CHAPTER ONE
INTRODUCTION

1.1 Background

Nepal is a tiny Himalayan country in the world map sandwiched between the two giant countries i.e. China and India. It has common borders with the *Tibetan Plateau* of China to the north while India to the south, east and west. It is completely surrounded with the land of India and China so that it is categorized as a landlocked country in the topographical map of the world. It is approximately 885 Km. in length from east to west and 175 Km. in breadth from north to south and is located between $88^0$4' to $88^0$12' east longitude and $26^0$22' to $30^0$27' north latitude. The total land area of the country is 1,47,181 Sq. Km. Nepal is small in size but has typical type of geo-diversity and it is divided into three ecological regions, running from east to west viz. the Mountain, the Hill and the *Terai* constituting 35 percent, 42 percent and 23 percent of the total land area and accommodating 7 percent, 46 percent and 47 percent of the total population respectively (CBS, 2006). The entire northern border of the country is a lateral white wall of eternal ice and snow. Comprising the *Great Himalayan Mountain Range* of the ten highest peaks of the world; eight are in Nepal, including the highest mountain "Everest" with the height 8,848 meter from sea level. The climate of the mountain region is temperate. The hilly region comprises the greater part with landmasses such as, steep slopes, plain villages, valleys and slopes with typical cluster systems composed of different indigenous groups. The sub-tropical climate is remained in this region, which is called "Ideal climate" by the people. The southern border of Nepal lies on the upper parts of the vast *Gangetic Plain* of the Indian Sub-Continent. This region is known as the "*Terai*" which is 30 to 50 Km. widths and slumbered from east to west at the lap of *Mahabharat* and *Chure Hills*. The *Terai Region* is considered to be the most productive area of the country as a whole and, thus, it is called "Granary of Nepal". It lies in the elevation of a few hundred meters above sea level, and has typical type of climate i.e. hot weather in monsoon and cold weather in winter season.

Nepal's topography has made possible the nation's isolation from the rest of the world together with the governmental policy prior to 1951. Consequences of such natural and governmental conditions are still visible, especially in remote areas. Some mountain tribes, ethnic groups and remote villagers of Nepal are still unaware of their larger national identity; and larger social organizations, beyond that of family, village or tribe, are still incomprehensible to them. Nationalistic spirit is confined to small groups of people in areas where communication and travel are easy. Central government's policies and decisions are hard to communicate and implement because of the barriers created by nature. However, in present, government and non-governmental agencies are taking initiation to make aware people in remote rural areas.

Nepalese people consist of variety of races, with the people of the *Tibetan Origin* residing, mainly on the north, the people of *Indian origin* being concentrated towards the south and the central mountainous regions being populated by mixed *Mongoloid and Indo-Aryan races*. Nepal, therefore, can be described as "A Multi-Ethnic Society". This is the variety of culture, religion and folkways that decorate the *Nepalese society*. Hinduism, Buddhism, Animism and Bonpoism are found to coexist and intermix. There are also small groups following Christians and Muslim religious groups in Nepal. However, Nepalese society and culture exist not as separate are still discernible but are altered because they exist as parts of a new combination.

The *Indo-Aryan people*, especially the *Brahmins* and the *Chhetris* have been, for a long times, the dominant group in Nepal. They are scattered all along the middle belt of Nepal. And, recently they have been settling in the *Terai regions* as well. The other dominant groups consist of the Newars, who are mainly concentrated in the *Kathmandu Valley* and, are primary a commercial community. The administrative, legal and military foundation of the present Kingdom of Nepal was established by the end of the eighteenth century.

From the time immemorial, Nepal has been predominantly an agricultural country where more than 81 percent farming people depend on agriculture for their livelihoods and more than 86 percent people live in the village. Therefore, agriculture is the "Backbone" of Nepalese economy due to its unchallenging contribution to the Gross Domestic Product (GDP) i.e. 46.4 percent (CBS, 2006). The tradition of GDP shows that Nepal's recent production is not sufficient to support the rapidly growing population because the growth rate of population is 2.3 percent and the growth rate of agriculture production is 1.4 percent respectively (CBS, 2006). The condition of agriculture practice is very miserable in Nepal because it is traditionally practiced without systematization of the local resources in the application and implication of indigenous system management in agro-production with the collaboration of the line-agencies or government led agencies, Non-Governmental Organizations (NGOs), International Non - Governmental Organizations (INGOs) and the farmers. Because of the lack of industrial development, agriculture in Nepal has remained as base-block of the Nepalese economy since the time immemorial. Nepal is still one of the poorest countries in the world with per capita income of about US $ 300 only (CBS, 2006). Nepalese agricultural management system not only plays an important role in national economy but also has strong influence on the socio-cultural and religious life of the people and its religious calendar is closely associated with the farming system, which has significant role in rural development of Nepal.

Coupled with their general poverty and primitive techniques of agricultural are also their own cultural beliefs and practices together with their responses and reactions to change, which are more or less the same throughout the rural areas. In fact, rural

people are engaged in subsistence farming, and the current necessity of meeting the ritual, ceremonial and other social obligations present compulsions to seek secondary occupations. Thus, we find that the majority of the *Nepalese people* are engaged in more than one occupation either continuously or periodically.

Nepalese economy is not out of the touch of the process of globalization but the modernization in the various prospects of the agricultural production system has not affected. Yet, the bulk of rural population of Nepal has to depend upon the agricultural sector. Agricultural sector is characterized by the small farms and farmers, unevenly distributed land, small fraction of cultivated land and systematization of the local resources, experiences, skills, methods, techniques, knowledge and practices; and difficult topography. According to 1998 record, two-third (66.7 percent) of the total households hold less than one hectare accounted only 17.4 percent of the total cultivated land and only 9 percent households hold 47.3 percent of the total cultivated land area. Besides, landlessness and marginalization of the poor peasantry is also increasing over the years in Nepal.

Nepalese economy is predominantly agricultural, small fraction of land area could be brought under cultivation due to its geo-diversities and limited resources. The agricultural structure reveals that the majority of people own less than one hector of land. So, the poorest of the poor shows either landlessness or a small part of land holdings, also insufficient even to feed themselves for livelihoods. More than 40 percent population of the total population lives under the poverty line. By measuring the various parameters, Nepal is identified as the poorest country in the world.

The annual growth rate in agriculture production has remained lower in comparison to the annual growth rate of population, which can not meet the necessity of the rapidly growing population with the lack of systematic management of the local resources by applying own fundamental local techniques, skills, methods, practices and experiences. However, the government of Nepal, in the Tenth Plan, has aimed to increase its annual Gross Domestic Products (GDP) from 3 to 5 percent, annual Gross National Product (GNP) from 0.5 percent to 3 percent per person cereal consumption from 270 Kg. to 426 Kg., and to decrease economic and regional disbalance to uplift the lives of people who are under the poverty line (Tenth Plan-Economic Survey, 2006).

Mainly, the agricultural production in Nepal depends on monsoon rainfall while its uncertainty has made the low productivity. Hence, irrigation has proved to be one of the most important means of agricultural production in those areas where the rainfall is not adequate in quantity. Therefore, irrigation is identified as the key component to accelerate, intensify and sustain the agricultural production, not only in Nepal but also in the world.

The Nepalese farmers have recognized the importance of water resource for century ago with their own initiatives and have been constructing irrigation infrastructures themselves to increase their agricultural production that is known as Farmer Managed Irrigation System (FMIS). The various irrigation systems prevailing in our country have been managed by the farmers for many years. The tradition of farmers' involvement in the development, operations, mobilization and maintenance of the irrigation system has given birth to the farmer managed irrigation systems scattered all over the country, Nepal.

The time and place of irrigation origin in this world is unknown. However, Beda Byas, who wrote Bedas, has written about the importance water resource in his *Atharva Beda*: "*let that earth put us into the same rich fortunes, which were enjoyed by our predecessors, upon which the oceans, the great rivers and others types of waters, which causes and products different kinds of grains, eatables and other vegetation, and which nourishes all the breathing and moving animates*".

In Nepal, for the irrigation of terraces made by the river basins, farmers divert water of the rivers by making temporary barriers filled with boulders. '*Bhimsen-Kulo*' in *Gorkha District*, '*Argali-Kulo*' and '*Tallo-Kulo*' in *Palpa District* and other '*Raj-Kulas*' in the *Kathmandu Valley* are the typical examples of ancient farmer managed irrigation systems in Nepal.

To scratch out the irrigation history in different places of the world, the irrigation development has several domains such as, religious trust, individual initiatives, community efforts, royal directives, government initiatives and farmer initiatives. Water resource management activities like water allocation, distribution, operation, maintenance, resource mobilization and conflict management of irrigation channels using their own techniques, methods, skills, knowledge and practice have come up in an indigenous way in Nepal over years. In west Nepal, the edict of King Ram Shah of *Gorkha State* that the people do not bring water disputes to the court for adjudication.

The late King, *Prithvi Narayan Shah*, has directed on the importance to land reclamation and settlement. In case, there are homes on lands, which can be converted into fields, these will be shifted elsewhere, irrigation canals will be constructed, and the fields will be used for cultivation.

No doubt, irrigation plays a significant role in the development of agriculture and socio-economic condition of the people of an agro-based country. During the *Rana regime*, the condition of irrigation was unsatisfactory because of the lack of well management of irrigation and agricultural system; and thought of the *Ranas,* their own individual and family interests rather than public ones. After overthrowing the *Rana*

regime, the democracy was established in 1950s and planned development was brought into force. The First Five Years Plan was started since 1956s and people were motivated and encouraged to participate in the various irrigation related activities and system management through their own initiatives.

Out of the total 26,45,000 hectares agricultural land, only 17,66,000 hectares land can be irrigated in Nepal. Before the plan period, the land area under irrigation was 6,228 hectares and until now, 8,24,331 hectares land has been provided with water facility, in which surface farmer managed irrigation system captures 5,92,310 hectares of land with more than 71 percent (Irrigation Diary, 2006). Out of the total cultivated land, the government has targeted to irrigate a total 2,49,400 hectares land by the end of the Tenth Plan with 23 percent (NPC, 2006:485).

Since long ago, people of the *Terai Region* in Nepal have been managing and promoting the farmer managed irrigation system in their localities with the indigenous techniques, methods, skills, experiences, knowledge and practices. Irrigation also has various socio-cultural aspects along with the indigenous processes and technology adopted by the people with their own attempts and initiatives in rural areas of Nepal.

In fact, irrigation systems practiced by the local farmers in the villages of Nepal prevail farmers' diversified skills, technology, methods, knowledge and performance, which are appropriate and bearable in the local context fitting into their culture in a sustainable way. In the same way, Uphoff (1986) has illustrated, "*Large irrigation and settlement projects often draw farmers with varying degrees of experience in irrigation, and one of the difficulties in getting them to assume responsibility effectively can be heterogeneity of skill and will among water users for participating in management of the system. An agency working in an irrigated settlement area should involve farmers in planning its training and technical assistance so that appropriately differentiate kinds and amounts can be provided".*

In this regard, operationalization of the irrigation systems also have their own rituals, rules, regulations and culture. Farmers in the rural areas of Nepal have autonomously been utilizing small types of canal system for the operationalization and functionalization of irrigation. As one of the main characteristics of water management, they do not have any systematic approaches on irrigation system management. As Chambers (1986) has discussed, "*The operation of the canal system, both the main canal and minors, occurs without specific regulation of discharge, elevation, timing or duration, and with no consistent criteria for decisions, record of water levels, nor any knowledge of the flow rate at any point in the system".*

Nepalese farmers do not have adopted the official recommendations from the government to manage small-scale irrigation systems but, according to their culture,

they have indigenously been experimenting to manage and preserve natural resource viz. irrigation. Budhathoki, et. al., (1996) have explained on, "*Farmers' knowledge and skills resulted from years of observation, experience, trial and error imposed by the need to survive with the available resources under the various stressful and unfavorable environmental conditions".*

Farmer Managed Irrigation Systems (FMISs) have thrived in Nepal for several centuries as a means of survival. These systems are sparsely distributed in all the regions viz. terai, hills and mountains. In this ground, Uprety (2000) has discussed, "……..*and demonstrate a very high degree of organizational and managerial inputs, both of which become imperative in view of the shortage of capital for the construction and maintenance of the canals. Over time, the indigenous irrigation organizations have developed their own rules and regulations regarding resource mobilization, water allocation, property rights in water and like".*

In this pertinent, the study of FMIS of Nepal is one of the great importance to provide the details to the government, policy makers, development activists, planners, project implementers, academicians, irrigation engineers, local leaders and farmers in formulating clear, applied and empirical idea, methods, tools and policies. This, in a way, helps to identify the strengths of FMIS.

Keeping this into account, *Tinmuhani Irrigation System* (*TIS*) of *Rupandehi District* is a FMIS situated in the *Terai village* of western region of Nepal with the multi-culture and multi-ethnic groups dominated by the *Tharus* and *Madhise* people, which have been selected as the research site. It has covered about 400 hectares of land covering *Mainhiya VDC*. Thus, the local people's cultural patterns i.e. institutional development, institutional structure, culture and customs in system operations, system management and transformational development of the users' groups has been explained on the ground of rural development. Irrigation management system of *Tinmuhani Irrigation System* (TIS), which is completely Farmer Managed Irrigation System (FMIS), is included into the *Terai Irrigation System* that is enforced by applying the local techniques, methods, skills, experiences, knowledge and practices by the locale from long time ago.

Although, this dissertation entitled **"Rhetoric of Farmer Managed Irrigation System in Rural Development of Nepal:** A Study of Tinmuhani Irrigation System of Mainahiya VDC in Rupandehi District**:** A Study of Tinmuhani Irrigation System of Mainahiya VDC in Rupandehi District" is an academic research for the partial fulfillment of the requirements for the Degree of Master of Arts in Rural Development. However, it has goal to observe landholding size, socio-economic condition, sustainability of the local resources, techniques, methods, skills,

experiences and practices of the locale in *Tinmuhani Irrigation System* as farmer managed irrigation system from the perspectives of rural development.

1.2 Statement of the Problem

Ecologically, Nepal is divided into three regions viz. the Mountain, the Hill and the *Terai.* The mountain region is less important for the agriculture production because of its high geographical structure and fragile climatic condition. About 2 percent of the land areas are suitable for cultivation and it is the most sparsely populated region accommodating with 7.3 percent population. The hilly region comprises several attractive peaks, fertile valleys such as, *Kathmandu and Pokhara Valleys* and about one tenth of its land area is suitable for cultivation accommodating with 46 percent population. Similarly, the *Terai region* is important with its high agriculture production rate. Almost 40 percent of its land area is suitable for cultivation accommodating with 47 percent population (CBS, 2006).

The annual population growth rate is 2.3 percent (CBS, 2006) and the annual agriculture growth rate is constant as the previous years. Therefore, Nepal has been facing the various difficult problems of feeding its rapidly growing population with a limited arable land and present farming system, which have been dominated agriculture production until now.

Nepal is not self-sufficient country in food production in present but in the past, also a good exporter of rice. In 1965, it was estimated that 3,48,000 metric tons of rice was exported from the *Terai region* of Nepal to India, making Nepal the fifth largest rice exporter country in the world.

More than seventy five percent monsoon rainfall is concentrated in the period from the Mid-June through September. Dependency of the Nepalese farmers on the monsoon associated with its uncertainty is the main cause of low agriculture production even in the *Terai* or in the *Hilly regions*. Areas without the irrigation facilities between Octobers to May are provided without the lack of water from the multiple cropping to which the temperature allows it. Irrigation is the most important means of increasing agriculture production in areas where the rainfall is not adequate in quantity. The Government of Nepal has targeted the development of irrigation to increase agriculture production by promoting the people's participation in the various water-related activities of the FMIS.

The irrigated land is unevenly distributed in Nepal because of geo-diversity as well as geological differences. Most of the irrigated land lies in the *Terai region* and agricultural practices are better than in the hills and the mountains. However, the ratio of cultivated land and irrigated land has increased in comparison to the previous years but agricultural production is constant. The concept is developed that agricultural

productivity can be increased by bringing more and more land under irrigation and; motivating and encouraging the people to mobilize the local resources by using the local techniques, skills, methods, experiences and practices in irrigation system.

In Nepal, food production is at very low level for the rapidly increasing population, because of unequal distribution of irrigation facility in different regions and poor management system of the local resources in the irrigation. To solve such problems, the various projects related to FMIS have been launched at national and international levels to promote the irrigation management system. Keeping this in mind, the government has formulated policies to participate the farmers in irrigation management system activities and encouraged in resolving the problem created in the process. In some cases, the government has developed the infrastructures for irrigation and the responsibility has given to the Water Users' Associations (WUAs) for the mobilization. In this context, studies on the FMIS are of the great significance to provide the details about the situation of the irrigation management system to the Government of Nepal and make aware the government policy makers in formulating clear and applicable policies for the sustainable development of irrigation management system. In this rationality, exploring the underlying knowledge, practice and cultural factors through the case studies, would be more informative in the study of *Tinmuhani Irrigation System*.

Nepal is the second richest country in the world possessing about 2.27 percent of the water resource (CBS, 2006). Because of the lake of well knowledge, practice, experience, technology and methods, the water resource as natural resource is not properly utilized in Nepal. Only 804,995 hectares of land area has been provided with irrigation facility until now in which the FMIS possesses 70 percent (CBS, 2006).

Tinmuhani Irrigation System is in operations in *Mainhiya VDC* in which the permanent source of water is *Tinau River* running from north to southern part. Farming system, irrigation management system, resource mobilization, socio-economic condition, etc. are determined by the local knowledge, practice and culture that have age long history, which is stamped in the mind of the people. So, experiences of the local farmers about the water acquisition, allocation, distribution, resource mobilization and conflict management in *the Tinmuhani Irrigation System* have been making the system more efficient and sustainable. In this regard, this research study aims in answering the following research questions:

- What is the level of knowledge, techniques, skills, practices, experiences and tools applied on *Timuhani Irrigation System Users* (TISU)?
- What is the pattern of water resource utilization in irrigation system?
- How has the irrigation system been influencing the village economy for livelihood?

- How have people been managing the irrigation activities like water acquisition, allocation, resource mobilization, operations and maintenance?
- Is there government and non-government agency intervention or not?
- Whether the local people have faced irrigation conflicts or not? What are the resolution practices?
- What are genuine positive aspects in managing and handling *Tinmuhani Irrigation System*?
- What are the cultural guiding principles in the system operations?

On the basis of the above-mentioned key questions, knowledge, practice and culture adopted by the local people concerning the *Tinmuhani Irrigation System* have been scratched throwing the eye witnessed overview on the irrigation management system initiated and developed by the farmers or the local people.

1.3 Objectives

The objectives of this research are:

- to examine knowledge, practice and tools used by the rural people and users' groups in operationalization of farmer managed irrigation system,
- to observe the people's underlying cultural patterns and grassroots reality in the operations of farmer managed irrigation system and;
- to propose methodological tools that help to generate policies and strategies for water resource management in Nepal.

1.4 Scope of the Study

Though, this thesis entitled "**Rhetoric of Farmer Managed Irrigation System in Rural Development of Nepal:** A Study of *Tinmuhani Irrigation System* of Mainahiya VDC in *Rupandehi District*" is an academic study undertaken for partial fulfillment of the requirements for the award of the Degree of Master of Arts in Rural Development. It also gives the holistic picture of *Tinmuhani Irrigation System* (TIS) for the in-depth study. Thus, the study of TIS prevails an academic as well as practical importance. Practically, this study throws light to investigate knowledge, practice and tools; and cultural patterns in the oprationalization of FMIS adopting fundamental and empirical skills, methods and technology. These components provide some bases for the improvement of irrigation management system and an effective implication of the future programs to preserve, promote, protect and sustain the system. Therefore, this study is of the great significance in academical and many practical senses. Similarly, it will provide the database on the irrigation management system for others too.

CHAPTER TWO
RESEARCH METHODOLOGY

This chapter presents a brief discussion on the research methodology adopted to collect and analyze the data needed for the research study. The tools/techniques like research design, nature of data and household census under sources of data and information, questionnaire schedule, key informants' interview, Focus Group Discussions (FGDs) and participant/direct observation under method of data collection, data processing and the method of analysis; and limitations have been employed to pick up necessary information of the research area.

2.1 Sources of Data and Information

Research design, nature of data and household census has been employed as the sources of data and information to make the research work tangible.

2.1.1 Research Design

Exploratory as well as descriptive research designs have been employed for the study of TIS. The exploratory research design has been preferred to provide an opportunity for considering knowledge, practice, tools and culture under the study.

2.1.2 Nature of Data

Both primary and secondary data has been used for this study. However, the present study has mainly been based on the primary data. The primary data has been collected from the intensive fieldwork. The actual fieldwork has been of one calendar of year. The users' group of the command area is the main source of primary data in regard to TIS. Because of the educationally and the socio-economically disadvantaged society, only the local knowledgeable persons and intellectual personnel has been consulted as the key informants whereas the secondary data has been obtained from the local institutions i.e. local Water Users' Committee (WUC), *Mainahiya* VDC Office and District Irrigation Office (DIO), *Rupandehi*. And, the various books, journals, articles, dissertations, project reports, etc. related to this study has also been consulted as the sources of secondary data.

2.1.3 Household Census

The universe of this study comprises of 110 beneficiary households of TIS. All the households of the study area have been studied consisting of various facts related to population, landholding pattern and socio-economic conditions. So, census method has also been used for the household survey. To grasp knowledge, practice, tools and culture adopted by the local people, 9 individuals consisting of the former VDC chairman, acting VDC chairman and secretary, ward leader, a teacher, chairman of the informal WUA, an age-old person and three active farmers of the head, middle and tail users has been involved.

2.2 Method of Data Collection

The necessary data have been collected by using the following tools/techniques like questionnaire schedule, key informants' interview, Focus Group Discussions (FGDs) and participant/direct observation.

2.2.1 Questionnaire Schedule

The survey questionnaire has been employed for the collection of reliable information at household level. The questionnaire schedule has been designed covering the various aspects such as, socio-economic characteristics of the water users (Educational status, land tenure, land holding patterns, occupation, population composition, etc.). And, various questionnaire schedules have been designed to carryout the practice of FMIS related activities existed in the study area.

2.2.2 Key Informants' Interview

This technique is an important tool employed to generate the key data on various aspects of the system and individual roles in irrigation management system, resources mobilization and conflict management. It is chosen for its flexibility to provide an opportunity for knowing the respondents' opinions related to TIS. A list of key informants has been obtained during observation and consulting to the farmers from among the people of various status and strata such as, a teacher, a ward leader, former VDC chairman, acting VDC leader and secretary, chairman of the Water Users' Associations (WUA), an age-old person and 3 more active farmers of the head, middle and tail users. The key informants has been interviewed under the Rapid Rural Appraisal (RRA) principle concerning knowledge, skills, practice, methods and technology applied to operate the system.

2.2.3 Focus Group Discussions (FGDs)

The present study has also included Focus Group Discussions (FGDs) to obtain the qualitative data required for the research of TIS. Among the people of different status and strata i.e. ethnicity/caste, education and social strata has been documented. Likely, various data related to irrigation management system related activities: water acquisition, water allocation, operations, maintenance, decision-making, resource mobilization, communication and conflict management has been dealt with the help of FGDs. Also, to obtain the data regarding the history of TIS and other irrigation management system related activities, three FGDs among the farmers of the head, middle and tail parts each consisting of 5 to 10 members has been involved. Each FGDs has separately been conducted.

2.2.4 Participant/Direct Observation

Participant observation is an intensive fieldwork of the researchers. And, it usually refers to a situation, where the observer/researcher becomes as near as may be a number of the group is studying and participates in their normal activities.

Similarly, direct observation is one of the most important techniques of data collection for the social problems and it is also the primary method employed to acquire information about the physical structure of systems including canal walk and drainage, which are used as the foundation of the research work.

2.4 Data Processing and Method of Analysis

The data analysis has been undertaken adopting a systematic way. All the data collected or documented during the desk studies and fieldwork have been processed or edited, first and the errors have been avoided. Secondly, the data has been classified into two major categories: quantitative and qualitative. Thirdly, quantitative data has been computed in the tabular form on the basis of research content. Similarly, various qualitative data collected during the field study concerning cultural aspects in irrigation system operations have been incorporated with the qualitative data as per the need of the contents developed. While analyzing the qualitative data, special attention has been given to examine the cause and effect relationships of various dependent, independent and extraneous variables included in the study. Moreover, to give strengths to the findings of this study, various tables and annexes have properly been incorporated for the illustrative overview and content analysis.

2.5 Limitations

Every social research is bounded with the limitations. Time and money are the main constraints of the research work. It is an academic research for partial fulfillment of the requirements for the Degree of Master of Arts in Rural Development. As a researcher, many hardships have been facing in the study. However, a micro-level study has been done in TIS *of Mainahiya VDC* in *Rupandehi District*. Despite, the various difficulties, TIS has been viewed in a "Holistic approach" and its activities can be understood by an "Interdisciplinary approach". However, the study has not been free from its limitations, which can be shown in terms of following points:

- This study has only been confined to TIS of *Mainahiya VDC* in *Rupandehi District*. So, the findings of it may be equally applicable in all of other irrigation systems of different parts of Nepal.
- Primarily, this study has been focused on knowledge, practice, tools, culture and existing management system undertaken by the farmers in TIS operationalization and hindering factor to the smooth management. Thus, it has not covered all other aspects like women's role, cost analysis, water rights, etc.

CHAPTER THREE
LITERATURE REVIEW

Literature review is the most significant component of the previous research and study, from which the researcher gains the other's experiences and ideas. Also, it helps to gain insights on particular research issues, which assists in formulating the research problems and acknowledging the previous efforts made by the scholars, predecessors and researchers; and helps to reach in the depth of a particular subject matter. It can be a strong bridge between the previous and the present efforts to carry out the fundamental assumptions without which a research work can never be shaped. Similarly, study of literature on Farmer Managed Irrigation System (FMIS) as an indigenous management system has been overviewed to provide relevant concepts and implications of indigenous management system.

This literature review chapter presents emergence of concepts of irrigation management system and; general overview on indigenous system, farmer managed irrigation system in the global scenario and Nepal under theoretical framework on irrigation management system; and empirical studies on farmer managed irrigation system.

2.1 Emergence of Concepts of Irrigation Management System

Talking about the emergence of concepts, it is worth to study the definition of irrigation in brief that helps to penetrate into the subject matter. Monsoon rainfall provides water only for plants while irrigation is the means to nourish the crops in the process of cultivation. Irrigation is a process, which supplies the water artificially for crops or cultivated plants. On the basis of characteristics, many definitions about irrigation are drawn in different periods of time. According to the Dictionary of Geography, "Irrigation is the artificial application of water to the land in order to grow crops or improve yields."

Further more, Peter Stern (1979) in his book "Small-Scale Irrigation" has defined irrigation as "Any process, other than natural precipitation, which supplies water to crops, orchards, grass or any other cultivated plants".

Similarly, Oxford Dictionary lays down the meaning of irrigation as "The action of applying land with water by means of canals or streams, the distribution of water over the surface of the ground, in order to promote the growth and productiveness of plants".

Likewise, Rao (1945) has defined, "Irrigation includes all operations or practices in artificially applying water to the soil for growing crops. It includes also, in general sense, the conservation and storage of water supply, the carrying of water from the

source of supply to the irrigable area and distributing it to the lands. It may involve, in many cases, the development and bringing to the surface of water from the underground source by pumping or other means to the lands, which cannot be reached by gravity from the source of supply".

In sum, the researchers/scholars have given various definitions related to irritation management system in the time span. Thus, it can be said that irrigation management system is the process of supplying the necessary amount of water artificially for the agriculture production or plants.

Beside this, the previous history of irrigation and agriculture has to be scratched altogether to carryout the original facts. The history of irrigation seems to have flourished along with agriculture development as an inseparable component in human civilization.

About 13,000 years ago, the human predators and animal's preys might have come to remain in ecological balance for thousands of years. The terminal phase of the Ice Age created an ecological catastrophe in Earth. As a result, woody rhinoceros, wild ass and the whole genus of goats suddenly became extinct. The collapse of hunting culture by the Mesolithic Age, the pattern of subsistence became more diversified. By 800 BC, the New World Hunter-Gatherers started sedentary village life, which used to depend mostly on agriculture. As a result, it gave way to evolve the first human settlement and; then hunter-gatherers people started intensive farming, which helped to raise a series of technological advancement in society. Thus, horticulture or rudimentary gardening used to rely on irrigation. The fact was that the irrigated agriculture was five times more productive per man-hour than horticulture production. Therefore, the primitive people had favored irrigated based agriculture production for their livelihoods.

In the Old World, people started to establish village and about 2,000 years later, the wild plant-seeds started to have domesticated. Early people used to collect barley, wheat and wild-seeds for their subsistence. In the favorable environment, they used to get meat and vegetables nearby the settlement area and, gradually started to walk long distance in search of victims and foods. And, they started to adopt intensive agriculture as a form of horticulture characterized chiefly by technological aspects such as, using plough and hoe, improved farming, using draft animals, applying fertilizers to the land, developing irrigation and other water storage techniques. Irrigation made the land habitable or very productive and people started to settle in the bank of big rivers in parts of Mesoamerica, Southern Iraq, the *Nile Valley* and other areas. Thus, the irrigation systems had resulted access to productive land and contributed to the development of a stratified society. As a result, the significance of irrigation may have increased its intensification of agriculture production.

The history of irrigation management system of the sunken island of Atlantic had an elaboration system of canals for irrigation and it reveals a glimpse of an irrigation forming for back 20,000 years ago. Hesiod, 3,000 years ago, has said that irrigation has been practiced long before his time by the Chinese people. Rao has noted that 47,000 years ago, a clever Egyptian ruler named *Menes* turned the course of the Nile on the higher ground for irrigation purposes. The Raja of *Mysore* in India has constructed an enormous dam across the *Cavery River* in about 1,700 AD and diverted the water of the river into his kingdom. Likewise, many proofs are found that irrigation has been practiced in Egypt, Iraq, India, the Philippines and other parts of the world for the last several thousand years. The practice of irrigation management systems in China is known to have had irrigation before 2,200 BC. Famous Chinese irrigation work, *Tu-Kian Dam*, was built about 200 BC, which used to provide water for about 2,00,000 hectares of land. In Mexico, Herman Certes found an ancient agricultural civilization based upon extensive and skillful irrigation.

Nepal has abundant natural water resource but it has not been a long history of irrigation in Nepal. In the past, *Raj Kulos* (Indigenous canals) were taken into use. It is believed that feudal lords, *Amshuvarma* and *Jisnugupta*, have had constructed a number of *Raj Kulos*. Several "*Naikes*" were appointed for regulating, governing, maintenance and operations of the *Raj Kulos*. By the middle of the 12th century, the King, Shivadev, had built a dam at *Balkhu Khola* (Stream) near *Kirtipur* for the purpose of irrigation. Before the implementation of the periodic development plan in 1956, only three canals viz. *Chandra Canal* (1926), *Jagadish Canal* (1942), and *Juddha Canal* (1946) were constructed in *Saptari, Taulihawa and Rautahata* respectively.

According to geographical varieties, the various types of irrigation methods were applied in Nepal, i.e. *pynes*, terrace, well and canal irrigation. After the implementation of planning system, several irrigation projects were undertaken in the various parts of Nepal for the development of canal irrigation. Nepal's irrigation potentiality is estimated at 10,50,000 hectares in the *Terai* and 2,00,000 hectares in the Hills. The government of Nepal has targeted the development of irrigation to increase agriculture production. Out of the total 26,45,000 hectares agriculture land, only 17,66,000-hectares land can be irrigated but the recent figure shows that only 10,55,617 hectares land has been provided with irrigation facility in Nepal. The government has aimed to irrigate a total 2,49,400-hectares land and about 23 percent of the total cultivable land of the country is estimated to be irrigated by the end of the Tenth Plan (NPC, 2006:485).

In this regard, *Tinmuhani Irrigation System* of *Mainhiya VDC* in *Rupandehi District* as a farmer managed irrigation system has been undertaken to study to judge the stakeholder's knowledge, practice, tools and underlying culture in system operations. Mainly, the farmer managed irrigation systems are based in the rural areas of Nepal

and they are functional and operationalized applying local knowledge, practices and tools in a specific culture over years. In such a case, *Tinmuhani Irrigation System* is an example that prevails the farmers' real portrait.

2.2 Theoretical Framework on Irrigation Management System

Tinmuhani Irrigation System as a FMIS, mobilized by the people using local knowledge, practice and tools concerning it, reflects the relationship between the local peoples' skills, technology, methods and practice; and their adaptive patterns on the process of subsistence with agriculture production. Therefore, ecological approach would be helpful in the application of the local technology, skills, knowledge and practice of the local people in *Tinmuhani Irrigation System* related activities.

In this regard, Murphy (1977) defines as; "The theory and method of cultural ecology posit a relationship between the resources of the environment, tools and knowledge available to exploit them, and the patterns of work necessary to bring the technology to bear upon the resources".

Wittfogel's hypothesis (1957), further more, deals with, "Small-scale irrigation requires organization, and the structures of organization will be, to some extent, on adaptation to the environmental conditions of the irrigation systems".

Similarly, Fanizationorde (1969) focuses on, "Interrelationship between physical environment and social organization". In Nepal, the various systems of irrigation are launched by the government and non-government agencies but the FMISs are the most important method for subsistence and preservation of the environment.

Farmer managed irrigation system is set traditionally to maintain the local peoples' subsistence pattern adopting specific knowledge, practice, tools and culture in operating the system. Farmer managed irrigation system that covers around 70 percent, out of the total land in Nepal. To understand the FMIS, it is necessary to understand the perception of the locales towards irrigation management system related activities i.e. water acquisition, allocation, distribution and construction; operations and maintenance.

2.2.1 General Overview on Indigenous System

Indigenous systems may incorporate elements and processes from the outside world, provided the initiative for their incorporation is local (Gill, 1996:24). Thus, indigenous system refers to system generated by internal initiative of the people from within the local community on the basis of facts and logics; and it is initiated and developed by the local people for the survival of their communities and; culture is known "Other word" to be indigenous management system. It has evolved from many years of experiences and; trial and error problem solving basis by people working to meet

challenges, they face in their local environments, drawing upon resources, they have at hand for survival.

Indigenous system is an accumulative local skill, technology and methods of the people that are derived from the interaction of human beings and their environment. It is also a lump of experience, skill and technology, knowledge and practice of the people for adaptation in ecological balance that passes from one generation to another and it helps to make more creative, innovative and skillful to the people. Thus, indigenous system is initiated, derived and evolved by the local people themselves by applying easy and cheap skills, methods and technologies; and it has potential value for sustainable development. Though, it is not efficient to solve modern problems arising in the human society. However, in the recent years, the experience and importance of indigenous resource management systems have been recognized by the government and community. It, therefore, can be said that indigenous system is the forefathers of modern systems, which have been passing implicitly through generations to generations over periods of time.

The farmers, women, rural artisans, cattle herders, shamans, traditional healers and others are the sources of indigenous system in Nepal. Thus, indigenous system appears to ensure livelihoods of the rural people as the primary stakeholders and beneficiaries of *Tinmuhani Irrigation System* that reflects fundamentally the indigenous system practiced for the mobilization of the local resources using the skill, method, technology and practice to regulate the system.

Nepalese farmers do not have adopted the official recommendations on the use of indigenous resource management systems. Even the majority of the Nepalese farmers have been using indigenous system on their day-to-day lives. They experiment themselves and apply that method in the process of using indigenous system. Farmers' knowledge, skills and experience resulted from years of observation, experience, trial and error imposed by the need to survive with the available resources under the various stressful and unfavorable environmental conditions (Budhathoki, Gurung and Lohar, 1996:82). Therefore, indigenous system is people friendly, which is appropriate for sustainable development and method of usage is very easy.

Farmers' knowledge, practice, tools and organizational skills facilitate the creation of effective farmers' organization for irrigation management system. So, they are capable of using own skills and organizations to incorporate their knowledge and practices in irrigation management system. Thus, indigenous irrigation development is essential to intensify agriculture production in Nepal and it can accomplish the farmers' participation in the program. Some farmers managed irrigation systems have demonstrated that farmers are capable of creating an extensive and complex organization for managing their systems.

From few years ago, some scientific literature has emerged on the subject matter of indigenous system, method, knowledge and practice. After 1980s, scholars, anthropologists, sociologists, economists, historians, government officials, development activists, development planners, foreign scholars and researchers from the various disciplines in Nepal have been focusing their eyes on the scope of indigenous system and its role in the sustainable development. In fact, indigenous system is precious stuff with priceless value in any of the development arenas. In a way, on the process of adaptation and livelihoods in the specific environmental condition, local people use their knowledge, skills, experience, efforts, costs, tools, technology and methods in management and utilization of various types of resources on trial and error basis passing from generations to generations with facts and logics in an easier and practical way.

In this regard, *Tinmuhani Irrigation System* is an example of indigenous irrigation system that is constructed, operated and maintained by using the cheap, easy and local methods, knowledge, skills and practice over years in a specific culture.

2.2.2 Farmer Managed Irrigation System in the Global Scenario

The past observation on farmer managed irrigation systems (FMISs) as indigenous irrigation systems are undertaken in the context of the world in sustaining the environment and development work at global and local levels by mobilizing the local resources and labors; and skills, methods, technology and practices on the process of survival in natural conditions.

As a component of development, development workers focusing on some aspects of social organization or culture have produced information based on FMIS. Geertz (1967) uses the Balinese Subaks of Indonesia and Petter (1975) uses the *Muang-Fai Systems* of Northern Thailand as vehicles for understanding important principles of rural organization. The Hunts (1974) employs irrigation to understand political powers and processes in Mexico. Lewis (1971) examines irrigation groups in the Northern Philippines to explore issues of habitat and social organizations. Leach (1961) looks at irrigation in Sri Lanka while pursuing his basic interests in kinship and social organization, and Mitchell (1976) studied irrigation in Peru as a part of his analysis of political and ritual life.

Can we develop small-scale irrigation without destroying indigenous management capacity? (FMIS published by IIMI, June, 1992). To clarify the above-mentioned question, some comments are undertaken on the development of indigenous management system for small-scale irrigation in Morocco and Swaziland.

The farmers' knowledge of the local situation has to be utilized for "Sustainability" of the farmer managed irrigation system. Programs designed for these irrigators face the

dilemma that intervention should be counter-productive for reinforcement and various issues are explored from Africa, the traditional systems of the Atlas Mountains in Morocco and the other in Swaziland.

Lees (1974), Goldring (1985) and Hunts (1986) studied government strategies toward farmers-managed system in North and Central America providing assistance for "Improving" systems. Lesswell studied the process of government assistance to farmer managed systems in the United States, especially such as, New Mexico, Colorado and Utah. Maass and Anderson (1978) have written on systems in Colorado and Utah as part of their analysis of irrigation organization and performance. Thompson (1984) is presenting irrigation organization and its performance. Thompson (1984) is presently undertaking a research project to understand the various forms of financial assistance provided to farmer managed systems in the Western United States.

Ssennyonga (1983) carefully analyzed traditional furrow systems in a region of the Rift Valley and discussed regional development and Fleuret (1985) has examined on farmer-managed systems in the *Taita Hilly Region* of Southern Kenya.

The *Thana Irrigation Program* (TIP) of Bangladesh launched in early 1970s was an extensive effort of government to create new farmer managed irrigation system. TIP's design was based on "Experimental" work at *Comilla* in which the field staff designed and tested approaches for introducing tube wells and low lift pumps through village co-operative societies.

Patil and Kulkarni (1984) studied farmer managed *Phad Systems* in *Maharastra* in India that is affected by government assistance but extensive research has been done on the tank systems of *Tamil Nadu*, which are the subjects of a major "Modernization" as well as tanks of other areas in south India.

Van Furer Haimendorf (1980) studied about farmer managed irrigation systems in *Arunachal Pradesh* in India. Coward (1986) has mentioned that small irrigation systems are numerous in the *Himalaya Region* but there have been few studies of these systems in India. Joshi (1982) has written about an innovative project to the *Siwalik Hills* near *Chandigarh.*

Wilkinson's (1977) study of irrigation systems in Oman represents irrigation ethnography. His research purpose is to understand irrigation systems and resettlement forms of larger historical processes of political control and he discusses the local irrigation systems of central Oman and it is said to be "*Falaj*".

Taillard's (1972) study of traditional irrigation systems in Northern Laos is a prominent example of irrigation ethnography, which gives the geographical setting, the types of apparatus used to acquire and distribute water; and features of the social organizational arrangements for handling water distribution.

Grader's (1960) study of Balinese *Subaks* in the region of *Jembrana* is straightforward description of the "Ideal" organization of *Subaks*, tending in the *Subak* board; *Subak* services and levies, *Subak* religious activities and *Subak* regulations. He describes the hiring of tunnel diggers by the traditional district government official for coordinating *Subak* affairs (*Sedahan Agung*). After the tunnel digging, the lands would be irrigated. Irrigation ethnographers typically uncover the considerable complexity of technical and institutional arrangements developed in a farmer managed system.

Farmer managed irrigation systems were reviewed about colonial compilation and development descriptions of irrigation systems but, in which irrigation is incidental to the issues being studied. Irrigation ethnographies that describe how existing farmer managed systems operations and development oriented studies, having examination of farmer managed system programs for assisting farmer managed systems transforming autonomous farmer managed irrigation systems, are dependent on government actions, resources and staff and forcing a standard logic of operations on farmer managed systems.

Water Users' Associations (WUAs) have vital role for the operations and maintenance of the systems and beneficiaries are involved in operations and maintenance activities, which shows the role of stakeholders in the irrigation system. Castes and ethnic groups are also determinants for irrigation management activities. Women are also having active involvement for the management of irrigation system.

Traditional irrigation systems in South Sumatra of Indonesia are dominant in farmer managed irrigation systems. A pilot project was conducted in Indonesia by the Department of Agriculture to assist the farmer managed irrigation systems and was funded by the United States Agency for International Development (USAID) and the Ford Foundation. As a result, the Department of Agriculture was authorized to deal only with the community organizers; were fielded both in government managed irrigation systems and in farmer managed irrigation systems, or what are usually referred to as traditional irrigation systems.

Development-oriented irrigation studies are either external involvement in farmer-managed system or studying farmer managed system for the purpose of making development recommendations.

De Los Reyes and colleagues (1977) in the Philippines have studied in close collaboration with the National Irrigation Administration (NIA) to develop or more participatory style of government assistance to farmer managed system, called "Communal". The study was based on a survey of a national sample of communal, which helped to carryout other development oriented work on farmer managed systems.

Frutchey (1969) studied the activities of people's irrigation systems in Northern Thailand to better understand the institutional aspects of irrigation development. Pasternack (1972) and Vander Meer (1968-1971) studied irrigation development activities in Taiwan provided the setting for development-oriented studies. Vander Meer's work caught the transition from formerly independent farmer managed systems to government systems but farmers remained significant managers.

Traditional irrigation systems are developed in *Lahat* in South Sumatra and it is most important because of the following reasons. First, the systems are traditional ones, which are fully managed by the farmers. Other projects, which are community organizers, are government irrigation systems. Second, in this project, construction is low by "*Swakelola*" (Agency force account), in which the farmers, through their local irrigation committee (*Panitia Siring*) act as contractor. In other projects, a private contractor is normally engaged. Third, even though, the government is investing in the development, the irrigation systems remains the property of the farmers, after construction is completed.

Customary water allocation, canal operations and maintenance system have been in existence for many years. A participatory strategy was undertaken in the planning and construction of the rehabilitation, operations and maintenance of the canal. "The *Swakelola*" strategy was also applied through indigenous organization to implement their irrigation systems. To utilize the farmers' experience in developing irrigation systems, their participation have to be implemented and the institutional strategy as the pilot project systems, which are created by the farmers also, is to be implemented, the *Panitia Siring* already exists.

The above-mentioned facts prevail that there are a lot of evidences in the various regions of world reflecting examples of farmer managed irrigation system in an indigenous way, which are context and place specific.

2.2.3 Farmer Managed Irrigation System in Nepal

Nepal is regarded as a "Water Rich" country. The spatial and temporal distribution of Nepal's water resources create surpluses at some times and places; and shortages at others. Surpluses occur at many places along hill and mountain water resources. Many of the small streams in the hill and mountain districts have fully been exploited

and utilized by the farmer managed irrigation systems. The larger rivers, however, are so deeply incised that the only means of exploiting their water resources would be via costly lift irrigation systems.
The wide range of studies on farmer managed irrigation system in the rural communities of Nepal has revealed their importance in irrigation development. Farmer managed irrigation systems resemble indigenous water resource management for subsistence of the local people, which involve system operations, system maintenance and water allocation. Farmers make decisions regarding the use and management of irrigation based on their knowledge, practice and culture because irrigation is vital for both survival and culture. Gradually, the norms, values, rules and roles relating to irrigation management system have evolved in the mind of the Nepalese people. The farmers have collectively and individually devised, decided upon, designed, constructed, planned, implemented, maintained and improved indigenous systems for the management of irrigation system through many centuries.

Many instances of irrigation activities are already farmer managed irrigation systems in Nepal. More productive question is, why the existing irrigators do not upgrade the system? The relevant answers include lack of knowledge and practice in the related field. To ensure success, the various agencies are working with existing social institutions. Because of the community management systems, the operations of new social and economic environment could have the negative effect. However, the existing arrangements related to irrigation were designed, constructed, operated and maintained by the local farmers. As modern agencies and institutions dominate the local knowledge and technology by the financial and technological help. So, to promote the FMIS, the fundamental framework of FMIS has to be established to sustain it in the local context.

The water resources of the Smaller *Terai Stream* are fully exploited by existing irrigation schemes, generally, farmer managed irrigation schemes and; the medium and major irrigation projects are overlapped by the farmer managed irrigation systems in the *Terai*. Irrigation development projects in Nepal are, especially centralized in the *Terai Region* because of the huge mass of land, high potentiality of agriculture production and down flow of the big river.

Rajpur Irrigation Project located in the plains of Western Nepal is one of the largest farmer managed irrigation systems in Nepal. Before hundred years, building of the *Burhi Kulo Irrigation System* was started to construct from the *Karnali River* at the initiative of the *Tharu Community Leaders*. Therefore, *Tharus* are called "Born Irrigation Engineers (BIE)". The present government policy of Nepal for irrigation development has made to participate the beneficiaries in farmer managed irrigation system and well responsibility of operations and maintenance is given to the farmers because of the limited resources and a ceiling on the cost of the rehabilitation has to be fixed. The

issue has talked in how to assist farmer managed irrigation schemes without damaging their capacity and self-reliance. Irrigation systems in Nepal have become sources of communal unity and harmony. In a homogenous ethnic society, the working of irrigation associations has to be effective. Government intervention in rehabilitation or modernization of farmer managed irrigation system has created a dependency. Nearly one third of the *Rajpur Farmer Managed Irrigation Systems* is occupied by the external ethnic groups migrated from hills and purchased from original inhabitants (*Tharus*) (IIMI, 1992:4).

One of the most important examples of farmer managed irrigation system is *Chhattis Mauja*. Before 150 years, the permission of construction of canal was given to *Jetha Tharu* from the Tinau River in Butwal and linked with the *Kumari Village*. Then, the *Chhattis Mauja Irritation System* came into existence as large sized farmer managed irrigation system, which was designed to serve *Chhattis Maujas or Village*s and it is also called "*Kumari Irrigation System* (KIS)", for it served the *Kumari Village* in the beginning. The water users are participating in the decision-making process concerning water management. The farmers to manage the system form a three tiers organizational structure. This committee especially had to be active in the monsoon paddy cultivation. If the users do mistakes, they are given punishment in cash and kind to maintain irrigation system properly. In the farmer managed irrigation system, the farmers have to work to acquire and distribute water themselves in agriculture production. Beneficiaries of the *Chhattis Mauja Irrigation System* are expected to provide labors to operate and maintain irrigation system. The water is allocated and supplied according to demand of the farmers/users. Conflicts occurred in the system are solved through the democratic way using participatory tool.

The *East Rapti Irrigation Project (ERIP)* in *Chitwan District* of Nepal represents the original plan of agency intervention conceived with disregard for existing farmer managed irrigation systems within the command area and had to be modified as a result of intense pressure from farmer groups and environmentalists. The proposed diversion across the *Rapti River*, which has been environmentally detrimental to the *Royal Chitwan National Park*, was cancelled for rehabilitation and improvement of existing farmer managed irrigation system and strengthening of Water Users' Associations (WUAs). Process documentation of the East Rapti Irrigation Project is a social science method developed out of the wider paradigmatic shift that has been taking place over the decades or in many disciples. The new shift reflects a wider acceptance of the developmental premises among farmers.

Tamai Farmer Managed Irrigation System is located in *Jyamirgadi VDC* of *Jhapa*, a *Terai District* in Eastern Development Region. This farmer managed irrigation system has a history of twenty years. The form of organization was an irrigation construction committee, a group of farmers, who would mobilize the local resource to operate

and maintain the system. The farmers operated the system by mobilizing the local labor as per the requirements. The objectives of *Tamai farmer managed irrigation system* include construction of a permanent diversion weir and intake structures and support and; training to farmer to organize into functional and viable association in preparation for the efficient operations and maintenance of the irrigation system.

The various irrigation management and organizational structures of irrigation systems are existed for operations and maintenance of the system having the specific knowledge and practice; and technology in the hill irrigation systems. Thus, organizational set-up of irrigation systems helps to promote knowledge and practice, technology and skills in the mind of the common people. So, the FMIS is found to be more relevant to irrigation development and management in Nepal.

The farmer managed irrigation systems located in the hills need to be enhanced through better management practices and there had been constructed, managed and operated by local farmers from traditional ways. Due to the weak organizational ability of WUCs, the government assistance is sought for operations and maintenance. Given scientific training on irrigation management system, the farmers' own repertoire of local knowledge and skills; and irrigation management and legal recognition of WUCs, small irrigation systems could be better managed to obtain higher agriculture yields.

In general, hill schemes require higher subsidy rates than *Terai Schemes* to generate comparable financial return because of variation on comparative advantage production. This exists possibility to provide differential subsidy rates at least across ecological belts in order to ensure balanced distribution of investment opportunity across ecological belts and geographical regions. So, for FMIS subsidy policies are formulated and implemented on trial basis. Policies formulated in 1985 and amended in 1989 AD and 1992 AD have taken neither of these issues into account. The optimum subsidy rates that make investment in FMIS financially and socially attractive has been worked out and possibility of providing differential subsidy rates for investment on FMIS across ecological belts has been explored and utilized for the system operationalization.

In *Kavre District*, eleven basins and *Kulos* are undertaken for the study as the farmer managed irrigation systems. These were made in the bank of the *Indrawati River*, the *Sunkosi River*, the *Roshi Khola* and the *Bagmati River* basins and other tributaries are also taken as the FMISs using the local resources as well as skills, technology, methods and practices for the mobilization of the system.

Palpa District was also taken as the study area; where twenty-five basins and *Kulos* were remained in the study of farmer managed irrigation systems. Many basins were

made in the side of the *Kali Gandaki* and the *Tinau Khola* Rivers were constructed from the rivers to irrigate in the river basins. Therefore, the beneficiaries of the systems have been adopting local knowledge, skills, methods and technology for the operations and maintenance at local level.

In *Surkhet District*, many irrigation basins situated in the sides of many small rivers were taken as indigenous irrigation systems. All most thirty-six basins and *Kulos* are there nearby the side of the *Karnali River*, which carry out the importance of the farmer managed irrigation systems. Small tributaries are mixed with the *Karnali River* and the basins and *Kulos* are constructed by the side of this river to irrigate in the river basins for agriculture production adopting indigenous resources as well as knowledge, skills, technology and practice (IIMI, 1995:5).

Tara Khola in *Baglung District* is an example of FMIS. Despite, voluminous water flow during the monsoon, Tara Khola has never changed its course and damaged any farmland or population settlement all the way down to *Ridi*. Instead, it has created vast stretches of fertile fields from about 10 Km. below the village and irrigates them in all seasons for a variety of agricultural productions, mainly in the river basins, mainly in the river basins.

Like that, the *Chherlung Thulo Kulo* and *Argali Raj Kulo* Irrigation Management Systems, which are the examples of FMISs, have been undertaken into study by Martin (1986) and Yoder (1986). In the *Chherlung Thulo Kulo* and the *Argali Raj Kulo*, water allocation was managed in proportion to size of handholding in the command area. Water allocation and distribution was undertaken by the means of *Saanchos*. Operation, water acquisition, water allocation, water distribution, resource mobilization, decision-making and conflict resolution of the *Chherlung Thalo Kulo* and the *Argli Raj Kulo* were handled with an organization forming of *Mukhiya, Sachiv, Pale Thekne, Pahiro Janchne* and *Pani Janchne*. Everyone has their own duties to maintain systems in a proper way.

Arubote farmer managed irrigation system is located in *Devpur VDC* of *Kavrepalanchowk*, a Hilly District in Central Development Region. The local farmers constructed this irrigation system more than two hundred years ago. The local water users under an informal organization had operated this FMIS. *Arubote Irrigation System* was managed by informal farmers' organization. However, farmers were not able to tap it. The WUAs were designed to achieve the objectives of farmers' organized participation in planning and construction of the irrigation systems, and accepting full operations and maintenance responsibilities of irrigation water upon the completion of construction and mobilizing local resources for sustaining improved management system. *Arubote farmer managed irrigation systems* were organized to external agricultural production as they faced the problems of getting necessary credit,

fertilizers, pesticides, and storage and marketing facilities. In the case of identified FMIS, similar estimation cannot be made with the level of information available at present. Only highly generalized and tentative indications can be made based on the few available relevant studies and on limited local knowledge and experience of FMIS. Such indications are required to allow some master planning assessment to be made with respect to potential improvements to farmer managed irrigation system.

The cost of FMISs investment is significantly different in the Hills and the *Terai Regions*. Investment cost in the hills is almost double than in the *Terai*. There is differential subsidy rate to across ecological belts due to the geographical varieties to implement FMISs.

The Water Use Inventory (WUI) of the *Andhi Khola basin* conducted under the supervision of the Water and Energy Commission Secretariat (WECS) in 1991 indicated that, in the *Andhi Khola basin*, there are 157 irrigation systems providing irrigation for 2,268 hectares land. All the irrigation systems in the river basins are Farmer Managed Irrigation Systems (FMISs) and they are rehabilitated by NGOs, INGOs and government agencies for the mobilization of the irrigation system.

Small Farmer Managed Irrigation Systems (SFMISs) have operated successfully in the Hills and Mountain Area of Nepal for centuries. There is a large expenditure of labor every year to restore the system or to maintain them. In spite of these limitations, FMISs have demonstrated impressive managerial skills that have kept them functioning and contributing to Nepal's food supply (IIMI, 1989:17).

Research issues include the effects of changes in the socio-economic environment on the viability of farmer managed irrigation systems. These systems have been able to adapt to environmental changes. Integrating into regional and national economic systems isolates self-sustained communities. The various rapidly changing forces are being brought to bear on the irrigation organization.

In this regard, *Tinmuhani Irrigation System* is included in the *Terai Farmer Managed Irrigation System* situated in *Mainahiya VDC* of *Ruapandehi District* of Western Region. Because of the inaccessible plain area of Nepal, the new technology and the government assistant have not reached there. Therefore, the local resources are mobilized on its own way in terms of construction, operations and maintenance by using the local skills, technology, methods and practice for preservation, promotion and sustainability of the irrigation system.

2.3 Empirical Studies on Farmer Managed Irrigation System

Today's human setting is a result of the basin's settlement pattern in ecology and the ensuring human development in the various aspects and use of the land and the river system in farmers managed irrigation systems as irrigation system management.

The role of Farm Irrigation and Water Utilization Division (FIWUD) extended into the development of small gravity irrigation system in the hills. Farmers in each system have developed an organizational structure that fits the needs of their system in its particular environmental setting. The structure has evolved over many years and continues to change. Some organizations are very sophisticated and organized; and have a written constitution, well-defined roles and responsibilities; and paid functionaries.

The important strengths of farmer managed irrigation systems in Nepal are set up based on local resources and they have ability to respond for maintenance with well-defined rules, roles and organizations for operations, maintenance and mobilization. Unreliability of the physical structures is existed in the farmer managed irrigation systems because of environmental instability resulting form floods, landslides and soil erosion. Most farmer managed irrigation systems are well managed institutionally but operation is below their potentiality because the government of Nepal also has identified farmer managed irrigation systems to expand in a broader way and intensify irrigation development in the country.

After 1983 AD, the various agencies have been established for improvement, rehabilitation and expansion of farmer managed irrigation systems. The government to create suitable policy recommendations to support farmer managed irrigation systems has introduced numbers of policy reforms. National plan of the government has the policy of self-sustaining development of local governments, private organization and users' associations in irrigation development. The government irrigation policy has emphasized on long-term irrigation development that seeks users' participation and its policy gives the legal recognition on the construction and improvements of the farmer managed irrigation systems. After the completion of construction and rehabilitation work, users take over the operations and maintenance of the systems on their own way.

Farmer managed irrigation systems reveal locally adopted knowledge, practice, tools and culture in irrigation management related activities, i.e. water acquisition, water allocation, water distribution, resource mobilization and conflict management.

To observe farmer managed irrigation system at local level, certain organizational systems and water use activities have to be undertaken for the creation, maintenance and preservation of irrigation system existed prevalent in Nepal. Understanding the

institutional and organizational management for a few irrigation system are facilitated by a matching of the basic concepts of rules, roles and groups with the fundamental tasks of allocation, maintenance and conflict management for the system operations.

The various attempts on irrigation management systems deal with the key organizational and water use activities relating to indigenous irrigation management systems and local institutional arrangements and such irrigation systems do not have any relations with the state and governmental agencies. The patterns of interaction and institutional arrangements are shaped by local interactions and negotiations among the people. So, institutional arrangements, organizational processes and technologies of the local people for irrigation management system are retained as an indigenous irrigation management system.

Nepal is a country where the majority of people depend on farmer managed irrigation systems. For several centuries, farmers in Nepal have come adopting the land and water resources of the country for irrigated agriculture. Some of the farmer managed irrigation systems have come performing to meet the basic needs of Nepal's growing population. Farmer managed irrigation systems in the recent years could be employed to improve the value of assistance being given to improve and expand these systems. Some farmer managed irrigation systems are assisted by the various projects and they conduct their work jointly collaborating with the systems. Farmers' participation in the design and implementation was mandated to ensure the operations and maintenance. System built and managed by farmers in diverse environment exhibit a wide range of management capacities. Because of the awareness programs of assistance by government agencies intended to make the system productive and sustainable.

Farmer Managed Irrigation Systems (FMISs) were developed in the *Andhi Khola Basin* before the unification of Nepal by the *Prithvi Narayan Shah*, the great. They have played vital role in irrigated agriculture. Before 1923 AD, there was completely farmer managed irrigation systems, no state or agency managed irrigation system, FMISs' main characteristics are that they are built by the farmers and; operated and maintained by themselves with little help from state. The institutional weaknesses and environmental problems as well as the required improvement works may not be within the financial capacity of the farmers necessitating outside assistance. Nepalese FMISs have existed on self-help basis. An extensive assistance program "Fulfillment of basic needs" includes improvement, rehabilitation, extension and renovation of the FMISs.

Irrigation systems, which are found in Nepalese farmer managed irrigation systems, depend on many factors. Some factors such as, rehabilitation and expansion of the system, accommodation of new user’s equal respect and treatment, water

distribution process, maintenance of systems, participation of users in the management, involvement in decision-making conflict resolution, etc. are dominant in irrigation management systems.

For centuries, small farmer managed irrigation systems are operated in the Hilly and Mountainous Areas of Nepal. Larger expenditure of labor enforced to restore or maintain the systems. Therefore, FMISs have demonstrated impressive managerial skills functioning and contributing to Nepalese peoples' food necessary.

IIMI is one of the most important agencies to have research on farmer managed irrigation system. It is collaborating with the Water and Energy Commission Secretariat (WECS) of the Ministry of Water Resources to develop processes for assisting farmer managed irrigation systems (IIMI, 1994).

Nowadays, governments are giving more attention to the farmer managed systems. Farmer managed systems are being subsumed under the mandate of Department of Irrigation. Water users have pressured to increase the involvement of government in farmer-managed systems. The significant increasement of government involvement in farmer managed systems has raised several important and inter-locked consensus for imposition of inappropriate planning, design and operational criteria; and increased concern for escalating costs of both construction, operations and maintenance work.

In Nepal, the hill ground and surface water schemes are *Chhinchu* and *Seldata* and the *Terai Water Schemes* are *Siyari* and *Udain*, which are conducted by the various caste/ethnic groups for the construction, operation and maintenance of the system. Farmer managed irrigation systems are to be supported by social assessment for improvements and modernization (IIMI, June, 1995).

The government of Nepal also has declared policy to preserve and promote irrigation management system by activating the farmers' participation in the various irrigation programs. The main objectives of irrigation policy 1992 AD are to sustain irrigation development and environmental protection. In the various aspects of irrigation, the farmers have to be given opportunities to use their knowledge, skills, experience and technology in irrigation development. Irrigation systems in which farmers take overall management responsibility, a continuous basis and control the water from resource to disposal of access as drainage, are referred to farmer managed irrigation systems.

Farmer managed irrigation systems, in general, have self-sustainability and more effective then agency managed irrigation systems. Greater self-sustainability and effectiveness of these systems have been attributed largely to more effective mobilization of local resource for their operation and maintenance, and well defined right to water use.

In farmer managed irrigation systems, the control is completely in the farmers' hands and the water distribution is practiced in the rotational way. In farmer managed irrigation systems, the beneficiaries' participation in decision-making is called to address particular problems through periodical meetings of the beneficiaries for the use of the farmers' indigenous knowledge and practices; and skills in deciding a particular design, shape and size. Therefore, they should be encouraged to utilize irrigation technology, skill, knowledge and practice in agriculture production effectively.

For many centuries, farmers in Nepal have been constructing farmer managed irrigation systems for controlling water at their own initiative by a religious trust, an individual, and a community effort. As a result, "*Chandra Nahar*" constructed in 1923 AD and "*Raj Kulos*", having state patronage, were constructed using local technologies, which were managed by beneficiaries. Though, the Government of Nepal has not played vital role in indigenous irrigation development. Farmers' involvement in the development, operation, and maintenance of irrigation system have given birth to farmer managed irrigation systems scattered all over the country. The local administration and the legal tradition have permitted farmer managed irrigation systems to operate without interference from governmental administration and government irrigation agencies. The community undertook the responsibility of indigenous irrigation management system and conflicts relating to irrigation were also to be resolved by the community themselves.

Thus, the farmer managed irrigation systems are like living organisms. They continually change in relation to the changing environment, resource endowments, and; economic and social changes. Because the environment is not static, the irrigation organizations have to be dynamic to meet the challenges created by the socio-economic, physical, technological, political and demographic conditions in terms of farmer managed irrigation systems operations.

The water users' local perception in existing farmer managed irrigation system must be recognized and incorporated in the development process. The farmers' knowledge and practice, experiences, expertise and skills are to be utilized in irrigation development and organization. So, they are known to be as engineers, community organizers, experts, and consultants in the various development sectors. Peer training and farmers to farmers' exchange programs are carried out having the intention of tapping the farmer managed irrigation systems based on organizational and institutional arrangements. As a result, the government of Nepal also has carried out the policy to involve farmers as real partners in irrigation development.

In fact, the indigenous irrigation management system, in general, throws some light on farmer managed irrigation system practiced by the local people in different places of

the world exploiting local tools and technology for subsistence on the basis of socio-cultural values and norms. The process of farmer managed irrigation system related activities has helped to utilize and sustain the local resources and system in practice applied by the locale. Traditional system does not meet the necessity of the people. So, facts from the traditional system have to be grasped to push up the indigenous system forward.

Therefore, the present study reveals the holistic approach to generalize indigenous system practiced by the people in *Tinmuhani Irrigation System* on the ground of socio-culture. Similarly, it differs from the past studies and provides socio-cultural approach to assess existing farmer managed irrigation system as an indigenous irrigation management system on the basis of exploitation and utilization of the local methods, tools, technology and resources. It helps to visualize the cultural importance of indigenous irrigation management system and gives indigenous insights to comprehend irrigation development and management system. Cultural approach is taken into use to understand perception, knowledge, skills, methods and socio-economic and socio-cultural aspect rooted in the society. Along with knowledge and practices of the people, this study helps to investigate the rooted culture in the operations of *Tinmuhani Irrigation System*, the process of institutional development and new findings regarding indigenous system of the rural people related to farmer managed irrigation system in practice.

CHAPTER FOUR
DESCRIPTION OF THE STUDY AREA

The chapter four, description of the study area, *Tinmuhani Irrigation System* of *Mainahiya VDC*, discusses about physical setting, change and development, economic and social setting and infrastructure development. Physical setting discusses on location of the study area, topography and environmental condition. Similarly, climate, land use pattern and water resource have been discussed under environmental condition. Change and development talk about change and development process and migration pattern. The sub-chapter economic and social setting has been divided into economic setting and social setting. Mainly economic setting discusses about land status, cropping pattern, variety of paddy, well-being status, animal and livestock species, castewise occupation and human resource, tool/implement and natural resource. Likewise, social setting discusses about population, ethnic composition, educational status and types of family. And, the fourth, sub-chapter, infrastructure facilities come with tangible product initiated by government, non-government and local community.

4.1 Physical Setting

This sub-heading, physical setting, discusses location, topography and environmental condition of the study area.

4.1.1 Location of the Study Area

Mainahiya VDC lies in the middle of *Rupandehi District* in the western region of Nepal and it is about 8 Km. far from the District Headquarters, *Rupandehi*. It is bordered by *Tikuligadh* and *Chiliya VDCs* to the east, *Harnaiya VDC* to the north, Kamariya VDC to the west and *Hatti Bangai VDC* to the south. The research site, *Tinmuhani Irrigation System*, is located on the northern belt of the VDC at the elevation of 100 m. The northern, middle and southern belts of the VDC is covered with agriculture land with unevenly scattered settlement pattern of the *Madhise* and *Pahade* people and; somewhere cluster settlement pattern of *Tharu* people has been existed.

4.1.2 Topography

On the basis of ecological variation, *Mainahiya VDC* is located in the *Terai* region of Nepal. It is totally an agriculture-terraced land with plain areas. The average altitude is 100 m. from sea level. The VDC consists of similar topography all over the VDC. Structure of VDC resembles rectangular. It is surrounded with plain lands from all the directions. The major settlements are existed in the plain land and small villages where agriculture practice is carried out for subsistence. Soils are deep and well drained and are used for arable agriculture. Therefore, the VDC possesses similarity in topographic feature, where abundant natural resources are available, which can be applied either in irrigation or in other sectors.

4.1.3 Environmental Condition

This sub-component under physical setting presents climate, land use pattern and water resource of the study area.

4.1.3.1 Climate

Mainahiya VDC has hot climatic condition with an average temperature 30-35° C due to the altitudinal similarity in all areas. It has a mix of temperate and hot climate with warm summer and cool winter with deadly cold wave; and heavy rainfall during the monsoon and dry during the winter. Because of fragile environmental condition and low agriculture production, the people, in this area, are sparsely inhabited to fulfill the scarcity of resources needed in the daily life.

Both winter and summer seasons are hectic for the people of *Mainahiya VDC* because the heavy rainfall damages land mass in the rainy season and cold wave causes the death of old people and little children. Not only that The *Tinau River* cuts the river banks every year damaging agro-products lands. In the change of life pattern, most of greenery is encroached by the people that cause bad consequences in climate change.

4.1.3.2 Land Use Pattern

The total land area of *Mainahiya VDC* is 2310.46 hectares. Land-use pattern of this VDC can broadly be divided into forestland, rain-fed cultivated land, shrub land, irrigated land, barren land and landslide area. These land-use patterns cover 1143.47 hectares, 627.78 hectares, 245.45 hectares, 187.97 hectares, 94.10 hectares, 8.19 hectares and 3.5 hectares land area comprising of 49.49 percent, 27.17 percent, 10.62 percent, 8.14 percent, 4.07 percent, 0.35 percent and 0.16 percent respectively. The huge agriculture land covers the largest area and the landslide area covers the least area in the riverbank. The physical, socio-economic and cultural factors as well as the altitude have determined the spatial land-use pattern.

4.1.3.3 Water Resource

Tinmuhani Irrigation System of *Mainahiya VDC* is the major source of water in this VDC and is used for irrigation. *Tinmuhani Irrigation System* flows down to the northern belt of *Mainahiya VDC* and northern part of *Kamariya VDC*. There are also many small canals of water: dip well, boarding, pond of water and damp for drinking and feeding water to the domestic animals. The rain-fed reserved water of the pond is used for drinking and feeding to the cattle. However, water resources are utilized for subsistence exploiting the local technology that is sustained in the local environment. Water resources in this VDC are depleting, according to the local people, due to the deforestation and unnecessary land encroachment.

4.2 Change and Development

This sub-heading discusses development process and migration pattern of the study area.

4.2.1 Change and Development Process

In the time span, big change has occurred change in the thought and developmental activities in their self-initiation and enforce by the governmental and non-governmental agencies. Socially, people are becoming more liberal and generous. As a whole, gradually community has been proceeding ahead in support of government, non-government and self-initiated efforts. Government offices like DDC, VDC, sub-health post, veterinary office, post office and *Gramin Bikash Bank* have been working in this VDC. Beside that, non-governmental agencies like World Vision, *Seto Gurans*, family planning association of Nepal, partnership for new life, *Indreni Rural Development Center*, *Namuna,* local development fund and participatory district development project have been working for social and economical development of the community.

4.2.2 Migration Pattern

The migration takes place in the research area is of temporary and permanent nature. Because of slack agriculture production, the males of a few households migrate to the cities of India and gulf-countries (*Saudi Arab, Kuwait, Baharain, Quatar, Oman* and *Dubai*) to maintain their own and family's survival. Nowadays, the tendency of young generation going to the gulf-countries as labor workers is rapidly increasing. Some of the households of the *Brahamin* and *Chhetri* communities have been migrated to the *Terai* for the permanent settlement. Nowadays, other castes' people are also migrating to this VDC.

4.3 Economic and Social Settings

This sub-heading has been divided into two components i.e. economic setting and social settings.

4.3.1 Economic Setting

Economic setting consists of land status, cropping pattern, variety of paddy, well-being status, animal livestock species, castewise occupation and human resource, tool/implement and natural resource of study area.

4.3.1.1 Land Status

Land, which is supposed to be the symbol of political, social and economic prestige in the research area, is considered to be an important immovable property. Total 110 beneficiary households are owners cum cultivators of the land. All of them work in their own lands. During the transplantation and harvesting reason of crops, rich people hire laborers on daily wage basis. People of economically well status have

come keeping regular laborers to handle their daily household chores and agricultural activities. The land is mainly categorized into two types i.e. *Khet-land* (Low land) and *Sukkha Land* (Barren land). Because of the marshy land, paddy is predominantly cultivated in the *Khet-land* and the barren land is kept open as grazing land. Farming system in the research area is practiced applying both the local and modern technologies for the survival on the basis of long time trial. Thus, due to the possibility of availability of water from *Tinmuhani Irrigation System*, trees and forests have been swept away by the local and newly migrated people and made paddy land.

Table 1
Landholding Pattern

Caste	Size of Land (In *Bigha*)	
	Khet-land	
	No.	%
Tharu	180	52.94
Madhise	93	27.35
Brahamin	28	8.24
Chhetri	4	1.18
Pahadi Janajati (Magar, Gurung, etc.)	20	5.88
Dalits (Dhawal, Kami, etc.)	15	4.41
Total	340	100.00

Source: Field Survey, March 2008.

In the table above we see that the average Khet-landholding per ethnic groups in the research area is 56.66 percent in which the *Tharu, Madhise, Brahamin, Chhetri*, *Pahadi Janajati (Magar, Gurung*, etc.) and *Dalits (Dhawal, Kami*, etc.) people comprise of 52.94 percent, 27.35 percent, 8.24 percent, 1.18 percent, 5.88 percent and 4.41 percent respectively. Among all the ethnic groups, the *Tharu* people hold greater percentage of the *Khet-land* and the *Chhetri* people hold the lowest percentage. Thus, *Brahamin* people have been possessing greater percentage and the *Chhetri* people have been possessing the least percentage. In the research area, people, who have been holding the *Khet-land*, are supposed to be men of well status in the society. Also the above figure shows that the *Tharus* are the major groups in the research area.

4.3.1.2 Cropping Pattern

People in the research area have been planting summer maize, summer paddy, soybeans, beans, yam, cucumber, pumpkins, peas, potato as well as winter wheat, leguminous crops, winter wheat and oilseed in the middle and ridges of the *Khet-land*. Out of the total population, 80.32 percent people depend on agriculture activities for livelihood. Similarly, economically active people in the VDC cover 67.44 percent (District Profile, 2007). Agriculture works and practices are done almost round the year and irrigation works in the study site are undertaken in the summer season at

the time of seed sowing and harvesting of paddy and wheat planted in the winter is also irrigated twice or thrice in the *Khet-land*. Works concerning daily activities are divided on the basis of division of labor for well mobilization of economic and subsistence activities. Mainly, young men and women are engaged in agriculture works and practices and irrigation activities in the research area and the works of children and old aged people are to look after house and livestock and cooking meals, fetching water, hauling manure, giving fodder to the cattle, fetching firewood in the house. People have practiced labor exchange system and co-operative works to solve the problems of labor scarcity and to complete the works in time. Though, agriculture production has not met the food requirement of the VDC and the people depend on other resources to support their subsistence activities.

The major crops grown in the research area are rice, wheat, maize and corn. Two crops cultivation pattern in a year is practiced there. Monsoon paddy and winter wheat are the principle crops grown in the *Khet-land*.

Table 2
Cropping Calendar

Crops	Month to Plant	Month to Harvest
Paddy	June to August	October to December
Wheat	October to December	March to May

Source: Field Survey, March 2008.

Farmers establish seedbed in May month while wheat is about to ripe. A field, which is called "*Diya*", is ploughed spreading manure of cow, goat and buffalo and is irrigated. It is ploughed again and again and leveled. Locally made compost fertilizers are used scattering all over the field to improve the seed of paddy. After one and half months of seed sowing, farmers transplant rice using exchanged and hired labor in between the second and the third week of June after the harvestation of wheat and mustard. Soybeans are planted along the ridges of the paddy terraces. A farmer depending on the amount of land transplants his entire field in a single day. All the farmers frequently irrigate their fields after the transplantation of paddy. If there is not adequate water, farmers irrigate their fields even at night. Farmers of the research area begin to weed paddy once in the first week of August. From the last week of October within November and December, farmers harvest their paddy after selecting a good day to start eating rice offering to several Gods and Goddesses. Various social values and norms are existed on the process of paddy production in the research area rooted in the society as culture.

After harvesting of rice, sowing of wheat is followed by the last week of November. The dry field is ploughed and seed is sown in the *Khet-land*. Wheat is harvested from March through May.

4.3.1.3 Variety of Paddy

The following table provides the variety of paddy planted in the research area.

Table 3
Variety of Paddy

Name of Rice	Area of Land (In *Bigha*)	%
Saba Rice	165	48.53
Sabitri Rice	69	20.29
Radha Char Rice	54	15.88
Radha Char Rice	30	8.83
Golden Rice	22	6.47
Total	340	100.00

Source: Field Survey, March 2008.

From the table above we see that out of the total land area, *Saba Rice, Sabitri Rice, Radha Char Rice and Golden Rice* cover 165 *Bigha*, 69 *Bigha,* 54 *Bigha*, 30 *Bigha* and 22 *Bigha* land area comprising of 48.53 percent, 20.29 percent, 15.88 percent, 8.83 percent and 6.47 percent respectively. Since the research site is the Terai area, nowadays-modern species of paddy are being planted by the farmers to get high production from the limited land areas. Traditional varieties of rainy paddy are also being transplanted over long time practices.

4.3.1.4 Well-being Status

The table below provides a general picture of well-being status of households in the research area.

Table 4
Well-Being Status
(On the basis of food grain consumption)

Duration (in months)											
Households	8	7.27	20	18.19	46	47.92	26	27.08	8	7.27	110
Months	1-3	%	3-6	%	6-9	%	9-12	%	12 above	%	Total

Source: Key Informants' Interview, March 2008.

From the table above, well-being status of the people in the research area prevails that out of the total households, four households consume food grain for 1-3 months comprising of 7.27percent. Sixteen households consume food grain for 3-6 months comprising of 18.19 percent. Like that, forty-six households consume food grain for 6-9 months comprising of 47.92 percent. Similarly, twenty-six households consume food grain for 9-12 months comprising of 27.08 percent and eight households

deserving 7.27 consume food grain for twelve months above and are said to be rich people.

People, who do not produce sufficient food grain for consumption, perform different types of labor works in the fields, farms and different works of the rich people for livelihood. Besides, these works they fulfill their needs with the earning of young men from the Indian army and the British army soldiers and civil services in India and gulf countries. People, who produce food grain for more than 12 months, sell their produces to the neighbors to whom it is required.

4.3.1.5 Animal and Livestock Species

The table below provides the status of livestock species.

Table 5
Status of Livestock Species

Name of Species	Number	%	Remarks
Buffaloes	195	41.76	
Cows	75	16.06	(Pigs are kept only by ethnic people and *Dalits*)
Bullocks	136	29.12	
Goats	54	11.56	
Pigs	7	1.50	
Total	467	100.00	

Source: Field Survey, March 2008.

From the table above we see that types of livestock species, which are mainly raised in the research area, are buffaloes, cows, bullocks, goats and pigs. The total numbers of livestock species are 467 in which the numbers of buffaloes, cows, bullocks, goats, and pigs kept by the people constitutes 195, 75, 136, 54 and 7 comprising of 41.76 percent, 16.66 percent, 29.12 percent, 11.56 percent and 1.50 percent respectively. Mainly buffaloes are raised by the local people of the research area to produce dung and for the consumption of milk, ghee, whey and meat. Cows are raised to reproduce bullocks and for dung. Bullocks are used to pull Halo (Plough) at the time of ploughing the fields and the farms during the transplantation of crops. Goats are raised for meat and dung and pigs are raised by the *Magar* people for meat and celebrate gathering many neighbors at the time of cutting pig. The untouchables also eat the meat of pigs but they do not keep it. Because of the cultural lag, the people of upper class neither eat pig nor touch it.

4.3.1.6 Castewise Occupation

The table below provides a general picture of castewise occupation.

Table 6
Castewise Occupations

Caste	Agriculture		Service		Business		Student	
	No.	%	No.	%	No.	%	No.	%
Tharu	224	46.09	40	58.82	2	66.67	124	45.76
Madhise	61	12.55	5	7.35	0	0	22	8.12
Brahamin	102	21.00	8	11.77	0	0	79	29.15
Chhetri	12	2.47	2	2.94	0	0	8	2.95
Pahadi Janajati (Magar, Gurung, etc.)	20	4.12	4	5.88	1	33.33	9	3.32
Dalits (Dhawal, Kami, etc.)	67	13.79	9	13.24	0	0	29	10.70
Total	486	58.67	68	8.21	3	0.36	271	32.76

Source: Field Survey, March 2008.

From the table above we see that out of the total farmers in the research area, people of the *Tharu, Madhise, Brahamin, Chhetri, Pahadi Janajati (Magar, Gurung*, etc.) and *Dalits (Dhawal, Kami*, etc.) castes possess the occupation of agriculture for subsistence applying indigenous knowledge and technology on the process of exploiting the local resources in practice comprising of 46.09 percent, 12.55 percent, 21 percent, 2.47 percent, 4.12 percent and 13.79 percent respectively. In comparison to the people of the other castes, more *Tharus, Pahadi Janajati (Magar, Gurung*, etc.) and *Dalits (Dhawal, Kami*, etc.) castes' people depend on agriculture.

The service consists of both the government and the private services. Out of total service holders, people of the *Tharu, Madhise, Brahamin, Chhetri, Pahadi Janajati* (*Magar, Gurung,* etc.) and *Dalits (Dhawal, Kami*, etc.) castes have been possessing the various types of services of the government as well as the private sector either in home country or in abroad comprising of 58.82 percent, 7.35 percent, 11.77 percent, 2.94 percent, 15.88 percent and 13.24 percent respectively. In the research area, most people of the *Tharus* and *Madhise* castes are found to have held government job because of their old settlement, but others are in minority. Young people of the *Magar* and *Gurung* castes are found to have recruited in the British and the Indian army forces and some young people also go to the gulf countries and India for the civil services. Because of the lack of well education, low social status, economically and politically backwardness, the *Dalit* castes' people are less in government services.

Out of the total businessmen, 66.67 percent of the *Tharu* people and 33.33 percent of the *Dalit* people have possessed as part time business in the morning and in the evening but they are not professionals and have to depend on agriculture in the time of mid-day. People of the *Madhise, Brahamin, Chhetri* and *Dalits* do not possess any business professions in the research area.

Similarly, out of the total students in the research area, school going students of the *Tharu, Madhise, Brahamin, Chhetri, Pahadi Janajati* and *Dalits* comprise of 45.76 percent, 8.12 percent, 29.15 percent, 2.95 percent, 3.32 percent, and 10.70 percent respectively. The *Brahamin* castes' people comprise of the highest position in the educational level and the *Dalits* have possessed the lowest position because of the social discrimination and conservative sentiments.

The table above shows that out of the total population in the research area, agriculture, services (Government and private), business and students occupations holders comprise of 58.67 percent, 8.21 percent, 0.36 percent and 32.76 percent respectively. Therefore, more people of the study area have been depending on agriculture for subsistence in the local environment adopting age long experiences and technology. The business occupation is in the lowest position because of the low education level social taboos of not sending their girl children into schools.

4.3.1.7 Human Resource, Tool/Implement and Natural Resource

The table below provides a general picture of indigenous human resources; tools/implements and natural resources existed in the research area.

Table 7
Human Resources, Tools/Implements and Natural Resources

Human Resources	Tools/Implements	Nature Resources	Rank
Farmers	Spade	Water	1
Cobblers	Sickle	Rocks	2
Black-smiths	Bullocks	Clay	3
Carpenters	Plough	Earthen-material	4
Masoners	Stick	Tree trunks	5

Source: Key Informants' Interview, March 2008.

The table above portraits that indigenous resource found in the research area. Agriculture does not have any exception and it has determined adaptive strategy of the local people. Therefore, farmers are the main indigenous human resource. Likewise, cobblers, blacksmiths, carpenters and masoners have also practiced various types of occupations applying the local methods; techniques and experiences existed in the specific social setting.

Likewise, indigenous tools/implements such as, spade, sickle, bullocks, plough and stick are used on the process of irrigation and agriculture production. Spade is used to clean up the canal, to smash clods of clay, and to dig out the corner of the fields and farms. Similarly, sickle is used to cut down shrubs and tree trunks remained near by the canal and is used to cut paddy, wheat and grass. Despite these, Bullocks are

used to pull plough in the time of ploughing. Plough is used to plough the field and farm. Similarly, stick is used to push herbs and shrubs remained nearby the canal and to chase out the snakes and harmful insects.

Similarly, indigenous natural resources such as, water, rocks, clay, earthen- material and tree trunks are the most important components of irrigation and agriculture existed in the research area. Because of sufficient availability of resources, these can easily be applied forever in irrigation and agriculture production that are applied by the local people with longtime practices on the basis of trial and error.

4.3.2 Social Setting

Social setting consists of population, ethnic composition, literacy rate and types of family of the study area.

4.3.2.1 Population

According to District Profile 2007, the population of *Mainahiya VDC* is 6708 of which the females deserve exactly the half comprising of 50 percent and the males are 3354 comprising of 50 percent. This VDC has almost 1322 households with the maximum 400 households in Ward No. 3 and the minimum 167 households in Ward No. 6 comprising of the average household size of 5.22 (District Profile 2007). The religious, social and cultural preference to have sons lacks the awareness of the family planning to be the higher number of females. The most of the males out-migrate for the various services such as, teachers, policemen in home country and military and civil services even in abroad. The traditional role of women is to look after children, livestock and agriculture works at home.

Mainahiya VDC is a multi-ethnic society. Due to the division of labor through the Hindu religious values and norms, the settlement pattern of the people is intermixed and scattered. However, the population distribution and composition of the research site is provided in table 8.

Table 8
Population Distribution and Composition

Sex	In number	%
Male	3354	50
Female	3354	50
Total	6708	100.00

Source: Field Survey, March 2008.

From the table above, we observe that there are 3354 males with 50 percent and 3354 females with 50 percent in the research area with the total population of 6708 individuals. The sex ratio of the research is 0. There are altogether 110 households consisting of the heterogeneous ethnic groups constituting the beneficiary population.

4.3.2.2 Ethnic Composition

The ethnic / caste composition is provided in Table 9.

Table 9
Castewise Distribution

Caste	Sex				Total	
	Male		Female		Number	%
	Number	%	Number	%		
Tharu	185	47.44	205	52.56	390	47.10
Madhise	46	52.27	42	47.73	88	10.63
Brahamin	90	47.62	99	52.38	189	22.83
Chhetri	10	45.45	12	54.55	22	2.66
Pahadi Janajati (Magar, Gurung, etc.)	16	47.06	18	52.94	34	4.10
Dalits (Dhawal, Kami, etc.)	46	43.91	59	56.19	105	12.68
Total	393	47.46	435	52.54	828	100.00

Source: Field Survey, March 2008.

Like other villages and areas in Nepal, the research area is a caste-stratified society and people belonging to these six categories are sparsely resided there. According to the caste system, the division of labor is allocated to exploit the resources. The predominant population of the *Tharu* group constitutes 47.10 percent of the local population. Within this community, males are 47.44 percent and females are 52.56 percent. Madhise people constitute 10.63 percent of the local population comprising 52.27 percent males and 47.73 percent females. *Brahamin* caste consists of different sub-caste groups i.e. *Neupane, Paudyal* and Sharma in the research area and comprise of 22.83 percent of the local population in totality. Within this community, males are 47.62 percent and females are 52.38 percent. Only *Chhetri* caste deserves 2.66 percent of the local population. *Dalit* groups are included in untouchables and are occupational castes known as the blacksmith and the cobblers. Culturally, they observe practices similar to the *Tharu* and linguistically; they are similar to the *Tharu* and *Madhise* groups in the study area. Among them, the *Pahadi Janajati* constitutes 4.10 percent. Within this community, males are 47.06 percent and females are 52.94 percent. Similarly, *Dalits* caste constitutes 12.68 percent of the local population in which males are 43.81 percent and females 56.19 percent.

In this study, the caste has been taken up as one of the socio-cultural characteristics of the population in the research area, and the roles, responsibilities and perception of the local people in irrigation management system.

4.3.2.3 Educational Status

The literacy among the canal users is provided that reveals the actual educational status of the people of the study site.

Table 10
Educational Level

Caste	Sex							
	Male				Female			
	Edu.*	Lit.**	Illit.***	Total	Edu.	Lit.	Illit.	Total
Tharu	24	148	13	185	7	152	46	205
Madhise	0	40	6	46	0	29	13	42
Brahamin	8	76	6	90	0	71	28	99
Chhetri	1	9	0	10	0	11	1	12
Pahadi Janajati (Magar, Gurung, etc.)	0	14	2	16	0	15	3	18
Dalits (Dhawal, Kami, etc.)	0	33	13	46	0	35	24	59
Total	33	320	40	393	7	313	115	435
%	8 .40	81.42	10.18	100	1.61	71.95	26.44	100

Source: Field Survey, March 2008.

*Educated: People, who have academic qualification above S. L. C. qualification, are kept under educated category

**Literate: People, who can read and write their name and students up to 10 class, are kept under literate category

*** Illiterate: People, who cannot read and write, are kept under illiterate category.

According the table above, the male and female educational level is analyzed. Among the total 393 male people of the *Tharu, Madhise, Brahamin, Chhetri, Pahadi Janajati* and *Dalits* castes, educated male, literate male and illiterate male comprise of 33 persons, 320 persons and 40 persons with 8.40 percent, 81.42 percent and 10.18 percent respectively. Likewise, among the total 435 female people of the Tharu, *Madhise, Brahamin, Chhetri, Pahadi Janajati* and *Dalits* castes, educated male, literate male and illiterate male comprise of 7 persons, 313 persons and 115 persons with 1.61 percent, 71.95 percent and 26.44 percent respectively.

Out of the total 185 *Tharu* males, male educated, literate and illiterate comprise of 24 persons, 148 persons and 13 persons respectively. Likewise, out of the total 205 *Tharu* females, female educated, literate and illiterate comprise of 7 persons, 152 persons and 46 persons respectively.

Out of the total 46 *Madhise* males, male educated people is not found and; literate and illiterate comprise of 40 persons and 6 148 persons respectively. Likewise, out of the total 42 *Madhise* females, female educated people is not found and; literate and illiterate comprise of 29 persons and 13 persons respectively.

Out of the total 90 *Brahamin* males, the male educated, literate and illiterate comprise of 8 persons, 76 persons and 6 persons respectively. Likewise, out of the total 99 *Madhise* females, female educated people is not found and; literate and illiterate comprise of 71 persons and 28 persons respectively.

Out of the total 10 *Chhetri* males, the male educated and literate comprise of 1 person and 9 persons; and illiterate female people is not found among the Chhetri women. Likewise, out of the total 12 *Madhise* females, female educated people is not found and; literate and illiterate comprise of 11 persons and 1 person respectively.

Out of the total 16 *Pahadi Janajati* males, the male educated people is zero and; literate and illiterate comprise of 14 persons and 2 persons respectively. Likewise, out of the total 18 *Pahadi Janajati* females, female educated people is not found and; literate and illiterate comprise of 18 persons and 3 persons respectively.

Out of the total 46 *Dalit* males, male educated people is not found and; literate and illiterate comprise of 33 persons and 13 persons respectively. Likewise, out of the total 59 *Dalit* females, female educated people is not found and; literate and illiterate comprise of 35 persons and 24 persons respectively.

4.3.2.4 Types of Family

The term "family" has been taken from the Roman word "Famulus" which means servant. The word, according to the Roman law, denotes the group of producers and slaves or servants as well as members connected by common descent or marriage. In the American Bureau of the census, family is defined as "A group of two or more persons related by blood, marriage, or adoption and residing together, all such persons are considered as members of one family". Similarly, Clare defines that "a family is a system of relationship existing between parents and children".

On the basis of structure, family is divided into three categories: nuclear, joint and extended family. A nuclear family is an autonomous unit free from the control of the elders consisting of the husband, wife and their children. A joint family is the combination of two or more than two nuclear families consisting of parents, married sons and unmarried grandsons and grand daughters who have been adopting common property, living, eating and working.

Similarly, an extend family is the merger of several nuclear families consisting of an old man and his wife, their sons, the sons' wives and the sons' children and it is crammed into a single house or a cluster of houses.
The types of family are provided in the table below.

Table 11
Castewise Family Size

Type of family	Nuclear		Joint		Extended		Total	
	No.	%	No.	%	No.	%	No.	%
Tharu	26	43.33	20	45.45	2	33.33	48	43.64
Madhise	20	33.33	7	15.91	0	0	27	24.55
Brahamin	11	18.34	12	27.27	1	16.67	24	21.82
Chhetri	0	0	0	0	1	16.67	1	0.92
Pahadi anajati (*Magar, Gurung,* etc.)	0	0	2	4.55	0	0	2	1.82
Dalits (Dhawal, Kami, etc.)	3	5.00	3	6.82	2	33.33	8	7.72
Total	60	100	44	100	6	100	110	100

Source: Field Survey, March 2008.

From the table above we see that out of the total 110 households, the *Tharu* caste covers 48 households. This caste is educationally, socially, politically, and economically marginalized in the research area, though they are in majority. Among them, nuclear, joint and extended family comprise of 43.33 percent, 45.45 percent and 33.33 percent respectively. This caste does not live in the extended family. The *Chhetri* caste covers 27 households in which nuclear and joint families, in the study area, consist of 33.33 percent and 15.91percent respectively. The *Brahamin* caste covers 24 households with nuclear, joint and extended family comprising of 18.34 percent, 27.27 percent and 16.67 percent respectively. Only one *Newar* household of extended family is existed comprising of 16.67 percent, out of the total extended family. The *Pahadi Janajati* has only 2 households of joint family comprising of 1.82 percent, out of the total joint family. Similarly, the *Dalit caste* covers 8 households of nuclear, joint and extended family comprising of 5.00 percent, 6.82 percent and 33.33 percent respectively.

Among all the castes existed in the research area, 60 households consist of nuclear with 54.55 percent coverage, 44 households consist of joint family with 40.00 percent coverage and only 6 households consist of extended family with 5.45 percent coverage.

Traditionally, as an indigenous group of Nepal used to live in mega family but, in th course time they prefer nuclear family structure. *Madhise, Brahamin, Chhetri, Pahadi*

Janajati and Dalits are migrated from the hilly regions so they tend to live in nuclear family. Mostly, people of the *Brahamin* and the *Chhetri* castes tend to live in nuclear family. Modernization process has been influencing the life style of these groups.

Society in the research area is predominantly patrilocal, patrilineal and virilocal. Elder males of the family are accorded the headmanship and sons live with his parents until having marriage and offspring and daughters after being married go to live in their husband's house. After having children joint and extended family break up into nuclear families. In case of more sons, the parents almost always live with their youngest son. More females mobilize the responsibilities of house and the males take the burden of external works done out of house. However, all of them have equal participation, according to the division of labor, in different activities related to irrigation management activities.

4.4 Infrastructure Facilities

The research site, *Tinmuhani Irrigation System* drained area, lies in *Mainahiya VDC*. Transportation facilities with the blacktopped road system are excessive in this VDC from the District Headquarter, Bhairahawa. The graveled motorable roads have been touching each corners of the VDC. Similarly, drinking water facilities are given to the villagers from underground water sources like hand pumps and boarding. Besides that, the water in the study site is used for drinking purposes as well as for bathing, washing clothes, washing utensils and also for feeding to the livestock.

Tinmuhani Irrigation System has been existing for about 200 years ago but due to its poor management, the villagers have not been able to derive sufficient benefits from it. The maintenance works in the canal are being carried out with the financial support of the VDC fund and by self-initiation of the stakeholders.

As a leader school, there is only one secondary school in the study site. The name of school is *Shree Mainahiya Secondary School*, *Mainahiya*. As feeder schools after the completing the primary schooling, the primary schools send their students to *Mainhiya Secondary School* at *Mainahiya* walking on foot and by cycles. Medical treatment and post office facilities are available in this VDC. The villagers go to the nearest sub-health post and the post office at *Mainhiya* for medical check up and to drop out their letters and documents. There are facilities of mobile phones and landline phones but all the people cannot own these facilities

Various indicators prevail that the study site according to social structure is rich for indigenous technology and resources exploited by the local people portraiting century long experiences collectively integrated for adaptation compare to modern tools and technology.

CHAPTER FIVE
OPERATIONAL MEASURES OF FARMER MANAGED IRRIGATION SYSTEM

The very early evolutionary history of *Tinmuhani Irrigation System* is obscure because of the lack of written documents about the system. The system, according to the local knowledgeable persons, was started by local people. Three sources from *Timuhani* have been emerged so that it is called *Tinmuhani* and is extended with more potentiality of irrigation in *Mainahiya VDC*. In the past time, field and canal were small in size and in the due course of time; they were extended by the local people using the local technology to increase agriculture production with economic activities for subsistence. Nowadays, because of migration of people from the hilly area to the Terai area have become the system holders.

Tinmuhani Irrigation System constructed in *Mainahiya* is the largest canal of the VDC located in the northern part. It serves water for irrigation in the Khet-Land for the agriculture productions i.e. paddy in the rainy reason and wheat in the winter and it is known as the *Tinmuhani Irrigation*. *Tinmuhani Irrigation System* users' participation in irrigation management system needs to be understood within the context of the local cultural norms and values as well as their indigenous knowledge, techniques, practices and perception about the local environment and sustainable resource management system. The situation of mass practices of knowledge for the management of the irrigation system has characterized as an indigenous irrigation management system, which is prevalent dominant in the rural areas of Nepal even in the study area. The various techniques, practices, experiences and processes adopted by the locale are not only reflecting their century long culture but also providing a glimpse of dynamics occurred there in the process of system mobilizations. Therefore, irrigation management system related activities: water acquisition, water allocation, water distribution, maintenance, resource mobilization and conflict management are enforced by the users' group for the agriculture production, environmental protection and sustainable development in the local level.

Due to lack of written history, tradition existed in *Tinmuhani Irrigation System* is verbal. There is no written history concerning irrigation management system. The system has come over with the customary roles, rules and regulation pertaining the legal recognition. Thus, *Tinmuhani Irrigation System* has been launched with the local farmers' association on the process of subsistence.

People of heterogeneous castes live in *Mainhiya Village* adopting the fundamental and empirical strategies for livelihood. All the castes have equal participation on the process of mobilization of *Tinmuhani Irrigation System*. Rules and regulations developed as the customary laws and culture concerning the irrigation management activities is

assigned on the basis of the caste system and the division of labor. Experience, skills and technology gained for century long by the local people give the strategic vision of the indigenous knowledge and practice on the process of exploitation of resources.

Numbers of indigenous irrigation management system related studies in the context of world have been done. In due course of time, the scholars, in a way, have developed various techniques, skills, methods and experiences. Of them, Norman Uphoff's conceptual framework (1986) of irrigation management system related activities such as, water use activities (water acquisition, water allocation, distribution, and drainage), control structure activities (design, construction, operation, and maintenance) and organizational activities (decision-making, resource mobilization, communication, and conflict management) is undertaken as practical one. Therefore, *Tinmuhani Irrigation System* is operated on the basis indicators of the conceptual framework of Norman Uphoff to reveal indigenous knowledge rooted in the peoples' mind in practice.

5.1 Water Use Activities

Indigenous irrigation management systems on the use of water are known as water use activities. The activities related to irrigation organization, as water use activities are water acquisition, allocation, distribution, and drainage. Therefore, *Tinmuhani Irrigation System* is undertaken into operation on the basis of these operational indicators.

5.1.1 Water Acquisition

Nepal is the second richest country in the world possessing about 2.27 % of the world water resource (CBS, 2006). However, the availability of water varies in all parts of Nepal according to season and location. Thus, the water resources in the country, according to the geographical variations, are difference. Therefore, water acquisition is the process of acquiring water from the water source. Similarly, the water resource of *Tinmuhani Irrigation System* is collection of water that flows from the northern part to the southern part of the study site. Usually, the water of canal is mixed to irrigate the *Khet-land* of *Mainahiya VDC*. *Tinmuhani Irrigation System* is an earthen-canal dug by the farmers to convey water to all the plots of field. Water acquisition related activities such as, design, construction, operation and maintenance of *Tinmuhani Irrigation System* are carried out by the local people applying their skills over the past years. Most part of the canal is completely made of the local materials such as, rocks, clay, herbs, shrubs, tree trunks and earthen materials, which are available in the study area but, in some areas, concrete cement wall has been used to mend and make it more stronger. In summer, there is sufficient water in *Tinmuhani Irrigation System* and the water flows with full capacity in the canal. But in winter, the level of water in the canal becomes low and the dam of the stream is completely closed and downward of the stream becomes dry and the water sinks into the bog.

Therefore, volume of water in the canal becomes low in the winter season. During the winter season, the farmers in *Tinmuhani Irrigation System* share water for irrigation on the basis of turn. The beneficiaries in summer season freely use water for irrigation. But in winter season, the head users get the first turn and the turn transfers to the middle and tail users on the basis of their rituals. Sometimes, the rule of "first come, first serve" is also practiced because of the limited water acquisiting condition.

The water of *Tinmuhani Irrigation System* is mainly available for crops: summer paddy and winter wheat. Because of the low altitude and availability of water, multi-cropping patterns, according to the local people, can be grown.

5.1.2 Water Allocation

Water allocation, on the basis of the users' group and the cultivated land, means the sharing of water of the system on the process of irrigation. The water allocation means the sharing of water from an irrigation system and basis by which are shared among the beneficiaries and water users.

In *Tinmuhani Irrigation System*, the process of water allocation among the farmers has been undertaken on the basis of the size of cultivated land, requirement of area, and types of crops grown. Farmers, who have contributed labor, cash and kind during the canal construction, operation and maintenance or one has bought from others, have equal water right on the processes of sharing of water and utilization of water of the system. According to seasonal variations, the boggy land requires less water and the dry land requires much water through the perspectives of irrigation. The rules and regulations concerning water allocation and water rights are not fixed in *Tinmuhani Irrigation System* on the process of irrigation by the users' association. Neither, water allocation process and water right can be bought nor can be sold to the others. Thus, farmers have been applying the local techniques and knowledge on the smooth mobilization of water allocation process, which is mechanistically, rooted in the peoples' heart as cultural values and norms for crop cultivation with the century long practices.

Because of the dry season, the quantity of water in winter season in *Tinmuhani Irrigation System* becomes low. But the demand of water supply becomes relatively high for crop cultivation. Water is completely diverted into the canal from the dam. Thus, water allocation practice, according to the seasonal variations and the demands of water, is different. The head users of the universe get the first turn to irrigate their land followed by the middle and tail users and “first come, first serve system” is also practiced on the process of water allocation. One of the aspects is that the leakage of irrigated water from the upper terraces makes wet to some parts of the lower terraces with full of water bogging and urges to the continuous irrigation process to

the lower lying terraces. The strange thing is that digging of holes in the canal or even in the terrace during the cropping season with mice, to some extent, has created the problem of water allocation.

The quantity of water in the summer reason in *Tinmuhani Irrigation System* increases remarkably high creating unnecessary discharge flowing the rapid motion to the downward. Water allocation for cultivation, according to the local people, in rainy reason is not intensively required in the sub-canals because water from the upper terraces autonomously flows to the down terraces. In this season, farmers also frequently do not go to the field. Therefore, water allocation activity reveals its traditional methods adopted by the local farmers on the basis of long time practice for economic activities on the process of subsistence.

5.1.3 Water Distribution

Water distribution means physical delivery of water to the field as per water allocation practice done in the system. In *Tinmuhani Irrigation System*, the process of water distribution is completely similar to water allocation adopted by the local people. Water is distributed among the sub-canals, according to the needs in the land. Several sub-canals are constructed to make quick and easy distribution of water. They are not equal in size. Thus, distribution of water is also not equal in practice to irrigate the field for crop cultivation. Water distribution depends on the physical aspect of the canals. This, sometimes, is practiced through the rotational way. But all the farmers have equal chance to irrigate their *Khet-land*.

Therefore, all the farmers in the command area have equal right in the distribution of water but water is shared according to their size of land.

5.1.4 Drainage

Drainage, in general, is an activity of the irrigation management system and, in particular, an activity of water use on the basis of physical structure of the canal. *Tinmuhani Irrigation System* is a not man-made. The main canal of *Tinmuhani Irrigation System* is constructed in the northern part of the command area extending from the north to the south by making small dams. The access of water in the canal in rainy season is drained to other sub-canals to control water in the main canal. Similarly, farmers drain water to the main canal to dry cropping the *Khet-land* and to prepare the land for wheat cultivation in the months of October and November. Water of the boggy spring and damp is drained to the stream by making small canals to dry the land for crop cultivation. In the winter season, water is completely drained to the main canal from the dam or elsewhere. When the time comes to wet wheat crop, water is diverted to the sub-canals. The drainage system in the command area is permanent and it is easy to mobilize the system.

5.2 Control Structure Activities

The set of irrigation management activities deals with the physical structure for controlling the water. Thus, water control structure related activities: design, construction, operation and maintenance of the system are the physical structure activities fostering water acquisition in the system to ensure equitable irrigation practice. Therefore, the existing conditions of water control structure activities such as, design, construction, operation and maintenance of *Tinmuhani Irrigation System* are undertaken to study through the perspective of an indigenous resource management system.

5.2.1 Design

Design means the initial conceptualization and visualization of the framework of the system observing the physical structure by the experts. *Tinmuhani Irrigation System* is completely designed by the local farmers who are known to be the local engineers, organizers, and experts. Thus, the local farmers' experiences, expertise, and indigenous knowledge are applied in practice to design the system about 200 years ago.

The alignment of the canal is designed to uplift the socio-economic condition of the local people by growing more crops with the process of internal resource mobilization. Therefore, the canal has been designed by the local farmers using their own local technology and consulting each other according to the process of adaptation in nature.

5.2.2 Construction

Construction means the organizational management activities: diversion, alignment and tunnel of canal in the physical system. In fact, proof of the canal construction of *Tinmuhani Irrigation System* is not documented yet. According to the key informants, the work of the canal construction of the system has been started in 200 years ago having objective to irrigate the land. The local expertise and resources are materialized for the construction of canal. The amount of money is not invested because the construction of canal have been collectively made by the local farmers utilizing the available local resources on the application of their own expertise, technology knowledge, and experiences with the long time practice on the basis of trail and error. The headwork of canal construction is temporary but it is easy to materialize due to the available local resources such as, rocks, earthen materials, tree trunks, and sticks. The earthen wire of diversion structure has been produced the full discharge of water into the canal.

On the process of irrigation practice done in the study area, the major rehabilitation/ improvement works of the system have been done by the labor contributions of the local farmers with their own initiative for the mobilization. But, the VDC and DDC

occasionally provides cash supports for the rehabilitation/improvements of the system. The objective of the amount could not be completed due to the conflict on the process of allocation among the beneficiaries and could not be used in the proper place and time. However, some concrete living works of rehabilitation/improvements have been done at the main canal where seepage and leakage carried heavy loss of water. The problem of water loss and landslides occurred in the universe has been resolving to a considerable extent in the local level. All the landholders have been paying equal labor contribution for the rehabilitation/improvements works. Activities of the organizational management in *Tinmuhani Irrigation System*, more particularly, the resource mobilization activities, have thrown impact upon the physical activities, especially construction of the system. All the beneficiaries have equal chance in the decision making of the rehabilitation/ improvements of the system that has been well accepted by all the beneficiaries. Therefore, rehabilitation/improvements works related to the canal construction and irrigation have been done with the local farmers' initiation in the water use activities.

5.2.3 Operations

Operation means the continuous process of mobilization of the system on the basis of technology, resources, and physical system. Because of the altitudinal, seasonal and environmental variations, the variations in the operation of the irrigation management system are also existed from one place to another. Thus, organizational structure of the *Terai irrigation management system* is also different from the hill and mountain irrigation management system. Similarly, *Tinmuhani Irrigation System* is completely by the altitudinal, seasonal and environmental variation on its operational activities.

Tinmuhani Irrigation System has completely been operated by the local farmers. The formal committee for the operational work is not organized there. There are numerous verbal rules and regulations related to the system operations. Thus, the main functions of the local farmers related to irrigation management system are to manage resource, to develop the cultural values and norms concerning farmer-managed irrigation system, and to communicate each other for the operational activities of the system in the study area. Similarly, traditional rules and regulations are also undertaken into practice for the operation of the system. The local or verbal practices stamped in the peoples' mind related to the irrigation management activities have been developed as culture on the process of adaptation in nature utilizing the local resources as well as applying the local technology in the system operation. All aspects of the system are resolved through the democratic way in the study area.

5.2.4 Maintenance

Maintenance means the tasks of repairing and cleaning of the canal for regular and efficient water acquisition, distribution and removal. In case of *Tinmuhani Irrigation System*, the main canal has been constructed with the collective labor contribution of

the local farmers. In the study time, the maintenance works, in general, have been carried out according to the needs of cultivation and, in particular, before the transplantation of summer paddy in the month of June and the works include removing of grass, gravel, dry leaves, and tree trunks accumulated in the main canal, which blocks the flow of water. Thus, the maintenance activities in the main canal and sub-canals are corresponded with the cultivation of paddy and wheat in the study area. So, the routine maintenance works have been undertaken before the plantation of winter wheat and summer paddy. Farmers assemble in the fixed place of the command area as informed by the active farmers to discuss about the requirement and to mobilize their collective labor and kind resource in the canal maintenance. If any one is absent, he/she is obliged to pay cash instead of the physical labor in the study area.

Similarly, the tasks of emergency maintenance mainly involve the removal of mud, rock, leaves and herbs from the main canal and the sub-canals and the construction of the damaged parts of the main canal by the over flooding where the emergency problems are encountered in the system. When the heavy rain fall causes the landslide and damages the main canal and the sub-canals, the first person who witnesses the landslide, informs to the fellow farmers or the users' groups and then, the farmers assemble and mutually undertake the maintenance works.

Therefore, formal organization and written rules and regulations for harmonious management of the irrigation system related activities have not undertaken into practice and all the activities are mobilized by the verbal rules existed from the time immemorial in the research area. The maintenance of the system has been materialized by the local farmers using the local skills and knowledge in organizational management activities in practice as well as the physical system from the informal way.

5.3 Organizational Activities

Organizational activities are concerned with the management of the institutional values and norms that regulate the functioning of the organization itself. Decision-making, resource mobilization, communication and conflict management are the key points in the organizational activities.

5.3.1 Decision Making

Decision-making refers to the institutional management of the irrigation system on the basis of organizational values and norms. It is one of the most important key points that mobilize the system in the proper way. The rules and regulations concerning decision-making can be changed forming the new ones.

On the process of mobilization of *Tinmuhani Irrigation System*, the local farmers make almost all the decisions themselves to regulate the system. Generally, the mass meeting of the farmers is not called for the decision-making. Only a few active persons individually convey the message to the fellow farmers for the tasks. If big destruction occurs in the system, all the farmers are called for meeting in the particular place for the decision-making. At meeting, all the users are democratically given to put forward their views on the occurred problems and decisions making. Internal cases occurred in the system is decided by the users' groups with their own initiative in the local level and is not forward to the upper legal board. Consensus is made when all the participants come into the conclusion of decision. Thus, all the decisions and consensus are made on the basis of verbal rules and regulations. People of the research area do not have practice of keeping the record of decisions concluded at meeting in the documentary form, which is practiced in the behavioral way. There is the tradition of keeping record of economic affairs and big disputes in the written form for the future proofs. For the communal issues, the farmers make decisions assembling in-group level whereas the decisions, in case of individual issues, make decisions at household level. They also make decisions consulting the elder persons who have knowledge about the system. Therefore, decision-making in the research area is made in the local level harmonizing organizational activities in the irrigation management system.

5.3.2 Resource Mobilization

Resource mobilization is the function to handle the management of organizational activities of irrigation system. The effective mobilization of cash, labor, and material resources can develop the irrigation system that becomes sustainable. The sustainable development and peoples' participation in the developmental programs have been becoming common through the perspective of the resource mobilization. The concept, in this respect, is developed that the maximum resource mobilization is the synonym of development. Thus, the major functions of farmer managed irrigation system are to mobilize the maximum local resources to grow more crops for subsistence. Labor contribution, cash contribution and material contribution are the local resources, which can easily be used for the irrigation management and sustainable development. Therefore, the resource mobilization in *Tinmuhani Irrigation System* has been undertaken into research in terms of internal resource mobilization. The internal resource mobilization performs these indications: What are the local resources? How do the farmers collect the local resources? How do the farmers mobilize the local resources? Which determine the sustainability of the system in practice?

The original construction of *Tinmuhani Irrigation System*, according to the key informants, has been started with free labor and material services of the local farmer to fulfill the objective of irrigation. Every landholder has paid equal labor

contributions in the construction of the system and the local resources are exploited to mobilize the system. Thus, all the beneficiary households have equal contribution of labor and cash. Every landholder in cleaning, repairing and maintenance are compelled to contribute free labor services on the mobilization of the system and local resources. If any one cannot contribute labor, he/she has to pay cash equal to the labor contribution. Therefore, cleaning, repairing and maintenance works of the canal are done once a year before the transplantation of paddy but there is not the tradition of cleaning, repairing and maintenance in the time of transplantation of winter wheat. Occasionally the VDC board provides financial supports for cleaning, repairing and maintenance of the system in cash. Nowadays, when the floods damage the canal, the emergency maintenance has to be carried out of labor and cash contribution in the system. According to the local farmers' needs, the resource mobilization is set utilizing the local resources on the application of the local methods, knowledge and technology to sustain the system, local resources and technology. In the research area, the labor and material resources have dominated the cash resource on the process of mobilization of the system for the sustainable use.

5.3.2.1 Local Materials

Local materials and technology in indigenous irrigation management system is studied in the context of *Tinmuhani Irrigation System* identifying an indigenous resource management system for improving the socio-economic conditions of the local people. No doubt, farmers are local engineers for planning and applying of various local materials and technology on the smooth mobilization of various resources existed in the study area. Indigenous materials, technologies, and resources are used both in irrigation system management activities and in agriculture practices. Various local materials and technologies such as, spade, plough, sickle, stick as well as skills, methods and knowledge are used in "the *Khet-land*". Similarly, spade is used to clean and repair the canal, to dig the corner and ridges of the terraced *Khet-land* and to smash clods of clay. Plough is used to soften the mud of the fields. Sickle is used to cut ripped crops such as, paddy, wheat, maize stalk, millet and so on. Stick is used to remove herbs, shrubs and to chase snakes and harmful insects on the way round..

5.3.2.2 Natural Resource Management System

Local systems of natural resource management are effective and efficient in *Tinmuhani Irrigation System*. Local people have better management systems and their management systems are effective, attractive and successful "because of the fact that local residents have both the most stake in, and most information about, natural resources" (Uphoff, 1986:23). Local natural resource management system in the research area is socially equitable, environmentally sustainable, and economically profitable for subsistence. Local people have been utilizing their strategies for coping with the farmer-managed irrigation system of *Tinmuhani Irrigation System* on the

application of local natural resources: rocks, clay, brush, leaves, tree trunks and earthen materials. Local natural resources such as, rocks and tree trunks are used to divert the water of stream into the canal and leaves, brush, clay and earthen materials are used to plug leaking in the dam and the ridges of canal. *Tinmuhani Irrigation System* mostly undertakes local natural resources to mobilize the system.

5.3.2.3 Human Resource Management

The local people have developed rituals as culture for sustainable development of various systems in the local environment. The relationship among ritual practices, natural environment and human resources has undertaken into study on the basis of local manpower prevalent existed in *Tinmuhani Irrigation System*. The division of work is set among the people for equitable and sustainable application of local resources. Thus, people in the study area not only make economic activities with natural resources, but also they possess indigenous knowledge for subsistence pattern in practice.

The local manpower is analyzed on the basis of human resources such as, *Haliya, Masdura, Ropain Masdura, Baithauni, Mandiha and Malik* in the system mobilization. Every household's head observe the whole system during irrigation. The major works of *Halihya* and *Mandiha* are to make the terraced *Khet-land* plain and ridges of the terraced land. Diya's work is to uproot the seed of paddy and to distribute to Masdura for the transplantation. Though, the transplantation of paddy is the main work of women Masdura. After having finished the works, all the workers return back from the field and celebrate having snacks and local liquor. Therefore, system existed in the research site is developed as culture in terms of resources utilization.

5.3.3 Communication System

Communication in irrigation management system is an organizational activity that is universal and one does see it (Chamber, 1975:30). The communication system in organizational activities plays dominant role in functioning of the system and transfers knowledge, technology, experiences, ideas, decisions, rules and information from top to bottom and bottom to top to verify organizational norms in terms of the mass population. Thus, the farmer-managed irrigation system in the local level is functioning in intended way using the local material resources and technology and every beneficiary should be aware of the activities of system determined by the community. Similarly, the communication system is adequate for the mobilization of irrigation management system activities: water allocation, distribution, operation, maintenance, resource mobilization and so on.

The communication system in *Tinmuhani Irrigation System* is required to transfer messages to the head, middle and tail users about the cleaning, repairing, maintenance, mass meeting, operation of the canal and the sub-canals during the crop

cultivation. The farmers, on such an occasion, practice communication through the individual way and the individual roles are determined by the traditional values and norms for communication that obeyed by all the people. The lack of formal committee in the study area, all the activities related to irrigation management system are mobilized through the individual way that are adjusted to the local atmosphere. If there is special issue occurred on the decision-making about the system, all the members are called for the mass meeting. If anyone becomes absent, the member of the nearest household conveys the message concluded in the meeting or gathering. Therefore, the communication system in the study area has been practiced with the informal way determined by the traditional social values and norms developed as culture in the society.

5.3.4 Conflict Management

Conflict is the manifestation of competition, discussion and dispute with the physical threat, fight, war and so on. If two groups, at a time, possess the right to use material resources system, the conflict occurred in its use, is a universal phenomenon. Therefore, conflict resolution means to solve the problems occurred in the management system of organizational activities. These activities can be occurred in case of the farmer-managed irrigation system, which is a common property of the local people. Thus, the conflict may occur among the members of the users' groups, individuals and systems, and inter-groups within the system, and outsiders and system on the process of mobilization of organizational activities in the irrigation management system.

Water conflicts and its resolutions in *Tinmuhani Irrigation System* are common phenomena because activities related to irrigation. The rules and regulations of irrigation management system cannot wholeheartedly be obeyed by all the members of head, middle and tail users. Though, the people of the study area, solve the problems occurred in the system in the local level with their own initiation. That's why, where the conflict, there the resolution.

The conflicts related to water use and rights, which are of the great challenges, have affected the system as a whole. Water rights, turn overlapping, water stealing, water rights of the up stream and the down stream, and the canal encroachment are the major causes of the conflicts occurred in *Tinmuhani Irrigation System*. The conflicts cases related to the system are of simple nature and are resolved at the farmers' level under the mutual consensus. The conflicts keep occurring in the system for the improvement/maintenance of the system and are found to be resolved under the mutual discussions, suggestions and understanding among the farmers, users' groups and concern parties. Because of the lack of formal committee of irrigation management, the conflict resolution is practiced through mutual understanding or

discussions or processes. Therefore, all the conflict cases related to irrigation have been resolved with the negotiation between the offenders and defenders.

CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS

Conclusion of the findings of the study of *Tinmuhani Irrigation System* in practice and recommendations in preserving, promoting and sustaining the farmer managed irrigation system in Nepal are drawn into overview in this chapter.

6.1 Conclusion

More people in Nepal live in the rural area, where they have been practicing their own fundamental systems, either in irrigation or in other natural resource management system that are characterized by food deficiency, illiteracy and the socio-economic barriers.

Tinmuhani Irrigation System is a farmer managed irrigation system run by the local people in an indigenous way that the local people initiated, operated, organized and maintained possessing valuable skills and technology as the indigenous engineers, system organizers, planners and implementers. The local people have undertaken the system into practice for subsistence under livelihood in the local cultural setting. They have a lump of practical knowledge and experience for the system management and resources mobilization.

Due to the typical features of *Tinmuhani Irrigation System*, it is vast different from the other systems and can give fundamental assumptions and insights to the farmers, planners, and policy makers for the further programming concerning irrigation system management related activities. Also, it gives a glimpse of the real vision of the rural people that shows the peoples' age long experience, skills, attitudes and concepts stamped in the mind of the local people and rooted as social values and norms; and culture in the society, which transfers from generation to generations. Rules and regulations developed for the management of *Tinmuhani Irrigation System* is being practiced in the verbal way without any written documents that is recognized as the customary laws.

The local people using empirical knowledge, skills, methods, and technology for subsistence in the local cultural setting have maintained this system. The system has been acknowledged on the socio-economic and the socio-cultural grounds having objective to fulfill the food requirements of the local people for livelihood. This, in a way, becomes a bridge between traditional and modern concepts. Therefore, *Tinmuhani Irrigation System* in the ground of farmer managed irrigation system prevails empirical as well as fundamental insights, assumptions, experience, skills and technology on the sustainable use, development and promotion. In this respect, the local human resource, tools and technology, strategy of natural resources management system, collective indigenous knowledge, experience, skills and attitudes

of the people and their initiation and participation on the process of the resource exploitation seem to be more sustainable and realistic.

Undoubtedly, *Tinmuhani Irrigation System* of *Mainahiya VDC* in *Ruapndehi District* is in accessible place from the market and road access. However, people have been using their own fundamental knowledge, skills, tools and resources on the basis of facts in the system operations and management due to low awareness level of people. Human resource mobilization based practice is predominant than the cash contribution in making the system functional. As a matter fact, social cohesiveness among the system users is prevalent in the conflict less culture. Operation and maintenance works of the system have been carrying out with the locally available resources. Thus, the system on the basis of long time trial and error have been developed by the beneficiaries in an integrated way that has helped to preserve, promote and sustain the system.

6.2 Recommendations

Irrigation system in Nepal prevails century long history. Out of the total irrigation systems, the farmer-managed irrigation systems cover more than 70 percent. Due to the geo-diversities, the structure of farmer managed irrigation system varies from one place to another or from one region to another. Similarly, the farmer managed irrigation systems consist of indigenous irrigation management system developed utilizing the local resources, manpower and technology. *Tinmuhani Irrigation System* is a locally developed system for economic arrangements in course of subsistence pattern growing paddy and wheat as that provides insights of the local people. Therefore, the following suggestions on the basis of the above findings of *Tinmuhani Irrigation System* are provided to dig out the rhetoric of farmer managed irrigation system for sustainable use, development and promotion through the holistic approach.

Ideas, facts and genuine information discovered in the research work of *Tinmuhani Irrigation System* have to be incorporated in all the phases of farmer managed irrigation system for sustainable development and promotion at national and international level:

- Farmers are taken as the local engineers, experts and organizers of farmer managed irrigation systems. Thus, the representative of the farmers has to be involved in planning, designing, demonstration, operation and maintenance of the system to promote, preserve and sustain the systems.
- Government and non-governmental agencies related to irrigation organizations should be aware about the value and importance of farmer managed irrigation system in agriculture production.

- Practical knowledge, skills, experience and ideas have to be documented for preservation that can be learning for future generations and can be replicated in other parts of Nepal and world.
- Experiences gained over period of time, knowledge, skills, tools and practice of the people; and external suggestions have to be integrated for institutional and sustainable development of the farmer managed irrigation system.
- Institutional development of *Tinmuhani Irrigation System* needs external economical and technological supports from the government and other concerned sectors for its sustainable use, development, promotion and preservation in the initiation and ownership of the users' groups.
- An inventory of users' groups, agricultural aspect, financial aspect, spatial, technical aspect and; cultural value and norms of *Tinmuhani Irrigation System* has to be developed to promote the importance of farmer managed irrigation system in reality.
- Policies concerning farmer managed irrigation system have to be developed by the government and other related agencies and undertaken into enforcement for smooth mobilization of the system.
- Though, farmers have a lump of skills, techniques, experience and knowledge but not systematized. So, training from farmers to farmers and professionals to farmers and observation tours concerning farmer managed irrigation system mobilization and agriculture practice has to be launched in degrees.
- Traditional system of irrigation management is not sufficient to increase agriculture production for reducing the scarcity of the rapidly growing population. Thus, traditional, indigenous and external systems have to be integrated to promote and sustain the farmer managed irrigation system.
- People have to be encouraged, motivated and induced for their age long experiences in the farmer managed irrigation system and having practiced the local rules and regulations as law for the sustainable use, development and promotion.
- The valuable lump of indigenous knowledge, methods, tools, skills, practice, technology and culture of people of the research area that are being disappeared, which are useful for the community development, have to be documented and integrated in the rural development programs to alleviate poverty in a sustainable.
- The fundamental framework of *Tinmuhani Irrigation System* has to be established from the perspective of the farmer managed irrigation system as an autonomous unit.
- Farmer managed irrigation system is prevalent in Nepal. It deserves the majority part in all irrigation systems. So, the government and other concerning agencies need to undertake in-depth study and make master plan to increase agriculture production for the rapidly growing population in Nepal.

APPENDICES

QUESTIONNAIRE

Appendix A: Respondent's information

1. Name of the household head

Village: ----------Ward No.:----------Rupandehi

Caste/Ethnicity: ----------Age: ----------

Sex: Male----------Female----------

2. Educational background of the respondent

a.	Illiterate	
b.	Literate to class 5 pass	
c.	Class 6 to SLC pass	
d.	Class 11 or above	

3. Occupation of the respondent

a.	Farming/Agriculture	
b.	Business	
c.	Driving, transportation work, factory work, carpenter, etc.	
d.	Service in government or non-government organizations/ teaching	
e.	Unskilled wage labor or others	
f.	Jobless or student	

4. Type of family

a.	Nuclear family (Parent and children)	
b.	Joint family (Grandparent, parents and children)	
c.	Extended family (Grandparent, parents with their cousins and grandchildren)	

5. Landholding size

a.	1 to 10 Gattha	
b.	11 Gattha to 1 Bigha (20 Gattha = 1 Bigha)	
c.	2 Bigha or Above	

6. Type of land

a.	Irrigated land	
b.	Rain fed land	
c.	Homestead land	
d.	Cultivated land	
e.	Shrub Land	
f.	Barren Land	
g.	Landslide Area	

7. Status of food sufficiency

a.	1- 3 months	

b.	4 - 6 months	
c.	7 - 9 months	
d.	10 - 12 months	
e.	Above 12 months	

8. Status of livestock

S. No.	Livestock	No	Yes	Number, if Yes
a.	Buffalo			
b.	Cow			
c.	Bullock			
d.	Goat			
e.	Pig			
f.	Sheep			
g.	Others			

Appendix B: Interview with the key people

1. Beneficiary households by users

a.	Head users	
b.	Middle users	
c.	Tail users	
d.	Total	

2. Source of the system

a.	Forest	
b.	River	
c.	Seasonal Rainfall	
d.	Water spring	

3. Type of climate

a.	Tropical	
b.	Sub-tropical	
c.	Warm	
d.	Temperate	

4. How old is the system ----------

5. Type of system

a.	Farmer-managed	
b.	Agency-managed	
c.	Government-managed	
d.	Others	

6. Nature of the system

a.	Permanent	
b.	Semi-permanent	
c.	Temporary	

7. Major development and reforms in the past year

---

8. High demand of irrigation water by season

a.	Monsoon	
b.	Winter	
c.	Spring	
d.	Autumn	

9. Basis of water allocation and distribution

a.	Turn by turn	
b.	First by head users	
c.	First by middle users	
d.	First by tail users	
e.	First come, first use	
f.	By force	

10. Status of water sufficiency for irrigation

a.	Sufficient	
b.	Sufficient in monsoon	
c.	Partly/moderately sufficient	
d.	Insufficient	

11. When and how are the maintenance work done?

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12. How do people participate in operations and maintenance of the system?

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13. If anyone does not participate, what are the systems of punishment?

---

14. What is the process of decision-making?

---

15. How does the people communicate to each other?

---

16. Who is guiding the contributors at resource mobilization?

---

17. What types of conflict are faced in the system?

---

18. What is the process adopted to resolve the conflicts?

Appendix C: Knowledge, practice and tools on system operations

1. Before making the irrigated land, how was the structure of the command area and how was mobilized?----------

2. When was the work started? ----------

---

3. When was the committee organized?----------
4. Type of organization? ----------

a.	Formal/registered	
b.	Informal/non-registered	
c.	CBO	

5. Is there any organization for operation and maintenance of the system?

---

6. What is the nature of organization?

a.	It is formulated by the election process	
b.	Local people formulated	
c.	Government and agency formulated	
d.	Any other	

7. What is the structure of organization?----------
8. How is organization mobilized?----------
9. Who does the date and place fix for the meeting of organization?----------
10. What is frequency of major repairment and maintenance program in the system?

a.	Once a year	
b.	Once a crop season	
c.	Several time	
d.	When needed	

11. Who do the farmers inform for repairment and maintenance?----------
12. Who does the labor share for repairment and maintenance?

a.	Government agency	
b.	Voluntary organization	
c.	Every farmer contribute labor	
d.	Any other	

13. What are the bases of water distribution?

a.	Time basis	
b.	Depth basis	
c.	Crop basis	
d.	Area basis	

14. Are there any conflict among the farmers?

---

15. How is the conflict resolved? What are the practices and tools of conflict resolution?

Appendix D: Underlying culture in system operations and grassroots reality

1. When was this system started to build? What was the purpose?

---

2. What type of activities and reforms were done in the past?

---

3. How is the water acquisited?

---

4. What is the status of water acquisition?

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5. What is the basis of water allocation?

---

6. Are the beneficiaries satisfied from the present water allocation?

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7. What are the methods of water distribution?

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8. What are the rules and regulations for water distribution?

---

9. Who is responsible for water distribution activities?

---

10. In which seasons/months drainage management works are done?

---

11. What is the purpose of operation and maintenance?

a.	Improve	
b.	Preventive	
c.	Other (specify)	

12. What is the work done in operation and maintenance?

---

13. What are the rules and regulations of operations?

---

14. What are the processes of operations?

---

15. How is the meeting called?

---

16. How do they make the decision over the issues?

a.	Vote	
b.	Veto	
c.	Consensus	
d.	Other specify	

17. What is the process of communication?

---

18. Who is responsible for communication tasks?

---

19. What types of resources are mobilized?

---

20. What is the basis of resource mobilization?

---

21. What are the purposes for resource mobilization?

a.	Construction	
b.	Routine operation and maintenance	
c.	Emergency operation and maintenance	
d.	Other specify ----------	

22. What types of punishment are made if anyone does not mobilize the resource required? -

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23. What are the main causes of conflict?

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24. What types of conflicts mainly occur in the system?

a.	General	
b.	Complex	
c.	Both	

25. Who is responsible to resolve the conflicts?

---

26. What are the bases and rules for conflict resolution?

---

27. What are the main factors of hindering or problems for the smooth irrigation system activities? ----------

28. How is the problem affecting the irrigation system activities?

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29. How do farmers tackle the problems?

BIBLIOGRAPHY

Bautista, H. B. (1989): **IIMI Case Study No.1.** ***"Experiences with Organizing Irrigator's Associations: A Case Study from the Magat River Irrigation Project in the Philippines"***. International Irrigation Management System, Srilanka.

Border, Francais (1968): ***The Old Stone Age***. New Work: McGraw-Hill Book Company, USA.

Budhathoki, K. et. al. (1996): ***Vegetable Crops: Indigenous Knowledge and Technology in the Western Hills of Nepal***, in D. Tamang et. al (eds.) P.p. 70. Indigenous Management of Natural Resources in Nepal, Winrock International, Kathmandu, Nepal.

Bulletin of DDC (2008): ***Rupandehi Bikash Patra*** published by DDC Office, Rupandehi, Nepal

CBS (2006): ***Statistical Year Book, 2006***. Government of Nepal.

Chambers, Robert (10 December 1986): ***IN SEARCH OF A WATER REVOLUTION: CHAPTER: 6 MAIN SYSTEM MANAGEMENT: THE CENTRAL GAP***. Institute of Development Studies, University of Sussex, Brighton, East Sussex, U.K.

Chambers, Robert (2004): ***Rural Development: Putting the Last First***. Published by Pearson Education (Singapore) Pte. Ltd., Indian Branch, 482 F. I. E. Patparganj, Delhi 110 092, India.

DDC Office, Rupandehi-Information, Research and Publication Section (2008): ***Rupandehi Eka Parichaya*****,** DDC Rupandehi, Nepal

District Profile (2007): ***District Development Committee***, Rupandehi.

DOI and CMS (P.) Ltd. (1992): ***Experience Document NEP/89/006***. Nepal Irrigation Sector Pilot Program: Principles, Process and Performance.

FMIST (1998): ***Report on FMIS Award and Training on the Theme of Conservation Measures in Irrigation Systems***. Kathmandu, Nepal.

Fowler, Alan (1997): Striking a Balance: ***A GUIDE TO ENHANCING THE EFFECTIVENESS OF NON-GOVERNMENTAL ORGANIZATIONS IN***

INTERNATIONAL DEVELOPMENT. Earthscan Publications Ltd., London, UK.

Gautam, Upendra and Rana, Shrish (Edited in 2001): ***CHALLENGES TO FARMER MANAGED IRRIGATION SYSTEMS: Proceedings of International Seminar on Challenges to Farmer Managed Irrigation Systems held on 28 and 29 March 2000, Kathmandu,*** *Nepal.* Farmer Managed Irrigation Promotion Trust, Kathmandu, Nepal February, 2001.

Gill, G. R. (1996): ***Indigenous Systems in Agriculture and Resource Management in Nepal.*** In Indigenous Management of Natural Resources in Nepal. P. p.24 edited by D. Tamang et. al, Winrock International (1996), Kathmandu, Nepal.

Global Water Partnership (1999): ***A Strategic Plan***. New Delhi, India.

NPC (2006): ***Tenth Plan***. National Planning Commission, Government of Nepal.

IIMI Country Paper-Nepal-No. 3 (1990): ***Assistance to Farmer Managed Irrigation System***. WECS and IIMI, Kathmandu, Nepal.

International Irrigation Management Institute (1989): ***Public Intervention in Farmer Managed Irrigation Systems***. Kathmandu, Nepal.

Irrigation Diary (2006): ***Department of Irrigation***. Government of Nepal, Kathamndu, Nepal.

Irrigation Policy (2006): ***Department of Irrigation***. Government of Nepal, Kathamndu, Nepal.

Malla, G. L. and Khadka, S. S. (1996): ***Farmer Managed Irrigation System in Nepal***. Some Issues and Trends, IIMI, Kathmandu, Nepal.

Manor, S. et. al. (15-20 May 1989): ***Role of Social Organizers in Assisting Farmer Managed Irrigation System***. Kathmandu, Nepal.

Myers, B. L. (2004): ***Walking With The Poor: Principles and Practices of Transformational Development.*** Published by Orbis Books, Maryknoll, New York, USA.

PEET, RICHARD and Hartwick, Elaine (2005): ***Theories of DEVELOPMENT***. RAWAT BUBLICATIONS, Jaipur, Delhi, India.

Tuladhar, N. M. et. al. (2007): ***CONTRIBUTIONS TO NEPALESE STUDIES***, Journal of Center for Nepal and Asian Studies (eds.). Volume 34, Number 2, July 2007. Tribhuvan University Kirtipur, Kathmandu.

Uprety, L. P. (2000): ***Functions of an Organization in an Indigenous Irrigation System: A Case Study from a Hill Village*** in R.R. Regmi et. al (eds.) P.p. 41. Occasional Papers in Sociology and Anthropology, Vol. VI. Tribhuvan University, Kirtipur, Kathmandu, Nepal.

Uprety, L. P. et. al. (Edited in 2007): ***Nepalese Journal of Qualitative Research Methods,*** Local Initiative Promotion Trust (eds.). Volume 1, December 2007, Lalitpur, Nepal.

Uphoff, Norman (1986): ***Improving International Irrigation Management with Farmer Participation: Getting the Process Right***, Westview Press, Colorado, USA.

Warren, D. Michael, Slikkerveer, L. Jan and Brokensha, David (1995): ***THE CULTURAL DIMENSION OF DEVELOPMENT: Indigenous Knowledge System.*** Intermediate Technology Publications Ltd. 103-105 Southamton Row, London WC1B 4HH, UK.