CHAPTER ONE

Introduction

1.1 Background of the study

Nepal is a mountainous and landlocked country and situated in the Himalayan region. The country lies between 26 22' to 30 27' north latitudes and 80 4' to 88 12' longitudes and bounded on the west, south to east by India on the north by peoples' Republic of China. Nepal has a total population of 23,151,423 living in 4,253,220 households and the total land area of the country is 147,181sq.km (CBS, 2002).

Energy is an essential tool both for economic development and to improve the quality of life in rural area. Nepal has great potential sources of renewable energy like biogas, solar, micro-hydro, improve cooking stove, etc. But due to lack of appropriate information people continue to have heavy reliance on traditional biomass sources like fuel-wood, agriculture wastes, animal dung, etc. Electrical grid connections in rural areas are prohibitively expensive because of the geographical diversity. Population growth has been also creating tremendous pressure on forest resources resulting increased work-land to rural people particularly women and children to greater extent and deteriorating environment.

The studies conducted by various government agencies, show that the total energy consumption in Nepal was 8.205 million TOE (ton oil equivalent/about 15GJ per capita) in 2002 (Shrestha J.N., et. al, 2003, cited Shrestha 2006). Traditional energy provides 85.27%, commercial energy provide about 14.24% and renewable and other provides only 0.48% of the total energy consumption in 2002 (MOF, 2003).

Historically, Nepal's rural population has been meeting their energy needs from traditional sources like fuel-wood and other biomass resources. This is neither sustainable nor desirable from environmental consideration and the need to improve the quality of life. Therefore, there is a need to substitute as well as supplement the traditional energy supply system by modern forms of energy in terms of resources and technology. Because of the country's dependence on imported fossil fuels the high cost of grid connection and low and scattered population density, a decentralized energy supply system because the natural choice. Decentralized new and renewable energy system like micro-hydro, solar photovoltaic (PV), biogas, improved cooking stoves (ICS), etc. provide feasible and environmentally friendly energy supply options in rural areas.

Renewable energy is virtually uninterruptible and infinitely available because of its widespread complementary technologies which accommodate Nepal's need to diversity supply. Being environmentally friendly, there is reduced, negligible impact on the landscape, climate, physical, geographical and natural environment. The most important renewable energy technologies (RETs) in Nepal are related to Pico hydro-power and micro-hydropower; biomass energy (biogas, briquettes, gasifires, improved cooking stoves, etc); solar PV energy (solar home system, solar PV water pumping, solar battery charging, etc.), solar thermal energy (solar water heater, solar driers, solar cooker, etc.),and wind energy (such as wind generator, wind mill, etc.).

Water is vital natural resources, utmost essential for all living beings on the earth. Water is an essential need for healthy, productive life with out any substitution. Obtaining clean drinking water is a constant challenge in many countries. Unfortunately, over a billion people in the developing world do not have access to satisfactory water supply. The WHO (1997) has estimated that up to 80 percent of sickness and diseases in the world is caused by inadequate sanitation, polluted and unavailability of water.

Many people in most developing countries are suffering from in adequacy or hazardous condition of public water supply. Even though, the International Drinking Water Supply and Sanitation Decade (1981-1990) has already been celebrated to achieve the goal of providing about 90 percent of human population with an adequate, safe community water supplies, the storage of water supply and their actual or potential pollution from anthropogenic sources, inadequate treatment and resultant spread of associated diseases are still unresolved problems (WHO, 1999).

The recently developed system for water supply is directly related to solar energy. Solar water pumping system is a practical means to provide safe drinking water and irrigation in rural and urban areas which are suffering from water scarcity in developing countries (IDRC, 1990, Cited in Sharma, 1994).

Solar energy is a form of renewable energy that is abundant and accessible in most southern countries. It is not only environmentally friendly but also an alternative energy source to solve the global problem of energy crises. So, the exploitation of solar energy in water supply is gaining its interesting popularity as a sustainable water pumping system. It is the most suitable for adoption in the developing countries where sunshine is bountifully available.

Solar radiation represents a potentially enormous source of renewable energy. It has been estimated that 125 trillion KW of solar energy strikes our earth in the form if radiation. The total solar insulation of Nepal's landmass is estimated to be nearly 27 million MW a small fraction of which can fulfill our energy needs. In recent days, PV system is emerging as one of the potential systems for all scale lighting, communication, drinking water and irrigation schemes in isolated islands and countries having difficult geographic terrain like Nepal.

Developed countries are facilitated with solar water pumping systems and desired level of purity is easily gained. However, most of the developing countries, constrained by socio-economic conditions and lack of financial resources and technical know-how are not able to implement such modern system. The drinking water in these countries is in the preliminary stages of development. Nepal is also facing the serious challenges in providing safe and sufficient drinking water all of its population in spite of having abundant water resources. This study was focused on the implement of solar water pumping system which can be enjoyed by people living in rural areas of Nepal.

In Nepal, more the population live in area where they do not have easy access to water all round the year for drinking, household purpose, live stoking and irrigation. The diesel pumps are commonly used due to low capital cost. However, the fuel supply may be expensive and unreliable in remote places. The engines themselves are unreliable and have a short life unless they are well maintained. Diesel pumps have a rather high output (3 KW and above) for small communities. So, the plan of government to provide easy access to water supply for the entire population may not be accomplished fully using traditional method unless new technologies like solar PV water pumping systems are used.

On average, Nepal has about 6.8 sunshine hours per day, i.e. 2482 sunshine per year with the intensity of solar insulation ranging from 3.6 to 5.9 KW h/sq. m/day which in average about 4.5 KW h/sq. m/day (Climatic and Hydrological Atlas of Nepal, ICIMOD, 1996). Now a day, small PV water pumping sets (100 watt DC pumps to 1.4 KW AC pumps) are becoming popular to use especially for drinking water and drip irrigation purposes (RONAST/NEDO, 2003).

So, solar water pumping system could be a potential solution to problems related with water supply both for drinking water and cash crops micro-irrigation especially in water deficient rural areas.

1.2 Statement of the Problem

Though, Nepal is an agricultural country with rich in water resources it can not fulfill the safe drinking water and can not produce enough food for the increasing population due to geographical diversity. So, the country always faces the food deficit problem as well as different diseases related to water. Its main cause is unavailability of irrigation facilities and drinking water. Therefore, it is essential to develop the irrigation facility in the country to produce more food grain. So, the solar water pumping system is the alternative subject of the study in the context of safe drinking water and irrigation development in Nepal.

Many people in rural areas of developing countries are suffering from a shortage of water supply. This leads to bad life conditions and in extreme cases, the migration of rural population to urban centre. Efforts to overcome this problem have made the water pumping programs a priority of many developing countries and donor groups. In many reasons, this goal can only be achieved by the utilization of ground water resources. In remote areas, there are many possibilities to make use of this resource such as, hand pumps, wind or solar pumps. But in comparison, with diesel pumps solar water pumps are today economically advantageous.

This study aims to investigate existing practice and situation and different issues related to water availability and benefit sharing as well as to analyze the socio-economic impact after and before the installation of solar water pumping system with its management aspect.

Mainly the study has attempted to answer the following questions;

i. What are the social impacts on the community after the installation of PV pumping system?

ii. What are the problems to maintain the system?

iii. How does it take place in benefit sharing process?

iv. What are the recommendations and suggestions to well manage the PV system?

1.3 Objectives of the Study

Solar water pumping system is operating for no more than 15 years in our country. Its continuity on installation means it has been getting continuous support in the context of alternative energy resources in which the most important part of renewable energy resources use especially for more difficult geographical areas. The people of command areas, they believe if they have irrigation and drinking water facilities, they can get more benefit. And they also use that system for their domestic animals, income generating sectors such as nursery of different plants like fruits, vegetables, flowers, etc.

The general objective of this study is to analyze the impact of solar water pumping system in rural sector of Benighat VDC, Dhading district. However, this study has been carried out to fulfill the following specific objectives:

i. To analyze the social impact after the installation of solar water pumping system in the community,

ii. To identify the problems of water and benefit sharing process from solar water pumping system,

iii. To identify the operation and maintenance in system management,

iv. To recommend some suggestions for better management of SWP system.

1.4 Significance of the Study

In a country like Nepal, agriculture is the backbone of its economy, better health of the people and irrigation play vital role for better products. It has been realizing that the safe drinking water and nutrient food keep our body healthy and energetic to do all of the daily works. So, solar PV water pumping system is a help-line to fulfill our one of the basic needs water.

HMG/N has also given emphasis to the PV pumping system since the begging of the Eighth five-year plan, which was included in RONAST. Then continuously, solar PV pumping systems have been given priority. For that purpose, community income increasing program, sustainable solar energy programs, solar energy data collection programs have been emphasized with entrepreneurs motivation program with low cost and high quality program have been emphasized.

Nepal with a per capita energy consumption of about 15Gj. is one of the five least energy-consuming countries. Nepal has 2.27 percent of the total hydropower potential. About 1.4 percent by Nepal's total energy demand is being met by electricity and 12.4 percent by petroleum products and others commercial sources of energy. About 86 percent of its total energy is generated from traditional energy resources such as fuel wood, agricultural residues and animal waste. This has led to grave consequences on ecological and environmental degradation as well as difficulties in balance of payment. Keeping this in mind, HMG/N has provided policy guidelines in its tenth five-year plan to encourage the development of RETs including photovoltaic.

The solar PV pumping system is being popular for safe drinking water and drip irrigation purposes that would get much success. Therefore, solar PV pumping system has conceived the higher priority in Nepal. In recent years, the important of PV pumping system in rural development (especially for difficult geographical area) has been increasing.

1.5 Definition of the Working Terms

Alternative energies such as solar energy for the purpose of drinking water is very useful in the rural sectors. In general PV water pumping system needs no external power supply, thus reducing the operational cost. It is light, modular, easy to install has long life.

Development- An event in which something is caused to grow or advance. For the purpose of this study, it refers any change which results to increase prosperity.

Project- A project is a development undertaking or a scheme which intends to connect out to a desired result. A complete project cycle essentially consists of all development actions such as detailed design, implementation operation and maintenance of services, etc.

Technology- It is the practical application of knowledge and use of mechanical arts and applied sciences for example, engineering in productive activities. Technology incorporates both hardware (tools and machines) and software (knowledge and ideas) components involved in different productive activities.

1.6 Limitation of the Study

The SWP systems have spread over different districts of our country. This system helps to fulfill the water scarcity especially in rural areas where the people are suffering from the safe drinking water and micro irrigation due to the geographical diversity. The present study is concentrated only on the community of Benighat VDC where the SWP system is installed. Even within the VDC, the study is based on data collection from all of the systems. This is one of the limitations. Similarly, research study is basically non experimental as well as descriptive and based on field survey.

1.7 Organization of the Study

In this project report, there are six chapters included where chapter one refers to the whole introduction part of the study topic (such as background, statement, objectives, importance, limitations, etc) and literature review of related topic is included in chapter two. Similarly, background and methodology of the study area is included in chapter three. In chapter four, background characteristics of study area and whole data analysis and interpretation as well as tabulation and figures are represented. Then scheme details of the study area is presented in chapter five and conclusion, suggestions and recommendations are included in chapter six.

CHAPTER TWO

Literature Review

A significant part of the early development of solar technology was concerned with water pumping. A solar steam engine pumped water at the Paris Exposition in 1978. The development and commercialization of a viable solar-thermodynamic pump was pioneered by the French company. In that date 1970's many of these pumps were installed around the world. Development of PV pump was also pioneered in France. The first system used a motor pump comprising a surface-mounted permanent-magnet DC motor driving a "submerged centrifugal pump". The motor was connected directly to the PV array. Several demonstration units were installed in 1970's (Barlow R., 1993).

In 1978, a team at the World Bank presented a compelling case for a program to apply small PV pumps for micro irrigation on a huge scale. A goal of 10 million units installed by the year 2000 was presented as appropriate, as having a significant impact on world food production yet representing only 10 percent of potential farmer users (Barlow R., 1993).

Application of solar PV pumping system has recently received increasing attention due to various benefits and reliable operation. It is more popular for drinking water and irrigation in remote area as well as urban. Since the first installation in 1978 (Barlow, 1993), the PV pumping market has been consistently growing; some studies indicate more than 10,000 PV pumps in operation up to 1994. Many of them will be devoted to the supply of water to rural villages from medium head boreholes of 15 to 50 meters (Kabore, 1994; Lorenzo, 1997; cited in Baral, 2003).

British scientists have tested and found an Australian water pumping system driven by solar power to be of very high efficiency. Researchers at the University of Reading recently tested the 'sun-pump' of Australia's Suntrap Power Products (ASPPs) and showed a record conversion efficiency of about 9 percent. A solar pump's efficiency is calculated as the ratio of the water flow to the energy produced by PV panels (UN, 1970). The pumping system uses a new submergible brushless DC motor and controller. The motor is so designed as to equalize and maximize the quality of water produced over a whole day, rather than that achieved only during peak conditions (ASTN, Aug-1995).

Easwarkhanthan, T. (1981, cited in Baral, 2003) presented the thesis entitled "Small Scale PV Water Pumping Direct Coupled Systems Driving Centrifugal Pumps". The study showed that the system with maximum power point tracker (MPPT) starts pumping earlier than the direct couple system and that could pump even during cloudy atmospheres. Moreover the simulation of daily flow, through a year indicates that MPPT, the yearly flow increases by around 25 percent. Saravan R. and Karthikeyan G. (1998) investigated the performance evaluation of solar PV water pumping systems. They evaluated the performance of PV water pumping with tracking of three times manually (cited in Baral, 2003). Pulfrey (1987) developed a Prototype PV Pumping System capable of supplying 15 m cubic of water per day in full sunlight at a head of arrow 35 m (cited in WECS, 1994).

A new solar powered water pumping and purification system, which can supply 1,200 l/day of potable water, is being tested in Australia. Developed by Solar Energy Systems (SES), Venco Products and Murdoch University, the Village Water Potable System (VWPS) incorporated a water pump together with a method for cleaning polluted, salty and brackish water (Australian Energy News, Dec-1999). In that system, water is first pumped into an overhead tank from a bore well by a solar powered pump drive. The water then flows down through two filters and is forced through a custom-made membrane and purified. The reverse osmosis purification process separates out dissolved salts and water borne particles, including harmful pathogens. Low voltage PV panels supply power to the system and no batteries are required. The system would be ideal for use in remote areas and developing nations. The pump in this system could also be used for stock watering and irrigation. At present, a 400 l/day system is also available (Australian Energy News, Dec-1999, cited in Karki, 2001).

Because of the relatively high cost of PV modules, solar pumping is most economical for small power demand applications, say less than 1000 w. This is well matched with the type of pumping loads that are the most appropriate in the developing world. The major demand for water supply falls into two fairly distinct categories: i.e. village drinking water supply and irrigation.

At first in 1988-89, three solar electrification stations were established with the help of French Government in Nepal. ADB/N has installed 5 PV based solar pump stations in collaboration with the French Assistance Program. NEDO/RONAST has also installed about 3 PV based solar pump stations. AEPC has also installed about 20 PV based water-pumping stations through different companies. The total PV pumping comes out to be about 60KW. Now, there are about 55 solar pumps are installed by Solar Electricity Company in Nepal. Only in Dhading district, about 12 solar pumps are installed and installing process is also increasing.

From the review of above literature, it can be seen that lots of contributions have been made to improve the efficiency and to install PV pumps by using different types of tracking system and different capacity peaks to solve the rural and urban water problems. There is growing need for application of solar energy in developing country like Nepal. So, the PV pumping should be properly used with keen concentration on how greater amount of electricity can be generated using the least area of solar modules.

CHAPTER THREE

Research Methodology and Source of Data

This chapter discusses the research methodology adopted for the study. Both qualitative and quantitative methods were used in this study by using both primary and secondary source of information.

3.1 Selection of the Study Area

The solar water pumping system has installed in different districts (around 20 districts). Among the districts Dhading is one of the main districts where more than 13 solar water pumping systems are installed by various installer company with funded by various funded organizations. Benighat VDC is one in Dhading and a significant number of SWP systems were found in which represent seven numbers. There is no study conducted about this system in this VDC. Thus the Benighat VDC has been purposively selected for the study.

3.2 Sampling

This study has covered all the total number of SWP system of the VDC. The present study is mainly on field based and descriptive in order to fulfill the specific objectives of the study. However, the intention is to collect rich data about SWP system in a short period of time. The seven SWPS serve 1405 beneficiaries of 233 households. The detail breakdown of the population and households are given in table 5.2.

3.3 Nature and Source of Data

Both primary and secondary data has been used in this study. But mainly, this study was based on primary data and such data has been collected from the field survey by interview method. The method is applied by direct interview with the respondents on the basis of structured questionnaires using quantitative technique. Unstructured questionnaires were also used to collect related information by key informants and focus group discussion using qualitative technique. More over the secondary data has been used to understand the historical background and general information of the SWP system. The secondary data has been collected from the related offices or organizations and other available sources, such as books, reports, articles and so on.

3.4 The Respondents

The VDC is purposively selected. Every household of solar drinking water user groups was included in this study. To fulfill the objectives in this study information was also collected from the solar installer company.

The respondents from the installer company as the key informants are the operator or site technician of the SWP system, committee members of solar water user groups and the head of every household as well as the members of local NGO were included in this study. There were 14 households in Dumre solar drinking water user group (ward no. 3), 26 households in Kotgaun solar drinking water user group (ward no. 3), 24 households in Saichhap solar drinking water user group (ward no. 4), 56 households in Mohariya solar drinking water user group (ward no. 4), 24 households in Richok-Irang solar drinking water user group (ward no. 5), 55 households in Janagaun solar drinking water user group (ward no. 6) and 33 households in Warbang solar drinking water user group (ward no. 9).

3.5 Questionnaire Design

The questionnaire employed for the study was designed to obtained information of various aspects of solar water pumping system as well as social impacts and characteristics. Three types of questionnaire were designed for collecting information. The household schedule was used to get household information to obtain information on social characteristics of the household. Other two types of questionnaire were asked to anyone member of user committee and Installer Company as well as site technician to obtain information on general information of solar water pumping system, capacity, cost investment, etc. Some informal / unstructured interviews were also developed to the respondents.

3.6 Data collection technique and Tools

The questionnaire originally drafted in English but translated into Nepali when interview process. Mainly three types of questionnaires were used namely, general information about SWP system; house hold basis and manufacturer questionnaires. The observation researcher had personally visited the study areas and asked the questions for the head of the households, manufacturers and executive workers who operate and maintain this system.

Observation: Observation of the solar water pumping system sites was made to assess the installed physical status of the SWPS. Information in the condition of structures such as reservoirs, intakes, pipelines solar modules, etc. was collected by this method. The advantage of this method was that it gave an immediate and various understanding of the problem.

Structured Interviews: Structured interviews were carried out with head of the households, manufacturers and committee members of user groups and structured questionnaires were filled up.

Unstructured (Informal) Interviews: Unstructured interviews were carried out with the beneficiaries mainly included housewives, children and Installer Company as well as funded agencies.

Focus Group Discussion: The qualitative data was collected through focus group discussion with the user groups and key informants of the village.

3.7 Hypothesis

Solar water pumping system have greater potential to achieve safe drinking water especially for rural sector where the spring water is far from the settlement area and not possible to distribute water by direct pipelines.

3.8 Data Analysis and Interpretation

The statistical tools used in this study which are percentage, ratio, average, tabulation, figures, etc.

CHAPTER FOUR

Background Characteristics of the Study Area

Nepalese society is the layer of multi-ethnic groups of people living together in a community with different races, languages and cultures. Even today, multi-racial and multi-linguistic characteristics are quite visible with the population of Nepal. In this study, an attempt has been made in micro level to highlight on some of social and economic characteristics of study area. The study is included in household and average family sized, caste/ethnicity composition, family structure, use of toilet, educational status, land holding patterns, gender status to fetch water etc.

Benighat VDC lies in the western belt of Dhading district. This VDC is surrounded by Chitwan district (west), Gajuri VDC (east), Mahadevsthan VDC (south), and Trisuli River in the north.

This study is strictly concentrated to solar drinking water pumping system of Benighat VDC of Dhading district. Brahmin, Chhetri, Chepang Newar, Damai, Kami, Sarki, Ghale, etc. are different caste/ethnic groups of people residing in this VDC. Seven primary schools, one lower secondary and two higher secondary schools of government sector and one cooperative secondary school are in this VDC. There are one health post, one hospital, one rope way service, one post office also residing. There are seven solar water pumping systems using spring water, and some houses use solar home systems for small power electricity.

4.1 Households and Average Family Size

There are 233 households in the study area using SWPS for drinking water. The total population of those areas was 1405 where seven numbers of SWP systems are installed. In Dumre, out of total (14) households, only three households are of Bramins and remaining households represent Newars. Similarly, in Warbang, out of total (33) households, all households represented for Chepang and in Sahichhap, out of total (24) households, only two households represented for Brahmins and remaining households represented for Sarki. Average family size of total population with caste/ethnicity is shown in table 4.1.

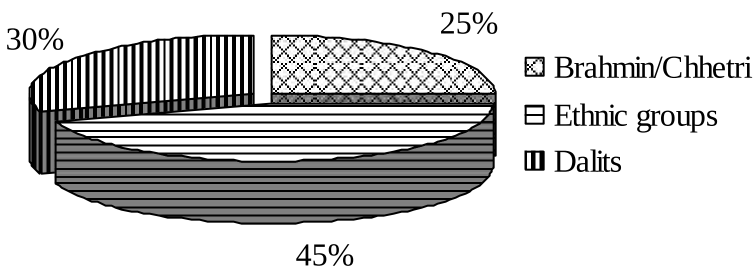
Table 4.1 Households, Population, and Percent with Ethnicity and Caste group

S.N.	Cast/Ethnicity	No. of Households	No. of Population	Percentage
1.	Brahmin	32	221	15.72
2.	Chhetri	24	137	9.75
3.	Chepang	33	185	13.16
4.	Magar/Bhujel	7	63	4.48
5.	Ghale	34	224	15.94
6.	Newar	19	145	10.32
7.	Tamang	2	11	0.78
8.	Dalit	82	429	30
Total		233	1405	100

Cast/Ethnicity	No. of Households	No. of Population	Percentage
Brahmin/Chhetri	56	358	25
Ethnic groups	95	628	45
Dalit	82	429	30
Total	233	1405	100

Source: Field Survey, 2006.

Figure 4.1 Populations with Ethnicity and Caste Group



In table 4.1, out of total (1405) population, ethnic groups represented for 44 percent which was the highest followed by 30 percent of Dalits. The remaining population was found to be 25 percent represents to the Brahmins/Chhetries.

Thus, the study shows that the largest numbers of ethnic groups with large number of Dalit are residing in the SWP system installation area (Chepang, Magar, Ghale, Newar, Tamang, and Dalit).

4.2 Involvement of Male, Female and Children in Fetching Water

Out of total population, the overall male population (712) in the study area was found to be 51 percent and female (693) represented for 49 percent.

In table 4.2, households to fetch water by male, female and children is shown where the people use the solar drinking water from different system areas.

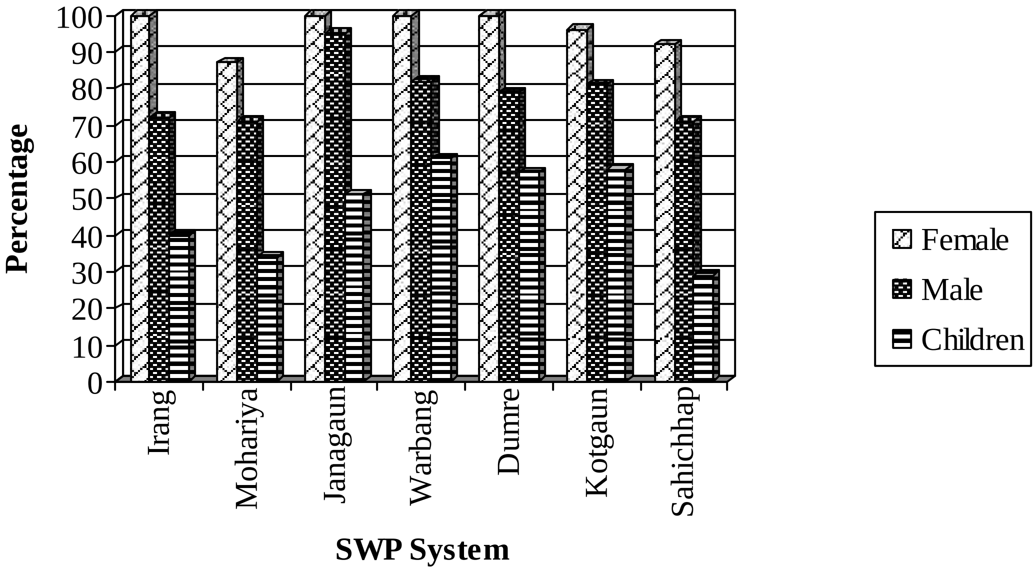
Table 4.2 Involvements of Male, Female and Children in Fetching Water

Name of Sites	No. of Households	Participant					
		Male	%	Female	%	Children	%
Irang	25	18	79	25	100	10	40
Mohariya	56	40	71	49	87	19	34
Janagaun	55	53	95	55	100	28	51
Warbang	33	27	82	33	100	20	61
Dumre	14	11	79	14	100	8	57
Kotgaun	26	21	81	25	96	15	58
Saichhap	24	17	71	22	92	7	29
Total	233	187	80	223	96	107	46

Source: Field Survey, 2006.

Out of total households (25) of Irang water users, female of total 100 percent households were involved to collect water and followed by 79 percent households in the context of male where children of 40 percent households were involved to collect water. Similarly, out of total (56) households of Mohariya, female of 87 percent households were involved to collect water while male involvement was found to be 71 percent and children involvement was found to be 34 percent.

Figure 4.2 Involvements of Male, Female and Children in Fetching Water



Out of total (55) households of Janagaun, female of total 100 percent households were involved to collect water followed by 95 percent households in the context of male where the participation of children represented for 51 percent. Out of total (33) households of Warbang users, female of total 100 percent households were involved to collect water followed by 82 percent households in the context of male where children participation was found to be 61 percent. Similarly, in the context of Dumre users, the data shows that out of total (14) households, female of total 100 percent were involved to collect water while male involvement is 79 percent and children involvement was found to be 57 percent. Out of total (26) households of Kotgaun users, female of 96 percent households were involved to collect water where male involvement was found to be 81 percent and children involvement was found to be 58 percent. At last, out of total households (24) of Saichhap, female of 92 percent households were activated to fetch drinking water where male participation was 71 percent and participation of children represented for 29 percent.

Thus, there is the largest female population had to activate in the context of collecting water in rural area.

4.3 Time Spent to collect water before and after installation of SWP System in Study Area

In Benighat VDC, except ward no. 1, all other wards are located in totally hilly area where the people have no access to water source. There is a lack of spring water nearby their settlement area and also very difficult to access water from pipe line due to the uphill settlement. So, before the installation of the system, people of study area had to spend more time to collect water.

Table 4.3 Time Spent to Collect Water per vessel

Sites	Time in Hours Before Installation of SWPS	Time in Minutes After Installation of SWPS
Irang	1 Hrs.	10 Min.
Mohariya	3 Hrs.	10 Min.
Janagaun	2 Hrs.	10 Min.
Warbang	3 Hrs.	10 Min.
Dumre	1.5 Hrs.	10 Min.
Kotgaun	1 Hrs.	5 Min.
Saichhap	1 Hrs.	5 Min.

Source: Field Survey, 2006.

Table 4.3 shows that the people of Irang had to spend minimum one hour to collect one pot of water before the installation of the system but now they get water only walking 10 minutes for getting water and get maximum water in a short time after the installation of the system. Similarly, in Janagaun, where people had to spend two hours for getting drinking water before the installation of system due to the geographical imbalance but now they get water by walking only 10 minutes. Similarly, people of Mohariya and Warbang had to spend minimum three hours each to collect one vessel of water due to the geographical imbalance but now they get water by walking only 10 minutes with the help of SWP system.

The people of Dumre area need to spend about one and half hours to fetch one vessel of water when their demand was minimum two hundred liters per day. At that time, they had no time to do other works but after installation of system they required to devote only 10 minutes to fetch one vessel of water. Similarly, people of Kotgaun and Saichhap area had to spend one hour to collect one vessel of water before the installation of system but now they need only five minutes to fetch one pot of water after the installation of system and get maximum water to fulfill their demand.

After the installation of SWP system, they use their rest time in other fields such as engaging in non formal education, vegetable production, care of child, live stock rearing, participate in 'Ama Samuha', consumer surplus program, micro credit program etc. Thus, we can say that the SWP system is one of the suitable systems especially for rural drinking water which is non polluted and sustainable utilization of alternative energy source.

4.4 Use of Toilet in the Study Area

Use of toilet is one of the indicators to measure the social status of people. Sanitation management always plays vital role to control the various diseases thus in this modern age, toilet is important for all the people of the entire locality.

Majority of the households of study area had been benefited from these SWP systems with access to safe drinking water. People of Irang water system area were suffering from the lack of toilet.

Table 4.4 Use of Toilet before and after installation of SWP System in Study Area

Sites	After SWPS Installation				Before SWPSm Installation				Not Use	
	Open		Close		Open		Close			
	No.	%	No.	%	No.	%	No.	%	No.	%
Irang	1	4	-	-	1	4	-	-	24	96
Mohariya	5	5	5	50	10	18	-	-	46	82
Janagaun	33	65	18	35	51	93	-	-	4	7
Warbang	1	3	32	97	33	100	-	-	-	-
Dumre	2	33	4	67	6	44	-	-	8	56
Kotgaun	23	92	2	8	24	96	1	4	1	4
Saichhap	-	-	-	-	-	-	-	-	24	100
Total	65	28	61	26	125	54	1	0.5	107	46

Source: Field Survey, 2006.

From table 4.4, out of total households of Irang (25), only one household (4%) was using the toilet before and after the installation of system which prefers open pit. Remaining people of 96 percent households had no toilet and still prefer defection in agricultural land.

In Mohariya, people of only 18 percent households had opened toilet before the installation of system. Out of that, 50 percent had opened toilet and 50 percent had closed toilet after the installation of system. Still now, people of 82 percent households had no toilet and they prefer defection in agricultural land and forest areas closed to their houses. Although they got maximum water after the installation of system they had not settled their mind to build permanent toilet.

In Janagaun, out of total households (55), seven percent of the households had no toilet and 93 percent were using open pit before the installation of system. After the installation of system, out of that, 65 percent were using open pit and remaining 35 percent had closed toilet.

In Warbang, people of 100 percent households were using open pit latrines before the installation of SWP system. When they got drinking water nearby their houses, they had wanted to build permanent closed toilet but they had not required money. At that time, they built closed toilet with the help of RIMS Nepal and government. Now, only one household (3%) are using open toilet and starting to build closed toilet.

In Dumre, people of 57 percent households prefer defection in agricultural land or forest areas close to their houses. Before the installation of SWP system, 43 percent of the total households were used open pit latrines and after installation, out of that, 67 percent had replaced in closed toilet and remaining 33 percent of the households are still using in open toilet. This data shows, lack of proper awareness, still they do not want to build toilet for their sanitation.

In Kotgaun, out of total households (26), only one household (4 %) had no toilet where remaining 96 percent households were used toilet. Out of that, four percent households prefer using closed toilet before the installation of system and 96 percent had open toilet. But after the installation of system, replacing household represented for eight percent had closed toilet and people of 92 percent households were still used open toilet. Though maximum water availability in this village they do not want to build permanent closed toilet due to lack of health awareness.

In Saichhap water system people of the hundred percent household had no toilet before the installation of system and till now they have not used toilet and prefer defection in agricultural land. Although they get maximum water after the installation of system they do not want to build toilet due to the lack of proper awareness.

Out of total households (233), before the system installation, less than 0.5 percent household had closed toilet where 54 percent had opened toilet and more than 46 percent had no toilet. After the system installation, 26 percent households have closed toilet where 28 percent have opened toilet and remaining 46 percent have no toilet. The SWP system is able to provide safe drinking water nearby their houses but due to lack of proper awareness, beneficiaries have not thought any idea about the use of toilet and its importance in their health status.

So, we can say that, the people who are not using toilet is in same level but open toilet are replacing in closed type.

4.5 Educational Status of the Beneficiaries in the Study Area

Educational status also helps to identify the social background of people in study area. In this topic, educational status of people in study area is given and where data was collected among above 5 years age groups.

Table 4.5.1 shows that the total population was found 166 above the 5 years age. Out of that, male accounts for 58 percent and 42 percent for female. Out of total, over all illiterate population was found to be 37 percent while male illiterates are 26 percent and female illiterates are 51 percent. Similarly, in primary level, 44 percent was found for male and only 27 percent was found for female where overall population in this level accounts for 37 percent. In lower secondary level, male accounts for 12.5 percent while female are six percent and overall population is 9.5 percent in this level.

Table 4.5.1 Educational Status of Irang Solar water User Group

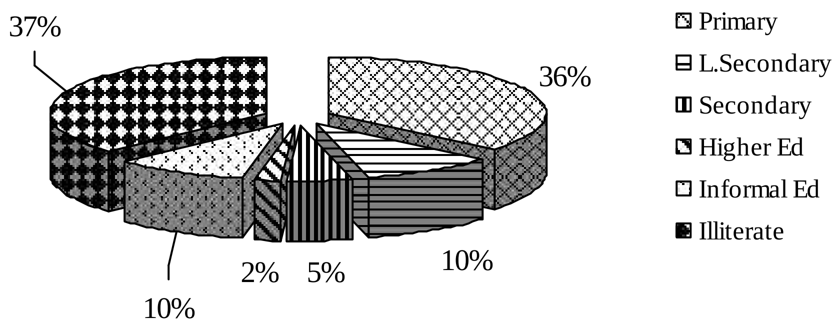
Level	Male		Female		Total	
	No.	%	No.	%	No.	%
Primary	42	44	19	27	61	37
Lower Secondary	12	12.5	4	6	16	9.5
Secondary	4	4.5	4	6	8	5
Higher Education	3	3	1	1	4	2
Informal Education	10	10	6	9	16	9.5
Illiterate	25	26	36	51	61	37
Total	96	58	70	42	166	100

Source: Field Survey, 2006.

Similarly, in non-formal education, male accounts for 10 percent and 9 percent for female where overall population is 9.5 in this level. Out of total, the lowest population was found to be two percent in higher education level while male includes three percent and female includes only one percent. Similarly, there was only five percent found in secondary level where male accounts for 4.5 percent and six percent for female.

According to the data, the highest female population was found to be 51 percent in illiterate group and the highest male population is 44 percent in primary level.

Figure 4.5.1 Educational Status of Irang Solar water User Group



In table 4.5.2, out of total population (244), male population is 49.5 percent and female 50.5 percent for female. Out of that, the largest population was found in illiterate group (39%) where female illiterates are 50.5percent and male illiterates are 27 percent.

Table 4.5.2 Educational Status of Mohariya Solar water Users

Level	Male		Female		Total	
	No.	%	No.	%	No.	%
Primary	37	30.5	32	26	69	28
Lower Secondary	7	6	7	5.5	14	6
Secondary	8	6.5	5	4	13	5.5
Higher Education	1	1	-	-	1	0.5
Informal Education	35	29	17	14	52	21
Illiterate	33	27	62	50.5	95	39
Total	121	49.5	123	50.5	244	100

Source: Field Survey, 2006.

Similarly, the second larger population was found to be 28 percent in primary level where female accounts for 26 percent and 30.5 percent for male. There was only one male found in higher education level. Similarly, in the secondary level, overall population was found to be 5.5 while male are 6.5 percent and four percent for female. In lower secondary level, the overall population is only six percent where male are six percent and 5.5 percent for female. About 21 percent was found in non formal education group where male are 29 percent and 14 percent for female.

Figure 4.5.2 Educational Status of Mohariya Solar water User Group

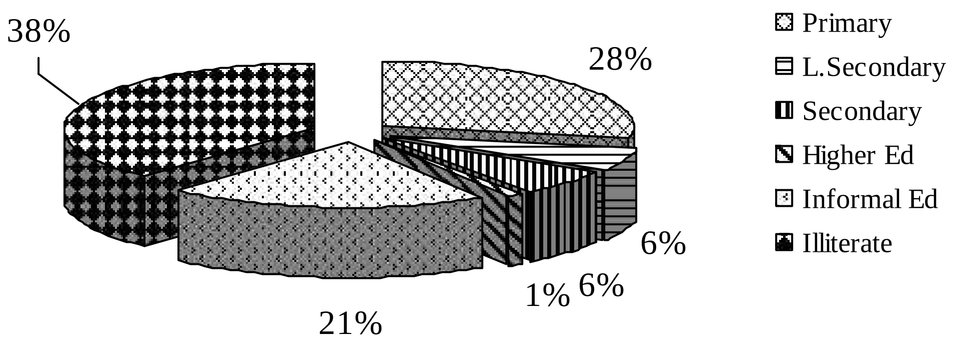


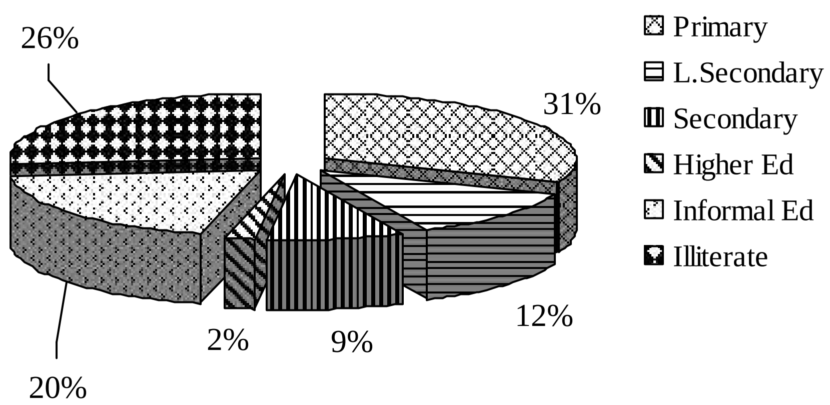
Table 4.5.3 Educational Status of Janagaun Solar Water Users

Level	Male		Female		Total	
	No.	%	No.	%	No.	%
Primary	47	31	47	31	94	31
Lower Secondary	19	12.5	18	12	37	12
Secondary	19	12.5	7	5	26	9
Higher Education	7	5	-	-	7	2
Informal Education	35	23	25	17	60	20
Illiterate	25	16	53	35	78	26
Total	152	50.5	150	49.5	302	100

Source: Field Survey, 2006.

From table 4.5.3, out of total population (302), male accounts for 50.5 percent and the rest was found to be 49.5 percent for female. Out of total, the largest population was found to be 31 percent in primary level where male are 31 percent and 31 percent for female. The second largest population was found to be 26 percent in illiterate group while male illiterates are 16 percent and female illiterates are 35 percent. The lowest population was found to be two percent in higher education level which prefers to only male and there was no one female who accesses to that level.

Figure 4.5.3 Educational Status of Janagaun Solar Water Users



Similarly, in secondary level, overall population was found to be nine percent while male are 12.5 percent and female are five percent. In lower secondary level, the overall population was found to be 12 percent while male are 12.5 percent and 12 percent for female. According to the data, the highest female population (35%) was found in illiterate group and the highest male population (31%) was found in primary level.

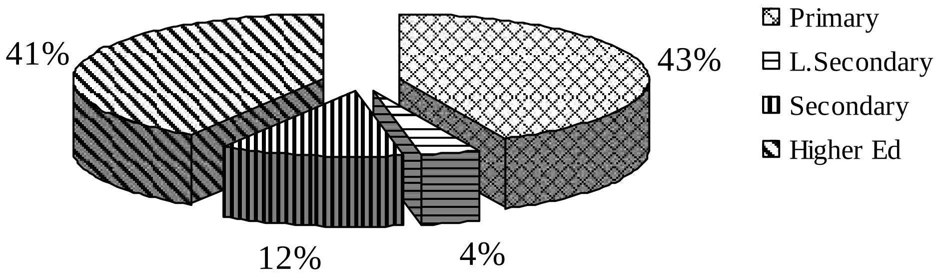
Table 4.5.4 Educational Status of Warbang Solar water User Group

Level	Male		Female		Total	
	No.	%	No.	%	No.	%
Primary	36	48	26	38	62	43.5
Lower Secondary	2	3	3	4.5	5	3.5
Secondary	-	-	-	-	-	-
Higher Education	-	-	-	-	-	-
Informal Education	14	18.5	3	4.5	17	12
Illiterate	23	30.5	36	53	59	41
Total	75	52	68	48	143	100

Source: Field Survey, 2006.

In table 4.5.4, out of total (143), male population accounts for 52 percent and female are 48 percent. Out of that, the highest population was found to be 43.5 percent in primary level where male are 48 percent and female are 38 percent. Similarly, the second highest population was found to be 41 percent in illiterate group where male are 30.5 percent and female are 53 percent.

Figure 4.5.4 Educational Status of Warbang Solar water User Group



There was no one population found in secondary and higher education level. The lowest population was found to be 3.5 percent in lower secondary level where male are three percent and are 4.5 percent. Similarly, about 12 percent population was found in non formal education where male are 18.5 percent and female are 4.5 percent. According to the data, the highest population of female was found to be 53 percent in illiterate group and the highest population of male was found to be 48 percent in primary level.

From table 4.5.5, out of total (79), male population was found to be 49 percent and 51 percent for female. Out of that, the largest population was found to be 48 percent in primary level where male accounts for 51.5 percent and female accounts for 45 percent. The second largest population was found to be 25.5 percent in illiterate group where male accounts for 18.5 percent and female accounts for 32.5 percent.

Table 4.5.5 Educational Status of Dumre Solar water Users

Level	Male		Female		Total	
	No.	%	No.	%	No.	%
Primary	20	51.5	18	45	38	48
Lower Secondary	4	10	4	10	8	10
Secondary	4	10	-	-	4	5
Higher Education	-	-	1	2.5	1	1.5
Informal Education	4	10	4	10	8	10
Illiterate	7	18.5	13	32.5	20	25.5
Total	39	49	40	51	79	100

Source: Field Survey, 2006.

Similarly, the lowest population was found to be 1.5 percent in higher education which prefers to only female. Similarly, in the secondary level, the population was found to be five percent which prefers to only male. The equal participation of female and male was found to be 10 percent in both lower secondary level and non formal education group.

According to the data, the highest population of female and male was found to be 45 percent and 51.5 percent respectively in primary level.

Figure 4.5.5 Educational Status of Dumre Solar water User Group

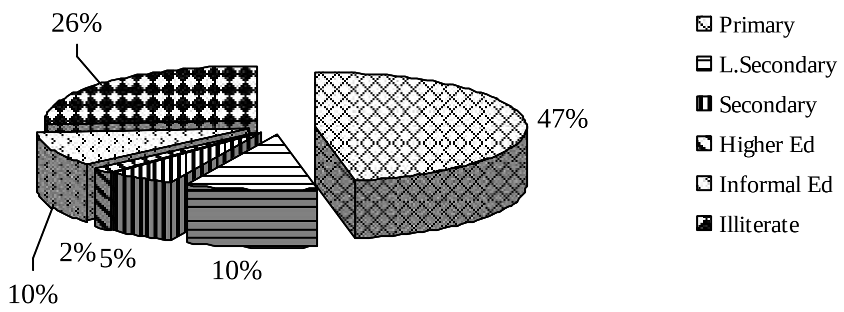


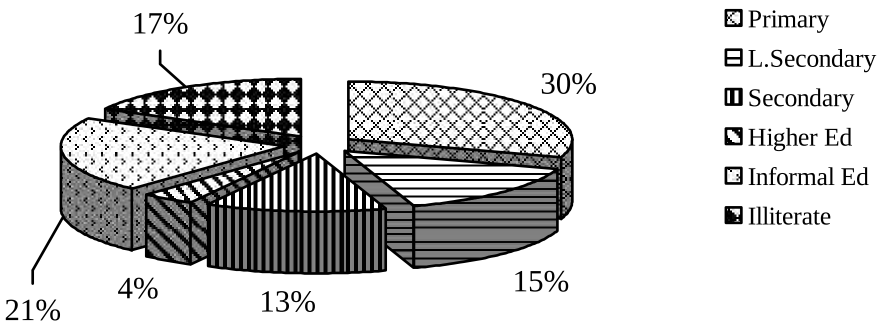
Table 4.5.6 Educational Status of Kotgaun Solar water Users

Level	Male		Female		Total	
	No.	%	No.	%	No.	%
Primary	18	27	24	35	42	31
Lower Secondary	9	13	11	16	20	15
Secondary	12	18	6	9	18	13
Higher Education	4	6	1	1	5	3.5
In/Non formal Education	18	27	10	14	28	20.5
Illiterate	6	9	17	25	23	17
Total	67	49	69	51	136	100

Source: Field Survey, 2006.

From table 4.5.6, out of total population (136), male accountsfor 49 percent and female accounts for 51 percent. Out of that, the largest population was found to be 31 percent in primary level where male accounts for 27 percent and female accounts for 35 percent. The second largest population was found to be 20.5 percent in non formal education group where male are 27 percent and 14 percent for female. The lowest population was found to be 3.5 percent in higher education level where male accounts for six percent and female accountsfor only one percent. Similarly, the second lowest population was found to be 13 percent in secondary level where male are 18 percent and female are nine percent. In lower secondary level, overall population was found to be 15 percent while male are 13 percent and female are 16 percent. Similarly, overall illiterate was found to be 17 percent while male illiterates are nine percent and female illiterates are 25 percent.

Figure 4.5.6 Educational Status of Kotagawn Solar water User Group



According to the data, the highest female population was found to be 35 percent in primary level and the equal highest male population was found to be 27 percent in primary level and non-formal education group.

From table 4.5.7, out of total (110), in male and female each 50 percent was found where the largest population was found to be 36 percent in primary level followed by 34.5 percent in illiterate group where male are 27 percent and female are 42 percent. Similarly, the lowest population was found to be 4.5 percent in secondary level followed by lower population (5%) in higher education.

Table 4.5.7 Educational Status of Saichhap Solar water Users

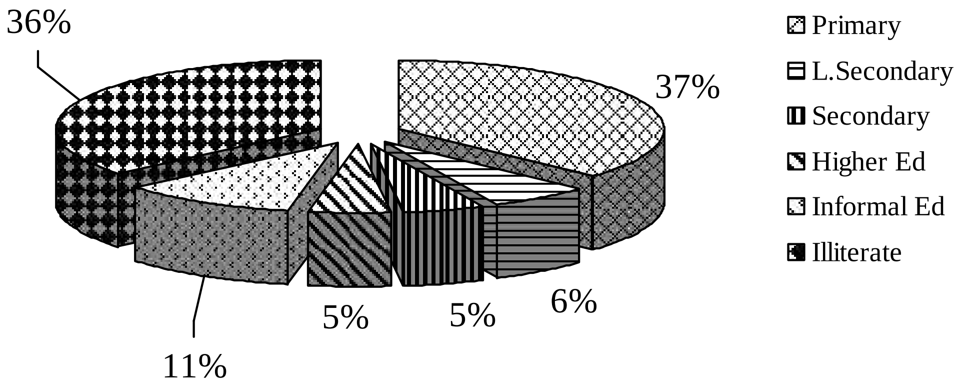
Level	Male		Female		Total	
	No.	%	No.	%	No.	%
Primary	20	36.5	20	36.5	40	36
Lower Secondary	5	9	2	4	7	6
Secondary	3	5	2	4	5	4.5
Higher Education	4	7	2	4	6	5
Informal Education	8	15.5	4	7.5	12	11
Illiterate	15	27	23	42	38	34.5
Total	55	50	55	50	110	100

Source: Field Survey, 2006.

The equal participation of female and male was found to be 36.5 percent in primary level. Similarly, the equal female population was found to be four percent in lower secondary,

secondary and higher education level where male are nine percent, five percent and seven percent respectively in such levels.

Figure 4.5.7 Educational Status of Saichhap Solar water User Group



4.6 Livestock Management in the Study Area

Nepal is an agricultural based country where about 85 percent people are living in rural areas and engaged in agriculture. To increase the agricultural production by making fertile land, live stocking plays a vital role. All of the farmers mix the cattle dung and other animal wastes in their farms. So, live stocking is one of the more important parts for the fertile land as well as to fulfill other human needs (milk, butter, meat, etc) by income generating. Thus it is a means of livelihood and to earn money for the rural people.

Table 4.6.1 Livestock Management in Irang User Group

Categories	One		2 to 5		More than 5		Total	
	Hhs	%	Hhs	%	Hhs	%	Hhs	%
Buffaloes	13	52	6	24	2	8	21	84
Cows/Oxen	1	4	11	44	2	4	13	52
Goats	-	-	6	24	18	72	24	96
Others (Pig)	1	4	-	-	-	-	1	4

Source: Field Survey, 2006

Table 4.6.1 shows, out of total households (25), the largest number of households was found to be 96 percent had kept goats where 24 percent households had less than five goats and 72 percent had more than five goats. About 84 percent households had kept buffaloes where 52 percent households had one buffalo, eight percent had more than five and 24 percent had two to five buffaloes. Similarly 52 percent households had kept cows or oxen in their shed where 44 percent households had two to five and there is equal number of households represent four percent had more than five and less than two cows or oxen respectively. At last, only one household includes four percent with having pig.

Table 4.6.2 Livestock Management in Mohariya User Group

Categories	One		Two to Five		More than Five		Total	
	Hhs	%	Hhs	%	Hhs	%	Hhs	%
Buffalos	39	70	7	12	-	-	46	82
Cows/Oxen	3	5	31	55	1	2	35	62
Goats	-	-	22	39	21	37	43	76
Others(no live stock)	-	-	-	-	-	-	4	7

Source: Field Survey, 2006

Table 4.6.2 shows that out of total households (56), the largest number of households include 82 percent were keeping buffaloes in there shed where 70 percent include for only one buffalo and 12 percent include for more than two buffaloes. Second larger number of households was found to be 76 percent were keeping goats in there shed where 39 percent had less than five and 37 percent had more than five goats.

Similarly, 62 percent households were keeping cows or oxen in their shed where 55 percent had two to five cows or oxen, five percent had less than two and only two percent had more than five. In this study area people of seven percent households had no live stocking.

In table 4.6.3, out of total (55), the largest number of households was found to be 95 percent had kept buffalos in their shed where 68 percent had one buffalo and 25 percent had two to five and only two percent had more than five numbers of buffaloes.

Table 4.6.3 Livestock Management in Janagaun User Group

Categories	One	Two to Five	More than Five	Total

	Hhs	%	Hhs	%	Hhs	%	Hhs	%
Buffalos	37	68	14	25	1	2	52	95
Cows/Oxen	5	9	28	51	-	-	33	60
Goats	-	-	17	31	31	56	48	87
Others(Wild Pigs)	-	-	1	2	-	-	1	2

Source: Field Survey, 2006

Similarly, 60 percent households had kept cows or oxen where 51 percent had more than five and nine percent had only one cow in their shed. In the context of goat stocking, 87 percent of the households had kept goats in their shed where 56 percent had more than five goats and 31 percent had less thenfive. In this area, only one household includes two percent with having pig.

Table 4.6.4 Livestock Management in Warbang User Group

Categories	One		Two to Five		More than Five		Total	
	Hhs	%	Hhs	%	Hhs	%	Hhs	%
Buffalos	15	45	11	33	-	-	26	78
Cows/Oxen	-	-	19	58	2	6	21	64
Goats	5	15	21	64	4	12	30	91
Others	-	-	-	-	-	-	-	-

Source: Field Survey, 2006

From table 4.6.4, out of total households (33), 91 percent of the households had goat in their shed where 64 percent represent for two to five number of goats and 15 percent and 12 percent households represented for less than two and more than five respectively. Similarly, 78 percent households were keeping buffaloes in their shed where 45 percent prefer to one buffalo and 33 percent for more than two. Same as, 64 percent households were keeping cows or oxen in their shed where 58 percent households represent for less than five and six percent for more than five numbers of cows or oxen.

Table 4.6.5 Livestock Management in Dumre User Group

Categories	One		Two to Five		More than Five		Total	
	Hhs	%	Hhs	%	Hhs	%	Hhs	%
Buffalos	5	36	5	36	1	7	11	79
ows/Oxen	-	-	6	43	2	14	8	57
Goats	-	-	5	36	9	64	14	100
Others	-	-	-	-	-	-	-	-

Source: Field Survey, 2006.

In the context of live stocking management in Dumre, out of total households (14), 79 percent had kept buffaloes in their shed in which equal numbers of households include 36 percent for only one buffalo and two tofive5 buffaloes in each and seven percent had more thanfive5 buffaloes. Similarly, out of total, 57 percent households had stocking cows or oxen in their shed where 43 percent had less than five and 14 percent had more than five numbers of cows or oxen. Same as, total percent of households had keeping goats in their shed where 64 percent had more than five and 36 percent had less than five numbers of goats. After the installation of system, the people of Dumre are engaging in goat stocking and for this purpose 'Local Shree Mohariya Self-Help Group' is responsible to provide micro credit to the villagers.

Table 4.6.6 Livestock Management in Kotgaun User Group

Categories	One		2 to 5		More than 5		Total	
	Hhs	%	Hhs	%	Hhs	%	Hhs	%
Buffalos	11	42	11	42	-	-	22	85
Cows/Oxen	5	19	14	54	2	8	21	81
Goats	2	8	12	46	9	35	23	89
Others	-	-	-	-	-	-	-	-

Source: Field Survey, 2006.

From table 4.6.6, out of total households (26), 85 percent were keeping buffaloes in their shed where equal numbers of households were found to be 42 percent for one buffalo and two to five buffaloes in each. Similarly, 81 percent households were keeping cows or oxen in their shed where 54 percent prefer to two to five numbers of cows or oxen and eight percent and 19 percent prefer to more than five and less than two numbers of cows or oxen respectively. Same as, 89 percent households were keeping goats in their shed where 46 percent had two to five goats and 35 percent and eight percent prefer to more than five and less than two numbers of goats respectively.

In this area, except Brahmin/Chhetri, the people of ethnic groups or dalit of grass-root levels could take micro credit by LSMSHG to keep live stocking after the installation of the system.

Table 4.6.7 Livestock Management in Saichhap User Group

Categories	One		2 to 5		More than 5		Total	
	Hhs	%	Hhs	%	Hhs	%	Hhs	%
Buffalos	12	50	2	8	-	-	14	58
Cows/Oxen	5	21	11	46	-	-	16	67
Goats		-	6	25	15	62	21	87
Others	-	-	-	-	-	-	-	-

Source: Field Survey, 2006

From table 4.6.7, out of total households (24); the largest number of households represented for 87 percent had kept goats in their shed where 62 percent had more than five and 25 percent had less than 5 goats. Similarly, 67 percent households were keeping cow or oxen in their shed where 46 percent had more than 2 and 21 percent had less than two cow or oxen. At last, only 58 percent households were keeping buffaloes in their shed where 50 percent had less than two and eight percent had more than two buffaloes.

4.7 Agricultural land Distribution in the Study Area

Agricultural land pattern is one of the indicators to measure social characteristics in the study area because all areas represent to total rural settlement where most of the people are engaging in agriculture.

From table 4.7.1, out pf total population (196), the largest population was found to be 38 percent had 5 to 20 ropanies agricultural land followed by 23 percent had less than five ropanies. Similarly, 22 percent people had 20 to 50 ropanies land where the smallest population was found to be six percent were landless and always depended on daily wages works.

Table 4.7.1 Agricultural Land Distribution in Irang

Land in Ropani	No. of households	Population	Percentage
0 - 5	6	46	23
5 - 20	10	74	38
20 - 50	6	43	22
Over 50	1	22	11
Land less	2	11	6
Total	25	196	100

Source: Field Survey, 2006

In this area, about 11 percent people (only one household) had more than 50 ropanies agricultural land. According to the study, most of the minor groups had less than five ropanies and landless also and most of the land represented to 'pakho bari' type.

Table 4.7.2 Agricultural Land Distribution in Mohariya

Land in Ropani	No. of households	Population	Percentage
0-5	7	26	9
5-20	41	216	72
20-50	8	57	19
Over 50	-	-	-
Land less	-	-	-
Total	56	299	100

Source: Field Survey, 2006

From table 4.7.2, there was no landless household where out of total population (299), the largest population include 72 percent had 5 to 20 ropanies agricultural land followed by 19 percent people had more than 20 ropanies where the smallest population was nine percent had less than five ropanies land. In this area, most of the land represented to 'khoriya and pakho bari' type.

Table 4.7.3 Agricultural Land Distribution in Janagaun

Land in Ropani	No. of households	Population	Percentage
0-5	6	26	8
5-20	32	203	58
20-50	17	116	34
Over 50	-	-	-
Land less	-	-	-
Total	55	344	100

Source: Field Survey, 2006

From table 4.7.3, out of total population (344), most of the people (58%) had 5 to 20 ropanies agricultural land followed by 34 percent population who had more than 20 ropanies land where the smallest population was found to be eight percent had less than five ropanies agricultural land. In this area, almost of the agricultural land represented to 'pakho bari' type where the people mainly had grown millet, maize, potato and tomato.

Table 4.7.4 Agricultural Land Distribution in Warbang

Land in Ropani	No. of households	Population	Percentage
0-5	15	84	45
5-20	14	72	39
20-50	4	29	16
Over 50	-	-	-
Land less	-	-	-
Total	55	185	100

Source: Field Survey, 2006

From table 4.7.4, all agricultural land was found to be 'khoriya' type and also strip because this area was situated in high land area. Out of total population (185), the largest population was found to be 45 percent had less than five ropanies agricultural land but strip type followed by 39 percent had 5 to 20 ropanies land where the smallest population was found to be 16 percent had more than 20 ropanies agricultural land. About 3-4 years ago, they had grown millet and potato which was their main production but now, most of the people of Warbang were engaging in tomato and potato production including maize.

Table 4.7.5 Agricultural Land Distribution in Dumre

Land in Ropani	No. of households	Population	Percentage
0 - 5	2	9	10
5 - 20	9	65	67
20 - 50	2	16	16.5
Over 50	-	-	-
Land less	1	6	6.5
Total	14	96	100

Source: Field Survey, 2006

From table 4.7.5, out of total population (96), only one household or people of six percent had no agricultural land and always depended on daily wages works where the largest number of people was found to be 68 percent who had 5 to 20 ropanies agricultural land followed by 16 percent had more than 20 ropanies land and remaining 10 percent people had less than five ropanies agricultural land. In this area, almost of the agricultural land represented to be 'pakho bari' type and they produced millet, maize and tomato.

Table 4.7.6 Agricultural Land Distribution in Kotgaun

Land in Ropani	No. of households	Population	Percentage
0 - 5	2	12	8
5 - 20	20	108	70
20 - 50	2	12	8
Over 50	2	23	14
Land less	-	-	-
Total	55	344	100

Source: Field Survey, 2006

From table 4.7.6, out of total population (155), the largest number of people was found to be 70 percent who had 5 to 20 ropanies agricultural land followed by 14 percent had more than 50 ropanies land where equal number of people was found to be eight percent indicating less than five ropanies and 20 to 50 ropanies agricultural land in each. The main income source of Kotgaun was orange production.

Table 4.7.7 Agricultural Land Distribution in Saichhap

Land in Ropani	No. of households	Population	Percentage
0 - 5	8	40	31
5 - 20	14	72	56
20 - 50	1	1	1
Over 50	1	16	12
Land less	-	-	-
Total	24	130	100

Source: Field Survey, 2006

From table 4.7.7, out of total population (130), most of the people (56%) had 5 to 20 ropanies agricultural land followed by 31 percent population who had less than five ropanies (pakho bari) land where only one percent (only one household) people had 20 to 50 ropanies land and only one household including 12 percent people had more than 50 ropanies agricultural land.

According to the field survey, all systems are installed in high land areas i.e. all study areas are situated in high land areas. Thus the settlement areas are in upper level where water source is found below the settlement area.

CHAPTER FIVE

Scheme Details

5.1 An Overview of the Implementation Agency

Shree Mohariya Self-Help Group is a non profit making and non governmental community based social organization registered in 2001 by the initiative of the group of Benighat VDC of Dhading district. Its function is always as a coordinator in developmental task where literate and illiterate, professional and non professional, male and female are associated. At present, LSMSHG is operating its activities mainly on two VDCs of this district.

The main focus of LSMSHG is to strengthen the capacity of deprived communities and group of people to meet their basic needs through the sustainable development or sustainable intervention. Basically, rural drinking water, non formal education, income generating activities, consumer surplus, micro credit programs, community awareness activities are the main focused working areas of LSMSHG. It has been involving in such activities since its establishment in Benighat district.

LSMSHG is working with INGOs, NGOs, GOs or other social organizations but mainly with santi Griha, AEPC and Focus Nepal. The main office of LSMSHG is located to Malekhu, the main high way (Prithvi High way) Dhading.

5.2 Water Supply Scenario in Benighat VDC by SWP System

There are altogether seven completed drinking water supply schemes by solar system namely Irang SWP, Janagaun SWP, Mohariya SWP, Warbang SWP, Dumre SWP, Kotgaun SWP and Saichhap SWP system. These systems altogether give benefit to the population of 1405 (233 Hhs). These systems give the piped water supply of the natural spring using by solar PV pumps. Table 5.2 shows the drinking water supply coverage and agencies involved in these processes and lay out of SWP system with single stage and double stages also given in figure 5.2.1 and 5.2.2. The remaining population of this VDC depends on the other sources such as Khola or Kuwa of traditional types which are far away from their settlement areas.

Table 5.2 Drinking Water Supply Coverage by Solar PV Pumps and Agencies Involved:

Scheme Name	Ward No.	Design Hhs.	Benefit Hhs.	Benefit Pop^n.	Construction Time	Financing Agency	Implement by
Irang	5	50	25	196	2003/04	Santi Griha & AEPC	Solar Electricity Pvt. Ltd.
Mohariya	4	155	56	344	2003/04	Santi Griha	Solar Electricity Pvt. Ltd.
Janagaun	6	61	55	344	2003/04	Santi Griha	Solar Electricity Pvt. Ltd.
Warbang	9	37	33	185	Nov- 2004	Santi Griha	Solar Electricity Pvt. Ltd.
Dumre	3	14	14	96	Dec-2004	Santi Griha	Solar Electricity Pvt. Ltd.
Kotgaun	3	26	26	155	Sept-2005	Santi Griha	Solar Electricity Pvt. Ltd.
Saichhap	4	24	24	130	May-2006	Santi Griha	Solar Electricity Pvt. Ltd.

Source: Field Survey, 2006

5.3 Description of Individual Cases

Prior to entering into detailed analysis and comparision of the seven cases, a short description of individual cases is given below.

Case I	Irang Solar Water Pumping System
Case II	Mohariya Solar Water Pumping System
Case III	Janagaun Solar Water Pumping System
Case IV	Warbang Solar water Pumping System
Case V	Dumre Solar Water Pumping System
Case VI	Kotgaun Solar Water pumping System
Case VII	Saichhap Solar Water Pumping System

This study focuses on small (less than 300 Hhs) solar water pumping schemes in rural hills of Nepal. The schemes are using PV pumping type i.e. the action of solar energy is utilized to move water to uphill from a natural spring water source. In the process of each system installation, required solar modules were installed on support structure where submergible solar pumps are used to pump water from intake to service tank. Then to supply the water from intake to reserve or service tank High Density Polythene Pipe (25 mm diameter) is used in all systems. The pipeline from intake to reserve tank is called transmission line. From the reserve tank, then water is collected to service or distributed tank and then distributed to several tap stands that are scattered through out the village via the distribution line.

5.3.1 Case I: Irang Solar Water Pumping System

Irang SWP system (2 stages) was installed with the help of Santi Griha for first stage and AEPC for second stage at 2003/04. This system was installed by Solar Electricity Co. P. Ltd. with the coordination of LSMSHG and local water consumer committee. The system has been installed for two years and operation and management is being looked after by local water consumer committee with a peon who gets Rs.700/- per month. For this purpose, villagers are engaging in consumer surplus program and every household collects Rs.55/- per month. They can use remaining money except peon salary as a micro credit medium. In this drinking water system, natural spring water from 'Pahiropani Mul' is used which has two intake tanks, one reserve tank and two submergible solar pumps. For this purpose service cable is used about 50 meters and the length of pipe is 400 meters from intake to reserve tank. Water is distributed to 196 beneficiaries through various service delivery points. The water available (500ltr/day) meets the demand of safe quality when average sunshine duration is 5hrs/day.

The system had faced the problem of motor pump, twice time till now where site technician Kumar Pandey had repaired for once but at the time of field survey there was a problem seen on the second stage motor pump and perhaves the pump might be changed.

5.3.2 Case II: Mohariya SWP System

Mohariya SWP system (single stage) was installed by Solar Electricity Co. P. Ltd. with the help of Santi Griha and coordinating by LSMSHG as well as local water consumer committee. In this system, natural spring water is used from 'Dharapani Mul' which has one intake, a reserve tank and one submergible solar pump with required PV modules. For this purpose, service cable is used about 80 meters from PV modules to intake and length of pipe from intake to reserve tank is 380 meters. Water is distributed to 299 beneficiaries through various service delivery points. The water available (6250ltr/day) meets the demand of safe drinking water when average sun shine duration is 5hrs/ day.

Now, the system has been installed for two years where operating and management is being looked by consumers with a peon. Every household collects Rs.60/- per month to repair any parts of the system and peon gets Rs.700/- per month and rest money can use by villagers themselves as a micro credit medium.

5.3.3 Case III: Janagaun SWP System

Janagaun SWP system (2 stages) was installed by Solar Electricity Co. P. Ltd. with the help of Santi Griha by co-ordinating LSMSHG and consumer committee at 2003/04. In this system, natural spring water from 'Tauwakhani Mul' is used which was going to dry out due to the then long dry season at the field survey time. So water quantity in this system is very low and usually motor pumps were closed (switched off).

The system has one intake, a reserve tank, two submergible solar pumps and required modules. For this purpose total length of pipe is used 350 meters from intake to reserve tank. Water is distributed to 344 beneficiaries through various service delivery points where water availability (5000ltr/day) meets the demands of safe drinking water when average sun shine duration is 5hrs/day. The system has been installed for two years old and operating and management is being looked by consumers with a peon. For the salary of peon and further maintenance or to repair the parts of the system, every household collects Rs.20/- per month and peon gets Rs.700/- per month and rest money can use them as a micro credit medium.

At the field survey time, there was a problem seen in one motor pump due to the low water quantity and site technician was visited to repair the motor pump.

5.3.4 Case IV: Warbang SWP System

Warbang SWP system (single stage) was installed by Solar Electricity Co. P. Ltd. with the help of Santi Griha by coordinating LSMSHG with local users at November, 2004. In this system, natural spring water is used from 'Baredi Mul' but at the field survey time the source was going to dry out due to the then long dry season. So, the water quantity was very low and usually motor pump was closed (switched off).

The system has one intake, one reserve tank, one submergible solar pump and required modules where water is distributed through various service delivery points to about 185 beneficiaries when average sun shine duration is 5hrs/day. The system has been installed for two years where operating and management is being looked by local users with a peon. The peon gets Rs.700/- per month by consumer surplus fund where every household collects Rs.25/- per month and rest money can be used by consumers as a micro credit medium.

5.3.5 Case V: Dumre SWP System

Dumre SWP system (single stage) was installed by Solar Electricity Co. P. Ltd. with the help of Santi Griha by co-ordinating LSMSHG and local users at December, 2004 at the total cost of Rs.10.9 Lakhs and villager's payment (Rs.150/hh) where natural spring water source is used. The system has one intake, a reserve tank, a submergible solar pump and required PV modules where 55 meters service cable is used from modules to intake and about 60 meters pipe is used from intake to reserve tank and 346 meters pipe is used from service tank to distribution point. The water is distributed to 96 beneficiaries through two service delivery points where one point for every seven households. Daily water requirement (2800ltr/day) is able to fulfill the demands of villagers with safe quality when average sun shine duration is 5hrs/day.

The system has been installed for two years and operating and management is being looked after by local water user committee with one peon. For the salary to give peon, every household collects Rs.60/- per month and peon gets Rs.700/- per month by consumer surplus program and money can be utilized by villagers as a micro credit medium.

5.3.6 Case VI: Kotgaun SWP System

Kotgaun SWP system was installed by Solar Electricity Co. P. Ltd. with the help of Santi Griha and coordinated by LSMSHG and local users at September, 2005 where natural spring water source is used from 'Bageshwari Mul'. It has one intake, a reserve tank, two submergible solar pumps and required PV modules and 45 meters service cable is used from modules to intake and 250 meters pipe is used from intake to reserve tank. Water is distributed to 155 beneficiaries through various delivery points and required water (5200ltr/day) meets the demands of safe drinking water when average sun shine is 5hrs/day. It has been installed for one year and operating and management is being looked by local water user committee. Every household collects Rs.40/- per month in consumer surplus fund and they use that fund to repair the system when necessary and the fund is also used by grass-root level's people of water user group as a micro credit medium.

5.3.7 Case VII: Saichhap SWP System

Saichhap SWP system was installed by Solar Electricity Co. Pvt. Ltd. with the help of Santi Griha and coordinated by LSMSHG and local users at May, 2006 where natural spring from 'Gomati Mul' is used. In this system, it has one intake, a reserve tank, one submergible solar pump and required modules and 350 meters pipe is used from intake to reserve tank. Water is distributed to 130 beneficiaries through various service delivery points. The water availability (4500ltr/day) fulfills the demand of safe drinking water when average sun shine duration is 5hrs/day.

The system has been installed for six months and operating and management is being looked by local user group with one peon. For this purpose, every household collects Rs.40/- per month in consumer surplus fund and out of surplus fund peon gets Rs.700/- per month and remaining money can be used by the villagers as a micro credit medium.

Generally, in the cloudy day, the system is hardly able to fulfill their demand. When water flow is very low due to the cloud or low amount of spring water, there may be a problem created in the meter box or controller box as well as in pumps, at that condition meter box is closed by peon or other people who is trained. Thus, sometimes the site technician visits to every system to check the all parts of system. By this process there is low chance to occur the problem.

5.4 Components of SWP System

To install these seven SWP system, Santi Griha had provided total fund but in Irang, AEPC had also provided the fund. Santi Griha had provided fund to the installer company then Electricity Co. P. Ltd. was responsible to install the system with all of the risks. The total amount was broken into small to collect and construct various required materials such as pump cost, PV module cost, cable accessories and pipe cost, PVC overhead tank construction cost, transportation cost, installation and commissioning cost, etc. In these altogether systems, all of civil construction was built under the supervision of SEC team (engineer, overseer and technicians). In this process Local Shree Mohariya Self-Help Group had coordinated with local villagers before the dispatch of necessary goods to the site from the Highway. To install the SWP system of 2 stage, 2 sets of 8 solar modules in the mounting structure, 5ft above the ground and 2 sets of solar pumps were used. Similarly, to install the single stage system, 2 sets 4 solar modules and one solar pump were used in required structure. List of required materials and components of SWP system of the study area is given in table 5.4.1.

Table 5.4.1 List of Material Supplied in the Study Area

SWP System	PV Modules (120 Watt)			Pump				Power Operation Box
	Origin	Model No.	Quantity	Type	Origin	Model No.	Quantity	
Irang	USA	Astropower AP 110	16	Submersible	S. Africa	Solar Star	2	2
Mohariya	USA	Astropower AP 110	8	Submersible	S. Africa	Solar Star	1	1
Janagaun	USA	Astropower AP 110	16	Submersible	Germany	Lorentz HR03	2	2
Warbang	USA	Astropower AP 110	16	Submersible			1	1
Dumre	USA	Astropower AP 110	8	Submersible	Germany	Dankoff ETA-HR 014H-600	1	1
Kotagaun	USA	Astropower AP 110	16	Submersible	Germany	Loerentz ETA-HR 04H-EP	2	2
Saichhap	USA	Astropower AP 110	8	Submersible		HR 04H	1	1

Source: (Solar Electricity P. Ltd.), Field Survey 2006

Table 5.4.2 Site Details of SWP System in the Study Area

SWP System	Daily Water Requirment	Capacity of Intake	Capacity of Reserve Tank	Service Cable	Net Head	Pu
Irang	5000 lit.	6 m^3	4 m^3	50 m	70m + 100m	
Mohariya	6250 lit.	8 m^3	6 m^3	80 m	180m	
Janagaun	5000 lit.	6 m^3	6 m^3		225m	
Warbang	4000 lit.	7 m^3	4 m^3	50 m	145m	
Dumre	2800 lit.	6 m^3	4 m^3	55 m	47m-Gross head 65m	
Kotagaun	5200 lit.	5 m^3	4 m^3	45 m	125m	
Saichhap	4500 lit.	5 m^3	4 m^3		145m	

Source: (Solar Electricity P. Ltd.) Field Survey, 2006

Table 5.4.3 Cost and Time investment Condition of SWP System in the Study Area

SWP System	Total Cost	PV Per Module Cost	Pump Cost	Installation Period	Hhs' Payment
Irang	Rs.12 lakhs	Rs.55,000	Rs.1,75,000	3 Weeks	Free Labour
Mohariya	Rs.14 lakhs	Rs.55,000	Rs.1,75,000	1 Week	Free Labour
Janagaun	Rs.19 lakhs	Rs.55,000	Rs.1,75,000	1 Week	Free Labour
Warbang	Rs.27 lakhs	Rs.55,000	Rs.1,75,000	17 Weeks	Free Labour, Rs.1200/hh
Dumre	Rs.10.9 lakhs	Rs.55,000	Rs.1,75,000	12 Weeks	Free Labour, Rs.150/hh
Kotagaun	Rs.9 lakhs	Rs.55,000	Rs.1,75,000	1 Week	Free Labour
Saichhap	Rs.11 lakhs	Rs.55,000	Rs.1,75,000	1 Week	Free Labour

Source: (Solar Electricity P. Ltd.) Field Survey, 2006

5.5 End Use of Water from SWPS and User's Experience

Altogether SWPS were installed to provide safe drinking water for those people living in high land areas and no any alternative source of drinking water nearby their settlement areas. Thus the SWPS are installed for the purpose of safe drinking water or domestic use. Specially, the people of the sites have used the water for kitchen purposes and end use for domestic animal and kitchen garden.

All the systems were installed for drinking purposes in seven sites working smoothly. The experience of the users regarding the performance of SWPS in these sites is presented in table 5.5.

Table 5.5 User's Experience with the Performance of SWPS

Sites	Satisfied/Unsatisfied	Remarks
Irang	Satsfied but not fully	The users wanted more supply of water (second stage was damaged)
Mohariya	Satisfied	Working smoothly
Warbang	Unsatisfied	No working smoothly (natural water was dried due to the long dry season)
Janagaun	Satisfied but not fully	The users wanted more supply of water (water source is going to dry out)
Dumre	Satisfied	Working smoothly
Kotgaun	Satisfied	Working smoothly
Saichhap	Satisfied	Working smoothly

Source: Field Survey, 2006

The users of four sites Mohariya, Dumre, Kotgaun and Saichhap reported that they are satisfied from the SWPS because they have got sufficient water for their all domestic purposes and altogether users are benefited. But the users of other remaining sites Irang, Warbang, and Janagaun reported that they have not fully satisfied since the low water discharge by the pumps which is insufficient as per their need. In the case of Warbang, the natural water source 'Baredi Mul' was dried out since March, 2006 due to the long dry season and then the people had to go long distance for drinking water. The solar system of those sites is useless due to the lack of water source.

Effectiveness of the SWPS depends upon various factors such as water resources, climate and good institutional or technical support. If water quantity is very low and system is opened the solar pump or inverter might be damaged.

5.6 Problems of Benefit Sharing Process

Today, SWPS is going to popular in the context of rural areas. Though it faces some problems such as high initial cost and low output in bad weather, provides safe drinking water without required any fuel. It needs some repair and maintenance costs in some cases; for example: pump and cables may damage due to the natural disasters or human errors.

Since the installation of SWPS, people of 4 sites Mohariya, Dumre, Kotgaun and Saichhap have got sufficient water for their domestic purpose as well as kitchen garden. Till now, those systems have not faced any kind of problems except Saichhap. In the context of Saichhap site, the pump was damaged but the site technician repaired the pump. Then the system has worked smoothly. The users are satisfied and they have a consumer surplus fund for the require maintenance of the systems.

In Irang there is double stage type of SWPS where first stage was installed in the water source site and water was collected in second intake where second stage was installed. People of Irang reported that they are not fully satisfied. At the survey period, pump of second stage of the system was damaged and site technician was also not able to repair the pump. People of that site had to go to the second intake to fetch the water.

People of Janagaun reported that due to the long dryness the source of water was going to dry out and they were suffering from insufficient water for their daily uses. They had needed to spend extra time to collect water but the system of that site was normal with discharging low water quantity for the beneficiaries.

Similarly, people of Warbang reported that the source of water 'Baredi Mul' was dried out due to the long dryness in rainy season and SWPS was going to useless. Then, altogether people of that site had to spend more time to collect water. There is a problem created to find out the alternative source of water.

The major problems found from the field visit are as follows;

- In the local market parts of SWPS are not available.

- At the local level, due to lack of manpower, repairing of the parts of the system may not be solved and sometimes site technician of the installer company has to go to observe the site.

- Once, in the saichhap, due to the running of the pumps without water, the inverter systems were badly affected.

- Due to lack of awareness and the proper training, the local users have no idea to repair and maintenance of the systems.

- In Mohariya, a problem occurred in the pump and they had to change the pump with the help of Installer Company.

5.7 Operation and Maintenance

Case I: Irang

SWPS of Irang was installed by SEC Pvt. Ltd. and funded by Santi Griha and AEPC at 2003/04. Local Shree Mohariya Self Help Group and local users activated as the coordinator with altogether responsibility. After the system installation, operating and maintenance is being looked by local users. They have organized a water user committee with a peon for the system operating. To activate the peon, they have a fund of Consumer Surplus. Every household collects Rs.55/- per month. In some cases, they can use the fund in repair the parts of the system as well as domestic purposes i.e. live stocking. The monthly salary of the peon is Rs.700/- per month.

If any problem is creating in this site, the local NGO (LSMSHG) helps to solve the problem and they consult with the installer company.

Case II: Mohariya

SWPS of Mohariya was installed by SEC Pvt. Ltd. and funded by Santi Griha at 2003/04. LSMSHG and local users activated with altogether responsibility at the installation period. Till now, operating and maintenance is being looked by the local users. They have organized a water user committee with a peon for the system operating. To fulfill the system repair cost and salary for the peon, they have a fund of Consumer Surplus. Every household collects Rs.60/- per month and peon gets Rs.700/- per month. If any problem is occurred in this site, the peon should consult with the site technician. If the problem is complex, site technician consults with the installer company. Otherwise, the site technician observes and solves the problem.

Case III: Janagaun

SWPS of Janagaun was installed by SEC Pvt. Ltd. and funded by Santi Griha at 2003/04. LSMSHG and local users activated with altogether responsibility at the installation period. Till now, operating and maintenance is being looked by the local users. They have organized a water user committee with a peon for the system operating. To fulfill the system repair cost and salary for the peon, they have a fund of Consumer Surplus. Every household collects Rs.20/- per month and peon gets Rs. 700/- per month. If any problem is occurred in this site, the peon should consult with the site technician. If the problem is complex, site technician consults with the installer company. Otherwise, the site technician observes and solves the problem.

Case IV: Warbang

SWPS of Warbang was installed by SEC Pvt. Ltd. and funded by Santi Griha at Nov-2004. LSMSHG and local users activated with altogether responsibility at the installation period. Till now, operating and maintenance is being looked by the local users. They have organized a water user committee with a peon for the system operating. To fulfill the system repair cost and salary for the peon, they have a fund of Consumer Surplus. Every household collects Rs.25/- per month and peon gets Rs.700/- per month. If any problem is occurred in this site, the peon should consult with the site technician. If the problem is complex, site technician consults with the installer company. Otherwise, the site technician observes and solves the problem.

Case V: Dumre

SWPS of Dumre was installed by SEC Pvt. Ltd. and funded by Santi Griha at December, 2004. LSMSHG and local users activated with altogether responsibility at the installation period. Till now, operating and maintenance is being looked by the local users. They have organized a water user committee with a peon for the system operating. To fulfill the system repair cost and salary for the peon, they have a fund of Consumer Surplus. Every household collects Rs.60/- per month and peon gets Rs.700/- per month. If any problem is occurred in this site, the peon should consult with the site technician. If the problem is complex, site technician consults with the installer company. Otherwise, the site technician observes and solves the problem.

Case VI: Kotgaun

SWPS of Kotgaun was installed by SEC Pvt. Ltd. and funded by Santi Griha at September, 2004. LSMSHG and local users activated with altogether responsibility at the installation period. Till now, operating and maintenance is being looked by the local users. They have organized a water user committee with a peon for the system operating. To fulfill the system repair cost and salary for the peon, they have a fund of Consumer Surplus. Every household collects Rs.40/- per month and peon gets Rs.700/- per month. If any problem is occurred in this site, the peon should consult with the site technician. If the problem is complex, site technician consults with the installer company. Otherwise, the site technician observes and solves the problem.

Case VII: Saichhap

SWPS of Saichhap was installed by SEC Pvt. Ltd. and funded by Santi Griha at May, 2006. LSMSHG and local users activated with altogether responsibility at the installation period. Till now, operating and maintenance is being looked by the local users. They have organized a water user committee with a peon for the system operating. To fulfill the system repair cost and salary for the peon, they have a fund of Consumer Surplus. Every household collects Rs.40/- per month and peon gets Rs.700/- per month. If any problem is occurred in this site, the peon should consult with the site technician. If the problem is complex, site technician consults with the installer company. Otherwise, the site technician observes and solves the problem.

5.8 Findings of Focus Group Discussion

To find out the acquire information; focus group discussions with the users of SWPS in altogether systems were conducted. The outcome is presented as below:

- The users got information about the SWPS from different resources such as; the organizer (local NGO) and manufacturers. The systems are installed as an experimental project at many places i.e. SEC, AEPC, Focus Nepal and so on were the various institutions or NGOs involved in it.

- The users reported positive way about the advantages of SWPS. In general, women and children were happy because SWPS has played the positive role to decrease the time consumption and they can spend their leisure time in other field such as; schooling, reading, and child care as well as live stock rearing and farming. Sometimes they sell their green vegetables of kitchen garden in the market and buy basic requirements such as; salts, oil, stationary for children and so on.

- The users are satisfied with the system and getting more benefit to pay small amount (Rs.20-60) per month.

- The users feel that, the system is useful for their better lifestyle, health and sanitation, social well being, etc. After the system installation, they also started to make permanent toilet for their sanitation and also make 'Gobar Gas' plant for cooking and lighting.

- The sites of Janagaun, Kotgaun and Dumre have not faced any problem till the installation date and operating or working smoothly.

- The sites of Saichhap and Mohariya have faced the problems of pumps at once a time till the installation date but after the required repairement have worked smoothly.

- Irang site has a major problem seen in the second stage system and the users wanted to replace the single stage for the better performance of the system.

- Warbang SWPS had no any problem at the field survey period and the system was closed due to the water scarcity. The spring water resource from 'Bardi Mul' was used by the system but that source was totally dried due to the long dry season. Now, the users consult with the Focus Nepal to install the system with using alternative water resource.

In conclusion, all the sites are located in highland area and most of the users are living in grass root level. Before the system installation they used to spend more time in water collection but after the system installation, the system able to reduce the time consumption for water collection. They use their leisure time in other field which helps to raise their life style.

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