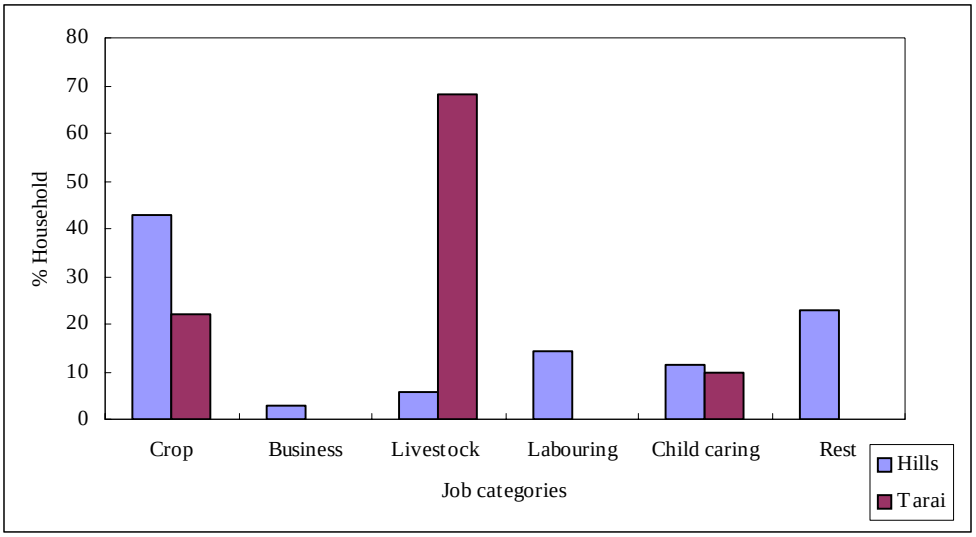


Figure 6.6 Saved Time Uses Pattern Among Biogas Users.
Source: Field Survey, 2000 & 2004

6.6.3 General Health and Sanitation

The contribution of biogas use in improving the peoples' health and sanitation is summarized in Figure 6.7. Since it is a smokeless and environmentally friendly gas, it helps to reduce occurrence of diseases caused by smoke, such as, eye infection, headache, cough, and others, by eliminating indoor air pollution, as well as, keeping the domestic utensils, bedding and surroundings clean. Further more, biogas, being produced by the use of animal dung, human excreta and solid wastes, makes homestead and surroundings cleaner. With the installation of biogas, villagers are encouraged to build the toilet that they are not used to before, thus, preventing contamination of water. Hence, it helps to minimize the occurrence of intestinal warm infection, and other epidemic diseases, such as, diarrhea, dysentery and others. Therefore, the use of biogas helps to improve the health and sanitation, and the cooking environment.

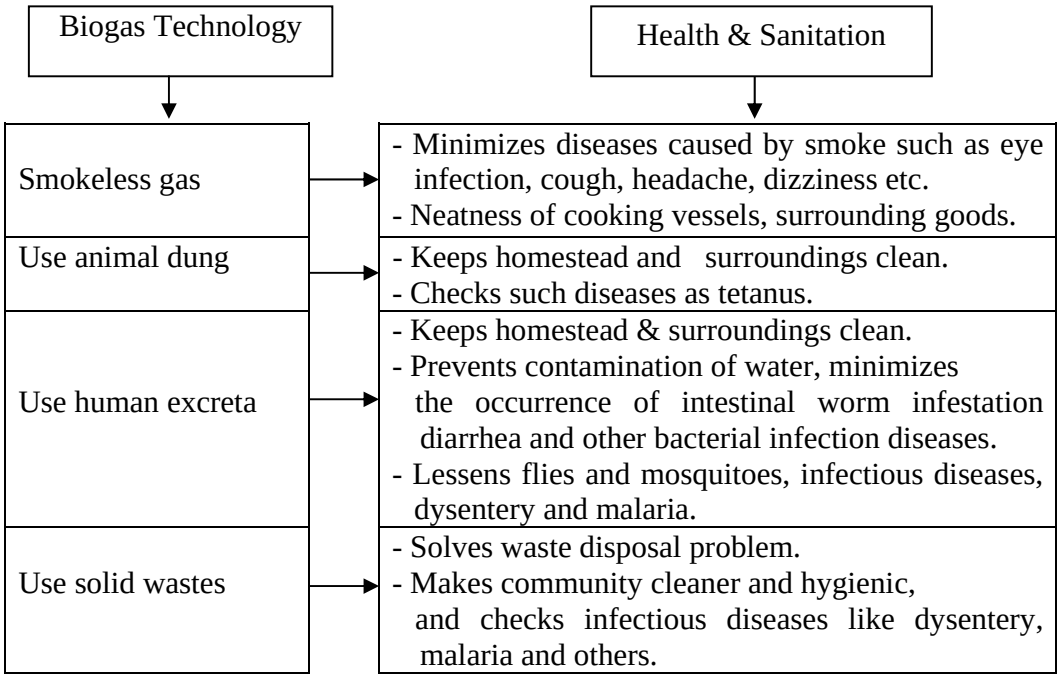


Figure 6.7: Relation of Biogas & human health & sanitation

Table 6.10: Health Situation After Using Biogas Based upon Respondents

Regions	Categories	Decreases	Increase	Do not have
Hill Village	Dizziness	34	1	0
	Headache	30	3	2
	Diarrhea	28		7
	Eye Infection	26		9
	Dysentery	25		10
	Cough	25		10
	Nauseous	21		14
	Mosquito/Housefly		8	27
Tarai Village	Dizziness	10		31
	Headache	24		17
	Eye Infection	37		4
	Cough	20		21
	Chest pain	9		32
	Mosquito/Housefly		6	35

Source: Field Survey, 2000 & 2004 (Sample size = 35 Hills, 41 Tarai)
Increase means increase in mosquito/housefly etc, in terms of disease, chronic disease

Table 6.10 shows that higher number of respondents mentioned that the frequency of suffering from various diseases, such as, dizziness, headache, diarrhea, eye infection, and cough, have been reduced after the use of biogas in both the regions. Few respondents also mentioned the increase in insects, such as, housefly, and mosquito after the installation of biogas plant in both the regions. It may be due to lack of proper managenent of slurry pits. In the study areas, there were no proper management of slurry, such that, slurry pits had no cover and in some places, slurry pits were not made.

6.6.4 Contribution in Household Income

The contribution of biogas in increasing the household income found mainly in three simple ways in the village is summarized in Table 6.11. Biogas not only helps to reduce the use of fuelwood for energy, but also helps to reduce the burning of biomass that provides manure for farmland. The digested slurry, which is better than the fresh dung can be directly used in farmland as manure in this fertilizer scarce village of the Hill areas, and contributes in sustaining and increasing the productivity of the marginal lands. The savings from purchasing fuelwood, increased income from farming by using slurry as manure, and savings from buying soap for cleaning are the direct monetary benefits in using biogas. The total evaluated savings per year varies from about NRs. 15,976 to 20,976 and NRs. 34,058 in the Hills and Tarai region respectively. It amounts to about 32% to 42% and 68% of the annual salary of a government primary school teacher, which is NRs. 50,000 per year. Whereas, the total cost of installation for $6m^3$ plant is NRs. 23,268 including NRs. 9,500 subsidy, and the average operating and maintenance cost is about NRs.400 per year. This would mean that the installation cost of the biogas plant, if used properly, could be paid back within a year or two.

Even if the earnings from farming is not evaluated, as they are indirect benefits, there would be around NRs. 6,000 savings per year, and the installation cost can be covered well within four to five years. This also confirms the findings by Devkota mentioned earlier.

Table 6.11: Annual Household Economic Benefits of Biogas Users

Regions	Item	Quantity/HH	Saved Amount/year (NRs.)
Hill Village	Fuel wood saved	*2,880 kg/year	5,760.00
	Earning from farming	Using slurry plus extra labor/year	10,000~15,000
	Saved soap for cleaning	** 12 Kg/year	216.00
	Total		(15,976.00~20,976.00)
Tarai Village	Fuel wood saved	*7,128 kg/year	14,256.00
	Earning from farming	Using slurry plus extra labor/year	19,232.96
	Saved soap for cleaning	60 pieces of soap + powder/year	569.27
	Total		(34,058.23)

Source: Field Survey, 2000 & 2004
Note: * 1 kg of Fuelwood = NRs. 2, **1 kg of soap = NRs. 18, 1 piece of soap = NRs. 9
($ 1= NRs. 74.35)

This finding reveals that the overall amount of saving or benefit per year of the biogas users in the Tarai village is higher than that of the Hill village. There are three important reasons, they are: (i) it was found that in Tarai, gas production is sufficient and regular whereas, in the Hills, gas production is sometimes insufficient especially in winter. (ii) the sampled area in Tarai is much more older than the study area in the Hill. (iii) well management of slurry in Tarai whereas, in the Hills, slurry management is poor.

6.6.5 Villagers' Perception towards Biogas Use

The villagers' perception regarding the biogas use is mostly positive in both the study areas. Completion of cooking work in about half of the usual time, easy vessels cleaning, smokeless kitchen, clean clothes and helping to reduce hardship, especially for women, less risk of fire incident are some of the positive aspects of the biogas use, according to villagers. These positive aspects have encouraged them to install and maintain the biogas plant. All the

biogas plants are connected to the toilet in the Hill region whereas, in the Tarai region, only few plants are connected to the toilet. In the Hill region, in the initial stage, people hesitated to use the gas that is produced with the use of dung and human excreta for cooking food. During the survey, some of them expressed that food will not be as tasty as cooking in firewood in the beginning, but latter on, they felt no differences. One respondent mentioned that villages where biogas plants have not been installed faced the problems of night soil in the village trials. But, those wards where biogas plants have been installed, such problems have been overcome. Even all the non-users in these wards have expressed that they want to install the plant in their houses as soon as possible.

Though people mentioned number of positive impacts of biogas technology, they also pointed out its negative parts. There is severe problem of mosquitoes experienced after the installation of biogas plant. The people said that, the number of mosquito/houseflies increased after biogas installation. But, the villagers were unaware of the reason behind the increasing number of mosquitoes. From the author's observation the reason behind it, was poor management of slurry. They generally use open slurry pits or drain the slurry openly from plant to pit. Sometimes, the slurry was freely flowing in the ground. It will give opportunity to mosquitoes/houseflies to breed. But, the government has already implemented the program of making covered pit to manage the slurry properly in both regions. Villagers who are undertaking this program of making covered pits are not facing this problem anymore.

Some of the respondents (11%) complained that the loans created unnecessary tension for them, as they did not have such practice of taking loan before. They feel tension more when the interest rate for the loan changes with the changes in government policies. But most of the respondents in this area have installed the plant without taking any loans.

The majority of respondents in both regions also mentioned that there is no warmth in the house in winter after using biogas and food becomes cool very quickly in absence of fire in the kitchen. But, most biogas users agreed that biogas is better for cooking than wood or kerosene, especially when the performance of the plants is good. Since all the plants are newly installed in the Hill region, the plants have been working properly and have no problem in operating. Also in Tarai, plants have been working well. Even if they face some problems, maintenance can be done quickly due to the presence of numbers of government biogas companies, as well as, private biogas companies near by. Hence, all these negative implications are comparatively minor issues, and lesser number of people complain about them.

6.7 Summary

Nepal is energy poor country, bulk of energy comes from traditional energy sources mainly fuel wood, agricultural residue and animal dung, and the rural residential sector is the biggest energy consumer. Overuse of fuel wood causes deforestation, consequently, soil erosion, and natural hazards make rural life harder. Biogas technology is regarded as an appropriate technology to generate energy from animal dung in Nepal where livestock is an integral part of farming. This technology is simple, uses animal dung readily available in the rural region, as a raw material. Recognizing the multiple benefits of this technology, the government of Nepal is encouraging the expansion of its use and closely working with donors and private sectors to promote it. Government also provides subsidy to the farmers in its installation as an incentive. With these endeavors, the uses of biogas have increased constantly

and reached 83,829 by 2001, 5.6% of the total potential users, producing 37.6million m^3 gas annually.

At the village level, it is popular among the farmers, especially, with livestock. It helps in saving time in fuelwood collection, cooking and cleaning. Such saved time is used in farming and other income generating activities or in domestic activities. The cost of installation of the plant can be easily covered within four to five years. It also lessens fuelwood consumed, and reduces burning of biomass that can be used in farm to generate more yield and income. It improves health and hygiene of individuals, household and community, and contributes in saving money used for purchasing fuelwood and soap. Availability of fuel reduces pressure on forest leading to reduction in deforestation and natural hazards. Providing environmentally friendly energy leads to maintain once of environment and makes good health. These finally lead to well being of the rural people. Although there are some negative aspects pointed out by few farmers in using biogas, they are rather minor and could be easily overcome with proper plant management. The relation between biogas technology and well being of the biogas users are summarized in Figure 6.8.

This study observed that biogas users are generally literate and better-educated farmers. Most of them being Bahuns, with more numbers of livestock and often better landed in both the regions. This would imply that the biogas technology is benefiting only the villagers who are better landed and have large numbers of livestock. People without livestock, landless farmers and or small farmers tend to be excluded from getting its benefit. In the Hill region, most of the Tamangs having a different food culture are also lagging behind in its use. In the Tarai region, all biogas users are dairy farmers belonging to Brahmin caste, having dairy farming as a main occupation for their livelihood.

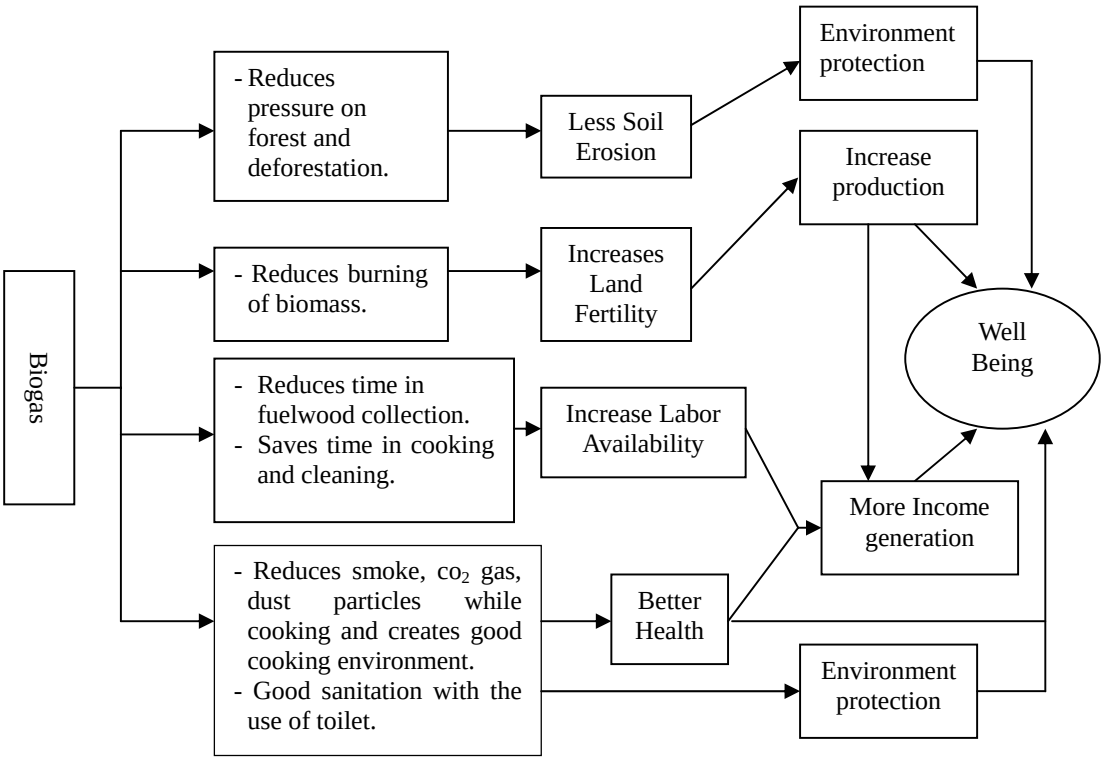


Figure 6.8: Relation Between Biogas Technology and Well-being of Biogas Users

Chapter 7: Livelihood Strategy at Household Level

7.1 Livelihood Strategies

The interaction between household's endowment and transforming structure and processes determine the livelihood strategies or activities set by a particular household. Depending on the assets people have, the structures and processes that impact on them, tradition, and the vulnerability context under which they operate, people choose livelihood strategies that will best provide them with livelihood outcomes. 'Livelihood strategies are composed of activities that generate the means of household survival' (Ellis, 2000). Scoones (1998) identifies three types of rural livelihood strategies; agricultural intensification, livelihood diversification, including both paid employment and rural enterprises, and migration including income generation and remittances. Carney (1998) lists these categories of livelihood strategies as natural resource based, non natural resource based and migration, while Ellis (2000), in his framework, categorizes livelihood strategies as natural resource based activities or non natural resource based activities including remittances and other transfers. The livelihood strategies followed by farmers in the study area are, in fact, very diverse. For convenience, they are grouped into two broad strategies; farm based (natural resource based), and non-farm based (non natural resource based), which are discussed briefly hereafter.

7.1.1 Farm based

Farm based activities are the main livelihood strategies adopted by almost all the farmers in the study area in order to maintain their livelihood. The percentage of engaging in farm-based activity is as high as 77% of the total economically active sample population in all

level of farmers. The farm-based activity is divided into three; crop farming, livestock farming mainly dairy farming, and agro-forestry. Since all the farmers are equally engaged in crop farming as well as, dairy in an integrated manner, it would be difficult to distinguish how much percentage of farmers are engaged in crop and dairy separately. None of the farmers are engaging in agro-forestry.

Table 7.1: Income Sources of the Farmers According to Farm Size

Category	Farm based	Non-farm based			Total
	Crop/ dairy livestock	Business	Clerical Job	Professional Job	
Small	44	1	10	2	57
Medium	168	7	24	18	217
Large	31		7	2	40
Total	243	8	41	22	314
%	77.3	2.5	13.1	7.1	100.0

Source: Field Survey, 2002
Note: Above 60 (22), under 6 (43), Student (279) is not included
Farming: Crop & livestock, Business: Shopkeeper, Trade.
Clerical Job: Government/non government service, Officer, meter reader, *lekhapad*, computer operator.
Professional: Teacher, Politician, Writer, Driver, Nurse, Police, Army, and Overseer.
Small: 0.2 to under 0.5 ha; Medium: 0.5 and under 2 ha; Large: 2 ha and above

7.1.2 Non-Farm Based

Non-farm based strategies followed by the farmers in the study area are also very diverse. It is also broadly divided into local job and migration job. Local job includes; business (shopkeeper and trade), clerical jobs (Government/non government service, officer, meter reader, *lekhapad*, computer operator), and professional jobs (teacher, politician, writer, driver, nurse, police, army, and overseer), whereas, migration job includes; people going to urban areas within the district and beyond. During the off-farm season, people shortly migrate to towns and market centers in the same district such as, Bharatpur, Tandi, Narayanghat, Chanuli, Bhandak, Kesharbag etc. and other districts such as, Kathmandu, Pokhara, Butwal, Dhading, Nawalparasi, Ilam, Nuwakot Baglung and so on, in order to engage in different

income activities. Few people also migrated to foreign countries such as, India, Malaysia, Dubai, Qatar and Bangladesh for salaried jobs. The people engaged in clerical job are 13.1%, professional job is 7.1%, and business is 2.5% (Table 7.1). The given economic activities are the main livelihood strategies of sampled households that also represent the whole district.

7.2 Location of Jobs

Almost all the farmers own their cropland inside the village near by distances, and they can go to work and come back home easily within a day. The majority of household members who are economically active, used to work in the farm to some extent, though they have other non-farm jobs as their main occupation. Table 6.2 shows that, about 23% of the total economically active people, engaged in non-farm job such as, clerical job; professional job and business are mostly outside the village. It is either in the city area (urban area) of the same district or different district. Few people, about 4% are working aboard. People who work abroad had tend to earn higher income compared to others. It indicates that except farming, all other non-farm jobs is in urban areas as it gives more opportunity to engage in non-farm job.

Table 7.2: Occupation Structure According to Job Kind and Location of Job

Farm Size	Main job category	Rural	Urban	Kathmandu	India	Other Countries	Total	%
Small	Farming	44					44	77.19
	Business		1				1	1.75
	Clerical Job	1	5	2	1	1	10	17.54
	Professional		1	1			2	3.50
Medium	Farming	161					161	77.00
	Business		7				7	3.33
	Clerical Job	1	16	1		6	24	11.42
	Professional		11	5	2		18	8.5
Large	Farming	30					30	76.92
	Clerical Job		3	3		1	7	17.94
	Professional		2				2	5.12
Total		237	46	12	3	8	306	100.00

Source: Field Survey, 2002
Urban: urban areas of different districts such as Kathmandu, Pokhara, Dhangadi, Dhading, Butwal, Nuwakot, Nawalparasi, Baglung etc and urban areas of same district, such as, Bharatpur, Narayanghat
Other countries: Malaysia, Dubai, Bangladesh, and Qatar.

7.3 Household Income Earning from Different Income Sources

In the study area, dairy farming is growing rapidly as one of the main income source of livelihood. Dairy farming, in the area is further supported by the increasing involvement of cooperative dairy and milk chilling centers in the district. Cooperative dairy plays a key role in supporting dairy farming by providing various services such as, milk marketing, extension and training program, saving and credit programs. Institute of Agriculture and Animal Science, Rampur, which is providing animal health services, also support it. Research has been carred out in the field of animal feed, and animal infertility in order to increase milk production in that area by Nepalese scholars as well as, Japanese scholars in the Institute. Japanese scholars visit there frequently in order to solve infertility problems faced by dairy farmers. They frequently organized infertility camp in the area and provide this service free of charge to the local dairy farmers. This helps to motivate people to engage in dairy farming. Being a dairy

pocket area and accessibility of road network to Kathmandu and other urban areas, are the main reasons behind gaining momentum of dairy farming in the area.

Table 7.3 and Figure 7.1 show that the distribution of income from farm and non-farm based sources. The average income earned from dairy production is one of the lowest in large farmers (NRs. 38,722) though they owned higher number of dairy animals compared to small and medium farmers. Where as, nearly double (NRs. 73,253) and about 41% (NRs. 66428) higher income from the same source has been earned by medium and small farmers, respectively, than the larger farmers. It is because of higher numbers of milking animals and well dairy management by small and medium farmers compared to large farmers. Small and medium farmers are using high labor force, high expense than the large farmers in dairy activities. Small and medium farmers are engaging in commercial ways, even in small scale, mainly to generate income and consequently for betterment of their livelihood. Whereas, the main aim of doing dairy activities for large farmers, is self-consumption and manure production. Some of large farmers also reported that they did not have to be fully engaged in commercial-scale dairy farming because they obtained a sufficient amount of income from crop farming, as well as, non-farm based activities. They occasionally sell surplus milk. Consequently, the income earning of large farmers from crop farming and clerical job is one of the highest and lowest income from dairy, as compared to small and medium farmers, about NRs. 63 thousand and NRs. 96 thousand respectively. On the other hand, medium and small farmers earned very less income from non-farm based activities.

Table 7.3: Annual Income from Different Income Sources Per Household

Farm Size	HH	Farm		Non-farm			Total (NRs.)
		Crop (NRs.)	Dairy (NRs.)	Business (NRs.)	Clerical Job (NRs.)	Professional Job (NRs.)	
Small	22	15,602 (14%)	66,428 (58%)	2,273 (2%)	24,891 (22%)	4,364 (4%)	113,557 (100%)
Medium	74	36,856 (25%)	73,253 (49%)	4,460 (3%)	21,027 (14%)	13,068 (9%)	148,663 (100%)
Large	8	63,567 (29%)	38,722 (18%)		96,750 (44%)	19,500 (9%)	218,539 (100%)

Source: Field Survey, 2002, Unit: Nepali Rupees (NRs.), $1 = NRs. 77.00
Farming: Crop & Livestock;
Business: Shopkeeper, Trade;
Clerical job: Service, Computer Operator, and Meter Reader
Professional Job: Teacher, Writer, Driver, Nurse, Police, Army, and Technician

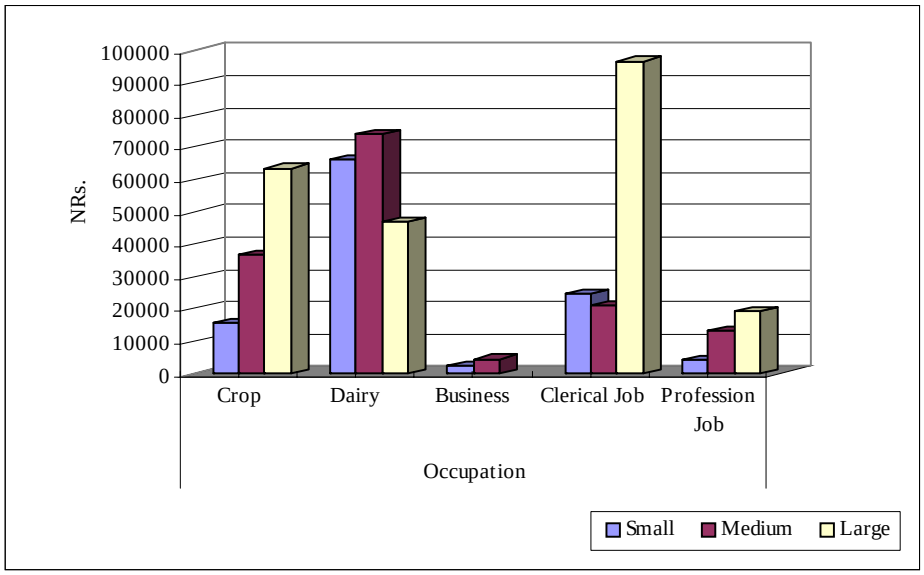


Figure 7.1: Annual Income from Different Income Sources per Household

7.4 Household Expense in Food and Non-food Items

The majority of households need to spend in all non-food items and to purchase some of daily foodstuff, which is not produced locally. Most of the sampled households need not to spend in the main food produces such as, paddy, wheat and maize in all level of farmers as their production is sufficient for their consumption. Table 7.4 shows the annual household expense in food and non-food items per household in the study area. The total amount of daily

food requirement is fulfilled in two ways; self-production and purchasing. Generally, farmers produce major crops like paddy, wheat and maize, dal/beans and little vegetables. On average, about 87%, 99% and 100% of paddy need is fulfilled by self-production in small, medium and large farmers respectively. It shows that the amount of self-food, paddy, is higher in large farmers as they owned more paddy land. Small and medium farmers produce 66% and 99% of wheat respectively, whereas, large farmers produced only 44%. All levels of farmers produce more than 80% of maize. Maize is mostly used for animal feed. *Dal*/beans, potato, vegetables and meat/fish are mostly fulfilled from the local market. Food, such as; beaten rice, sugar, oil/ghee tea/coffee is also fulfilled by purchasing from the local market.

The average annual expense in non-food items per household according to biogas holder and non-holders is shown in Table 7.5. It shows that the highest percentage of amount is spent in education children in all levels of the farmers. The average amount spent in it is, however, increasing according to the increasing farm size of the farmers. The average amount spent in festival, clothing, health, and electricity is also increasing according to the increase in farm size. The expense in LPG gas was found only in large farmers who are biogas non-users. A significant difference in expense in fuelwood can be found between biogas users and non-users on all levels of farmers. The difference in expense in fuelwood was NRs. 1000 in small farmer, NRs. 1407 in medium farmers and NRs.1500 in large farmers. This implies that about 500 kg, 703.5 kg and 750 kg of fuelwood were saved with the use of biogas by the small, medium and large farmers respectively. Similarly, the significant difference can be seen among the small farmers between biogas users and non-users who have no LPG gas.

Table 7.4: Annual Household Expense in Food Items Per Household

Food Items	Small			Medium			Large		
	Self (NRs.)	Purchased (NRs.)	Total (NRs.)	Self (NRs.)	Purchased (NRs.)	Total (NRs.)	Self (NRs.)	Purchased (NRs.)	Total (NRs.)
Paddy	7,714 (87%)	1,125 (13%)	8,839	11,374 (99%)	80 (1%)	11,454	16,050 (100%)	-	16,050
Wheat	500 (66%)	255 (34%)	755	658 (97%)	17 (3%)	675	395 (44%)	513 (56%)	908
Maize	363 (100%)	-	363	749 (89%)	97 (11%)	749	773 (86%)	125 (14%)	898
Beaten Paddy	-	226 (100%)	226	-	475 (100%)	475	-	822 (100%)	822
Potato	105 (18%)	480 (82%)	584	268 (27%)	722 (73%)	990	156 (14%)	988 (86%)	1,144
Meat/ Fish	39 (1%)	3,140 (99%)	3,178	68 (1%)	4,511 (99%)	4,579	425 (9%)	4,400 (99%)	4,825
Milk/Milk Products	7,615 (100%)	-	7,615	9,356 (100%)	-	9356	11,087 (100%)	-	11,087
Dal/ Beans	531 (45%)	656 (55%)	1,187	1,883 (68%)	871 (32%)	2,754	125 (29%)	309 (71%)	434
Green Veg.	259 (22%)	914 (78%)	1,173	499 (35%)	940 (65%)	1,439	275 (26%)	778 (74%)	1,053
Fruits	64 (12%)	457 (88%)	520	32 (5%)	593 (95%)	625	125 (23%)	413 (77%)	538
Spices	36 (4%)	888 (96%)	924	-	1,111 (100%)	1,111	-	1,263 (100%)	1,263
Sugar	-	1,686 (100%)	1,686	-	1,243 (100%)	1,243	-	2,842 (10050	2,842
Oil	-	936 (100%)	936	-	1,664 (100%)	1,664	-	1,481 (100%)	1,481
Tea/ Coffee	-	756 (100%)	756	-	1,077 (100%)	1,077	-	1,149 (100%)	1,149
Total	17,225 (72%)	11,517 (28%)	28,742	24,888 (71%)	13,303 (29%)	38,191	29,411 (72%)	15,081 (28%)	44,492

Source: Field Survey, 2002, ($1 = NRs. 77.00)

Table 7.5: Annual Household Cash Expense in Non-Food Items per Household

Non-food Items	Biogas Users						Biogas Non-users					
	Small		Medium		Large		Small		Medium		Large	
	NRs.	%	NRs.	%	NRs.	%	NRs.	%	NRs.	%	NRs.	%
Festival	4,743	10	5,875	13	12,333	21	9,071	15	10,446	15	5,833	7
Clothing	5,571	12	6,982	15	6,000	10	9,929	16	9,500	13	8,333	10
Education	16,171	35	20,861	45	25,000	42	22,000	36	32,679	46	12,500	15
Health	1,857	4	5,696	12	6,500	11	8,500	14	5,000	7	1,333	2
Kerosene	201	-	340	1	310	1	1,127	2	565	1	72	-
Fuelwood	-	-	232	0.1	1,000	2	1,000	2	1,639	2	2,500	3
Electricity	1,153	2	2,071	4	3,356	6	2,554	4	2,642	4	700	1
Telephone	729	2	1,054	2	833	1	879	1	1,482	2	333	-
LPG gas	-	-	-	-	-	-	-	-	918	1	1,167	1
Others	16,429	35	3,696	8	4,083	7	5,400	9	6,411	9	51,667	61
Total	46854	100	46807	100	59416	100	60460	100	71282	100	84439	100

Source: Field Survey, 2002. ($1 = NRs. 77.00)

Others: expense in marriage, funeral, and house repairing

Table 7.6 shows the share expense in food and non-food items. Large farmers have more expense about 66% on non-food items such as; education, festival, and so on as compared to expense on food items. This also coincides with the higher percentage of having high-level education among large farmers. Whereas, small and medium farmers have to spend more than 50% in daily foodstuff, about 58% and 51%, respectively as they produce less food crop on their farms.

Table 7.6: Share Expense in Food and Non-food Items Per HH

Farm Size	Food Expense (NRs.)	%	Non-food Expense (NRs.)	%	Total Expenses
Small	41,331	58	29,588	42	70,919
Medium	46,724	51	45,581	49	92,305
Large	53,728	34	106,666	66	160,394

Source: Field Survey, 2002, Unit: Nepali Rupees (NRs.), $1 = NRs. 77.00
Food: Paddy, wheat, maize, beaten Paddy, *dal*/beans, vegetable, meat, oil, spices, milk, tea etc.
Non-food: Festival, birth/funeral, education, health, clothing, kerosene, fuel wood, communication etc.
Purchased food: Salt, beaten Paddy, oil, tea, sugar, meat partly etc.
Self-food: Paddy, wheat, maize, dal/beans, vegetables, meat partly etc.

7.5 Share of Income form Different Income Sources in Total Household Income

In order to calculate the contribution of dairy farming to the total household income, it is important to know the contribution of other income sources as well. The percentage share of income from different income sources is presented in Table 7.7. It shows that the percentage share of dairy farming is decreasing according to the increase in farm size of the sampled household. Small farmers have maximum share of dairy income in their total household income, followed by medium and large farmers. Share of dairy income is found to be significant in small and medium farmers, which contributes 58% and 49% of the total household income, respectively. Large farmers have only 18% share coming from dairy farming. However, they have saved expense on milk for their daily consumption. About 50% of households are having indirect benefit of energy generation in terms of biogas, which

reduced expense on fuelwood, and getting income from crop production, by using slurry as manure, and increase health situation. This indicates that the dairy sector development has direct impact on poverty alleviation in rural areas by improving the household income, and higher crop production of the farmers and making sound cooking environment. Rest of the share comes from crop and non-farm activities. The share of non-farm activities have higher contribution in the case of large farmers than the small and medium farmers There is also little contribution of non-farm based activities on total household income of the small and medium farmers. These, however, mostly comes as remittance.

Table 7.7: Percentage Share of Different Income Sources According to Farm Size

Farm Size & Activities	HH	Farming		Non-farming			Total HH Income
		Crop	Dairy	Business	Clerical Job	Professional Job	
Small	22	14	58	2	22	4	100
Medium	74	25	49	3	14	9	100
Large	8	29	18		44	9	100

Source: Field Survey, 2002.

7.6 Livelihood Strategies at Household level

Households are found to depend on different strategies to fulfill the demand of non-food items. Crop and dairy farming are the main income sources of the entire households in the study area, where, more than 90% of households produce enough food to fulfill their household's food demands. Still, they have to depend on different strategies to fulfill the demand of non-food item such as, expense on festival, education, health, and so on o on. Table 7.8 shows different combination of income sources for meeting non-food need based on farmer's perception. The majority of small farmers have reported that milk selling is their only way to fulfilling non-food need as they have less income from crop, and other non farm jobs.

Few households, about 18%, informed that the way of fulfilling the non-food need is the combination of crop selling and selling of milk. In case of medium farmers, about 23% have milk selling as a main way of fulfilling is the. About 14% informed that crop income is the way of fulfilling non-food needs. Majority of large farmers have combination of income from crop and non-farm as the main way of fulfilling non-food items. Taking loan for fulfilling non-food items is very less even in small and medium farmers, whereas, large farmers do not have loan for that purpose. Small and medium farmers are taking loans from various sources according to their convenience for the purpose of non-food need. The main sources found are ADB/N, mutual fund, cooperative, relatives, and friend. The interest rate is varying from 16% to 36% according to the source of loan. Generally, in case of friend, interest is as high as 36%. The purposes of loan taking mainly found are wedding, health, house construction and repairing, and one case for education. Repayment time is varying from six months to three years. Taking loan is one of the main strategies to fulfill immediate needs.

Table 7.8: Income Sources for Meeting Non-food Needs According to Farmer's Perception

Strategy type and Farm Size		Small	Medium	Large
Selling of Crop	No.		10	3
	%		14	38
Selling of Milk	No.	9	23	
	%	41	31	
Income from Non-farm Job	No.	3	8	
	%	14	11	
Selling of Crop and Milk	No.	4	11	1
	%	18	15	13
Selling of Crop and Non-farm	No.		6	4
	%		8	50
Selling of Milk and Non-farm	No.	3	12	
	%	14	16	
Taking Loan	No.	4	3	
	%	18	4	

Source: Field Survey, 2002

7.7 Summary

The strategies followed by farmers in the study area are of two types; farm based and non-farm based. A large number of sampled households have been engaging in farm based activities that includes crop and dairy farming. About twenty two percent have been engaging in non-farm based activities such as, business, clerical jobs and professional job. Large farmers are mostly engaged in crop farming and non-farm based jobs. Few household members have been working abroad among the large farmers. Small and medium farmers have been engaging in solely dairy farming, as they owned less land resource, and are less educated compared to large farmers. Being highly educated and high economic status than the small and medium farmers, large farmers have more opportunity to get non-farm jobs in urban areas as well as abroad. Consequently, highest income earning, in the case of large farmers, come from non-farm based i.e. clerical jobs. In the case of small and medium farmers, the highest earning comes from dairy farming.

The expense in food item is more than 50% of their total income, in the case of small and medium farmers as they grow less food. Whereas, 66% of the total income expense in non-food item such as, children’s education and festivals by large farmers.

Chapter 8: Summary and Conclusion

The broad objective of this study was to understand the contribution of dairy farming on rural livelihood in rural communities of Nepal. Specifically, this study tried to analyze the contribution of dairy farming in terms of milk production, income generation and energy generation in rural livelihood. In order to achieve this objective, this study tried to analyze the household livelihood activities, which was found to be of mainly two types; farm based, and non-farm based. Further more, it also tried to analyze crop farming, dairy farming in particular and other non-farm activities in order to have better picture of share of income earning from different livelihood activities. This study was based on intensive field survey and secondary data sources. For the purpose of analysis, data was collected from different levels i.e. national level, district level, village level, and household level. National level data was analyzed to summarize the effectiveness of management policies, especially in three sectors i.e. crop farming, dairy farming and promotion of biogas technology.

Before 1950, population size was small and land and natural resource were abundant for cultivation. Thus, farming alone could fulfill all the requirements of basic foodstuff and other needs. The planning process was started after 1951. Eight periodic plans have been implemented from 1951 to 1990 in order to overall development the country. All the Plans were developed at the central level neglecting the concept of decentralization in planning process. Except some improvement in communication and infrastructure sectors, rest of sectors experienced slow growth. Agriculture sector became more or less stagnant, and development of non-agriculture sector could not achieve desired level. With the rapid population growth, degradation of forestland causes slow growth in crop production. As a

result, farming alone could not fulfill the increasing demand of food for the growing population. Consequently, the country had started to import food grains to feed its growing population after late the1990s. After the political change in 1990, the successive so-called democratic government implemented the Plans aimed at giving definite direction to the socio-economic improvement of the peoples by tackling the challenges of economic stagnation, rapid population growth, environmental degradation and increasing poverty. Agriculture Perspective Plan implemented aimed at dramatic change in poverty reduction by increasing food grain production in the country within 20 years of Plan period. However, the slow growth in food grain production still exists.

Rural households have been facing greater hardships in earning their livelihood from their own production due to the rapid population growth and degradation of resource base, mainly land and forest. As a result, they are shifting their emphasis from subsistence farming to other livelihood strategies to maintain their livelihood. The main livelihood strategy found in the study area is farm based and non-farm based. The majority of small and medium farmers have their main livelihood strategy as dairy farming, whereas, large farmers have crop farming as a main livelihood strategy. The income earning from dairy is higher in small and medium farmers, whereas, large farmers have higher income from crop, and non-farm jobs. About 90% of sampled household have sufficiency in major food like paddy, wheat and maize. However, for the other daily need food and non-food items, they have to purchase from the local market. Small and medium farmers have more expense in food item than non-food items. Children's education is paid more among the other sector by all levels of farmers. Selling of milk and crop become the main way of full filling a need of non-food items in all farmers.

Dairy is being a major component of livestock farming. The maximum contribution comes from dairy in livestock GDP. Cow and buffalo are major dairy livestock in which a large share of milk production is pertained in Nepal. With the establishment of various dairy institutions, and implementation of policy and planning in previous consecutive Five-Year Plans has some how improved the dairy sector in an organized way. With this, the numbers of milking cow and milking buffalo have been gradually increasing since the last 14 years. Consequently, milk production also increased even in a slow pace. The increased production is not because of increase in milk cow or buffalo, but increase in numbers of animals. Milk yield, however, is very low in both the cases; cow and buffalo due to various constrains such as, lack of improved breed, quality feed and fodder, health and extension services and marketing aspect.

DDC, Private Dairies and MPAs/MPCs have been playing an important role in milk collection, milk production and milk marketing, and also providing various services to the dairy farmers in the study area. After the introduction of MPAs/MPCs in the study area, people of the surrounding area have been encouraged to take part in dairy farming. The cooperative chilling centers as well as, Private Dairies started to buy milk from rural farmers. MPAs/MPCs have made the farmers to unite themselves in a group and they have been more sociable. Provision of various dairy facilities and establishment of dairy infrastructure through co-operatives has brought positive changes in dairy farming. About 66% of co-operative loans are used in crop/dairy farming which help in buying improved breed, quality feed leading to higher production. More than 90% of the farmers responded that they have improved their dairy farming after being cooperative members.

Finding shows that, the majority of sampled households have more than 90% of food self-sufficiency. Net income from crop production is higher in large farmers, as they owned more irrigated low land compared to small and medium farmers. Contribution of dairy farming is significant among small and medium farmers compared to large farmers. Milk production and total milk consumption is higher among large farmers but per capita milk consumption is higher among small and medium farmers. Net income from dairy is higher among medium and small farmer compared to large farmers. It was found that, only household labor is utilized in dairy farming, while in crop farming, the use of self, exchanged and hired labors is common. Labor using pattern in dairy farming is higher among small and medium farmers compared to large farmers. It was found that more female is also involving in dairy farming. This implies that dairy farming provide job opportunity not only for male but also for female who are mostly housewives.

This study finding in relation to biogas use found that, the biogas users are generally literate and better educated farmers. Most of them are Bahun, with more numbers of livestock and often better landed in both regions. This implies that the biogas technology is benefiting only the farmers, who are better landed and have large numbers of livestock. People without livestock, landless farmers and, or, small farmers tend to be excluded from getting benefit from the use of biogas. In the Hill region, most of the Tamangs, having a different food culture are also lagging behind in its use. In Tarai, all biogas users are dairy farmers belonging to Bahun caste, having dairy farming as the main occupation for their livelihood.

Another result found that, the livelihood strategy or activities in the study villages was found as farm based and non-farm based. Farm based activities includes mainly crop farming and dairy farming. Non-farm based activities are business, professional and clerical jobs. Most

of the large farmers have crop farming as a main activity to maintain their livelihood. Mainly household heads are engaged in crop farming. Other household members, who are better educated, engage in clerical jabs in the urban areas, as well as, abroad. As a result, the share of non-farm job is highest and followed by crop farming. Dairy farming is the main activity for small and medium farmers. Consequently, small and medium farmers have highest income from dairy farming. Very little share came from other activities such as, crop and other non-farm activities.

This study also aimed to understand the contribution of dairy farming in rural livelihood in the rural areas of Nepal. It is clear that dairy farming contributes significantly in case of small and medium farmers who have comparatively less natural asset and in some extent, human assets in terms of skill and education. It was found that dairy development can help to generate large amount of income for small and medium farmer who are the most target group in any development program and dairy contributes significantly in improvement of their livelihood. Thus dairy activity can be a one intervention, which designed to improve broader environment that affect household livelihood. Figure 8.1 shows the intervention of dairy activity as a main livelihood strategy for better livelihood, which is based on previous conceptual framework. This new framework gives emphasis on the role of cooperative dairy in the development of dairy activity in the rural areas. There are some intervention that can increase human asset such as human skills through training and extension program, and other dairy related education. It can develop new skills in dairy farming. Increase in financial capital helps to increase quality and quantity of dairy livestock and dairy infrastructure, which helps for market security. The development in dairy sector give livelihood outcomes in terms of increased milk production, availability of household energy and increase in income in cash

and kind, which finally lead to the better livelihood. Better livelihood again leads to increase in people's assets through savings.

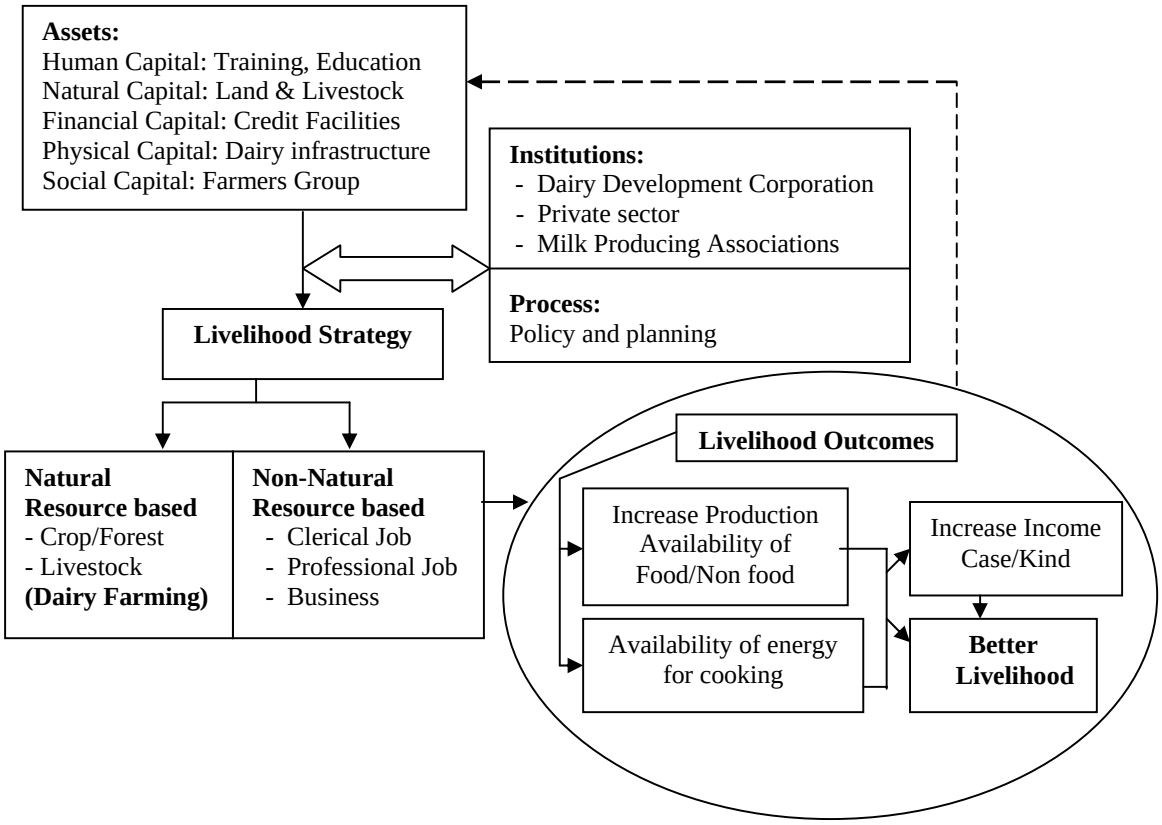


Figure 8.1: Intervention of Dairy as a Livelihood Strategy for Better Livelihood

In order to get these outcomes, great emphasis should be given to intervention of cooperative dairy in dairy sector development**.** Cooperative dairies ie DDC, private dairies and milk producer's cooperative are playing a key role in development of dairy farming by providing various services such as, animal health services, market facilities, infrastructure facilities, extension and training facilities and saving and credit facilities. These altogether leads to higher milk production. Higher production means higher income earning, more employment opportunities and improved self-consumption. This finally leads to better livelihood as shown in Figure 8.2.

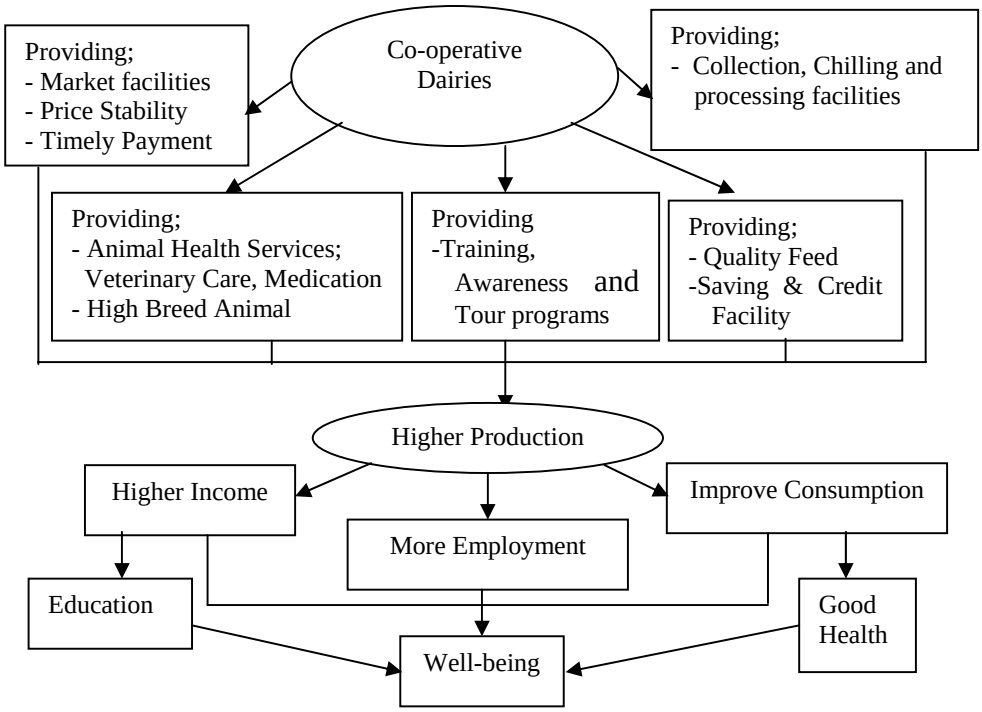


Figure 8.2: Relation between Intervention of Co-operative Dairies and Better Livelihood

Dairy farming, thus, is proved an important development program to improve the livelihood of medium and small farmers having limited access to land resources, which should be encouraged further. In addition, cooperative, a collective approach, focusing on small and medium farmers, found worthy in providing various services from input supply to marketing and dealing with the production as well as marketing problems. Therefore, cooperatives establishment should be encouraged to provide maximum possible service among farmers to benefit them through their own collective effort. In contrast to this, larger contribution of dairy on livelihood of medium and small households, larger farmers however, are benefited much from the biogas technology promotion programs. Medium farmers were also able to meet household energy requirement from biogas energy. Small farmers however, are least benefited from biogas technology promotion program especially in hills. Therefore, implementation of community biogas project should be expedited with the aim to meet the energy requirement of small farmers.

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