

**FARMER MANAGED IRRIGATION SYSTEM  
BALANCING WATER USES FOR SUSTAINING LIVELIHOOD  
(A Case Study of Naubise Irrigation System, Kavrepalanchok District, Nepal)**

A Thesis Submitted to  
The Central Department of Rural Development (CDRD),  
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Degree of the Master of Arts (M.A.)  
in  
Rural Development

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March, 2015

## **RECOMMENDATION LETTER**

This is to recommend that the thesis entitled **Farmer Managed Irrigation System Balancing Water Uses for Sustaining Livelihood: A Case Study of Naubise Irrigation System, Kavrepalanchok District, Nepal** has been prepared by **Sushila K.C** under my guidance and supervision in partial fulfilment of requirements for Master Degree of Arts in Rural Development. To the best of my knowledge, this thesis work has not been submitted for any degree in any institution. I hereby forward this thesis to the evaluation committee for final evaluation and approval.

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# VDC RECOMMENDATION LETTER



## गाउँ विकास समितिको कार्यालय Office of the Village Development Committee

शारदा बत्से, काभ्रेपलाञ्चोक  
Sharada Batase, Kavrepalanchok

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विषय (Sub):- जो बस हंग सरोवर राख्ने।

प्रस्तुत विषयमा जिभुवन विडव विद्यालय किराँतेपुर (काठमाडौं) मा स्नातकोत्तर द्वितीय बर्ष अध्ययनत का.प.नी पनौती नं.पा वडा नं. १० बस्ने शुसिला डे.सीले नेत्रिसे सिंघार्य आयोजना अर्न्तगत यस शाखा गा.वि.स.को वडा नं. ४ मा आई - तथापु सेकलन जारी लगेको ब्याहोरा जानकारीको लागि अनुपेक्ष का साथ सिफारीस गरिन्छ।

०६९/६/६  
इश्वर प्रसाद सापकोटा  
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## Approval Letter

The thesis entitled “**Farmer Managed Irrigation System Balancing Water Uses for Sustaining Livelihood**” A Case Study of Naubise Irrigation Project, Kavrepalanchok District Nepal submitted by Miss **Sushila K.C.** in partial fulfilment of the requirements for the Master’s Degree (M.A.) in Rural Development has been approved by the evaluation committee.

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# DECLARATION

I hereby declare that the thesis entitled **Farmer Managed Irrigation System Balancing Water Uses For Sustaining Livelihood: A Case Study of Naubise Irrigation Project, Kavrepalanchok District, Nepal** submitted to the Central Department of Rural Development, Tribhuwan University, is entirely my original work prepared under the guidance and supervision of my supervisor. I have made due acknowledgements to all ideas and information borrowed from different sources in the course of preparing this thesis. The results of this thesis have not been presented or submitted anywhere else for the award of any degree or for any other purposes. I assure that no part of the content of this thesis has been published in any form before.

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Sushila K.C

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## ABSTRACT

*Irrigation plays a major role in the developing country like Nepal where almost 80% people are still dependent in agriculture to increase the production and in order to sustain the livelihood of the people. FMIS proves as the milestone for the economic growth of the people and to bring major transformation in the lives of the people. The share of FMIS in the irrigated agriculture is almost 70% in Nepal. To know about the balance water uses for sustaining livelihood and to relate it with available data, a study was carried out in Sharada VDC of Kavrepalanchok District. Naubise Sichai Phant Yojana or Naubise Irrigation System has a great contribution in the complete transformation of the Sharada VDC.*

*The main objective of the study is to find out the people's participation in balancing water uses for sustaining livelihood. This research tries to access the balance use of water for sustaining livelihood; factors influencing participation for the effective management of water and the impact of irrigation management in the study area.*

*Literature Review was conducted through various sources such as previous studies report, different articles about FMIS, previous thesis and internet to identify the gap. The research was conducted under descriptive and exploratory research design. Both primary and secondary information were collected during the course of study. Primary data were collected through structured questionnaire survey from the farmers. Key informant interview, field visit, observation and focus group discussion were also carried out while secondary data were collected from various published & unpublished information sources i.e. relevant literatures, books, journals, reports, annual reports and other official sources.*

*The farmers have observed the complete transformation in the livelihoods of the people with 60 percent growth in investments, 30 percent growth in their savings and 10 percent growth in access to education as the major economic changes. Likewise, 40 percent increase in social harmony, 35 percent increase in decision making, 15 percent increase in access to credit and innovation as the major social changes and 50 percent increase in the construction of road, 30 percent increase in the construction of houses, 10 percent increase in the construction of canals and 2 percent increase in the construction of agro-*

*processing centre as physical sectors. The level of production has increased by about 80 percent in the study area. With the availability of irrigation, farmers in the area have started growing potatoes twice a year which has been the major source of the income.*

*After the formation of WUA in 2002 farmers are actively participating in the water management, irrigation repair and maintenance. The major factors influencing the participation are physical factors (30%), socio-economic factors (25%) and Psychological factors (45%). The trend of water availability is high in autumn season with 30 percent and whenever necessary 50 percent.*

*Irrigation has major impact in the decision making of women which is 60 percent followed by 30 percent in the development of self-help group and 10 percent conflict resolution. Irrigation has also played secondary role in the establishment of cooperative and has highly contributed in educational sector, economic growth and in the overall development of the study area. Women are actively participating in the effective management of water which helps to sustain the long term of the project.*

*Thus, FMIS has a great significance for community development, enhancing opportunities to participate for farmers including women and small farmers in the mainstream of development, which provides over all rural development.*

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## ACRONYMS/ABBREVIATIONS

ADB	Asian Development Bank
AMIS	Agency Managed Irrigation System
APROSC	Agriculture Project Service Centre
CBS	Central Bureau of Statistics
CMIASP	Community Managed Irrigated Agriculture Sector Project
DOA	Department of Agriculture
DOLIDAR	Department of Local Infrastructure Development and Agricultural Roads
DOI	Department of Irrigation
DTW	Deep Tube Well
et al	and others (from Latin <i>et alii</i> )
etc	and so forth (from the Latin <i>et cetera</i> )
FMIS	Farmer Managed Irrigation System
GDP	Gross Domestic Product
GON	Government of Nepal
GWRDB	Ground Water Resources Development Board
ha	Hectare
HH	Household
HMG	His Majesty of Government
IDE	International Development Enterprises
ILC	Irrigation Line of Credit
IMC	Irrigation Management Committee
IMT	Institute of Management Technology
INPIM	International Network on Participatory Irrigation Management
ISP	Irrigation Sector Program
IWRMP	Irrigation and Water Resource Management Project
MOLD	Ministry of Local Development
NARC	National Agriculture Research Council
NGOS	Non Government Organizations
NIIS	Nepal Irrigation Institutions and System Database

No.	Number
NPC	National Planning Commission
SAPPROS	Support Activities for Poor Producers of Nepal
S.N	Symbol Number
STW	Shallow Tube Well
TU	Tribhuvan University
WUA	Water User's Association
WUG	Water User's Group
WECS	Water and Energy Commission Secretariat
%	Percentage

# **CHAPTER -ONE**

## **INTRODUCTION**

### **1.1 Background of the Study**

#### **1.1.1 Irrigation**

Nepal is naturally a beautiful country. It contains abundance potentiality in agriculture, in spite of its tough topography; its potentiality in agro product is favoured by its peculiar climatic zones and geography. Nepal is primarily an agricultural country with about 26.6 million human populations out of which 83 percent population resides in rural area and 78 percent people are highly dependent on agriculture (CBS 2011). Water is an important natural resource of Nepal. The immense quantity of water available in the country and its potentiality to irrigate significant percentage of the total agricultural land, provide us the better opportunity of overcoming the barriers of economic development in this beautiful Himalayan country. Agriculture is the main source of subsistence for most of the people in developing countries including Nepal. It contributes about 32% of the GDP (CBS 2014). And provides employment for more than two third of the population of the country. Thus irrigation plays a vital role in agriculture-based country like Nepal. The volume of agricultural production directly depends upon irrigation, which directly affects the quality of life of the rural people and GDP of the country. In other sense, irrigation development is one of the means of increasing food production to feed the growing population in rural area, where most of the people are poor and living at subsistence level without having any opportunities of employment. Thus irrigation development is the need of the people and for the country as well.

In Nepal, there is limited scope for expansion of agricultural land to increase agricultural production. Therefore, the only alternative available for increasing the agricultural production is to increase productivity and cropping intensity by adopting suitable measures like increase in irrigated land, intensive use of available irrigation infrastructure, improvement in water management practices, in farmer's participation in the irrigation systems, development of non-conventional irrigation methods and coordination in supply and management of agricultural inputs include

marketing services. Farmer Managed Irrigation Systems (FMIS) have major contribution in providing irrigation facility in the country. But due to various problems outside the control of the farmers the FMIS are losing their capacity. Government of Nepal has initiated Small Irrigation Special Programme (SISP) with the view of supporting the existing small irrigation systems and utilizing small sources of water by making use of local technology and farmers' contribution. Under this program financial support is provided by the government to maintain/rehabilitate and improves the existing small irrigation systems, to construct new small systems and to develop non-conventional irrigation systems (like drip, sprinkler etc.) where feasible.

Nepal's agricultural productivity has remained relatively stagnant over the past 20 years or more (NPC, 2007), with modest average annual increases of 1.8 per cent in total cereal grain production (NPC, 2007). The potential for expanding areas being minimal, the only option left for improvement is the introduction of modern farming practices with the provision of irrigation facilities and their effective management.

Nepal is famous for its Farmer Managed Irrigation System (FMIS). At the beginning FMIS had existed on self-help basis. Those self-help groups, (locally named as Kulo Banaune) have established a mechanism according to the tradition of ownership, organizational capabilities, user's participation and mutual trust and accountability. With this system irrigation development in Nepal remained in the hands of the local people for many years. At present two types of FMIS are seen in Nepal. They are:

- Traditional irrigation system managed by farmers
- Handed over irrigation system from government and NGOs to the farmers.

Farmers' knowledge, with regard to local water resource, environment and experience with regard to construction of irrigation schemes and other activities related to water acquisition and management is valuable and important for sustainable utilization of water resource.

Irrigation systems have two basic semi-public good features that are; costly to exclude potential beneficiaries from using it and the use of water by one individual

reduces the availability of water to others. Thus the irrigation systems are characterized as common pool resources and water allocation and provisions are two major sources of collective action problems. Operating and maintaining of an irrigation system require coordination among many farmers. Collective action problems arise easily when each farmers has the incentive to use more water and invest less in the system. These problems often result in poor maintenance as well as conflicts and anarchy in water allocation (Tang, 1992). Solution for such problem requires institutional arrangements to provide a structure of rules.

To develop mutually beneficial arrangements in irrigation, participants need basic information about the physical and technological characteristics of the water flow and water delivery facilities as well as information about the respective preferences of individual participants. The information they possess at any given time and their ability to get more information affects their ability to develop appropriate institutional arrangements to tackle their problems in water allocation and maintenance. Thus it is equally important to know the factors influencing the participation and formation of institutions for the effective management of irrigation water.

Balancing water uses and environment conservation in irrigation system plays an integral role for the effective management and sustaining livelihood, People's participation in irrigation system is very important for getting positive results and making it sustainable. Therefore, it is must to involve local people's participation in every stage of irrigation development without whom it becomes difficult to achieve the sustainability of the project.

### **1.1.2 FMIS in Nepal**

Irrigation development and management in Nepal is probably as old as the rice terraces covered by the farmers. Until 1980's there was no formal recognition of the contribution of farmer's managed irrigation system (Pradhan, 2002). However, with the basic needs fulfilment program of the government during 1980's there been felt need for high rate of agricultural development which was not possible without the development of irrigation. For this it was not possible to develop large infrastructure by the government for the desired rate of agricultural growth. Thus

during 1980s government with different donor driven programs (e.g. Irrigation line of credit-ILC, Irrigation sector program-ISC) started to provide assistance to FMIS in different parts of the country and hence increased the record of irrigated area (Pradhan, 2002). Thus for a short period of time many of the FMIS came under the domain of Irrigation Department. The feasible land area for irrigation in Nepal is 1.76 million hectare. Out of the total irrigable land, around 60% has some kind of irrigation facility. However, less than one-third irrigated land has year-round irrigation facility.

Only the limited percentage out of total land area of Nepal is suitable for irrigated agriculture. Irrigated agriculture holds great potentiality to meet the development challenges and key to increased agriculture production to feed the growing population of Nepal. Besides, increasing the agriculture production, irrigation helps promote Green Revolution, contributes for poverty alleviation and helps promote rural growth and food security among people. Dilapidated irrigation system affects on all these fonts of development issues. In order to meet these challenges, the important question is: how can irrigation sector be revitalized? It is, therefore, necessary to revitalize the irrigation sector to feed growing population, to ensure livelihood and poverty alleviation and maximize the benefit of available natural resources like water to get more production from limited land availability (Pradhan, 1989a).

Irrigation helps to increase the production ratio of the farmers. It not only makes people life easy but also feasible to cultivate the crops as per their wish. The farmer needn't need to depend on rain water, so within a time limit huge quantity of products can be produced. This help to enhance the economic condition of the people by importing the produced goods to outside market paving a way for sustainable livelihood.

FMIS incorporate pluralistic democratic value and people's unified cultural heritage by means of their self-governing autonomy and egalitarian character. In day to day FMIS operations, these values and characteristics are expressed through the generation and use of the social capital. The share of FMIS in the irrigated agriculture is almost 70% in Nepal. In the remaining areas, some systems are being transferred wholly to water users association (WUAs) for management, whereas

some irrigation systems are being jointly managed by the government and WUAs (Shrestha, 2009).

There are about 16,000 FMIS and irrigate approximately 7, 14,000 hectare of cultivated area or 67% of the total irrigable area of the country. Historically the government of Nepal perceived irrigation development as being the domain of local concerns because of which farmers in disparate locations of the country organized themselves to construct, govern, operate and maintain a large number of irrigation systems (Lam, 1998).

There are different agencies which influence the irrigation sector of Nepal. The National Planning Commission (NPC), Ministry of Irrigation (MOI), Ministry of Finance (MOF) and Water and Energy Commission Secretariat (WECS) are responsible for initiating appropriate policy on irrigation development in Nepal. Recently, the GON has shifted towards mega-irrigation projects and inter-basin water transfer projects as well. However, the micro-irrigation like non-conventional irrigation systems, small and medium irrigation systems also contribute to ensure food security. These policy making bodies have to take comprehensive approach incorporating all these resource (mega, medium and micro systems) to decide on the investment, choice of appropriate technology, water right issue on different water sectors, allocation of water resources to different sectors keeping in view of integrated water resources management program, direction towards management types and governance modes etc.

Of the total agricultural land of Nepal only 1.8 million hectare of land is considered to have potential for irrigation. Of this, irrigation facilities have reached 1.252 million hectare (70.9%) land. Even in the areas with irrigation facilities, the facilities are often not available throughout the year (Economic Survey 2012-2013)

## **1.2 Statement of the Problem**

Due to population growth, the demand of agricultural production is increasing day by day in the country. In this situation to meet the present need it is must to increase

the agricultural production and to do so irrigation plays an integral role. Any irrigation system is beneficial to the farmers, since it enhances agricultural production in their farms and contributes to their livelihood.

The discouraging economic growth of Nepal is characterized by low agricultural productivity against the rapid growth of population. Provision of food to people is perhaps Nepal's most serious problem and will continue to be so over the next two decades. In Nepal, the duration of monsoon is short. It starts from June and lasts up to September. The country's participation record shows that it fluctuates highly with time and space. In this context, the surface irrigation is necessary for the cultivation of various crops like paddy, wheat, potato etc. Nepal is facing the shortage of agricultural production to meet the growing demand of food for the growing population. The growth rate of food production is only 1.4 percent per year, which is insufficient for growing demand. In order to increase the production of crops, it is necessary to improve present system of the use of water for irrigation so as to sustain the livelihood of the people.

Also there is huge gap between the scientific studies in irrigation and sustainable livelihood. This study aims to bridge the gap. Nepal has about 600 rivers and the total length of them is about 4500 km. It is the second richest country in the world possessing about 2.27% of the water resources. But lack of well knowledge, practice, experience, technology and methods, the water resources is not properly utilized as natural resource in Nepal (ADB, 1988).

In addition, the following research questions are mentioned to guide the study.

- a. What are the changes in the livelihood of the people through irrigation development?
- b. How are the livelihood assets analyzed in relation to maintain water use balance?
- c. What are the factors influencing the participation for the effective management of water?
- d. What are the impacts of irrigation management?

### **1.3 Objectives of the Study**

The general objective of the study is to find out the people's participation in balancing water uses for sustaining livelihood. The specific objectives are the following:

1. To analyze the changes in the livelihood of people and livelihood assets in relation to water use balance among various uses and users.
2. To examine the factors influencing participation for the effective management of water.
3. To assess the impact of irrigation management.

### **1.4 Significance of the Study**

Since, the study is completely concerned with the prospects of people's participation in irrigation management so, it gives the clear pictorial view of livelihood outcome, with the pros and cons of people's participation which will further enhance in various factors of rural development. The rationale of the study lies in the fact obtained from the analysis of the respondent view towards the people's participation in balancing water uses for sustaining livelihood. The theory that supports the aim of this study is that the development of rural area can be achieved only through the infrastructure development and social empowerment followed by social mobilization. This in turn seems to be viable only if the fundamental requisites of rural people are fulfilled. Thus the people's participation on a sustained basis helps in increasing farmers' household income and quality of life. It helps to build a sense of ownership of the system among the people which will lead to the sustainable water management.

Studies concentrating at Farmer Managed Irrigation System particularly at Sharada VDC are very little. Realizing this research gap in people's participation in balancing water uses for sustaining livelihood, an initiative was felt necessary. This could be a good reference for the future studies. Similar studies after some years will help observe the FMIS scenario in different parts of the country and balancing

water uses for sustaining livelihood of all possible sites, thus creating large knowledge pool.

This study is envisaged to narrow down the above mentioned research gap and will add a brick on Nepalese scientific research. That's why the study is of great valued from both socio-economic as well as academic point of view.

### **1.5 Assumption and Limitation of the Study**

The study was mainly confined to Sharada VDC of Kavrepalanchok District of Nepal. The study was very specific like that of case studies as the number of respondents interviewed in the study area represents only a portion of the total number so, the conclusion drawn from the study might not be conclusive. The sample selected was 40% of 200 household i.e. 80 household. As the study area was near to Kathmandu valley the total cost was effective. The time dimension was important limitation factor as the research was conducted for short period of time. The relevancy of the information lies on the assumption that the respondents have given true information and the phenomenon was studied for the one time field visit and analysis was done accordingly.

### **1.6 Organization of the Study**

Chapter I is the introductory section, which includes the background of the study which sheds light on the Farmer Managed Irrigation System scenario, national overview on FMIS, statement of problem, objectives, significance of the study and assumptions and limitations of the study.

Chapter II is the review of the literature concerned with the present study which includes review of concepts ad theories, review of previous studies, summary of the review and gaps in existing literature.

Chapter III covers the details of the methodology adopted for the research. It includes research survey design, nature and sources of the data and methods of the data analysis.

Chapter IV covers the setting of the study Area. It includes location and map of the study area.

Chapter V presents the finding of the study. In this section the results are presented according to the specific objectives. Charts, graphs and diagrams are drawn to illustrate the result.

Chapter VI is the discussion portion which includes mainly comparison of the results with previous studies where available. The results on each specific objective are thus discussed here. Some recommendations are also mentioned in this chapter.

# **CHAPTER -TWO**

## **LITERATURE REVIEW**

### **2.1 Theoretical Review**

#### **2.1.1 History of FMIS**

Until 1980's, there was no formal recognition of the contribution of farmer's managed irrigation system (Pradhan, 2002). However, with the basic needs fulfilment program of the government during 1980s, there was felt need for high rate of agricultural development which was not possible without the development of irrigation. For this it was not possible to develop large infrastructure by the government for the desired rate of agricultural growth. Thus during 1980s government with different donor driven programs (e.g., Irrigation Line of Credit-ILC, Irrigation Sector Program-ISP), started to provide assistance to FMIS in different parts of the country and hence increased the record of irrigated area (Pradhan, 2002). Thus for a short period of time many of the FMIS came under the domain of Irrigation Department.

Similarly during 1960s and 1970s huge investments was made for the construction of irrigation canals with the support of external agency and were managed by the government. Despite sophisticated engineering infrastructure and presence of highly educated staffs, the performance of these government managed irrigation system was poor (APROSC, 1978). In this context the devolution of responsibility for irrigation water resource management to local users 'organization has gained increasing importance in Nepal. Government of Nepal (GON) enacted Water Resource Act, 1992, Water Resource Regulation, 1993 and Irrigation Regulation 1999 which require registering the canal, though it is being managed traditionally by farmers. The right over the source and the canal can be protected only after the registration as the act established the ownership of water to state. GON has also adopted the policy of not only transferring irrigation systems to farmers but also creating a strong institution of farmers for the management of irrigation water (NPC, 2007).

In APP, providing reliable supply of irrigation water was prioritized as a prerequisite for enhancing agricultural production by reducing the risk of investing in the improved input packages. Accordingly, the Government prepared in 1997 a revised irrigation policy and a long-term Irrigation Development Plan (IDP) to accelerate irrigation development, with the principles of (i) participatory and demand-driven investments; (ii) transfer of DOI- managed systems to water user associations (WUA) and (iii) full O&M cost recovery by beneficiaries. To assist the implementation of these initiatives, ADB has supported FMIS improvement through Second Irrigation Sector Project (SISP), management transfer of DOI systems, and groundwater irrigation development, mainly covering the two eastern regions, along with capacity development of DOI. The World Bank is assisting the package of similar interventions through Nepal Irrigation Sector Project (NISP), covering the three western regions, whereas the European Commission is also assisting the selected FMIS. Assistance to FIMS has drawn attention in view of their opportunities for enhancing productivity with relatively low cost, quick gestation period and adopting a participatory approach building on the existing local institutions that have operated and maintained the facilities over the long term (HMG, 2004).

The major challenge in the understanding of livelihoods, social protection and basic services in the post conflict Nepal is the perceived notion of linking these terms together than separate it. Hence, there is a need to understand, first of all, that livelihood, basic services and social protection are interlinked to each other. After understanding the needs of people and their way of livelihood, the social protection packages are to be formed so that the state can cover these groups of people based on their needs and nothing less or above that. From the government's side, there is a need to collaborate with the organisations involved with providing livelihood options to the people so as to monitor on their progress towards lives and also to create protection mechanisms for these people. There is a need for researches on the recorded data of what area was covered with the protection mechanisms and what groups of people have improved their livelihoods [including what type of livelihood option, what organisation provided it, and who is involved in monitoring] (Upreti, 2012).

Livelihoods approaches offer, at least in principle, a way to link poverty, at the level

of the community, to actions taken by higher-level policy and decision makers, as well as to economic factors. This is a shift in approach in that it involves communities in their own needs assessment towards a process of involving communities in a holistic analysis of their own way of living, assets and coping mechanisms, and of the factors affecting their livelihood means and strategies. Livelihoods approaches also offer a way to judge poverty, relatively (not in absolute terms) against other members of the same community, while avoiding quantification. The sustainable Livelihood approach provides development practitioners with a coherent and flexible framework for programming, while also trying to establish micro-macro linkages. The approach has some practical tools and methods, such as guidance sheets, which describe how to use the Sustainable Livelihoods Framework, what information is needed and why, and how to go about obtain and analysing such information. It provides ingredients for the analysis of social, environmental, institutional, political, and policy issues, as well as options for livelihoods opportunities (Upreti, 2010).

The effect of the number of participants facing problems of creating and sustaining a self-governing organization is not yet clear. Although some scholars who have studied many-user governed forestry institutions have reported that success is more likely with smaller groups (Cernea, 1988). Others have found that smaller user groups are less able to undertake the level of monitoring needed to protect resources as moderately sized groups (Agrawal, 2002). Similarly, like size, the effects of heterogeneity on collective action are also problematic (see subsequent section). Groups can differ along various dimensions – cultural backgrounds, interests, and endowments (Baland and Platteau, 1996) – and each can operate differently. Since size and heterogeneity are not variables with a uniform effect on likelihood of self-organization. Ostrom (2001) suggests that instead of focusing on the variables themselves per se, studies should be directed towards determining how these variables affect other variables as they impact the cost-benefit calculus of those involved in negotiating and sustaining agreements.

Although recorded information on development of irrigation systems prior to 1950 is scanty we know that there are many small irrigation systems scattered all over Nepal which have been operating for more than a 100 years. The Nepal Irrigation Institutions and Systems Database (NIIS) indicates that there are 33 systems in the

database that have their origins before 1900 and 13 of them including the “Raj Kulo” of Argali, Palpa have been in operation before 1800. Similarly, at least 6 systems in East Chitwan alone date back to over a hundred years. Reviewing these statistics against the base year 1950, one begins to observe evidence of the capabilities of farmers to engage in fruitful collective action. 1950 is an important year in Nepalese history because it was only subsequent to this year that the state assumed an active role in the development activities concerning its citizens (Regmi, 2004).

Demographic forces are believed to be the primary reason that led to agricultural intensification techniques, irrigation being one of them. The manner in which the earlier systems were developed has a colourful and mixed history. Yoder (1986) cites the development of some of the earlier systems as having taken place through the individual initiatives of courtiers or soldiers after receiving land grants from the King. Invested with the powers of the state to draft tenants into constructing the systems in lieu of paying higher revenues the incentives were strong for constructing irrigation systems to boost productivity. Other driving forces have been “guthis” (land endowments), initiatives of local elite and royal directives. Although farmer-managed irrigation systems may have had its origins in “birta” (land grants awarded by the state) or “jagir” (temporary assignment of land by the state to compensate for services tendered) and the coercion of the state, there is evidence that some of them were built by farmers themselves (e.g. Cherlung Kulo of Palpa). There is also contemporary evidence to suggest that the vast majority of the irrigation systems have been self-governing.

From the very beginning, farmers were taking the responsibility for water acquisition, water allocation and distribution and overall management of the small irrigation canals on a continuous basis for increasing agricultural production in their fields. They were doing irrigation management utilizing their indigenous knowledge and skill. At the beginning farmer managed irrigation system (FMIS) had existed on self help basis. Those self-help groups, (locally named as Kulo Banaune) have established a mechanism according to the tradition of ownership, organizational capabilities, user’s participation and mutual trust and accountability. With this system irrigation development in Nepal remained in the hands of the local people for many years. This tradition afterwards changed to or gave birth to FMIS

scattered all over the country. Thus, the legal tradition and local administrative structures over a period of time have permitted FMIS in Nepal to operate without interference from an irrigation agency or other governmental administrative unit (Shrestha, 2009).

### **2.1.2 Farmer Managed Irrigation System**

Irrigation development and management is undertaken by different agencies of the government and private sector in Nepal. The institutions that are contributing for irrigation development in Nepal are: (a) Department of Irrigation (DOI), (b) Department of Agriculture (DOA), (c) Ministry of Local Development (MOLD) through DOLIDAR (Department of Local Infrastructure Development and Agricultural Roads), (d) Ground Water Resources Development Board (GWRDB), (e) ADB/Nepal (f) farmers' community, and private sector organizations (e.g., NGOs such as International Development Enterprises (IDE), SAPPROS/Nepal (Support Activities for Poor Producers of Nepal), etc (Pradhan,2012).

Similarly, the educational and research institutes like agriculture and engineering colleges and the National Agriculture Research Council (NARC) are also important players to contribute for the better performance of irrigated agriculture. Among these different agencies involved in irrigation sector development, the DOI has a major share in promoting and managing the irrigation systems in Nepal. The DOI is involved in multi-facet aspects of irrigation development. Prominent among them are surface irrigation system of all sizes above 25 ha (small, medium and large), ground water development by shallow tube well (STW) and deep tube well (DTW), and lift irrigation systems (Pradhan, 2012).

Smallholder irrigation is a highly case-specific, potentially complex, dynamic socio-biophysical entity influenced by a considerable number of internal characteristics and external driving forces and factors, and is a driver of considerable change on downstream sectors and users. Have we recognized this special nature of irrigation within livelihoods, food and cash production, river basins and the environment? (Lankford, 2001).

Shrestha (2009) defined FMIS as a community based organization operating at grass-root level. It plays an important role in increasing agricultural production and

productivity. It helps in increasing farmers' household income and quality of life. FMIS lays emphasis in institutional building of water users and provides them sense of ownership of the system. Local people's participation is very high in FMIS leading to optimum utilization of water resources for production purpose and sustainable water management.

Basnet (2013) elaborated FMIS as the system practiced in Mountains, Hills, Valleys and the terai plains covering area ranging from 5-10 Ha to even > 10000 Ha which consist well organized and functional water user Association/Committees with hierarchical system mostly functioning as per indigenous traditional practices relying on rules crafted over years. It is highly suitable and effective operation and maintenance mechanism of irrigation system which consists participatory and consensus approach to decision making management that changes over on annual basis. It has very strong on defaulters and absentees. In some case irrigation institutions also function to address other social issues.

Roder (1965) indicated that irrigation projects have been successful in enabling farmers to obtain a certain amount of wealth, ... substantially more than dry land farmers, probably more than employees of white farmers, and comparable to levels enjoyed by urban workers. This suggests that farmers in irrigation schemes as long back as the 1930s were earning higher incomes than dry land farmers. The schemes helped in reducing the rural to urban migration by offering the rural population an alternative source of employment and income.

FMIS are owned and managed by the farmers themselves. At present, about 40% of food requirement of the country come from these irrigation systems. Hence, they have an important role for food security as well their contribution to the Nepalese economy. There have been many modes of intervention in the FMIS in Nepal (Ostrom, Lam et al 2011; ADB 2006; WB 2007). IWRMP and CMIASP have the objective to improve agriculture productivity of existing small and medium size FMIS suffering from low productivity and high poverty incidence and help enhance the livelihoods of the poor men and women. These objectives shall be translated by providing improved means for WUA empowerment, improving irrigation facilities, promoting agriculture extension, targeting livelihood enhancement to build human

capital of the poor and strengthening policies, plans and institutions for more responsive service delivery (Pradhan, 2012).

Pradhan (2003) defined Farmer Managed Irrigation System as a mode of natural resource management in which there is participation of the member of the farming community in management decisions. A FMIS system comprises structure, methods and procedures for joint management and decision-making. In irrigation system managed by farmer's water is considered to be a community resource and it is water, which unifies farmer into a group that collectively makes decisions about for acquiring, distributing and applying water for agriculture. FMIS can promote polycentric mode of governance and in supporting equitable management of water. Uprety (2004) claimed that the irrigation system based upon the indigenous knowledge is successful. Therefore, the entire irrigation project must be based upon the assumption of putting the people first.

Coward (1979) in another context states that the operation of an irrigation system is a complex organizational enterprise that involves engineering and construction activities, the management of soil- water relationship, the allocation of water rights to groups and individuals, and other activities. While there are many tasks which must be organized to sustain the operation of an irrigation system, three are of fundamental importance: (i) the organization of Water allocation; (ii) physical maintenance activities; and (iii) conflict management.

The irrigation system activities could be divided into three categories: organizational management activities, physical system activities and water use activities. All of these activities are essential for productive and good irrigation management. However, the organizational management activities and physical system activities depend on the quality of organizational management activities (Uphoff, 1986). Kelly (1983) defined irrigation as more than an act of hydraulic engineering. It requires institutional arrangements for the constructions and maintenance of physical facilities and the procedures for the movement and distribution of water. It is economically important, politically significant as a source of power. And it is considerable social consequence because it defines pattern of cooperation and conflicts in irrigated agricultural region.

Irrigation development and management in Nepal gives importance in farmers' 'active participation. Success or failure of all irrigation development programmes is determined by individual farmers and their actions, their initiative and innovativeness (Martin and Yoder, 1986). Baidya (1968) believed that irrigation is very important activity which started in different ancient time and has been continued. He also stated that the relationship between crop productions has been positive and that irrigation can't be developed without enough capital, skill manpower and modern technology.

Steward (1995) had tried to explain how irrigation shapes social and political life in relatively arid part of the world. According to him; the irrigation force is the strong force to shape the political system of a territory. Similarly, Scott (1985) showed how the irrigation system encourage or restrain the change in social relationship and institutions.

Water on the context of Nepal is the prime natural resources which are used for the promotion of agriculture. Its development is of great importance to us. Only 10% of total land is under irrigation facilities. We have natural resources, but we could not utilize them fully due to lack of money and technical difficulties (Sapkota, 1973).

Lamage Irrigation System, Syangja concluded that higher the intensity in irrigation, higher will be the cropping intensities and crop yields. Further, Irrigation Management Committee (IMC) has concluded that irrigation is an important constrains to improve agricultural productivity. IMC had also made an Impact Assessment of Sirsa-Dudara Irrigation System and summarized that proportion of land covered by rain fed crops reduced by 5% and that covered early paddy remarkable incensement in yield for all cereal crops (Sapkota, 1973).

In Nepal, the surface irrigation is the main system used in various parts of the country. Based on traditional methods of irrigation: Nepal has pipes, well and canal irrigation (Shrestha, 1987).

Thulotar Kulo is the most successful example of farmer constructed and farmer managed irrigation system in Nepal. It is located in ward no.4 of the Rupakot VDC in Tanahun, in the mid hills of western Nepal during a year long period 1997 and 1998. It was constructed by a group of farmers who manage and use the system as

their common property, community; all farmers who are engaged in the management and use of Thulotar Kulo are defined as members of system and make up the Thulotar Kulo water users association (WUA). The executive committee of the Thulotar Kulo WUA is accountable to its general assembly, comprised of all meaning farmers of Thulotar Kulo (Poudel, 1996).

## **2.2 Empirical Review**

ADB (1988) stated that some of the world's oldest irrigation systems built; operated by farmers exist in Nepal and have made a substantial contribution in the irrigation development of Nepal. ADB (2012) believed that participatory irrigation management may generate more benefits, perform better, or generate greater positive impacts than other approaches under certain conditions. Conditions vary across irrigation systems, such as land and water distribution structures, farmers' dependence on agriculture for household income, commitment of the leadership, support to newly created water organizations, and so on. Understanding these conditions in the various contexts and identifying key features of successful participatory irrigation management is essential to the success of future irrigation and drainage projects.

Participation is defined as a process through which stakeholder's influence and share control of development initiatives and of decisions and resources that affect them. Thus, participation requires more than just disseminating information and giving farmers government-specified roles in projects. Participation in irrigation management involves a larger role for farmers, water groups, and other stakeholders. It may range from offering information and opinions during consultations, to fully enabling farmers to act as principal decision makers in all or most project activities. There have been increasing efforts to use participation in various forms to improve the quality, effectiveness, and sustainability of irrigation systems. This makes it important to learn what has and has not been achieved in efforts to improve participation in irrigation management. This synthesis highlights lessons from evaluations of ADB-supported irrigation and drainage projects, with a focus on participatory irrigation management (ADB, 2012).

ADB (2012) also believed that participation enhances careful and appropriate planning. Stakeholders have to be involved as early as possible, rather than in a residual activity after physical facilities are completed. The expected outputs of each stakeholder should be clearly identified and linked to the outputs of other Stakeholders, which will facilitate participatory monitoring and meeting project targets. In the irrigation component of the Earthquake and Tsunami Emergency Support Project in Indonesia, joint walkthroughs and field inspections with the affected communities formed the basis for identification and selection of the main rehabilitation and reconstruction options. The continuous involvement and participation of local communities resulted in agreement on scheme rehabilitation and reconstruction requirements. In addition, farmers' existing structures and traditional practices must be closely studied while designing irrigation facilities and projects should consider such practices as much as possible. The Rajapur Irrigation Rehabilitation Project in Nepal successfully demonstrated that farmers' participation can be easily solicited and augmented if the project and its components are planned and designed in response to farmers' needs.

Effective governance of Irrigation systems is crucial to Nepal because it is predominantly an agrarian economy dependent upon irrigated rice agriculture to feed a growing population. Agriculture contributes 40% to the GDP and provides employment to 80% of the labour force (Ministry of Finance, 1998). The Irrigation statistics of the nation further indicates that of the 2.621 million hectares of land cultivated nationally, only 853,030 hectares are serviced by some kind of irrigation system (Department of Irrigation, 1997). Farmer Managed Irrigation Systems (FMIS) contribute 75% towards the total irrigated area. There are 15,000 FMIS in the hills and 1700 systems in the Terai (Pradhan, 1988). Until the 1950s irrigation development nation-wide was a result of farmers' initiatives and investments in the construction and management of irrigation systems. These farmer initiated irrigation systems are referred to as FMIS. In the past a lot of investment was made on developing irrigation infrastructure by the government, however, the performance of these systems were reported to be unsatisfactory relative to the resources put into the sector (HMG/N National Planning Commission of Nepal, 1994). Failure to provide an assured supply of water, failure to reach water to farmers in the tail-end, and failure to achieve economies of scale in all spheres of

construction, operation, and maintenance in the systems supplied by the Government were among the problems reported.

Systematic study comparing the performance of Agency managed systems (AMIS) to FMIS in Nepal ( Lam, 1998) further showed that FMIS outperformed AMIS on most key parameters – agricultural yield, cropping intensities, ability to reach water to tail end. The farmers on the whole were able to overcome collective action problems but it cannot be assumed that the process is automatic. Although there are many key attributes of both resources as well as resource users that could interact in a multitude of ways to influence collective action, salience of the potential joint benefit and the existence of a supportive political system are considered to be important variables conducive to promoting collective action.

While the potential of FMIS is substantial, not every FMIS operates at an optimum level of performance and not every FMIS is successful in self-organizing and self-governing activities. It is important to understand why this occurs. Commons research indicates that the role of heterogeneity – unequal resource endowments, cultural differences etc. – in a commons outcome is not too well understood. Advancing our understanding in this direction can perhaps provide valuable inputs to designing intervention policies to support the irrigation sector in Nepal. The classification of Irrigation Systems in Nepal has been based on the topography of the terrain traversed by the rivers. Systems that tap into rivers whose gradients change rapidly as they flow downhill are called Hill Irrigation Systems, those that draw water from rivers that cut across valleys with gentle gradients are termed River-Valley Irrigation Systems, and those that draw water from relatively large rivers flowing across the flat Terai lands are called Terai Irrigation Systems (Pradhan, 1989). Although there are physical and institutional differences between these systems in terms of rate of change of gradient, idle canal length, efforts required at canal maintenance, farm types irrigated, the size of the command area, and rules governing resource mobilization & water allocation there are similarities too (Pradhan 1989, Ostrom, 1992).

Intake structures on systems in all classes are generally constructed from boulders, stones and brushwood located appropriately to ensure easy diversion of water; rights to water withdrawal are fairly well established within systems and water

distribution among appropriators are governed by commonly understood sets of rules; and maintenance of physical structures, especially the intakes, during high floods require significant resource mobilization (Parajuli 1999, Ostrom 1992).

In addition to this, another way that Nepali irrigation systems have been classified is on the basis of how they are governed. Systems that are owned, developed and managed by farmers are known as Farmer Managed Irrigation Systems (FMIS) and those owned and governed by the State are referred to as Agency Managed Irrigation Systems (AMIS) (Pradhan, 1989). The Agency managed systems are further subdivided into three components - agency managed, jointly managed with farmers, or farmer managed - to further distinguish ownership and control rights over the systems (Shukla & Sharma, 1997). The combination of these two classification methods results in 12 classes of irrigation systems. Thus, an irrigation system can be located either in the hills, river valleys, or in the terai and it can also be either farmer managed or agency managed. If managed by an agency then ownership and control can lie either entirely with the agency, or can be shared with farmers, or can also lie entirely with the farmers if the systems have been turned over to them. The irrigation systems studied for the purposes of this dissertation are mostly Hill based Farmer Managed Irrigation Systems.

The WUAs in Nepal and in many other countries, even to this date, are considered as non- entity. They are not considered as the social and organizational resource at the grass root level. It is equally important to consider the environment that allows them to undertake multifunction activities. On many occasions, WUAs are formed at the occasion of construction and rehabilitation/modernization of the irrigation systems. After rehabilitation, the importance of WUA gradually diminishes. The importance of WUA as viable socio-economic organization and their potential role in the development of irrigated agricultural system is yet to be recognized in Nepal and in many parts of the world (INPIM-Nepal, 2010).

Nepal has abundant water resources capable of irrigating 8 to 10 million hectares and providing 43,000 MW of hydropower. About 40 percent of the nation's 2.6 million ha of potentially irrigable lands are developed. Development of Nepal's rivers for irrigation is costly because of the large diversion structures needed to manage the annual floods, exacerbated by the large quantity of sediment these

waters carry. Consequently, groundwater-based irrigation has proved to be an attractive option in the Terai for both the private and public sectors. Irrigation in Nepal is broadly categorized according to ownership and management (public versus private schemes), to location (Hills versus Terai), and to source of irrigation water supply (surface versus groundwater). Private irrigation schemes have long been developed and managed by private farmers, and are classified as Farmer-Managed Irrigation Systems (FMIS). The rest of the irrigation schemes are publicly developed and managed by the Department of Irrigation (DOI) assistance from the Government of India. To this day India makes expertise and finance available to Nepal in exchange for water rights to the main rivers-which serve the large irrigation schemes in India. Even after construction of the Chandra Canal in 1928 and several later projects, the total irrigated area was still only about 25,000 ha in 1950 (World Bank, 2008).

World Bank (2008) also believed that more than two-thirds of total irrigation lies in the Terai, about a quarter in the Hills and less than five percent in the mountains. In the hills the mode is primarily gravity-fed traditional irrigation systems owned and managed by communities or farmers, while in the larger valleys many systems were developed with full or partial support of the government. Of the 1.06 million ha of irrigated land, government investment developed about quarter from scratch and a further quarter through upgrading community-owned schemes. The balance comprised 0.32 million ha developed by farmers alone; and 0.14 million ha developed with help from credits extended by the Nepal Agricultural Development Bank. One-quarter of all surface water-based irrigation is publicly-managed by DOI, the rest privately by farmers and farmer's groups. Similarly, government manages one-quarter of Nepal's 170,000 ha served by mechanized groundwater abstraction. Similarly, the design of large-scale irrigation project was based on the Indian policy of spreading water relatively thinly over large areas to provide insurance against drought for wet-season (kharij) crops. Distribution systems of all government-financed projects were developed only partially in the expectation that farmers would build water distribution systems-in practice much of the potential command went undeveloped because farmers were unwilling or unable (for socioeconomic or technical reasons) to invest. As a result only 71 percent of public investment in command area development is utilized, and only 38 percent of that

has year-round irrigation. More recently, government has helped finance the extension of distribution systems to the 50 ha level, as well as organizing water users' associations and providing agricultural support services. In addition, the dearth of agricultural inputs and fertilizer in particular explains in large part the slow growth of agricultural production and farmers' low productivity. This is part of the vicious circle by which low margins and insecure water supplies preclude collection of water user fees, jeopardizing adequate operation and maintenance and thus reducing water management efficiency. Uncertain or unreliable water supplies allied with low margins heighten risk aversion and lower the perceived benefits of fertilizer and investments in improved agricultural management.

The governance of irrigation management is important. The centralized management system of irrigation systems has proven that it is not conducive for better water management, resource mobilization and agriculture production. There is a big debate going on whether bureaucracy or community should be managing irrigation systems. There are even debates going on stating neither state nor private sector but the community can better manage the irrigation systems (Ostrom 1994). Therefore, revitalization of irrigation systems has to have multi-dimensional features to address resources (water), physical infrastructure (canal and other control structures) as well as placing the farmers in the driver's seat and creating appropriate governance procedures (irrigation institutions) (Ostrom, Lam et al 2011). A central agency is necessary for planning, investment, monitoring, and evaluation of the sector in the larger context. At present, one feels the absence of such a central agency to oversee the overall irrigation sector encompassing all sizes, types and technologies as the national resource to ensure the food security.

The rate of expanding irrigated areas has slowed further in the last 5–6 years. During 2003–2006, the total area brought under irrigation was roughly 50,000 hectares (ha), equivalent to the new area brought under irrigation in 1999 alone. About 83% of irrigated land is not irrigated year-round, significantly reducing productivity by not allowing multiple crops in a year. Although the expansion in irrigated area increased in 2007 to about 27,000 ha, the rate of expansion remains very low, and, if it persists at the current level, Nepal will take about 40 years to irrigate the remaining 1.1 million ha of potentially irrigable land. The required

investment could be as large as \$3.3 billion at current prices roughly one third of Nepal's GDP in 2007/08 (ADB, DFID, ILO, 2009).

IMT (and in this case the intervention process in general) must hold out the promise of significant net improvement in life situations for a significant proportion of members and the irrigation system must be the central resource to creating an improvement in farmers' life situation (Shah et al, 2002). Lam (1998) in his study of irrigation systems in Nepal also does not find any relationship between the number of appropriators and his performance measures.

Pradhan (1989) notes that probably due to such a setting communities of irrigators have always been able to institute their own rules, bidhan (charters), schedules of operation, and sanctions without undue interference from an irrigation agency or other administrative units. The legal and local administrative structures over a period of time have permitted farmers to operate their systems independently. Despite the historical presence of a national judicial framework for irrigation, farmer managed irrigation systems have always retained an independent and self-reliant character not through design but central neglect by the state.

Pandey (1978) has studied the Impact of Irrigation on Rural Development in India. He states that small size land holding family is higher in the irrigated areas. In the irrigated land, a different variety of crops are being cultivated and employment, literacy, income are higher compared to the non-irrigated areas. For examples, there were 71.44 percent illiterates in the non-irrigated land. Only two types of crops (paddy and maize) are grown in the irrigated area. The use of chemical fertilizer has been increasing whereas the use of traditional manures has been declining.

A socio-economic Impact Evaluation Study in Janakpur APROSC (1988) noted the principal crops grown in the project area as paddy, wheat, oilseed, pulses and potato. The yield rate in the project area for paddy is strikingly higher than in the non-irrigated area. The yield rate for early paddy is 0.57 metric tons higher per hectare in the project area than the non-irrigated area. Similarly, the yield rate of normal paddy in the project area also exceeds that of the non-irrigated area by 0.79 metric tons per hectare. Since paddy is the most important crop grown in the area, it can be assumed that the income and standard of living of the farmers in the project

area is higher than in the non project area. A little increase in the production of wheat has been found in the surface irrigation as compared to the non-irrigated area. In many areas as crop water available for irrigation is very low. This may be the factor responsible for such a marginal change. A slight increase is also observed in the production of oilseeds per hectare in the project area compared to the non-irrigated area which is recorded at 0.588mt/ha.

Studies on Nepalese case have confirmed the general hypothesis that irrigation is expected to have a positive effect on productivity, cropping intensity and input use. Agriculture credit survey (1980) shows that crop yield, cropping intensity and input use on irrigated farms are consistently higher than that of the non-irrigated ones.

In the study on the Impact of Chitwan Irrigation Project Pageni (1982) said that crop production, cropping pattern and socio-economic activities have increased because of irrigation facilities. He further said that there is also a negative impact of irrigation, the pumping scheme lifted sand with water during the irrigation period and pumping tools had been adversely affected by sandy water. Due to this sandy soil, pumping schemes may not be durable for long time to supply water.

Mainali (1987) has studied the Impact of Irrigation on Rice Production in Nuwakot and summarized that irrigation project substantially increased the farm productivity and family income through farm diversification and utilization of farm resources. Farmers adopted recommended technology such as high yielding variety, modern farming practices, use of fertilizers and pesticides because of the availability of irrigation facilities.

The wide range of studies on indigenous knowledge and practice in the rural communities of Nepal has revealed their importance in irrigation development. FMIS resemble indigenous water resource management for subsistence of total people which involve operation, maintenance, allocation and distribution. Farmers make decision regarding the use and management of irrigation based on their indigenous knowledge and practice because irrigation is vital for both survival and culture. Gradually, the norms, values, routes and roles relating to irrigation management system have evolved in the mind of Nepalese people. The farmers have collectively and individually devised, decided upon, designed constructed,

planned, implemented, maintained and improved indigenous system for the management of natural resource through many centuries (Upreti, 1989).

Lamsal (1989) has pointed out that the Vijayapur Canal Irrigation has a positive effect on agriculture. People are able to grow more food grains (rice, wheat, vegetable etc) after irrigation. The barren land is under cultivation. He added that the land value of that area has been increasing after the irrigation facility.

Dahal (1991) has studied the Rampur Irrigation Project in Chitwan District. He analysed the impact of irrigation on variables such as cropping pattern, cropping intensity and crop yield and found that the significant change before and after irrigation. Before irrigation project about 62 percent of the cultivated area was irrigated mostly in the monsoon season. The cropping intensity was 185, most of the cultivated land was covered by hardly bicultural and monoculture cropping pattern. Crop yield was low and also the cropping pattern was of self sufficient type. After the initiation of irrigation project 82 percent of the cultivated land had been irrigated. Therefore, the overall cropping intensity had been increased by 32 percent and cropping pattern had also been changed.

Parajuli (1991) has studied the Impact of Irrigation on Different Crops in Pokhara. The summary of his findings is as follows:-

After the irrigation facility the proportion of total irrigated land has increased and scale of production has also increased.

The cropping pattern has also been changing. People have adopted intensive agriculture and multiple cropping systems and farmers are more oriented towards cash crops.

The economic condition of households has also been improved by irrigation facilities. In 1983, the average household's income was about Rs 776 per ropani while in 1989 it was Rs 1,438.

The traditional farmer-managed irrigation systems have succeeded in addressing social issues such as equity among the water appropriators. In other words, there is always an effort for putting people first in such systems and therefore, they have been sustainable for relatively long period of time. When there had been no focus

on the people and other social issues under the modernization paradigm and over-emphasis on the rational technology in 1950s and 1960s, the development interventions including in the irrigation sector could not be sustainable. It followed as a corollary that a group of social scientists, mainly sociologists and social anthropologists, began emphasizing on putting people first" in development projects in 1980s (Uprety, 2002).

Nepal hills have other such examples of successful Farmer Management of Irrigation. The relatively high performance of Farmer Management in South Asian hill irrigation schemes may be attributed to the tradition of collective self-management of irrigation that prevailed here for several hundred years. The Panchkanya System itself was originally built 115 years ago by the Tharu community, which also operated it as a Farmer-managed Irrigation System (FMIS) until the Department of Irrigation built a pucca head-works and took over its management (Tushaar Shah, Barbara van Koppen, Douglas Merrey, Marna de Lange and Madar Samad, 2002).

Access to reliable irrigation water can enable farmers to adopt new technologies and intensify cultivation, leading to increased productivity, overall higher production, and greater returns from farming. This, in turn, opens up new employment opportunities, both on-farm and off-farm, and can improve incomes, livelihoods, and the quality of life in rural areas. Overall, irrigation water, like land, can have an important income-generating function in agriculture specifically and in rural settings in general (Hussain & Hanjra, 2004).

# **CHAPTER- THREE**

## **RESEARCH METHODOLOGY**

### **3.1 Research Design**

The research was conducted under descriptive and exploratory research design, it is because the characteristics intended to study quires how and in what respect the people's participation help in irrigation management on sustained basis? On the other hand, it was tended to analyze and discover degree of interdependence between various characteristics that were influenced by people's participation in irrigation system.

### **3.2 Nature and Sources of Data**

To fulfil the objectives of study, both primary and secondary data were collected.

#### **3.2.1 Primary Data**

This study aimed to explore the outcomes of people's participation in balancing water uses for sustaining livelihood. Thus the primary data were collected from the irrigation user's households of the study area. In the due course of my study, primary data were collected with field visit and observation, focus group discussion, interview and questionnaire as per the convenience to aid to my study.

#### **3.2.2 Secondary Data**

Since, this research has been composed up of the base of description and analysis, secondary data was must. The various internal and external sources were used for acquiring the secondary data. The various sources consisted of Ministry of Irrigation, Central Bureau of Statistics, District Irrigation Office, Google, Bulletins/Reports, and NGOs/INGOs etc.

### **3.3 Sample Size and Sampling Procedure**

In this study all the demographic population of Sharada VDC implicitly or explicitly one who is user and non-user of irrigation came under the universe or population frame. Primarily the investigation was targeted to irrigation users and

non-users and prospect users followed by observations at various household in respect to their level of participation. Since, according to the motive of research, probabilistic sampling method was used. The sample size was selected on the basis of stratified random sampling cum simple random sampling. Under this method the sample selected was 40% households out of 200 households of Sharada VDC. All together a sample size of 80 household was taken for the study.

### **3.4 Data Collection Methods and Tools**

To collect reliable and authentic data various research methods and tools were used, based on the nature of the study. The following tools and techniques were adopted to obtain primary data and information. The structure/questionnaire, unstructured interviews and observation methods were applied to generate the primary data.

#### **3.4.1 Household Survey (HH)**

The household survey was used to collect data related to agricultural production such as water availability, cropping pattern, use of fertilizers, other inputs and crop yields. Two different types of questionnaire were developed for local people and key informants. To generate the accurate data structured questionnaire were carried out to draw the socio-economic information of the farmers, factors influencing participation for the effective management of water. For this purpose, the respondents were requested to fill up the questionnaire. In case of the respondents who couldn't fill up the questionnaire, the questions were asked to the respondent and answers were filled up to collect the required information. Present scenario of the irrigation management, socio-economic, physical, educational and environmental impacts of irrigation management in the study area helped to visualize the impact of irrigation management.

#### **3.4.2 Key Informant Interview**

The numbers of key informants were interacted to access the changes in the livelihood of people, factors influencing participation and impact of irrigation management. The interaction programs were conducted with the concerned officials & local people. Structured interviews were taken with local leader, chairperson, vice-chairperson, local experts, social mobilizer and water distributor to find out the

reality of existing scenario of irrigation management. For this, interview schedule was prepared to obtain accurate and reliable information from the respondents. VDC officials, WUA person and members, health workers, volunteers and school teachers were the key informants.

### **3.4.3 Field Visit and Observation**

The primary information was collected from the field through direct observation. Crosscheck of such information was carried out during the FGD and discussion with the key informants. The households using irrigation system selected as samples were visited and observed. The checklist was prepared to collect the required information while observing the irrigation scenario, livelihood status of the people and the various impacts of irrigation etc.

### **3.4.4 Focus Group Discussion**

In order to obtain the information on the impact of irrigation systems on socio-economic activities focus group discussion with the different group of people were organized. For this, VDC officials, social mobilizers, school teachers, WUA personnel and farmers were gathered. Focus group discussion was carried out in Sharada village.

## **3.5 Data Analysis**

The data obtained from the field survey were coded and categorized according to requirement. Then the coded data were converted into tables with numbers, average and percentage through computer office program as MS Word and MS Excel. Simple statistical tools like tables, graphs were used in presenting the data. They were categorized and analyzed according to the objective of the study.

All the information of household questionnaire collected from the field was edited and coded prior to entering it into computer. The data was entered into the computer using the data entry format developed into Microsoft Access software for easy data entry work. The validity of data entry work was assured by checking all the information of the randomly selected questionnaires. The data was analyzed through the computer using the data processing software. Simple statistical tools like average and percentage have been calculated for different groups, sub groups

and irrigation schemes considering the nature of the study. The open-ended questions of the questionnaire have been coded manually and later it was processed through computer.

## **CHAPTER -FOUR**

### **SETTING OF THE STUDY AREA**

#### **4.1 Description of Study Area**

##### **a) Location**

Naubise Irrigation System is situated in eastern fringe of Kathmandu valley and lies about 35 km away from the centre of the capital city.



**Figure 1: Map of Nepal Showing Kavrepalanchok District**

It covers an area 150 ha of Panauti Municipality (Ward No.10) and Sharada VDC (Ward No. 2, 3, 4 and 5) in Kavrepalanchok District. It was initiated in the year 2001 and completed in 2004.

#### **4.2 Sharada VDC**

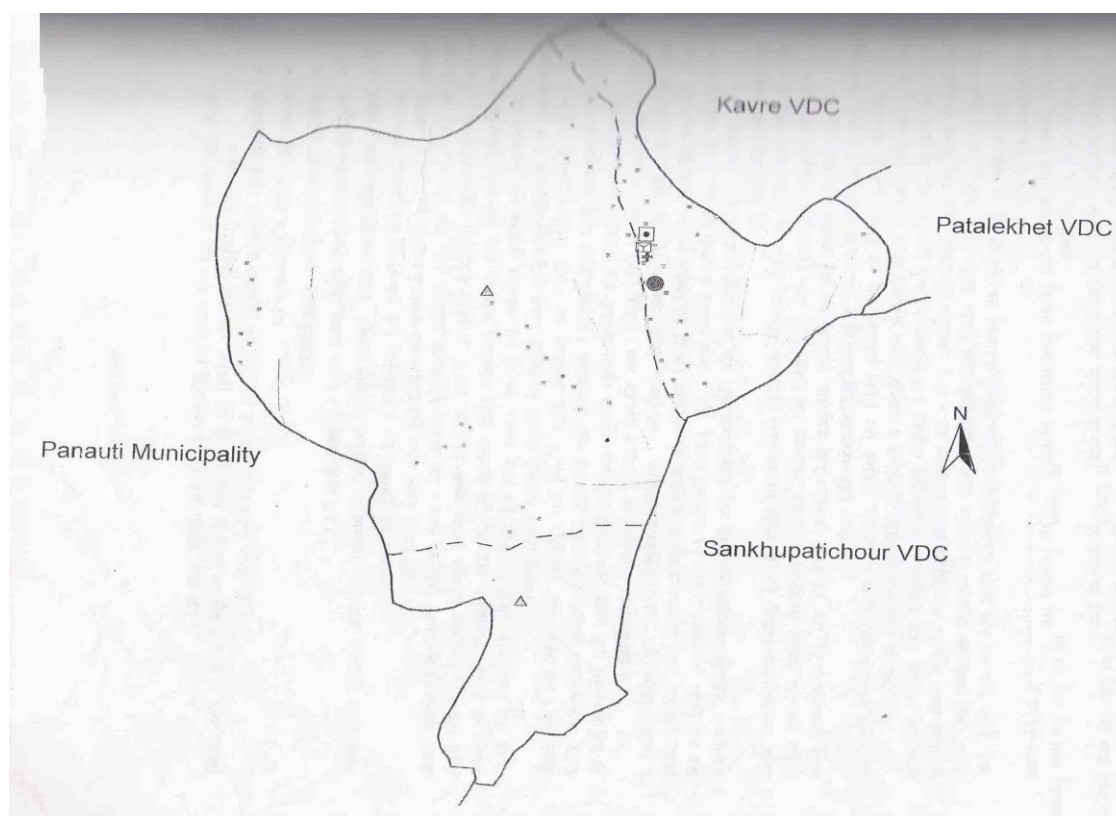
The site for social survey was conducted in Sharada VDC of Ward No. 2, 3, 4 and 5. The VDC was named after the Hindu Goddess Sharadadevithan. A temple is dedicated to the deity in Panauti. Sharada VDC covers an area of 5.18 square kilometers (2 sq mi).



**Figure 2: Map of Kavrepalanchok District Showing Sharada VDC**

The total population of the VDC is 2,368 (1,092 Males and 1,276 Females) on 2014. The total households were 511 as on census 2014 (CBS, 2014). The main ethnic composition in this area is Chhetri and Brahmin. The study area is easily accessible as this area is near to the capital city, Kathmandu. The education ratio of male and female is satisfactory although the education level of women is considerably poor. The person in this area is mainly engaged in agriculture and animal husbandry.

**Figure 3: Map of Sharada VDC**



*Source: Sharada VDC Profile, 2070*

Largely hilly in its terrain with few flat areas, the VDC is covered by forests. Naubise Irrigation system covers 1/3 area of the Sharada VDC.

### **4.3 Livelihood Status**

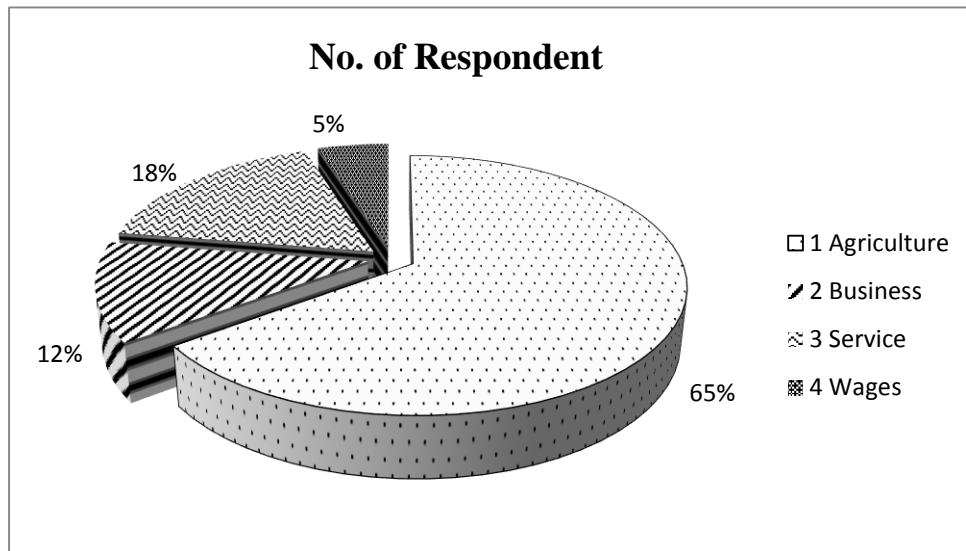
The local people predominantly depend on agriculture and livestock husbandry. The major occupation of the local respondents and the livelihood status in study area is represented by table 4.1 and Figure 4 respectively.

**Table 4.1: Major Occupation of Local Respondents**

<b>S. N.</b>	<b>Major Occupation</b>	<b>No. of Respondent</b>	<b>Percentage</b>
1	Agriculture	52	65
2	Business	10	12
3	Service	14	18
4	Wages	04	05

*Source: Field Survey, 2014*

**Figure 4: Livelihood Status in Study Area**



*Source: Field Survey, 2014*

The average family size of the household surveyed was 4.63 persons per family. The family income source of the household was particularly agriculture which accounted 65 percent whereas business, service and wages contributed 12 percent, 18 percent and 5 percent respectively.

#### **4.4 Livestock Herding**

Cattle, buffaloes and goat are the main livestock. From the survey 90 percent of the household were found to be rearing at least one kind of livestock and 10 percent of the household were not rearing single livestock. Of the total household 10 percent were rearing buffaloes and goat, 20 percent were rearing goat only and 70 percent were rearing cattle and goat.

#### **4.5 Climate**

The climatic pattern of the study area is mostly dominated by monsoon which occurs between June and September. The weather is also relatively dry which clearly visualize the need of irrigation in this area.

#### **4.6 Population Size**

The total no of household and the population of the study area are tabulated as follows:

**Table 4.2: Population Settlement in Study Area**

Name of VDC	Population			Total Households
	Male	Female	Total	
Sharada VDC	1092	1276	2368	511

*Source: Field Survey, 2014*

The population size in the study area is increasing with the improvement of the economic condition of the people due to the irrigation development. During the past few years, agriculture has been the chief source of income which is helping the local people to improve their livelihood status.

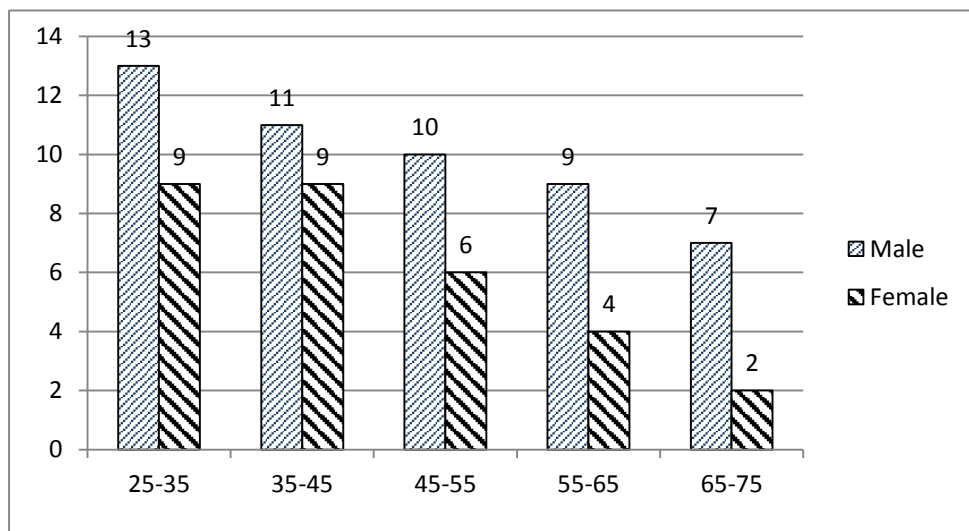
# CHAPTER- FIVE

## DATA ANALYSIS AND INTERPRETATION

### 5.1 Demographic and Socioeconomic Information of Respondent

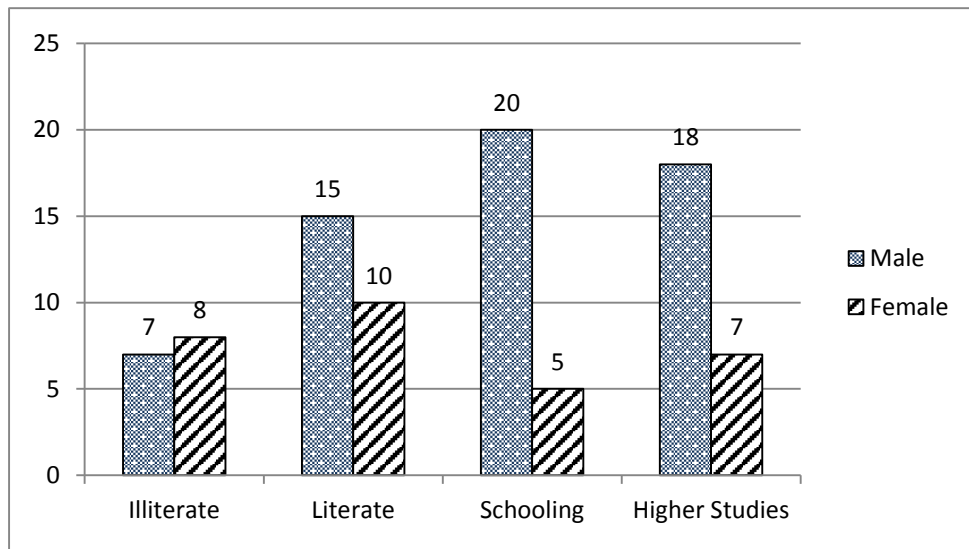
Altogether 80 local people were interviewed in the study area. The age distribution and educational qualification of the respondents are represented by the figure 5 and 6 respectively.

**Figure 5: Age Distribution of the Respondents**



Source: Field Survey, 2014

**Figure 6: Educational Qualification of Respondents**



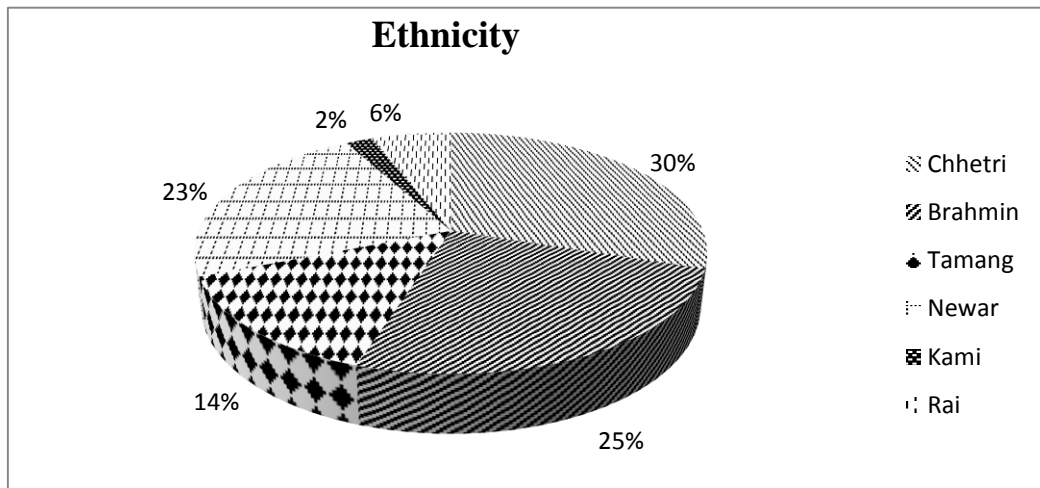
Source: Field Survey, 2014

Among them 30 respondents (37.5 %) were female and 50 respondents (62.5 %) were male who were considered for the questionnaire survey. The age of the respondents varied from 25 to 71 and the average age was 47.

Similarly, among 80 people interviewed, 18.75 percent were illiterate, 31.25 percent were just literate, 18.75 percent had schooling and 31.25 percent had higher studies. The educational status of women was poor in each category. Although the consciousness in the women education has aroused but still this area has to do a lot in the field of women education.

The figure shown below represents the ethnicity of the Sharada VDC.

**Figure 7: Ethnicity of the Respondents**



*Source: Field Survey, 2014*

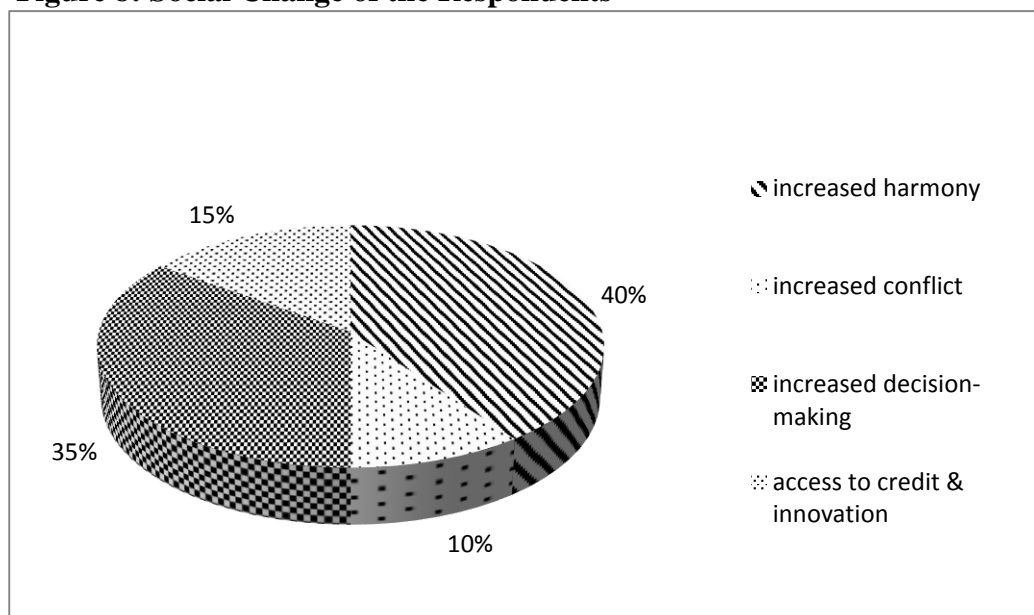
The ethnic diversity of the study area was high with 30 percent Chhetri, followed by 25 percent Brahmin, 23 percent Newar, 14 percent Tamang, 6 percent Rai and 2 percent Kami. We can say that a diverse ethnicity is found in this locality.

## **5.2 Changes in the Livelihood of Respondents**

### **5.2.1 Social Change**

The figure shown below represents the social changes of the respondents of the Sharada VDC.

**Figure 8: Social Change of the Respondents**



*Source: Field Survey, 2014*

The field study among 80 respondents showed that 40 percent of the respondents feel increased harmony in the society followed by 35 percent with increased decision making, 15 percent with access to credit & innovation and 10 percent with increased conflict after irrigation development.

Similarly the following table and figure represents the Communication status of the people in Sharada VDC.

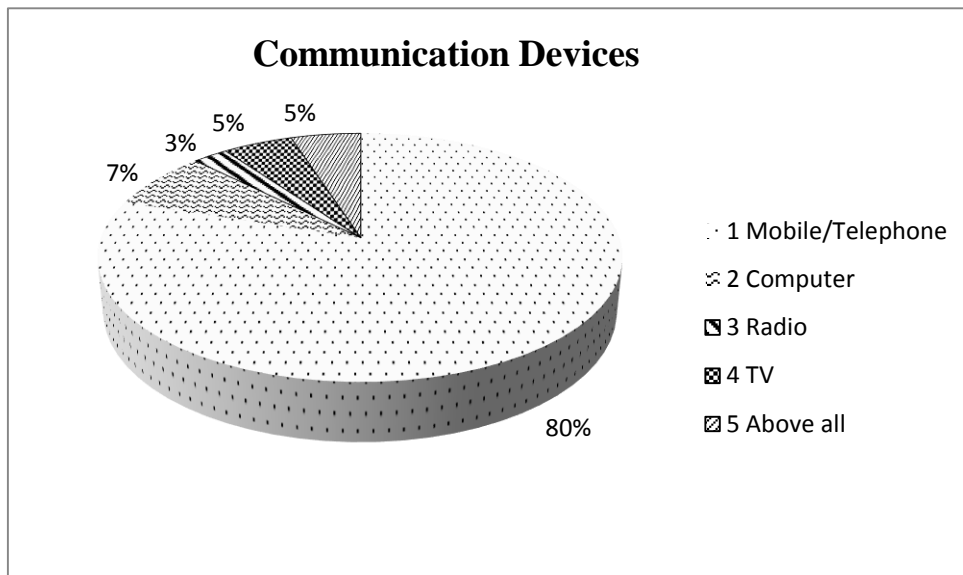
**Table 5.1: Communication in Sharada VDC**

S. N.	Communication Devices	No. of Respondents	Percentage
1	Mobile/Telephone	64	80
2	Computer	06	7.5
3	Radio	02	2.5
4	TV	04	5
5	Above all	04	5

*Source: Field Survey, 2014*

Out of 80 respondents of Sharada VDC, 80 percent of them have Mobile phones/Telephones followed by 7 percent having Computers, 5 percent having both TV, 3 percent having Radio and 5 percent having above all. People using the communication devices have increased rapidly in the recent years.

**Figure 9: Use of Communication Devices**



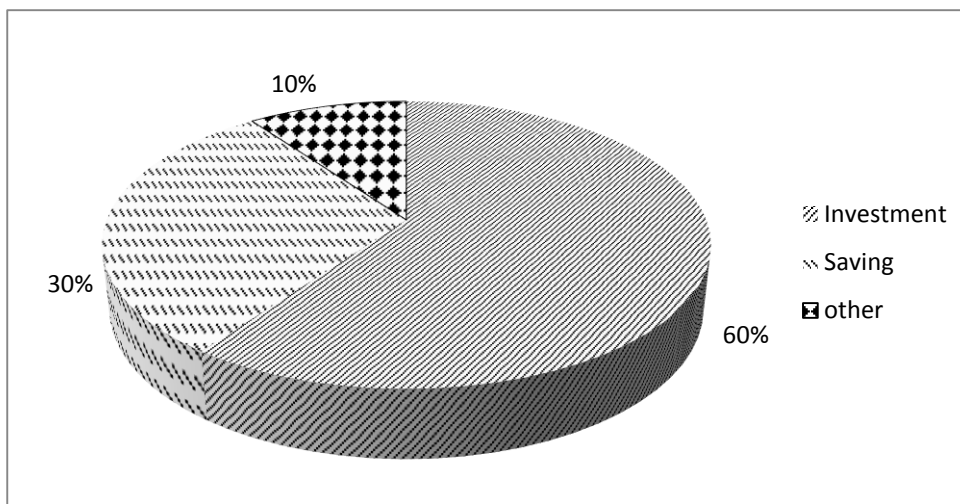
*Source: Field Survey, 2014*

All the means of communication are used by most of the people. Some people even have access to the internet facilities categorized under computer. Cable lines and Dish Home are used by the persons having televisions. These means of communication helps people to know about the prospects of agriculture, irrigation and ways to enhance them.

### **5.2.2 Economic Change**

Economic change of the people of Sharada VDC can be represented by the following figure.

**Figure 10: Economic Change of the Respondents**



*Source: Field Survey, 2014*

Out of 80 respondents, 60 percent of them have investments in business, educational sector followed by 30 percent having savings for future betterment and 10 percent have access to other field such as in furniture, construction etc. Very few people were found who wished to adopt agriculture in the future and have been saving for it.

### i) Level of Production

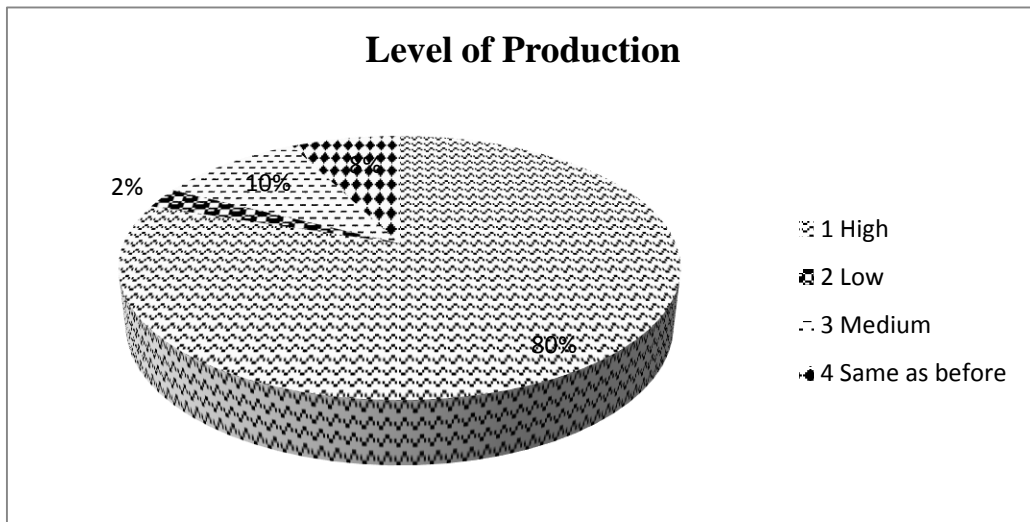
The level of production is represented by the below table and figure.

**Table 5.2: Level of Production**

S. N.	Level of Production	No. of Respondent	Percentage
1	High	64	80
2	Low	02	2.5
3	Medium	08	10
4	Same as before	06	7.5

*Source: Field Survey, 2014*

**Figure 11: Level of Production**



*Source: Field Survey, 2014*

The level of production is high with 80 percent followed by medium 10 percent, low 2 percent and same as before 8 percent. The current irrigation system has shown its positive effects in the production level. The prospects are such that in the future these figures will rise. Almost every people are benefitted with the current position of irrigation and with the further improvement in this some other people are also to reap the benefits.

## ii) Major Crops

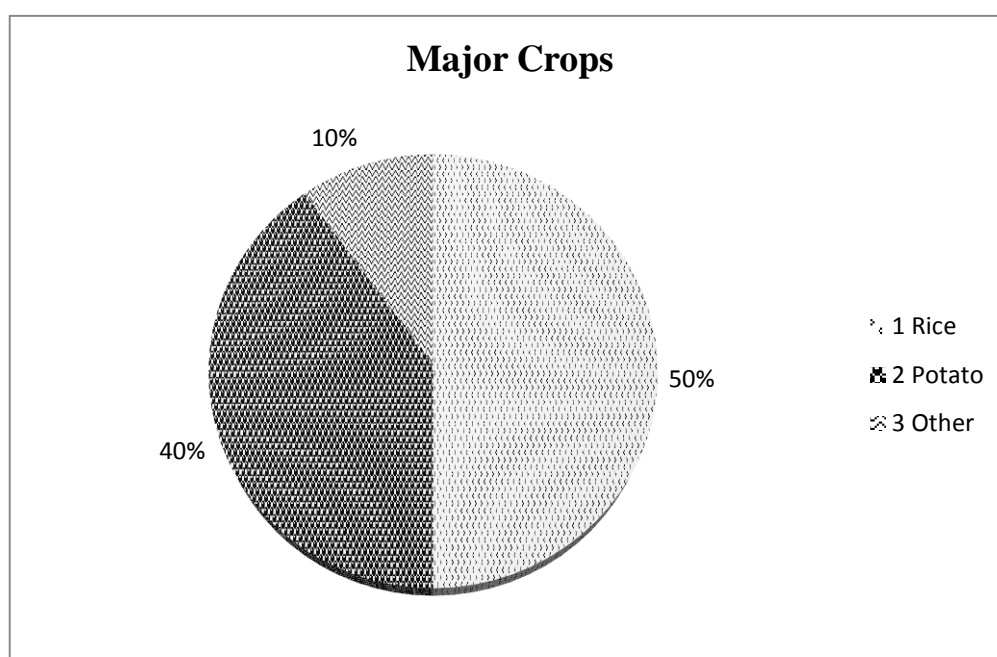
Table and figure below gives us idea about the major crops of Sharada VDC.

**Table 5.3: Major Crops**

S. N.	Major Crops	No. of Respondents	Percentage
1	Rice	40	50
2	Potato	32	40
3	Other	8	10

*Source: Field Survey, 2014*

**Figure 12: Major Crops of Sharada VDC**



*Source: Field Survey, 2014*

The major crops grown in the Sharada VDC were rice 50 percent followed by 40 percent potato and 10 percent other crops such as mustard, barley, maize etc. Reason behind the production of food crops like rice and potato is that the farmers have access to the irrigation system. The nearby river and the sources like well, canal has also helped the farmers to grow these crops.

### 5.2.3 Physical Change

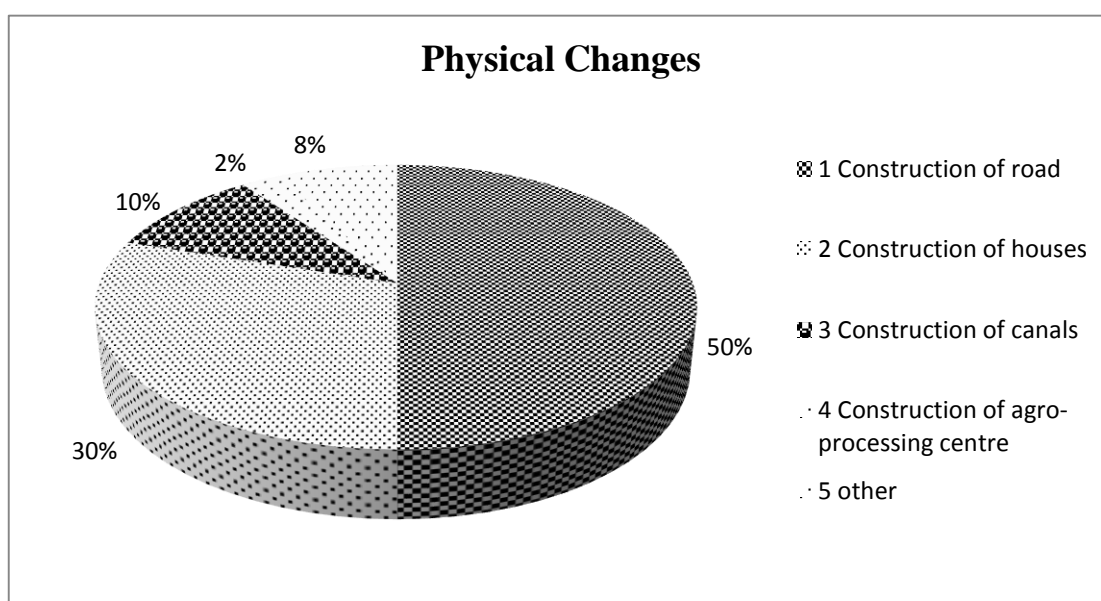
The table and figure below represents the physical changes in the Sharada VDC.

**Table 5.4: Physical Change in Sharada VDC**

S. N.	Physical Changes	No. of Respondents	Percentage
1	Construction of road	40	50
2	Construction of houses	24	30
3	Construction of canals	8	10
4	Construction of agro-processing centre	2	2.5
5	Other	6	7.5

*Source: Field Survey, 2014*

**Figure 13: Physical Changes in Sharada VDC**



*Source: Field Survey, 2014*

The major physical change that has been observed in the Sharada VDC is 50 percent construction of roads followed by 30 percent construction of houses, 10 percent construction of canals, 1 percent construction of agro-processing centre and 9 percent others such as construction of toilet, construction of bio-gas etc. Most of the places of this locality have access to the gravelled roads. Industrial growth has not yet been seen. The migration of people from distance towards the city area and the renovation of the old houses has increased the construction of houses. The concept of improved irrigation system has led to the construction of canals. With the increase in the income of the people have been constructing the concrete houses and sheds. Although proper drainage system has not been constructed we can observe the canals on the side of roads.

### i) Source of Fuel for Cooking

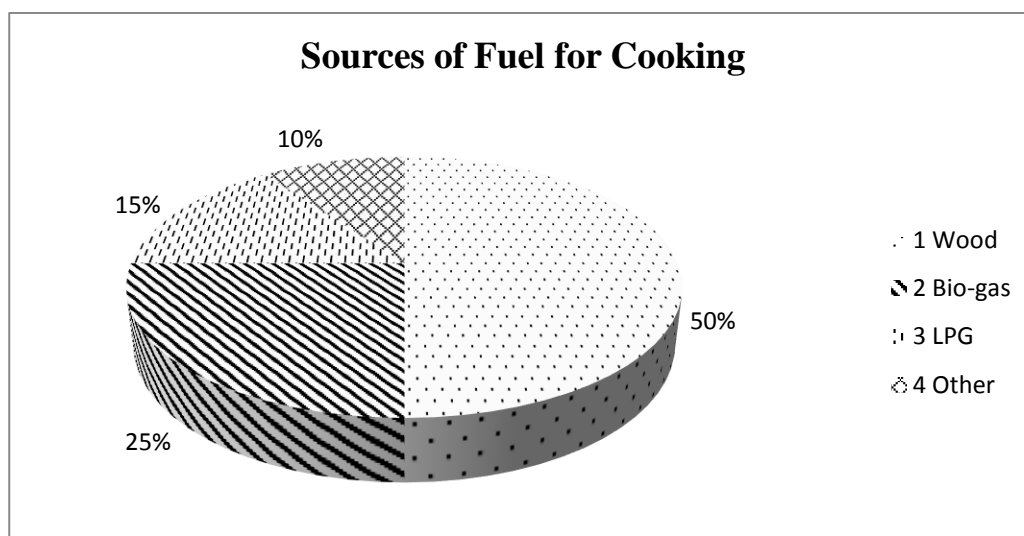
Major sources of fuel used by the people of Sharada VDC can be represented by the following table and figure.

**Table 5.5: Sources of Fuel for Cooking**

S. N.	Source of Fuel	No. of Respondents	Percentage
1	Wood	40	50
2	Bio-gas	20	25
3	LPG	12	15
4	Other	8	10

*Source: Field Survey, 2014*

**Figure 14: Sources of Fuel used by Respondents**



*Source: Field Survey, 2014*

Out of 80 respondents of Sharada VDC, 50 percent use wood to cook food followed by 25 percent using bio-gas, 15 percent using LPG gas and 10 percent using other fuel such as dung, kerosene etc. People have managed and used the nearby community forest for the firewood. Since most of the households have been using the dung for the bio-gas, some people manage to purchase the LPG gas from the near city.

### 5.3 Livelihood Assets

This study has analyzed five livelihood assets in relation to water use balance among various uses and users. Five livelihood assets or capitals selected were human, natural, physical, financial and social.

#### 5.3.1 Human Capital

Human Capital constitutes the Age and Gender which is represented by table 5.6.

**Table 5.6: Age and Gender of Respondents**

S. N.		Particulars	No. of Respondent	Percentage
1	Sex	Male	50	62.50
		Female	30	37.50
2	Age Group	25-35	22	27.50
		36-45	20	25.00
		46-55	16	20.00
		56-65	13	16.25
		66-75	09	11.25

*Source: Field Survey, 2014*

Economically active family members with different age and gender constituted the human capital. Among 80 respondents, 62.5 percent constituted the active male members and 37.5 percent constituted the active female members involved in irrigation system.

#### 5.3.2 Natural Capital

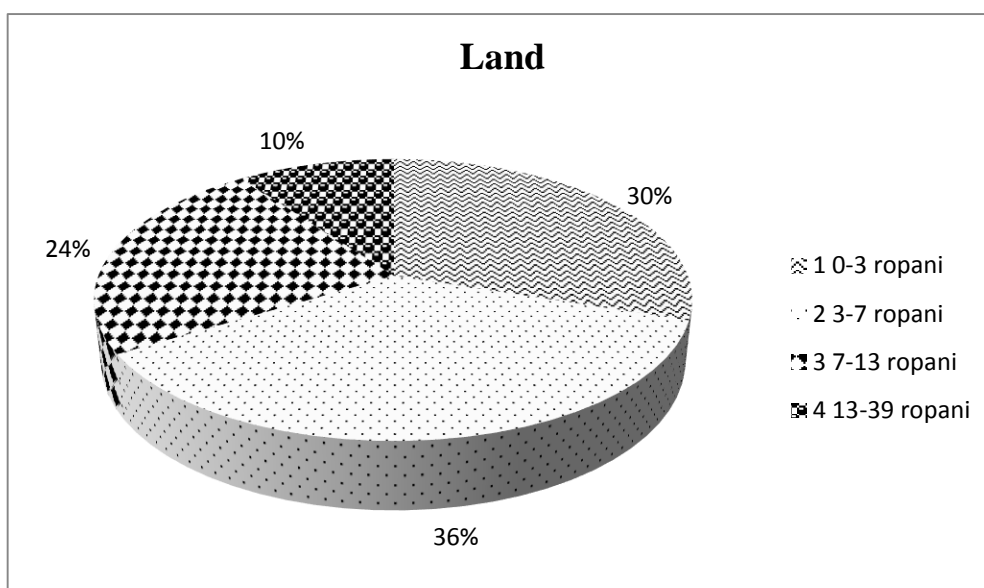
Similarly, water and land resources constituted the natural capital. Table 5.7& 5.8 represents the land and water sources own by the respondents.

**Table 5.7: Land Owned by Respondents**

S. N.	Land	No. of Respondents	Percentage
1	0-3 ropani	24	30.00
2	3-7 ropani	29	36.25
3	7-13 ropani	19	23.75
4	13-39 ropani	8	10.00

*Source: Field Survey, 2014*

**Figure 15: Land of Respondents**



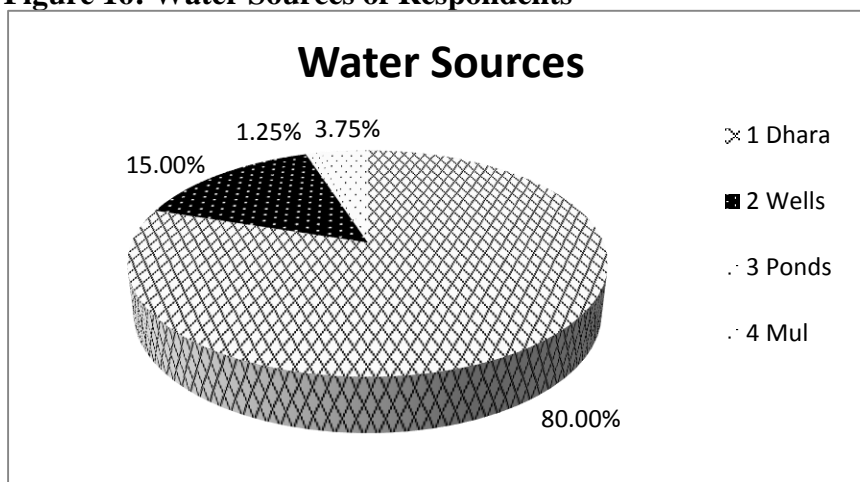
Source: Field Survey, 2014

**Table 5.8: Water Sources Used by Respondents**

S. N.	Water Source	No of Respondents	Percentage
1	Dhara	64	80
2	Wells	12	15
3	Ponds	1	1.25
4	Mul	3	3.75

Source: Field Survey, 2014

**Figure 16: Water Sources of Respondents**



Source: Field Survey, 2014

Majority of the people had on an average 3-7 ropani of land. The land as shown in the given data includes the cultivable land, uncultivable land as well as area covered by house. Although most of the land is used for cultivation some steep hills and rocky areas are not possible to be cultivated. Generally they are used for grazing of the animals. Most of the households have made available themselves the tap water but still some depends upon wells and pond for the water source. Local governmental bodies have been supporting the use of tap water for every household in this locality.

### 5.3.3 Physical Capital

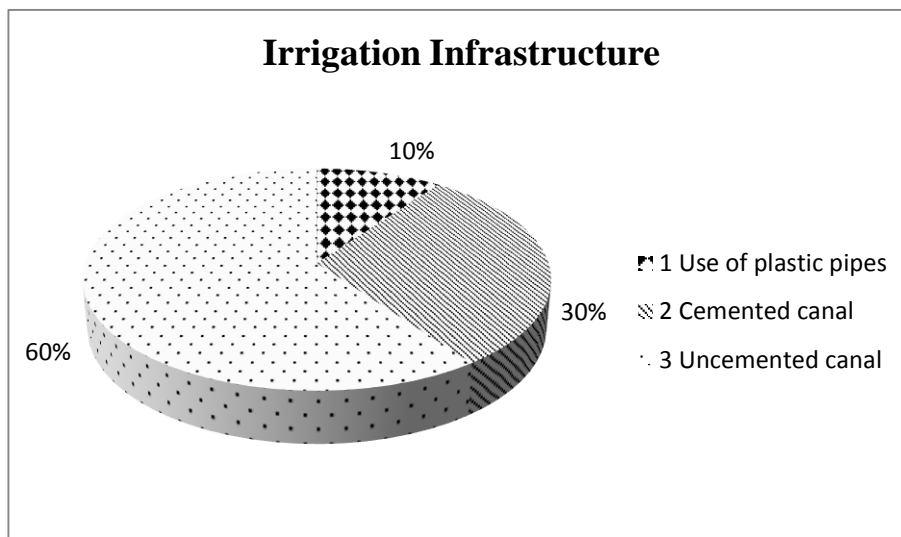
Irrigation infrastructure, road and agro-processing units constituted the physical capital. Table 5.9 represents the irrigation infrastructure.

**Table 5.9: Irrigation Infrastructure**

S. N.	Irrigation Infrastructure	Percentage
1	Use of plastic pipes	10
2	Cemented canal	30
3	Uncemented canal	60

*Source: Field Survey, 2014*

**Figure 17: Irrigation Infrastructure**



*Source: Field Survey, 2014*

Traditional canals were used by most of the households for the irrigation. Some people have also been started using the cemented canals funded by the local

governmental bodies and projects. For small irrigation people have also used the PVC pipes. The use of such infrastructure depends upon the need of the water for irrigation. Huge volumes of water are carried by the traditional canals that have been existed since decades.

### 5.3.4 Financial Capital

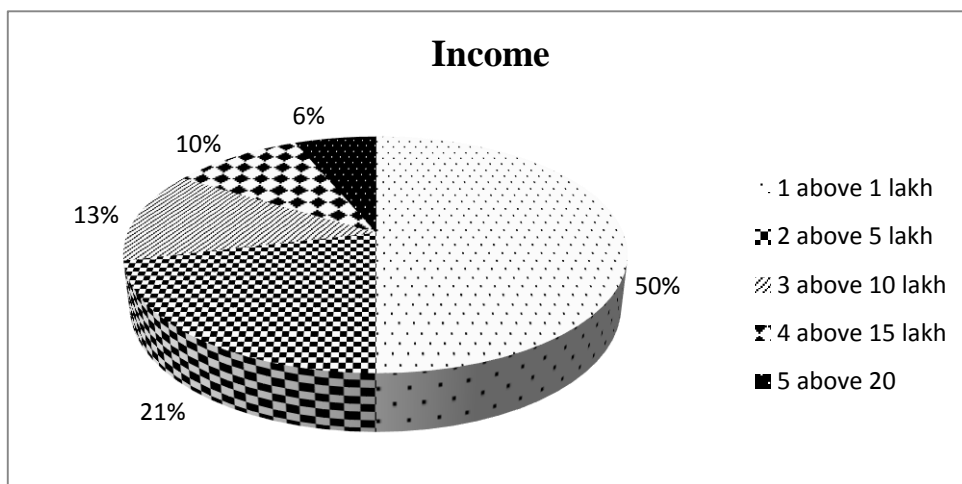
On-off and non-farm income constituted the financial capital. Table 5.10 represents the income of the respondents.

**Table 5.10: Income of the Respondents**

S. N.	Annual Income in Lakhs	No. of Respondents	Percentage
1	above 1 lakh	40	50.00
2	above 5 lakh	17	21.25
3	above 10 lakh	10	12.50
4	above 15 lakh	08	10.00
5	above 20 lakh	05	06.25

*Source: Field Survey, 2014*

**Figure 18: Income of the Respondents**



*Source: Field Survey, 2014*

Majority of the persons have yearly income below one lakh. This means most of the people are struggling hard to meet the basic daily needs although they spend most of the time in agriculture. 40 percent of the respondents have their income above 1 lakh followed by 17 percent respondents having their income above 5 lakh, 10 percent above 10 lakh, 8 percent above 15 lakh and 5 percent above 20 lakh.

### 5.3.5 Social Capital

Socio-economic and water allocation equities, literacy rate, access to credit and innovations constituted the social capital. Table 5.11 represents the literacy rate.

**Table 5.11: Literacy rate**

S. N.	Literacy	No. of Respondents	
		Male	Female
1	Illiterate	7	8
2	Below class 10	15	10
3	S.L.C	10	5
4	Intermediate	6	4
5	Bachelor	7	3
6	Master	5	0

We can say that most of the people are literate in this locality but they are not educated as required as represented above. Out of 80 respondents in the study area, 7 males and 8 females are illiterate, 15 males and 10 females have studied below class 10, 10 males and 5 females have completed their S.L.C, 6 males and 4 females have completed their intermediate, 7 males and 3 female have completed their Bachelor's level of study but only 5 males have completed their Master's. We can say that this VDC has the literacy rate of (81.25 %) which can be considered better than the national literacy rate (65.9 %) according to National Census 2011.

## 5.4 Factors Influencing Participation

Any irrigation system is beneficial to the farmers, since it enhances agricultural production in their farms. However, local people's participation in irrigation system is influenced by their socio-economic, physical and psychological factors.

### 5.4.1 Socio-economic Factors

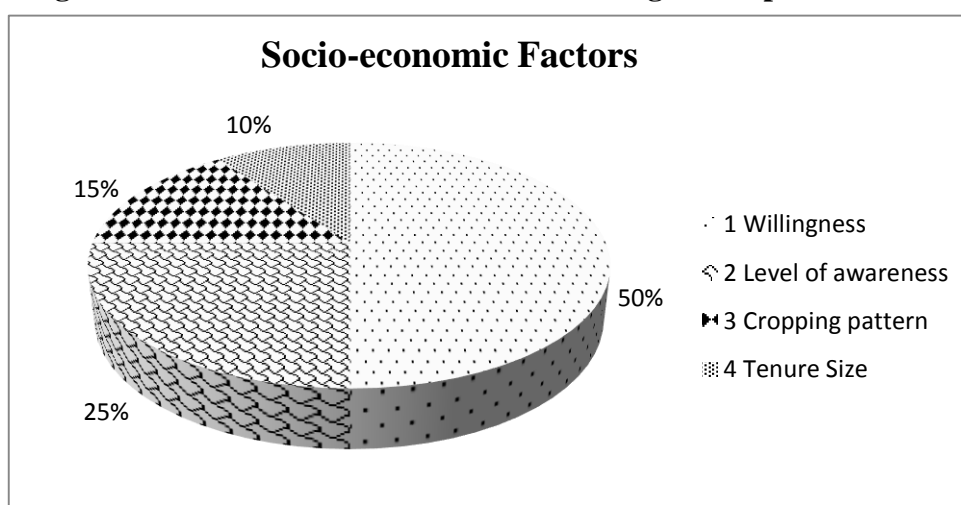
Socio-economic factors include tenure size, level of awareness, cropping pattern and willingness. The following table represents the socio-economic factors of the people of Sharada VDC.

**Table 5.12: Socio-economic Factors**

S. N.	Factors	Percentage
1	Willingness	50
2	Level of awareness	25
3	Cropping pattern	15
4	Tenure Size	10

*Source: Field Survey, 2014*

**Figure 19: Socio-economic Factors Influencing Participation**



*Source: Field Survey, 2014*

From the table and figure we can see that the dominant socio-economic factor which is 50 percent willingness followed by 25 percent level of awareness, 15 percent cropping pattern and 10 percent tenure size among the respondents. Willingness of the farmers to actively participate in the irrigation system has been found the major socio-economic factor influencing the participation.

#### **5.4.2 Physical Factors**

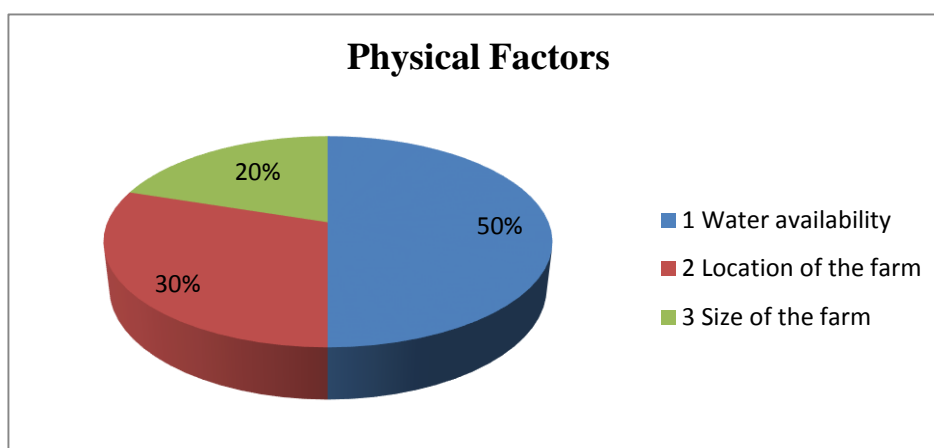
Physical factors include size of the farm, location of the farm and water availability. The following table represents the physical factors.

**Table 5.13: Physical Factor Influencing Participation**

S. N.	Physical Factor	Percentage
1	Water availability	50
2	Location of the farm	30
3	Size of the farm	20

*Source: Field Survey, 2014*

**Figure 20: Physical Factors Influencing Participation**



*Source: Field Survey, 2014*

The figure and the table given above shows that the dominant factor which is 50 percent water availability is followed by 30 percent location of the farm and 20 percent size of the farm among the respondents. Hence, water availability is the major physical factor that is affecting the people's participation in the study area so; the concerned authorities should make sure of the availability of the water always.

### **5.4.3 Psychological Factors**

Psychological factors include knowledge, feeling of ownership and benefit/satisfaction. The table below shows the psychological factors influencing participation of the people of Sharada VDC.

**Table 5.14: Psychological Factors Influencing Participation**

<b>S. N.</b>	<b>Psychological Factors</b>	<b>Percentage</b>
1	Benefit/satisfaction from the system	60
2	Knowledge	25
3	Feeling of ownership	15

*Source: Field Survey, 2014*

From the figure we came to see that the dominant psychological factor which is 60 percent benefit/satisfaction from the system followed by 25 percent knowledge and 15 percent feeling of ownership among the respondents. It also came to know that the feeling of ownership due to the participation has been gradually increasing than before.

#### 5.4.4 Participation of Respondents

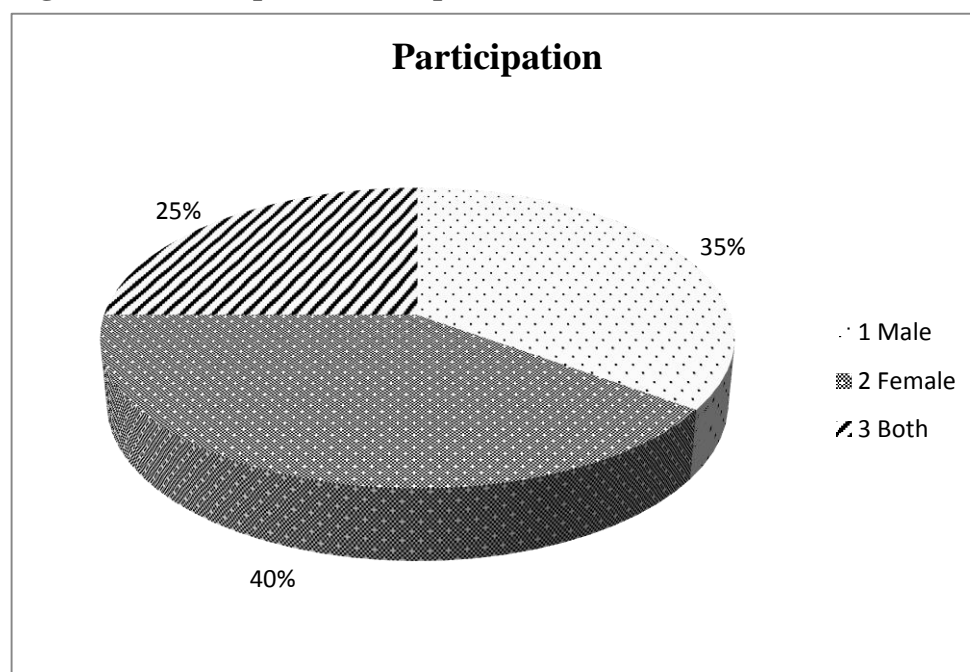
The following table represents the participation of respondents of Sharada VDC in the irrigation sector.

**Table 5.15: Participation of Respondents**

S. N.	Participation	Percentage
1	Male	35
2	Female	40
3	Both	25

*Source: Field Survey, 2014*

**Figure 21: Participation of Respondents**



*Source: Field Survey, 2014*

The participation in irrigation is high with 40 percent female, 35 percent male and 25 percent both. From the data we see that females were major respondents.

#### 5.4.5 Participation in Management of Water

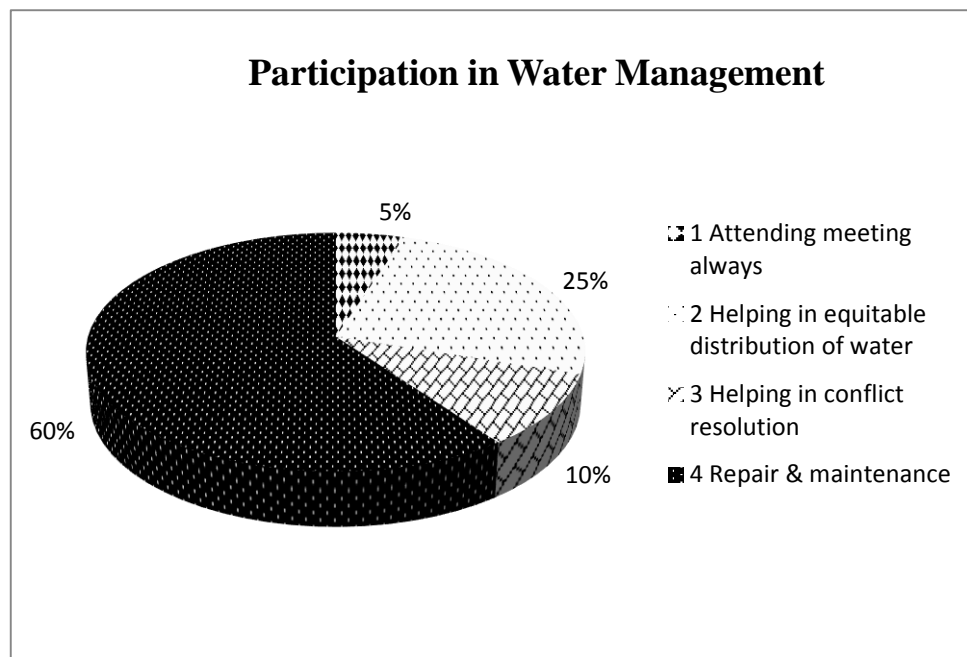
Table 5.18 represents the farmer's participation for the effective management of water.

**Table 5.16: Participation of Respondents in the Management of Water**

S. N.	Participation by	Percentage
1	Attending Meeting Always	05
2	Helping in Equitable Distribution of Water	25
3	Helping in Conflict Resolution	10
4	Repair & Maintenance	60

*Source: Field Survey, 2014*

**Figure 22: Participation in the Management of Water**



*Source: Field Survey, 2014*

The farmers participate in different ways for the effective management of water with 5 percent attending meeting always, 25 percent in the equitable distribution of water, 10 percent in conflict resolution and 60 percent in repair and maintenance. The social concern about the irrigation system for sustaining the livelihood has been increasing. People like to discuss and find out a consensus about how to enhance the current system of irrigation facilities and how to raise the economic status of the local people. The various national projects have also been playing a helping role in the participation of people for management of water.

#### 5.4.6 Level of Participation in Irrigation Repair and Maintenance

The regular maintenance of the irrigation canal is also required. Problems such as leakage of water, blockage of canals, landslides occurs sometimes which lead to disturbance in the regular flow of water. The following table represents the level of participation of people of Sharada VDC in the repair and maintenance of irrigation canals.

**Table 5.17: Level of Participation**

S. N.	Level of Participation	Percentage
1	I participate always	80
2	Sometimes only	8
3	Once	2
4	Twice	4
5	Whenever possible	6

*Source: Field Survey, 2014*

The level of participation in irrigation repair and maintenance is high with 80 percent participating always followed by 8 percent sometimes only and 2 percent once, 4 percent twice and 6 percent whenever possible. Table 5.19 represents the level of participation in irrigation repair and maintenance. People have themselves made a system to participate in such programs at least one individual of a family who is directly benefitted by the irrigation system.

#### 5.4.7 Cause of Participation

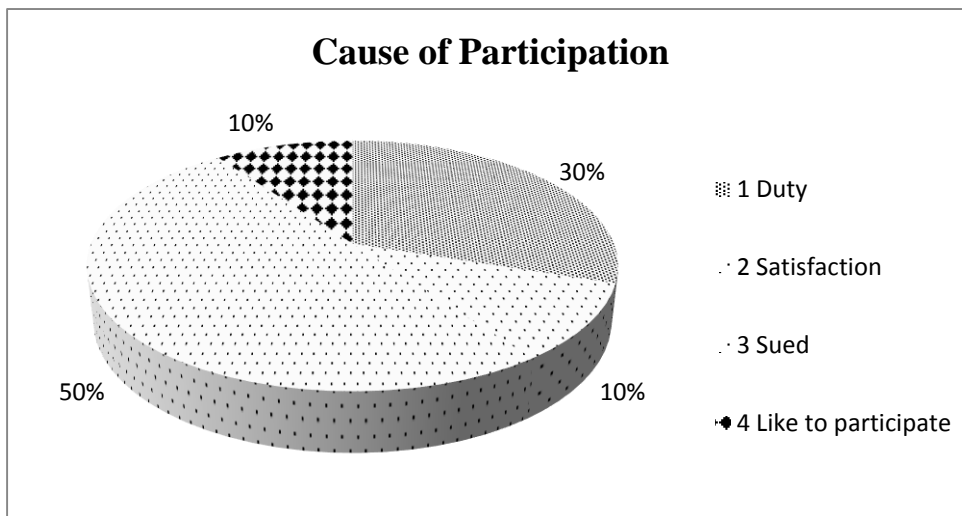
Table 5.18 represents the cause of participation of people of the Sharada VDC in the management of water.

**Table 5.18: Cause of Participation**

S. N.	Cause of Participation	Percentage
1	Duty	30
2	Satisfaction	10
3	Sued	50
4	Like to Participate	10

*Source: Field Survey, 2014*

**Figure 23: Cause of Participation**



*Source: Field Survey, 2014*

The major cause of participation in the management of water is to prevent them from being sued 50 percent followed by feeling their duty 30 percent, feeling satisfaction 10 percent and like to participate in irrigation management 10 percent. Hence, it can be concluded from the above figure that the people participate in irrigation management so that they won't be sued rather than feeling their duty and satisfaction.

#### **5.4.8 Trend of Water Availability**

Majority of the people had no availability of water as required before the irrigation management. Some had unnecessarily excess of water whereas some had their land dry during the required time also. After the irrigation management such situation changed. Table 5.19 represents the trend of water availability in Naubise Irrigation system.

**Table 5.19: Trend of Water Availability**

S. N.	Trend	Percentage
1	Whenever Necessary	50
2	Autumn Season	30
3	Winter Season	10
4	Summer Season	08
5	All Season	02

*Source: Field Survey, 2014*

The trend of water availability in Naubise irrigation system is high 10 percent in winter season followed by 30 percent in autumn season, 8 percent in summer season, 50 percent whenever necessary and 2 percent all season. Half of the respondents have access to the water resources whenever they require.

## 5.5 Impact of Irrigation Management

Irrigation helps in all-round development of the people living in society which is being used since many decades ago to increase the production yield. It has many impact in the all round development of the farmers. Similar, development has been faced by the people living in Sharada VDC due to irrigation development. People tend to cultivate of crops which requires irrigation and due to such irrigation facilities productivity of the land has increased.

### 5.5.1 Impact on Social Values

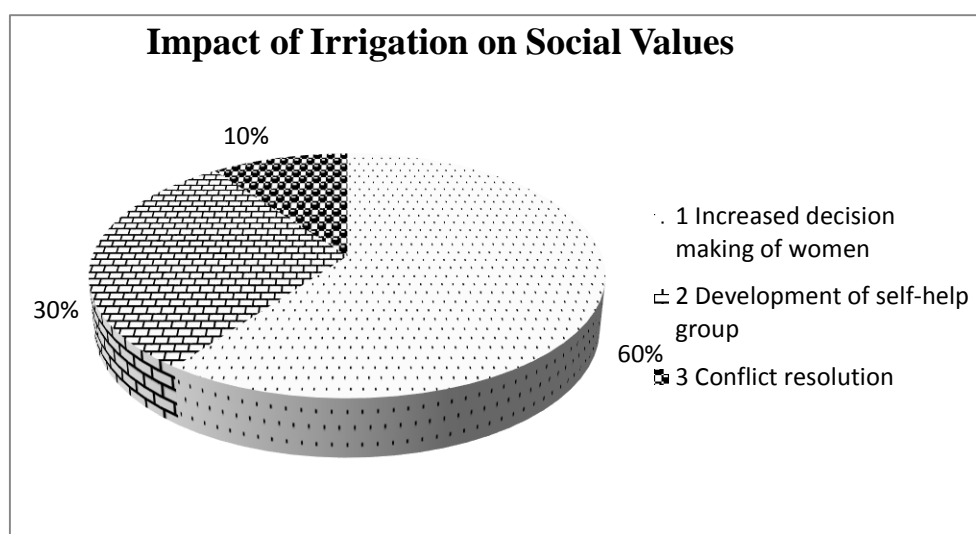
Table 5.20 represents the impact of irrigation on social values.

**Table 5.20: Impact of Irrigation on Social Values**

S. N.	Impact on Social Values	Percentage
1	Increased Decision Making of Women	60
2	Development of self-help Group	30
3	Conflict Resolution	10

*Source: Field Survey, 2014*

**Figure 24: Impact of Irrigation on Social Values**



*Source: Field Survey, 2014*

Naubise Irrigation System has a great impact on social values as 60 percent increase in the decision making of women followed by 30 percent development of self-help group and 10 percent in conflict resolution. The awareness among the women has been increasing and they are taking active part in the social programs. People are being conscious on how to increase the economic capability by enhancing the traditional irrigational systems. Group participation and cooperation has been increased leading to the conflict resolution.

### 5.5.2 Impact of Irrigation on Educational Status

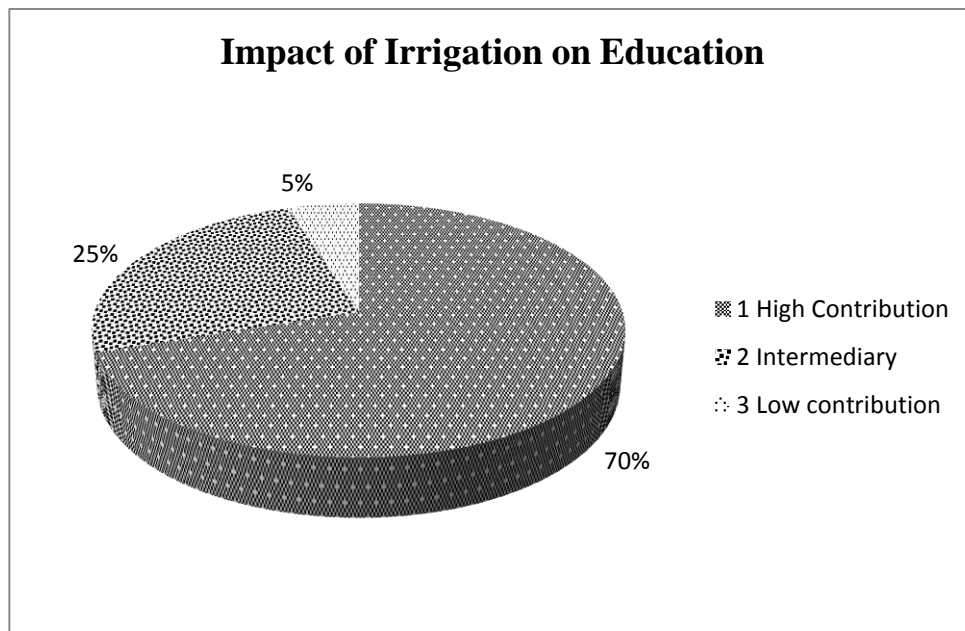
Table 5.21 represents the impact of irrigation on educational status.

**Table 5.21: Impact of Irrigation on Education**

S. N.	Impact on Education	Percentage
1	High Contribution	70
2	Intermediary	25
3	Low Contribution	05

*Source: Field Survey, 2014*

**Figure 25: Impact of Irrigation on Education**



*Source: Field Survey, 2014*

Naubise Irrigation system has 70 percent high contribution followed by 25 percent intermediary and 5 percent low contribution on the educational status of Sharada VDC. As the main occupation of the people of this locality is agriculture, with proper irrigation they have been able to make some more money and contribute towards the better education of their children.

### 5.5.3 Impact of Irrigation on Economic Status

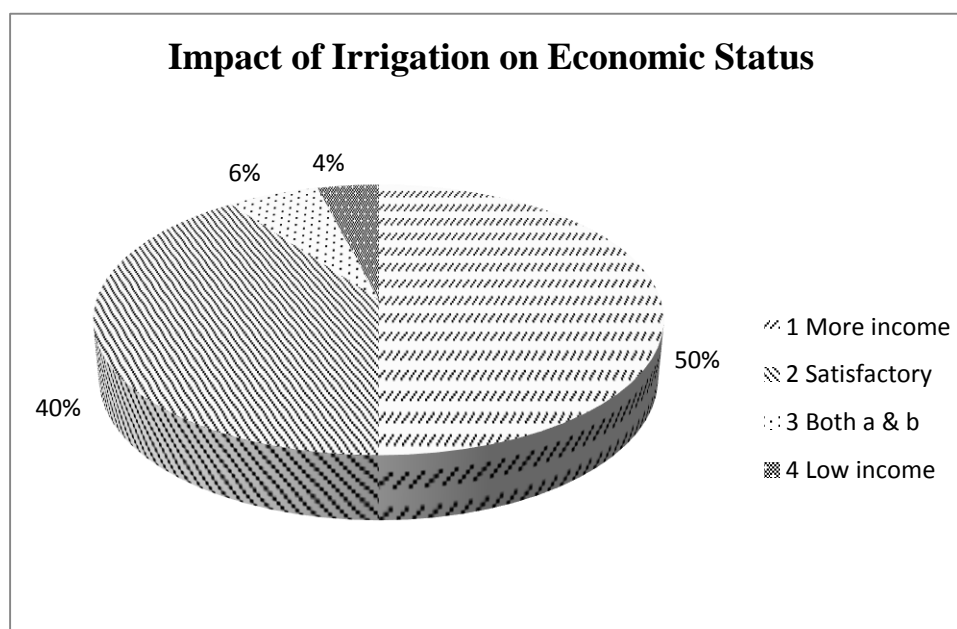
Table 5.22 represents the impact of irrigation on economic status in Sharada VDC.

**Table 5.22: Impact of Irrigation on Economic Status**

S. N.	Impact on Economic Status	Percentage
1	More Income	50
2	Satisfactory	40
3	Both a & b	06
4	Low Income	04

*Source: Field Survey, 2014*

**Figure 26: Impact of Irrigation on Economic Status**



*Source: Field Survey, 2014*

Economic status of the farmer of Sharada VDC has improved by the Naubise Irrigation System with 50 percent more income followed by 40 percent satisfactory,

4 percent low income and 6 percent both more income and satisfactory. No doubt the irrigation system has increased the productivity. Farmers have been able to grow crops even during the dry season which has directly contributed for the increase in income of the people.

### 5.5.4 Impact of Irrigation in Women

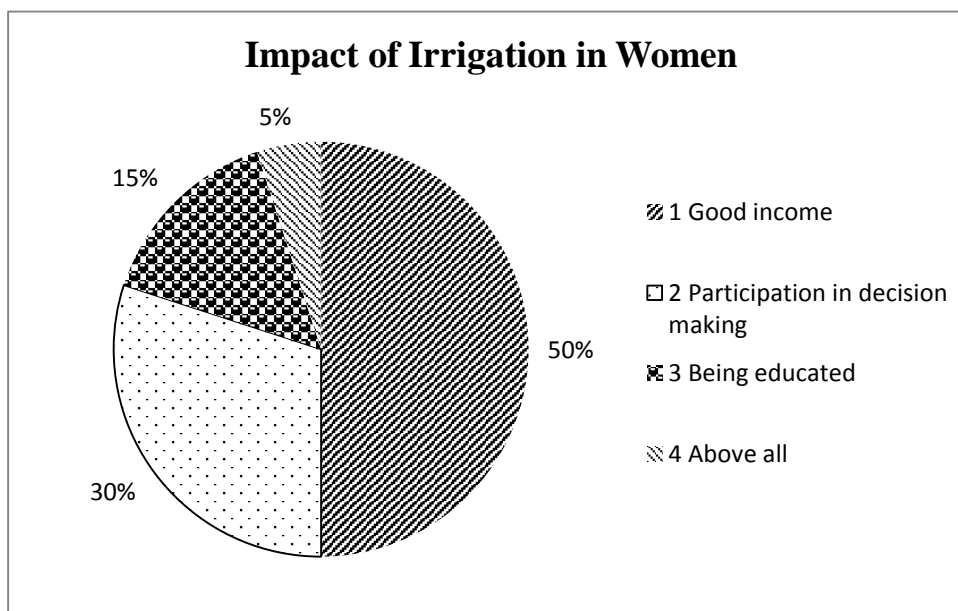
There is a great impact of irrigation in women seen in the Sharada VDC. This has been represented by the following table.

**Table 5.23: Impact of Irrigation in Women**

S. N.	Impact in Women	Percentage
1	Good income	50
2	Participation in Decision Making	30
3	Being Educated	15
4	Above all	05

*Source: Field Survey, 2014*

**Figure 27: Impact of Irrigation in Women**



*Source: Field Survey, 2014*

The above figure shows that the income level of women have increased with 50 percent followed by participation in decision making 30 percent, being educated 15 percent and 5 percent above all. Thus, it can be concluded that the irrigation system has major impact in the lives of the women in the study area.

# **CHAPTER -SIX**

## **SUMMARY, CONCLUSION AND RECOMMENDATION**

### **6.1 Summary**

Irrigation is the backbone of agricultural production so as to ensure the life of the people who are fully dependent to it for their livelihood. Agricultural irrigated land (% of total agricultural land) in Nepal was reported at 27.74 in 2008, according to the World Bank. Agricultural irrigated land refers to agricultural areas purposely provided with water, including land irrigated by controlled flooding. Irrigation and agriculture are inseparable in the sense that development of the latter cannot be anticipated without development in irrigation. In Nepal, irrigation development continues to be one of the priority sectors of public investment in almost all development plans and the Department of Irrigation (DOI) is the responsible public agency for the execution of irrigation projects. The Agricultural Perspective Plan (APP) of Nepal, which was formulated as a blueprint for economic transformation of the nation, envisages rapid growth in agriculture through irrigation development.

- Naubise Irrigation System was initiated in the year 2000 and completed in 2002 which brought drastic change in the livelihood of the people residing in Sharada VDC. The people felt 50 percent economic change which is the major benefit the farmers are getting through this system. The production of the major crops has been comparatively increased and the income source of the farmers has been doubled since this system came into existence.
- This system has contributed to increase harmony and co-ordination, decision making particularly among women. The farmers have access to savings and investment as they are earning more income so, the VDC is observing lots of physical changes such as construction of houses, roads etc. So, it can be concluded that the Naubise Irrigation System has played a vital role to bring changes in the livelihood of people.
- Agriculture is the main occupation of the sample population and is the major source of livelihood. The introductions of irrigation system have brought positive changes in terms of cropping patterns, yields. Since improved crop

varieties respond well and give higher yields under irrigated conditions, farmers have started using more fertilizers and plant protection materials after the irrigation development.

- Irrigation alone cannot bring remarkable changes in gross farm production. It has to be closely tied with other packages such as extension and credit support and linkages to the market which is quite satisfactory as the study area is near to the capital city, Kathmandu.
- Development of Irrigation system has helped in changing the traditional (rain-fed) cropping patterns in the surveyed area. The farmers got easy access to the irrigation water, and are able to carry out agricultural activities on time and adopt modern agriculture technology which in turn gave rise to higher crop yields and cropping intensity. Besides, some of the enterprising farmers in the sample area are found engaged themselves into growing high value crops, such as potatoes and rice.
- Moreover, due to availability of water area coverage under winter crops like potato and vegetables increased significantly. The availability of irrigation led to practicing Paddy-Potato-Potato cropping pattern. Potato which was hardly visible in rain-fed systems before irrigation becomes an important crop after irrigation development.
- There is no difference in the participation between male and female as they both equally participate in the management of water. Most of the people about 60 percent show their participation in the repair and maintenance and 25 percent in the equitable distribution of the water. About 80 percent people always participate in irrigation repair and maintenance so as to prevent themselves from being sued. Only 30 percent people feel that it's their duty to participate in irrigation repair and maintenance.
- The major factors influencing the peoples participation in the effective management of water is knowledge, feeling of ownership and benefit from the system. The water is distributed serially and haphazardly according to the necessity of water and is available mostly whenever necessary and in autumn season.
- The introduction of irrigation system brought positive changes in terms of cropping patterns, cropping intensity and yields. Farmers are able to prepare seed-beds on time so as to carry out transplantation as soon as the rain starts.

Potato and rice which were hardly visible in rain-fed systems before have become important crops after irrigation development in the area.

- The increase in income had positively contributed to the consumption level. On an average, 40 percent of the sampled respondents begin to consume more vegetables. Similarly 65 percent of the respondents begin to eat more nutritious foods like meat, fish and milk.
- The operation and maintenance of irrigation system has been found satisfactory which were handed over to water user's group (WUGs) after the completion of the project. The O&M cost accumulates the operating cost of irrigation system, remuneration to operator, and repair & maintenance cost. Actual O&M cost was calculated considering the all cost incurred in operation and maintenance and deducting the revenue collected from rent out of water and charges collected from the farmers.
- Mostly the impact of irrigation system has been found positive in educational status, social values and economic status and in women. The irrigation system has high contribution (70 %) in educational status. Similarly, it has played a vital role to increase more income (50 %) and the decision making in women (60 %).

The major bases on which the sustainability of any Ground Water Irrigation project depends are Investment Cost, Operation and Maintenance Cost, Project Life, Operation and Management, Efficiency of the Supportive Services and Repair and Maintenance Facilities.

## **6.2 Conclusion**

Naubise Irrigation System itself is an achievement of the government and people residing in Sharada VDC as there was no possibility of getting water to irrigate the agricultural land. It was the dream that came true only due to government efforts which were later handed over to the farmers for the sustainability of the project. It covers an area of 150 ha which spreads from Panauti Municipality (ward no.10) to ward no 2, 3, 4 and 5 of Sharada Batase VDC in Kavrepalanchok District.

The development of the irrigation system has contributed to complete transformation of livelihood opportunities and economy of the people in the area.

With the availability of irrigation, the farmers in the area started growing two potato crops after rice which has been major source of household's cash income. Likewise, the farmers in the area have started keeping one or two dairy animals (cow or buffalo) for milk production. There is a dairy co-operative operational in the area. Milk production has been the source of supplementary earning for the farmers. Registered WUA was formed in 2002 in the area. With the development of the irrigation schemes that led to increased saving of the farmers necessitating the initiation of credit and saving cooperative. The first credit and saving cooperative in the area was started in 1997. Since this time total of 12 credit and saving cooperative have been started in the area and 9 of them were started after the development of the irrigation scheme. Although WUA has not been instrumental directly in starting the credit and saving cooperatives, it has been essentially change in the economy of the people.

The level of participation of farmer is high in irrigation repair and maintenance. Farmers also actively involved in paying fees that are collected as per the land holding and crop cycle per year. The fee collected plays an important contribution in repair and maintenance. Irrigation development in the area has also increased the decision making of the women as the participation of women is high. The local people have positive attitude towards the development of irrigation in the area. Irrigation system in this area is supposed to be the supportive tool for lifting the living status of the local residents. Irrigation development in the area have created job opportunity, increase in income generation, development of self-help group and development of infrastructure such as communication facility, education, road etc.

The study shows that FMISs virtues have made it sustainable with minimum damage to natural environment and at the same time meeting growing demand for food and employment. Some important virtues were accumulated experiences, knowledge and skills on ecology, hydrology and layout construction, operation and maintenance of irrigation system. In addition, democratic and transparent decision making, socio-economic and water allocation equities and strong communication, mechanism were some of the foundations for social capital building. These have enhanced the development of trusts, mutual beliefs and networking among uses and users. These virtues have enabled FMISs to amass collective action at all time and levels and sustain for centuries.

### **6.3 Recommendations**

- The level of participation of the farmers should be ensured high in all-round development and maintenance of the irrigation system.
- The farmer who do not pay fees and violate the rule should be sued in order to prevent further violation.
- The meeting should be held once in a month so as to ensure the sustainability of the project.
- The farmers should be motivated towards more cash crops that could be grown throughout the year.
- The farmers should be allowed to use only main gates to irrigate their land so as to distribute water equally.
- The management team should be more responsible for the management of water and conflict resolution.
- The irrigation should be provided throughout the year not only when the time comes.
- The repair and maintenance of the irrigation system should be done on time.
- Furthermore, a master plan comprising of inventory assessment of the resource and a time frame use and a human resource development plan also has to be developed.

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# ANNEXES

## Annex 1: Checklist

### 1. Background Information

#### A. General

- Location and physical information about the study area.
- Infrastructure (Road, electricity, drinking water, education and health facilities).
- Population composition (Age, Sex, marital status, caste, ethnicity and educational Status).
- Family structure (food deficiency and surplus, gender specific in and out migration).
- Nature of socio political organizations including formal and informal organization related to irrigation.
- Agriculture history, cropping pattern and calendar.
- Land ownership and tenure patterns (trends in land use and ownership, number of people having land titles, number of irrigating households and average size of land in the command area per household).

#### B. The Irrigation System

- Map or sketch of the irrigated area to indicate relative location, water source, scheme layout, diversion points, command area, actual land irrigated
- Trends in water availability
- User's organization (history, criteria for membership, roles/positions within organization).
- Frequencies of meeting attendance of females, female decision making in meeting
- Type and degree of labor contribution of males (system construction and water acquisition, intake of diversion weir and types of materials used).
- Type and degree of labor contribution of females (system construction and water acquisition, intake of diversion weir and types of materials used).

- Basis of water allocation and distribution (rules and problems related to water acquisition and distribution and system maintenance, water allocation in different levels and persons responsible for conveying water to tertiary level).
- Basis for resource mobilization (types of resource mobilized, external and internal resources, nature and volume of task performed by males for system maintenance, male decision making on resource mobilization and system maintenance, rules and problems of maintenance, routine and emergency maintenance).
- Basis for resource mobilization (nature and volume of task performed by females for system maintenance, female decision making on resource mobilization and system maintenance, rules and problems of maintenance, routine and emergency maintenance).
- Conflict (Causes, nature and frequencies of conflict, mechanism for resolving conflicts, male engagement in activities considered illegal, male decision regarding conflict management and its resolutions).
- Conflict (female engagement in activities considered illegal, female decision regarding conflict management and its resolutions).
- Livelihood (Types of change in the livelihood of people and livelihood assets in relation to water use balance).
- Participation (Participation of male and female and types of factors influencing the participation of people)
- Impact (Positive, negative, social, physical, economic, educational impact of irrigation management).

## Annex 2: Questionnaire for Household Survey:

Name of Interviewer: .....

Date: .....

VDC/ Ward: .....

House No.: .....

### I. General Information:

Name: .....

Gender: Male  Female  Age: .....

Educational Qualification: ..... Occupation: .....

Family Size: ..... Family Income Source: .....

### II. Irrigation Information:

1. Are you a farmer? Yes  No

2. Do you have your own agricultural land? Yes  No

If Yes: How much land you own? .....

3. How do you irrigate your land?

a) From rainwater

b) From irrigation project

c) From tube well

d) Other..... (Specify)

4. Do you use Naubise Sichai Yojana to irrigate your land? Yes  No

5. When did you start irrigating your land through this system? ..... (Specify year)

6. Do you see any significant change at your village due to irrigation system?

a) Physical change

b) Economic change

c) Social change

d) Political change

e) Other .... (Specify)

7. How is the level of production after the initiation of this project?

a) High production

b) Low production

c) Medium production

d) Same as before

8. What are the major crops grown after irrigation development?

a) Rice

b) Potato

c) Mustard

d) Above all

9. What type of social change has occurred due to irrigation project?

a) Increased harmony & co-ordination

b) Increased conflict

c) Increased decision making

d) Access to credit & innovations

10. Are you the member of any social group? Yes  No

If yes ..... (Specify)

11. Do you have community forest in your village? Yes  No

If yes, are you the member of community forest? Yes  No

12. What type of economic change do you see among villagers?

a) Access to saving

- b) Access to Investment
  - c) Other
13. What is the trend of working in field?
- a) I work myself without the help of others.
  - b) We have perma system for working in field.
  - c) I pay money to others to work in my field.
14. How do you prepare manure to use in field?
- a) From cowdung
  - b) From straw
  - c) From pine leaves collected from the community forest
  - d) Above all
15. What is the physical change that has occurred in village?
- a) Construction of road
  - b) Construction of canals
  - c) Construction of agro-processing centre
  - d) Other
16. Who participate mostly in irrigation management?
- a) Male
  - b) Female
  - c) Both
17. Do you actively participate in the management of the system? Yes  No
18. How do you participate in the effective management of water?
- a) Attending meeting always
  - b) Help in the equitable distribution of water
  - c) Help in conflict resolution
  - d) By participating in repair & maintenance
19. What is the level of your participation in irrigation repair and maintenance?

- a) I always participate.
  - b) Sometimes only
  - c) Once
  - d) Twice
  - e) Whenever possible
20. Why do you participate in irrigation management?
- a) I feel it's my duty.
  - b) I feel satisfaction.
  - c) I won't be sued.
  - d) I like to participate.
21. How the water is distributed?
- a) Serially
  - b) Haphazardly
  - c) Both
22. What is the trend of water availability?
- a) All season
  - b) Summer Season
  - c) Autumn Season
  - d) Winter Season
  - e) Whenever necessary
23. How is the participation of women in decision making about irrigation management?
- a) High
  - b) Low
  - c) Satisfactory
24. What do you think are the factors influencing participation for the effective management of water?
- a) Level of awareness, cropping pattern, tenure size & willingness
  - b) Size of the farm, location of the farm & water availability

c) Knowledge, feeling of ownership & benefit from the system

25. Why do you think participation is necessary for irrigation management?

a) It promotes ownership & responsibility.

b) It enhances careful & appropriate planning.

c) Its approach to operation & maintenance is viable and effective option for sustaining irrigation projects.

d) It improves water delivery.

e) Above all

26. Do you think this irrigation system has positive impact in your livelihood?

Yes  No

27. What is the impact of irrigation on educational status?

a) High contribution

b) Low contribution

c) Intermediary

28. What is the impact of irrigation on social values?

a) Increase the decision making of women

b) Development of self-help group

c) Conflict resolution

29. What is the impact of irrigation on economic status?

a) More income

b) Low income

c) Satisfactory

d) Both a & c

30. What is the impact of irrigation in women?

a) They have started to empower themselves.

b) They are participating in decision making.

c) They are having good income.

d) They are being educated.

- e) Above all
31. What are the other organizations initiated to develop after irrigation development?
- a) Dairy
  - b) Aama Samuha
  - c) Nari chetana
  - d) Above all
32. What is the impact of irrigation on your overall development?
- a) I have my savings.
  - b) It has helped me to pursue my children's higher education.
  - c) It has helped me to arrange the necessary goods to live a luxurious life.
  - d) It has helped me to repay the loan.
  - e) It has overcome my most difficulties.
33. What are the problems regarding the water management?
- a) We get water only after being used by upstream people.
  - b) Meetings aren't held regularly.
  - c) Some farmer wants to irrigate their land as per their wish.
  - d) Farmer's do not actively participate
  - e) Above all
34. What are the causes of conflict during water distribution?
- a) Farmer's want to irrigate their land as per their wish.
  - b) Some farmer does not pay the cost and still wants to irrigate.
  - c) Some farmers do not cooperate with management committee.
  - d) All want to irrigate their land at first.
  - e) Some farmer use alternative gate rather than using main gate to irrigate the land.
35. How the conflict is managed?
- a) Convincing farmer to use main gate only to irrigate their land.
  - b) Implementing the turn wise system.

- c) Distributing water serially.
- d) Fine system to those who violate the rule.

36. What is the system of paying fees?

- a) Seasonally
- b) According to irrigated crops
- c) Once in a year
- d) Twice a year

37. How do you think this system should be managed for the betterment of the livelihood?

- a) Holding meeting regularly
- b) Doing repair & maintenance on time
- c) Effective participation of women
- d) Conflict resolution
- e) Above all

**III. Respondent comments:**

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### **Annex 3: Questionnaire for Key Informant Interview**

1. What is your name?
2. What is your main occupation?
3. How you are related to this irrigation sector/how do you work as?
4. How long have you been in this irrigation sector?
5. What is your main responsibility here?
6. When did this project start?
7. How this project has been initiated?
8. How many board members are there and what are their responsibilities?
9. Where is the starting point of this project and how the water has been accessed in the field of the farmers?
10. Do you know the budget allocation for this project?
11. I heard this project was developed by the government and handed over to the farmers. What do you want to say regarding it?
12. How it has been handed over to the farmers?
13. How do you distribute the water?
14. What are the problems faced during the water distribution?
15. How are you balancing water uses for sustaining livelihood?
16. What are the changes in the livelihood of the people after this project has been implemented?
17. How is the participation of people for the effective management of the water?
18. What do you think are the factors influencing participation for the effective management of the water?
19. What is the change in the scenario before and after irrigation development?

20. What do you think are the impact of irrigation management?
21. What plan is being implemented for the sustainability of this project?
22. What role the farmers are playing from their side for balancing water uses so as to sustain livelihood?
23. What are the drawbacks of this project?
24. Any future plans to sustain this project?
25. Any suggestions.....