LOCAL ASPECTS OF RENEWABLE ENERGY DEVELOPMENT IN NEPAL: A CASE OF MICRO HYDRO POWER PROJECTS

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A Dissertation

Submitted to

School of Education

in partial fulfillment of the requirements for the degree of

Master of Education in Environment Education and Sustainable Development

Kathmandu University

Dhulikhel, Nepal

January, 2014

DEDICATION

I dedicate this work to my parents and my brother for their moral support and bottomless inspiration during my graduate program.

This dissertation of *Master of Education in Environment Education and Sustainable Development* entitled "Local Aspects of Renewable Energy Development in Nepal: A Case of Micro Hydro Power Projects" by *Sajani Kandel* presented on 12 January 2014.

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ABSTRACT

For the degree of *Master of Education in Environment Education and Sustainable Development* presented on 12 January 2014 entitled Local Aspects of Renewable Energy Development in Nepal: A Case of Micro Hydro Power Projects

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Charles Pradhan

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With wide spread implementation of renewable energy technologies micro hydropower plants have become an important source of renewable energy for the rural poor. Its importance in terms of environmental, technical and economical aspect is well admired by local community with few exceptions, neglecting social component of electrification. On this basis the study focuses on people's perception regarding renewable energy (focus on micro hydro), their involvement in development of MHP and changes fostered in livelihood of local people due to access to electricity. Furthermore, it also explores how delinquencies in managerial and technical aspect can affect so called wide spread development of renewable energy technologies.

The study aligns to pragmatic paradigm using both quantitative and qualitative methods and is confined to micro hydro power users only. For quantitative method the study used questionnaire survey whereas for qualitative method Key Informant Interview (KII) and Focus Group Discussion (FGD) were used.

The study reports that electricity from micro hydropower plants can foster changes in habits of the residents that lead to stronger livelihoods. The ability to turn on a light bulb in the evening has important implications as they can reduce consumption of kerosene, have more hours of light in the evening and spend more

hours studying. By powering light machinery, electricity has been able to reduce drudgery for women and has allowed women to rest longer. Electricity introduced technologies, like mills, computers have been able to influence small changes in the daily lives of the rural poor people but these factors were found to be highly depended upon ownership, managerial and technical details as no proper involvement of local people has constrained strengthening capacity of micro hydro power projects and its impacts on community. Furthermore, constructing a piece of technology and handing it over without giving proper guidance and putting a place for feedback system has constrained expansion of micro hydro. The limited efforts of government and supporting donor's accountability towards the rural poor have compelled them to accept what they are given. So development planners, donors and the government, with attempts like handing over decision making to the beneficiaries themselves need to have efficient and effective system that follows up or else it would give unsustainable projects.

Keywords: Renewable Technologies, Micro hydro, Perception, Local involvement, Livelihood, Education

_____ 12 January 2014

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ACKNOWLEDGEMENTS

This research was funded by the NOMA program of Kathmandu University, School of Education, so I will like to express my sincere gratitude to this program and respected Dean of the school, Prof. Dr. Tanka Nath Sharma for giving me opportunity to study this course.

I wish to express my special appreciation to Mr. Charles Pradhan, my dissertation supervisor, for his guidance, inspiration, care and support to complete the research work. I also offer many thanks to committee members Prof. Dr. Mahesh Nath Parajuli and Assoc. Prof. Dr. Bal Chandra Luitel, program coordinator at School of Education (KUSOED) for inspiring me and guiding me through the research process, and providing insightful comments and feedback. The successful completion of this dissertation would not have turned into reality without the contribution of Asst. Prof. Parbat Dhungana who always held my hand and helped me whenever I needed. I also thank Mr. Binod Panta for his guidance in my study design, mathematical calculations in SPSS and for helping with the literature review. I also like to extend my veneration towards other faculties and staff members.

Similarly, this research would not have been possible without my friends Rupa Rai and Ramesh Pandey, who accompanied me during field research and trekked for hours to help me collect this data. Also, thank goes to Energy Environment officer of Tanahun Er. Prakash Bhandari for insightful feedbacks, Rural Empowerment Society Damauli Tanahun Nepal (RESDTN) for logistic support needed during field visit. My appreciation and love to my brother Sujan Kandel for his meticulous editing and insightful feedback. Naturally, thanks to all the participants and interviewees who graciously offered to speak with me despite their busy schedules.

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ACRONYMS

ACAP	Annapurna Conservation Area Project
AEPC	Alternative Energy Promotion Sector
CBS	Central Bureau of Statistics
DANIDA	Danish International Development Agency
DDC	District Development Committee
DEES	District Energy Environment Section
DEMI	District Energy Management Initiative
DESR	District Energy Situation Report
DoED	Department of Electricity Development
DFID	Department for International Development
EEO	Energy and Environment Officer
ESAP	Energy Sector Assistance Program
GDP	Gross Domestic Product
GoN	Government of Nepal
ICS	Improved Cooking Stoves
IEA	International Energy Agency
INGOs	International nongovernmental Organizations
MHP	Micro Hydro Power
MoEn	Ministry of Environment

MoF	Ministry of Finance
MoFSC	Ministry of Forest and Soil Conservation
MoH	Ministry of Housing
MosTE	Ministry of Science, Technology and Environment
NEA	Nepal Electricity Authority
NGOs	National Governmental Organizations
NORAD	Norwegian Agency for Development Cooperation
NOMA	Norad's Programme for Master Studies
NRREP	National Rural and Renewable Energy Programme
PEEDA	People Energy and Environment Development Association
RE	Rural (Renewable) Energy
REDP	Regional Equality and Diversity Partnership
RERL	Renewable Energy for Rural Livelihood
RESDTN	Rural Empowerment Society Damauli Tanahun Nepal
REN	Rural Energy Network
REN21	Renewable Energy Policy Network for the 21st Century
REP	Renewable Energy Project
RETs	Renewable Energy Technologies
RESC	Rural Energy Service Centre
SHS	Solar Home System
SPSS	Statistical Package for the Social Sciences

UNEP	United Nations Environment Programme
VDC	Village Development Committee
WECS	Water and Energy Commission Secretariat
WECD	World Commission on Environment and Development
WWF	World wildlife Fund

CHAPTER I

INTRODUCTION

Chapter Overview

This chapter sets the premise of the research. It elaborates the statement of the problem, justifies the rationale, and sets delimitations of the study.

Background

The availability of adequate energy resources at an affordable cost is a vital precondition for continued economic progress of any country as energy is fundamental requirement for quality of life. Adequate and consistent development of usable energy sources is one of the prerequisites for social and economic development of a country. Generally in Nepal, the notion of providing energy even to meet basic needs has been a big challenge mainly because of poor infrastructural development and lack of fund for investment in the energy generation and management (NRC, 2008). Therefore, Nepal has one of the lowest per capita energy consumption in the world and energy resources utilized mostly come from firewood. Total energy consumption in the year 2008/09 was about 9.3 million tonnes of oil(401 million GJ) in the country out of which 87% was derived from traditional resources, 12% from commercial sources and less than 1% from the alternative sources (WECS, 2010). Unlike other nations around the globe, Nepal's major share of energy consumption is for residential area rather than transportation (ibid). Though well-endowed with abundant biomass and hydropower potential, no efforts to provide efficient energy system and less effort to replace such consumption have severely affected energy use. In addition, erratic use of petroleum fuel and government being unable to provide it at

the sufficient basis has increased gap between demand and supply (Pradhan & Pradhan, 2006).

Energy consumption is increasing year by year. The country in FY 2010/11 has increase to 2.8% over its previous fiscal year (GoN/MoF, 2012). In the case of rural areas there has also been pressure on the forests, due to the lack of alternative sources of energy. Therefore, renewable energy has become high priority sector of the government with the goal of increasing the share of renewable from less than 1% to 10% of the total energy supply, and to increase the access to electricity from alternative energy sources from 10% to 30% within the next 20 years (WECS, 2010). Complementing these goals, the government plans to invest USD 1,076 million in renewable energy by 2020, which will include support for hydropower, solar PV and biogas technologies (MoEn, 2011). So, far these goals were mainly driven by climate change mitigation, but recently they are also driven by energy diversification, and the reduction of fossil fuel imports. In addition, other drivers like economic growth aspects such as job creation and mitigation of local pollution has also been recognized.

Statement of the Problem

The majority of the studies conducted concerning renewable energy systems for rural areas are focused on environment, technical and economic aspects. Most of the research carried out in this field neglect the social component of electrification projects and the household level as a relevant investigation level in understanding development processes (Carvajal, 2008, p. 10). Though public acceptance has been recognized as an important issue shaping the widespread implementation of renewable energy technologies and the achievement of energy policy targets (Wright, 2008), very few studies have focused on the public acceptance and have narrow turn

on national level (UNEP, 2007). In case of Nepal too there has not been any research which has been done solely to understand local community perceptions of renewable energy management. In addition, it has also ignored the fact that RETs particularly micro hydro will be successful in giving its environmental benefits, capacity development, reduced community drudgery and improved opportunities for education if there is proper community involvement with the local residents feeling a high degree of ownership towards the project (Upadhayay, 2009).

Therefore it has been necessary to find out why more often the user groups do not receive as much attention as they deserve? Is this because of policy delinquent, management delinquent, financial conflicts or it is because of insensitiveness in designing policies addressing local aspects that are very important in expansion of renewable energy? In addition, the factors that influence this public perception still need to be prioritized. Issues of trust, benefit, ownership and financial framework of a project implicate the degree to which local people are directly involved in the setting up of the projects (Wright, 2008). So it been high time, more research is needed in order to gather a clearer and more sensitive understanding of public attitudes and the ways they are formed and developed. As Kahn (2001) observed, there is a need to study renewable energy stating from different scientific disciplines and theoretical perspectives, in order to develop a more structured understanding about what characterizes renewable energy citing conflicts (p. 28). Therefore, public belief of renewable energy in Nepal, particularly focusing on Micro Hydro Plants (MHP) in terms of perception, involvement and changes in livelihood is the major concern of my study.

Purpose of the Study

The major purpose of the study is to investigate the people's perception of MHP in terms of its usage, their involvement in MHP activities; support/services provided by institutions involved in RETs sector and fostered changes in their livelihood.

Research Questions

This study seeks to answer the following research questions:

1. What is the perception of local people about RETs?
2. How is the public participation in terms of ownership, benefits and management of MHP?
3. What are the changes perceived by local people on education, economy and community development after connection with MHP?

Rationale of the Study

Past efforts have identified that development of the new energy systems entails many uncertainties (Shrestha, 1997). Successful implantation of RETs requires abundance of resources to support, with strong national programs and comprehensive assessment of the potential economic, employment, and cost reduction benefits associated with different forms of local technology manufacturing, as well as a detailed assessment of existing domestic capabilities in the renewable sector with set of policy tools to implement that strategy (Lewis & Wiser, 2005). Therefore research aims to explore people's perception of RETs, their involvement and the changes perceived in livelihood. Thus it will help to gain more insights on social component of MHP in Nepal, as it plays important role in analyzing existing gaps in goals and objectives of these projects with respect to the community (Sinclair, 2003). Furthermore, the research will also be helpful to the new researchers in the area to help generate their study objectives. It will equally significant to government,

development planners and policy makers who are directly or indirectly related to successful implementation of RETS.

Organization of the Study

The study is divided into five chapters. Chapter I covers the introduction, statement of the problem, rationale of the study, purpose of the study, organization and delimitations of the study. Chapter II reviews literature for the study. Chapter III presents methodology applied in the study. The methodology includes the philosophical orientation, philosophical consideration, research method, study area, instrumentation, data source, sample size, data collection procedure, quality standard and methods of data analysis. Chapter IV presents data from the study. Finally, Chapter V presents key findings, discussion, conclusion and implication of the study.

Delimitations of the Study

Among different RETs, this study has focused on Micro hydro Plants only. Furthermore, delimiting my study concern, perception was dealt in terms of understanding of RETs, role of different institution in development of RETs, satisfaction and willingness to pay. Change felt by people by MHP was dealt in terms of RETs contribution to education, local economy and community development. The findings of the study that are collected through the questionnaire following interview can just have analytical generalization (Cohen, Manion, & Morrison, 2007).

Chapter Summary

Background of the study along with the experiences and interest directed the research to highlighting the major concern about local people's perception towards micro hydro plants of Nepal. This chapter introduced statement of the problem, setting research questions to simplify the problem followed by rationale of the study. Delimitations of the research made it easy to create outline and working area of the issues.

CHAPTER II

THEORETICAL BACKGROUND AND LITERATURE REVIEW

Chapter Overview

It requires a clear understanding of the role of energy in the development process and how these policies can function as the mechanism for rural electrification. This chapter provides an overview of these topics and begins by introducing energy scenario of Nepal, renewable energy technology viability, its history, relevant policies and finally theoretical framework of Sustainable Livelihood. In addition this chapter also provides theoretical basis of the study and research gap.

Thematic Review

Thematic reviews of literature are organized around a topic or issue and allow us to look at the specific issues more closely and build relation among the respective concerns. On the basis of these themes research problems and questions can be justified.

Energy Scenario of Nepal

Energy is an essential element in our daily lives and is a system's capacity to produce external activity. Any interruption in its supply will cause major economic, social and political impact in any developed or developing society (Al-Baharna, 1987). Energy consumption is usually associated with the standard of living and high energy consumption generally means high quality of life. In context of Nepal rural sector is occupying an important place in the national economy, as high percentage of population, more than 83% live in rural areas (CBS, 2011). The overall performance of the country in the area of socio-economic development is largely influenced by the

development of the rural areas but the level of development of these areas as compared to that of the urban areas has lagged far behind even to this day. Furthermore Nepal is one of the least energy consuming countries in the world with the least per capita GDP (Basyal, 2008). Though the consumption of modern forms of energy has been growing rapidly during the past two decades, the non-commercial fuel still plays a dominant role in Nepal's energy scenario, as traditional energy covers major portion (WECS, 2010). According to the Water and Energy Commission Secretariat (WECS) use of primary energy sources is distributed as follows:

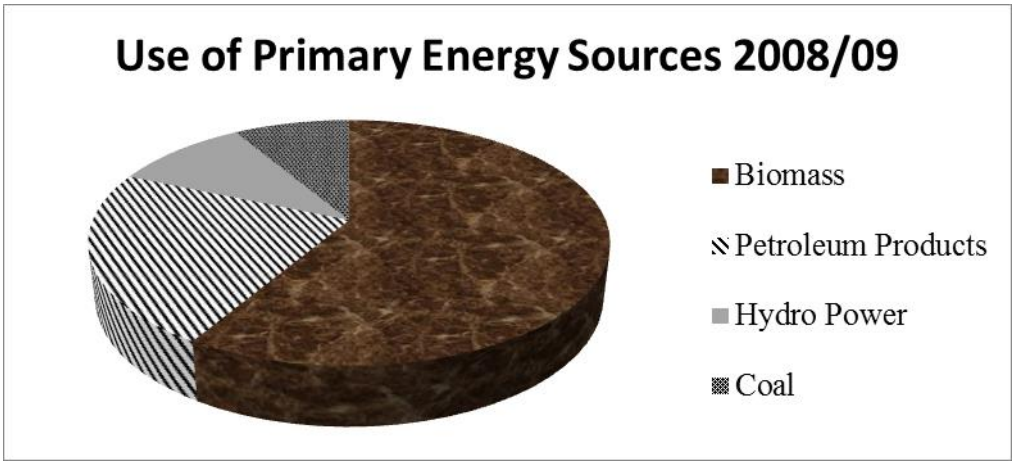


*Figure 1.*Type of use of primary energy sources (Source: WECS, 2010).

According to WECS (2010), new renewable energy sources (excluding large hydropower) such as biogas, micro hydro and solar energy contributed less than 1 % to the national balance in 2008/09 altogether but the share is still small. Furthermore it has increased by 40% since 2005 and between 2001 and 2009; the total energy consumption was growing at a rate of 2.4% per year in average (ibid).

Renewable Energy

Rural Energy policy 2006 defines "Rural Energy" as energy which is environment friendly and used for rural households, economic and social purpose such as Micro and Mini Hydro, Solar Energy, Wind Energy, Biomass Energy, etc. Rural energy is also known as renewable energy (p. 2). Rural energy/ Renewable

energy is obtained naturally from resources available freely in nature such as sunlight, wind, rain, tides and geothermal heat. These get replenished again naturally and continually. The most common types of renewable energy and the technologies that are used to extract the energy from the resources are:

Table 1

Different Types of RE

Renewable energy source	Technology/Application
Solar	Photovoltaic (PV) cells that produce electricity
	Solar thermal system that are used for heating water
Wind	Wind turbine: either single or multiple turbines that are used for producing electricity
	Conventional windmill to pump water
Water	Hydroelectric, wave and tidal systems that produce electrici
Biomass	Electricity or heat that is obtained from direct combustion of gas produced from biomass, or Biogas
Geothermal	Electricity or heat that is obtained from temperature of the earth

(Source*:* AEPC/REN21, 2011)

History of Renewable Energy Development in Nepal

The history of renewable energy is not so old and has increasingly received attention only after the Seventh Periodic Plan (1985 -1990). Since then, other periodic plans targeted policy measures for the development in renewable energy sector. After Eight periodic Plan (1992 - 1997), Alternative Energy Promotion Center was established as coordinating and executing body for the promotion of alternative energy technologies in Nepal. The Ninth Plan (1997 - 2002) then formulated long

term vision in the science and technology sector which has the fundamental goal of rural energy systems developed as to increase employment opportunity through gradual replacement of traditional energy with modern energy (Shrestha ,2010, p. 14). Renewable Energy Subsidy Policy and the Renewable Energy Subsidy Delivery Mechanism were formulated in 2000 to implement realized objectives that were set out in the plan. The Tenth Plan (2002 - 2007) gave priority to suitable and relatively smaller size systems and encouraged research on expansion of biogas systems in the Himalayan region and towards reducing the cost (Shrestha, 2010, p. 14). Soon after that government of Nepal with AEPC promulgated the Rural Energy Policy for the first time in 2006. After this policy came into existence technologies like Solar, MHP and other technologies were started to be linked with economic activities. By that time GoN approved a Renewable (Rural) Energy Subsidy, 2006 and the (Rural) Renewable Energy Subsidy Delivery Mechanism 2006 and was put forward to implement proper flow of subsidy.

In 2013 new subsidy policy and subsidy delivery mechanism; Rural Energy Policy 2013 and Rural Energy Subsidy Delivery Mechanism 2013 was approved and its implementation is awaited.

Renewable Energy Viability in Nepal

It is believed that interest in renewable energy was actually a response to energy shortages and price increase of the early and late 1970s especially for developing countries. But by mid-1990 international oil prices were back to level as low as they were in the late 1960s. In this context, it is instructive to reflect on why there is still interest in renewable energies to developing countries, and what is likely to be their future contribution (Hislop, 1991). Fast depleting forest and poor availability of commercial fuels have placed uphill people especially rural in a

situation where identification of development and adoption of sustainable alternate renewable energy sources and fuel saving devices have become a national priority (Prasad, 1998).

The energy problem in Nepal arises not from excessive reliance on non-renewable energy resources but rather form the fact that one from of energy(fuel wood) is being consumed at the unsustainable rate, while the vast potential of other forms of renewable energy remains unused (Rijal, 1986). Also Nepal being rich in water resources and the lack of fossil fuels, it is heavily dependent upon hydro-electricity for its energy requirements. Despite the documented capacity of water resources to produce more than 83,000 MW of hydro-electricity (WECS, 2008/09), Nepal has been facing severe energy shortage in the dry seasons over the past 7 years. Nepal's energy production has been highly insufficient to meet the demands. In addition, a decade long armed civil conflict caused damage to several power plants and left country with very little investment in this sector. Furthermore frequent natural hazards like flood has been seriously constraining energy system management in Nepal. The energy crisis has deepened every year as no proper and viable sources are identified at the national level. Therefore need of other alternative energy sources in large scale to uplift economy and crippling industries has become urgent.

Micro Hydro: One Form of Renewable Energy Technology

Micro hydropower is a form of renewable energy that relies on a fast flowing stream of water that is then channeled through a pipe or inlet into an electrical generator that turns and generates electricity (Shrestha, 2012). Micro hydro is a term used to describe electricity producing installations of up to 100kW (Chhetri, Pokharel, & Islam, 2009, p. 571). This technology falls into one of three categories: Peltric, Non-Peltric, and Improved Ghattas (Shrestha, 2012). AEPC has defined these three

categories in which Peltric sets are small, vertically-mounted units with impulse-type Turbines and induction-type generators, and usually produce less than 5kW (p.12) . Non-Peltric sets use Pelton or cross flow turbines and typically produces more than 5 kW and Improved Ghattas use a traditional water wheel but instead of wood, the wheel is steel (AEPC, 2005). This difference offers significant increase in productivity. Improved Ghattas are used exclusively for grinding and de-husking and do not produce electricity (AEPC, 2005).

Micro hydro projects are subsidy supported till now therefore are supported by different organization ranging national to international sector. Renewable Energy Subsidy Policy has place for Micro hydro, in which it has given Alternative Energy Promotion Centre (AEPC) a mandate for promoting Micro/Mini Hydro Projects upto 1 MW(Maskey & Kandel, 2013) . Hydropower Development Policy 2001, has given mandate of licensing hydropower projects above 100 kW to Department of Electricity Development (DoED) (ibid). Government of Nepal has launched National Rural and Renewable Energy Programme (NRREP) from Mid July 2012 to Mid July 2017, Renewable Energy for Rural Livelihood (RERL) is a programme of AEPC funded by UNDP and the World Bank. Different INGOs like WWF Nepal, ACAP, Winrock International, SNV etc. are also working in Nepal for the promotion of micro hydropower projects (Maskey & Kandel, 2013).

Role of Micro Hydro Plant on Improved Livelihood

Study done by AEPC to know "Impact of Mini grid electrification" identified increased business, employment opportunities and improved livelihood (AEPC,2011). In Nepal, women reportedly spend 12 hours on household chores but introduction of mills in village have prevented women to wake up early to grind the corn and have more time to rest (REDP, 2007, as cited in Bastakoti, p. 27). Availability of agro

processing mills, saw mills and grocery have saved time for various consumer goods available in the village. In addition, access of different communication technologies played vital role in bringing them more close and finally having positive impact on access to information.

Impacts on the Educational Outcomes

Children's living in mini grid electrified households has 2% points higher literacy rate (AEPC, 2011). The children were found to have an approximate 5 minutes more study time per day (ibid). These findings show that children had been diverting their time in household chores like grinding, water fetching but after MHP electrification children can read at night time using electricity resulting in positive impact on school attendance. In addition, improved education facilities could provide students to attain education that could enhance their capabilities for improved livelihoods (Chambers & Conway, 1992, p. 22). Furthermore, impact on school attendance and the schools ability to make use of electronic equipment like computer can enhance their teaching capabilities (Shrestha, 2012).

Role of Local People in Development of Community Based MHP

Micro hydro projects are called community based if they are owned and operated by local villagers. Burton and Holland (1983), point out that communities biggest motivation of involvement in MHP activities is the need to raise the quality of their children's lives. Micro hydro will be successful in giving its environmental benefits, capacity development, reduced community drudgery and improved opportunities for education if there is proper community involvement with the local residents feeling a high degree of ownership towards the project (Upadhayay, 2009). Though there are many literatures discussing about positives of community based MHP there are some which argue that community based plants are ideal in theory

only (Rijal, 2000). There exist gaps in goals and objectives of these projects with respect to the community (Sinclair, 2003). These gaps range from social to managerial problems.

Renewable Energy in National Energy Policies

Micro- hydro found its place in Rural Energy Policy, 2006 and Subsidy Policy for Renewable (Rural) Energy, 2009 of the Government of Nepal. Besides, there is a special delivery mechanism developed and under practice for micro hydro promotion.

Rural Energy Policy 2006

It presents the main guiding principles for the development of renewable energy including micro-hydro power systems (MHPS). Its stated objective is to encourage the development of rural energy or renewable energy including (off-grid) MHP developed by cooperatives or investors. It discusses institutional mechanisms which are to be created to promote the development of MHPS, including the creation of a Central Rural Energy Fund, a Rural Energy Central Coordination Committee and a mechanism to generate carbon emission credits for sale. It also encourages community based energy development initiative, social mobilization for dissemination and development of rural energy, focusing on linkage between energy and poverty and promotes private sector for the supply of RETs.

Rural (Renewable) Energy Subsidy Arrangement 2009

To make the Subsidy Arrangement, 2008 equitable, inclusive and effective, this Renewable (Rural) Energy Subsidy Arrangement, 2009 has been formulated. The main objective of subsidy arrangement is to maximize service delivery and increase service efficiency. It also supports rural electrification with an objective to reduce the growing gap between rural and urban areas. Another major role of this document is to make use of grant assistance in a more effective and objective way thereby attract

investors from national and international level in RETs sector. It also supports development and extension of RET market by attracting private sector entrepreneurs and supports long-term targets of GoN in providing rural electrification and energy services.

Institutional Arrangement of Energy Sector in Nepal

Three levels of institutional arrangement have been found in the RETs documents to implement policies and programmes i.e. National, Local (District and VDC) and Community level.

National Level

All kind of institutions have been identified at the national level of energy sector in Nepal. Central level support for the implementation of renewable energy is provided by Alternative Energy Promotion Center under different relevant ministries. In public institutions, several ministries have mandates affecting energy policy issues and the use of energy. These are the Ministry of Energy (MoE), the Ministry of Science, Technology and Environment, (MoSTE) and the Ministry of Industry, the Ministry of Forest and Soil Conservation (MoFSC) (plays a role in the biomass sector) and the Ministry of Housing (MoH) in the building sector. The Ministry of Commerce and Supplies is responsible for questions regarding the use of fossil fuels.

Alternative Energy Promotion Center (AEPC) established in 1996 which was formally attached to Ministry of Environment (now MoSTE) plays key role in promoting development and deployment of renewable energies and alternative energy technologies in Nepal (AEPC, 2014). Major activities of AEPC range from policy formulation to implementation of these policies at community level. For this, AEPC acts as intermediary between operating NGOs / private promoters of renewable energy and the policy decision levels in relevant ministries (AEPC, 2014). Central

Rural Fund was only formed after formation of subsidy policy. Delivery mechanism is responsible for the delivery of subsidies and financial assistance for off-grid rural electrification. In addition, regular monitoring, evaluation and quality control during the process of electrification projects is also one of main objective of AEPC. The major activities of AEPC are for rural area, for this purpose "District Energy and Environment Units" is currently operating in all 75 districts of Nepal. Moreover, it is supported by international cooperation projects. Some of them are Energy Sector Assistance Program (ESAP), mainly financed by DANIDA and NORAD, National Rural and Renewable Energy Programme (NRREP), Rural Electrification Development Programme (REDP) by UNDP and World Bank. NRREP, at present is supporting the government in implementing the Rural Energy Policy in all districts (AEPC, 2014). Furthermore, some small joint projects, focusing on community development through improved watermills and electrification, biogas and climate change adaption strategies are also ongoing.

Local Level (District and VDC)

District Energy and Environment Section (DEES) of the DDC operated in 75 districts were responsible for coordination, planning, local resource mobilization and day to day district operations (REDP, 2012). This included promoting collaboration among various partners and mobilizing support organizations (SOs), financial institutions, and the private sector in different VDCs of concerned district (ibid). Furthermore, DEESs were supported by District Energy and Environment Management Committees.

Community Level

Community mobilization is also considered as one of the important aspects of renewable energy implementation of GoN. The community mobilization functions

includes the dissemination of REDP information, helping communities develop action plans, accessing resources from various sources and monitoring local-level work and are performed by local non-governmental organizations (NGOs) selected on the basis of relevant project experience and experience with participatory development approaches(REDP, 2012). Private sector firms such as the Rural Energy Services Centre (RESC) provides technical support services to communities for feasibility studies and installation, operation and maintenance of RE systems (ibid).

Challenges in Energy Sector of Nepal

The energy policy of Nepal is characterized by certain drivers and challenges. With a need for dependable and reliable supply of energy and government being unable to supply has necessitated the adoption of cleaner fuels and cleaner technologies. But many obstacles exist in terms of expansion of renewable energy use, including inadequate institutional structure, the need for a comprehensive framework for energy service delivery to the poor, high upfront costs of alternative energy compared to traditional fuels, low purchasing power of rural people and lack of viable and sustainable RET financing mechanism, insufficient attention to productive uses that could pay for energy services, inadequate harmonized and collaborative efforts among the donors in national renewable energy programmes (Shrestha, 1997).

Theoretical Review

Theory like Sustainable Livelihood Framework is relevant for identifying and selecting renewable energy technologies for communities. In addition, sustaining these technologies is most important factor as it is directly related to life of local

people. Therefore theories like Sustainable Livelihood Framework and Sustainable Development will be guideline for the research work.

The Concept of Sustainable Development

The framework of sustainable development defines the parameters for an economic development approach in accordance with social and environmental needs (UNEP, 2007). The World Commission on Environment and Development published Brundtland Report in 1987 setting basics of the framework. This report defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WECD, 1987). The most applied notion of sustainability is the triple-bottom line defined by the sustainable development triangle (Munasinghe,2009). The triangle defines integration of well-known economic, social and environmental dimension with institutional dimension building a trans-disciplinary framework for development. If there is proper functioning of institutional dimension then only other three dimensions come into play and vice versa.

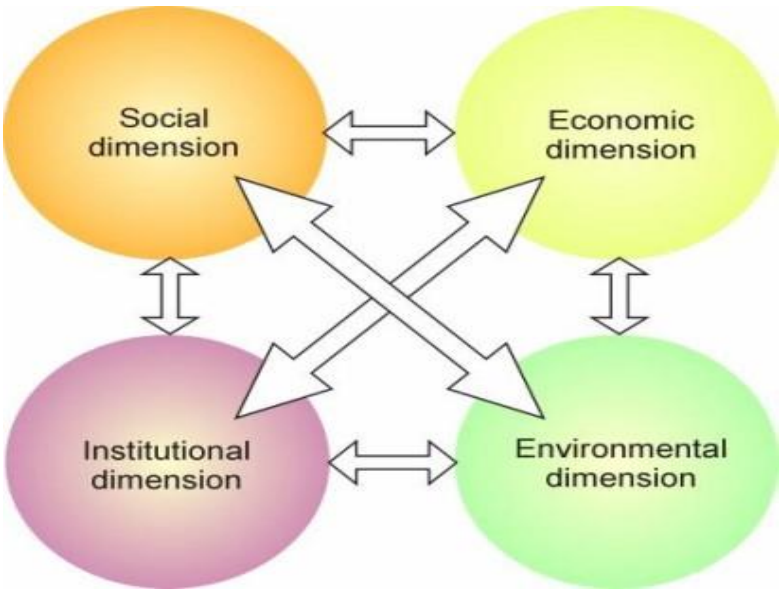


*Figure 2.*The complex interactions among the different dimensions of sustainable development.

Sustainable Livelihood Approach

Literatures related to renewable energy technologies highlight the importance of applying the Sustainable Livelihood Framework while identifying and selecting renewable energy technologies for communities. Evidence is provided that application of the Sustainable Livelihood Framework in renewable energy technology development can improve systems sustainability and enhance the positive impact of renewable energy technologies on sustainable livelihoods (DFID, 2007). Sustainable Livelihood Framework is a tool developed by the British Department for International Development (DFID, ibid). The framework is founded on the identification of strengths, weaknesses, opportunities, and vulnerabilities based on the financial, physical, natural, human and social capital of poor communities (Shrestha,2012) .Ellis and Freeman (2005) note that in the 'approach' "resources are referred to as 'assets' or 'capitals'" and are named as human capital, physical capital, financial capital, natural capital, and social capital. This framework is people centered and it emphasizes the important role of government, local institution, local law policies and private sector involvement as deciding entry points into poor communities. Participation of local communities is encouraged to generate sustainable livelihood indicators. So community participation will also be discussed in reference to this approach. In addition participation ensures transparent access to renewable energy systems, social equity, and synergetic interdisciplinary relationships that provide holistic solutions for poverty reduction in poor communities (Ellis, 1999).

The approach is robust in identifying people's needs and developing long term support measures for projects (Shrestha, 2012). While facilitating poor to access opportunities, it also makes sure to preserve cultural heritage in the community. This approach also supports that creation their own opportunities may turn out to be

substantially more cost effective for poverty reduction than attempting, artificially, to support particular sectors or sub-sectors of rural economic activity (Ellis, 1999).

Review of Previous Literatures

In this section, different related and relevant research papers, journal articles and studies are reviewed.

Khennas and Barneet (2000) conducted a study entitled “Best Practices for Sustainable Development of Micro Hydro Power in Development Countries” in which they suggested that management of MHP should be such that it should be in grasp of the ordinary rural farmers. Moreover their capabilities can be extended with additional training but should only be brought in exceptional cases where system failures are experienced. The study also showed that lack of energy planning at the local and regional levels can be attributed in part to lack of awareness on energy options available at that level. The study further suggested the process of getting information from the rural communities on local resources so that development needs could also be improved to allow for better planning incorporating energy issues.

Moriis and Institute for Local Self Reliance (2007) also conducted study entitled “Local Ownership of Renewable Energy Production is the Key” which examined in detail why local ownership and rural propriety is so critical to the prosperity of communities. While the link between increased demand for renewable energy and increased rural prosperity has been overstated, the link between local ownership and rural prosperity has been overlooked. It also suggests that there exists some correlation between ownership and rural prosperity as farmers can earn five to ten times more if they own a share of wind turbine than they do from leasing their land for an absentee owned wind turbine.

Silva's (2008) study “Factors Influencing the Development of Local Renewable Energy Strategies: The cases of Lolland and Samso Islands in Denmark" suggests that influencing factors are political , local economic resources, inclusion of community and networks and benefits obtained by the RE development at the local level.

A study by Wright (2008) explored public beliefs and policy implication in renewable energy sector in United Kingdom. The result indicates support for partnership with local communities and local use of generated energy and its profit was also found to be high across time. In addition, personal factors like respondents age, gender and employment status were also important in shaping the beliefs.

Upadhyay (2009) evaluated effectiveness of micro hydro projects in Nepal. She investigated the efficacy of community based micro hydro projects in two remote villages of Nepal and the role of public participation in these projects. She suggested that micro hydro projects are a temporary solution as technical performance and level of public participation of projects she studied were found to be very low.

Shrestha (2012) conducted a study entitled “Role of Micro Hydropower Plants in Local development suggested that micro hydro is important source of renewable energy for the rural poor electricity as it can affect the daily life habits of households and also foster the birth to new enterprises. This paper has assessed how electricity access can change the livelihoods assets of rural poor. The research has further suggested influencing changes in the daily lives of the rural poor through electricity generation can be long lasting satisfier towards the fulfillment of basic needs.

Research Gap

Energy consumption is expected to increase as the economy of developing countries continues to grow. Determining how to ensure a stable energy supply with

the least potential environmental pollution is a challenging task as development of a new energy system entails many uncertainties and requires an abundance of resources to support research and development (Shrestha, 1997). The approaches of energy planning consist of identifying and developing such energy sources, diversification of energy needs so as to reduce dependence on oil and formulation of policies to encourage and enforce efficient use of energy at all levels (Shrestha, 1997). In addition, the respective literature about rural electrification has shown that the diffusion of the technology is a complex task facing various difficulties of technical, economic, logistic, social, cultural, organizational, and management problems (Serpa & Zilles, 2007, p. 78). Though current debates place high emphasis on the need to integrate the views and needs of local communities in renewable energy process, most of the researches carried out in this field neglect the social component of electrification projects. Understanding local community perceptions of renewable energy management and the factors that influence these perceptions is important however, more often local community's perceptions do not receive as much attention as they deserve.

Therefore this study investigated the perceptions of communities towards existing renewable management approaches in Nepal and further analysis of factors that influenced these perceptions. In many respects RETs energy technologies are still new to Nepal and its costs are high in rural economic standards. However, at a time when the grid energy system is not expanding rapidly enough, this technology may provide valuable options for local people to meet their energy demand. In light of the contemporary state of research regarding rural electrification through micro-hydro and the named knowledge gaps, the present Master's thesis aims to gain more insights in this field.

Conceptual Framework

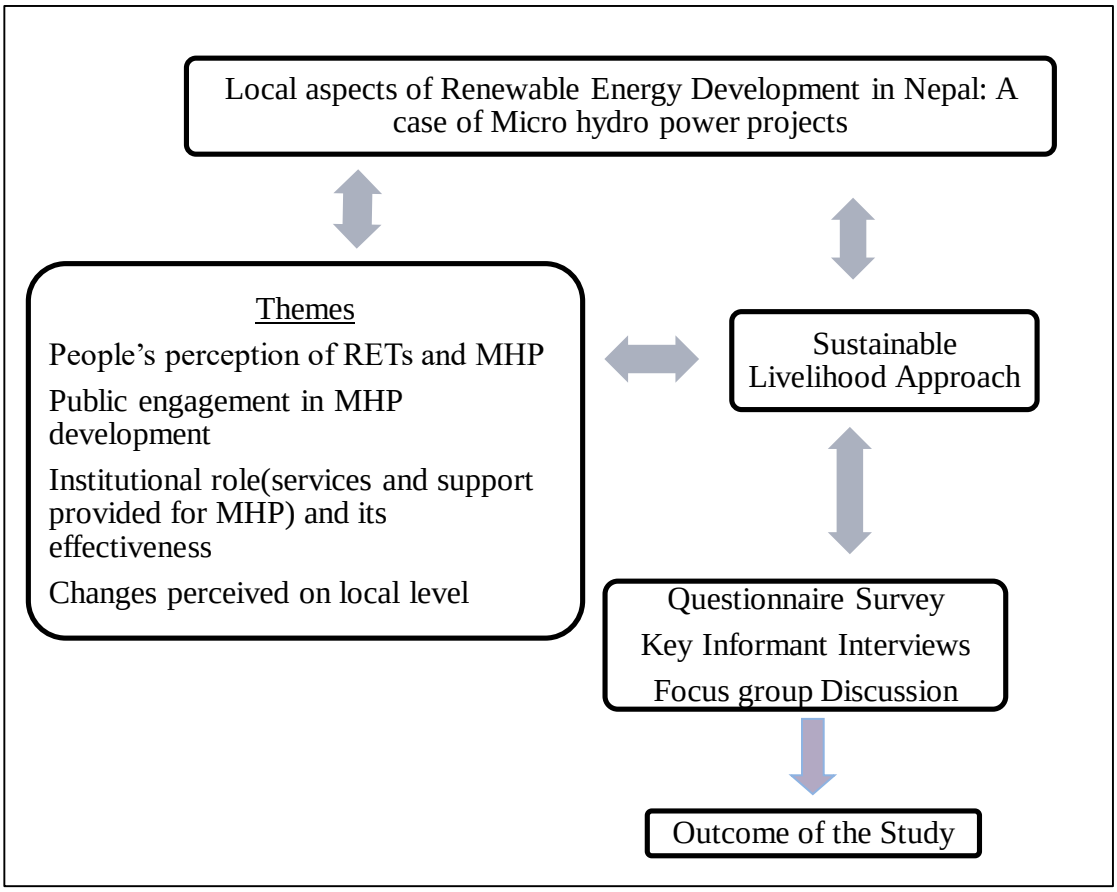


Figure 3.Conceptual framework of the study.

Chapter Summary

This chapter has given overall scenario of energy use of Nepal and the institution involved and has studied status of energy use with related examples from national and international context. Different RETs micro hydro and its contribution to aspects like education; livelihood with role of local people in MHP development have been briefly discussed. Theories related have helped to give proper framework to the research questions. Related research works done in the field of MHP have also been reviewed. Research gaps have been discussed to review aspects which have been overlooked over the period of time. Therefore, literatures have contributed a lot to validate the research work academically.

CHAPTER III

METHODOLOGY

Chapter Overview

This chapter offers research methodology applied for carrying out the research work. The chapter begins research paradigm with philosophical standpoint. The methodology includes research design, sources of data, sampling procedure, variables and their operationalization. Data collection techniques like questionnaires along with interviews and FGD were adopted in three VDCs of Tanahun District to obtain necessary information for the study. Furthermore, baseline information obtained from DDC of Tanahun district helped to visualize existing condition of study area.

Research Paradigm

As research is intended to answer both what and how questions, it is inclined towards pragmatism (Armitage, 2007). In contrast to other paradigms, pragmatism is inclined towards a practical philosophy. Rather than sticking to a mono-methodological debate, pragmatism provides a wider prospective in a multi-methodological or mixed approach. It opens the researcher to choose a variety of measures, tool, and techniques to fulfill the purpose of the research (Creswell, 2003). In addition, Denscombe (2010) states that the pragmatic starting point is the research problem and it gauges the value of any particular approach or method primarily in terms of how well the outcomes work in practice (p.128). So this research is inclined to the paradigm, as sticking to one approach or any mono-methodological approach of the study restricts us to identify the complexity of the social phenomena through constraining of our choice of methods and techniques and their appropriateness for problem solving (ibid, p. 130).

Philosophical Considerations

Philosophical considerations of my research are ontology, epistemology and axiology.

Ontology

Ontology is systematic account of Existence. It is based on principle that what "Exists" is that what can be represented. Ontology is concerned with the nature of reality. It refers to how objective or independent reality can be in reference to an observer or participant in an event. As multiple realities exist, being a researcher I will understand diversities or various realities of the people. So in my research I have drawn various realities from the field as status and impacts may have differed according to context.

Epistemology

Epistemology is the study of knowledge and justified belief (Stanford encyclopedia of philosophy, 2005). It studies the origin, nature and limits of human knowledge. There are various kinds of knowledge and also there exist multiple realities so knowledge and understanding of the people are different regarding the same thing. In the study epistemology theory will provide me with the way to largely objective and some subjective knowledge to know about people's perception, their involvement and changes at local level.

Axiology

Axiology is the study of value, or goodness, in its widest sense. Being a researcher I will value the understanding and work of participants. The axiology of positivist paradigm says inquiry is value free whereas interpretivism argues on the value bound principles, however, pragmatic paradigm values are situational or relative (Beatty et al., 2007). Axiology is what are worthy as right criteria for judgment (ibid). Considering this in the research the people's perception will be evaluated through not

only questionnaire but also giving equal opportunity to explore their experiences about the use of renewable energy technology and their impacts.

Research Design

The study belongs to pragmatic paradigm that incorporates both the explanation of knowledge by positivism and interpretivism. Pragmatists believe that knowledge results from experience and use of scientific method (Beatty et al., 2007). This research study examined local aspects of renewable energy in terms of public perception of renewable energy in Nepal. These aspects were studied as evaluated by the people, their engagement on micro hydro development and operation and changes in livelihood, education and community development at local level. The study used survey (quantitative method) to find out people's perception, participation, acceptance and engagement there by its effects on local level. Key informant interviews with officials of government/ non-government institutions working on renewable energy sector was done to identify institutional set up, their roles in development of MHP and deployment strategies in Tanahun District. Furthermore, FGD was conducted with MHP users to cross check the results.

Study Area

The study was conducted in three VDCs of Tanahun District, namely Kota, Kotdubar and Baidi with 4 MHP installations. Kota has a MHP called Barsa khola, Kotdubar has two, Wanza and Lima Khola and Baidi has Cherranga khola MHP. From the point onwards, kota(Barsa khola) will be termed as "Kota" , Wanza khola(Kotdurbar) is as "Kotdurbar I" , Lima Khola as "Kotdurbar II" and Baidi(Cherranga Khola) as "Baidi".

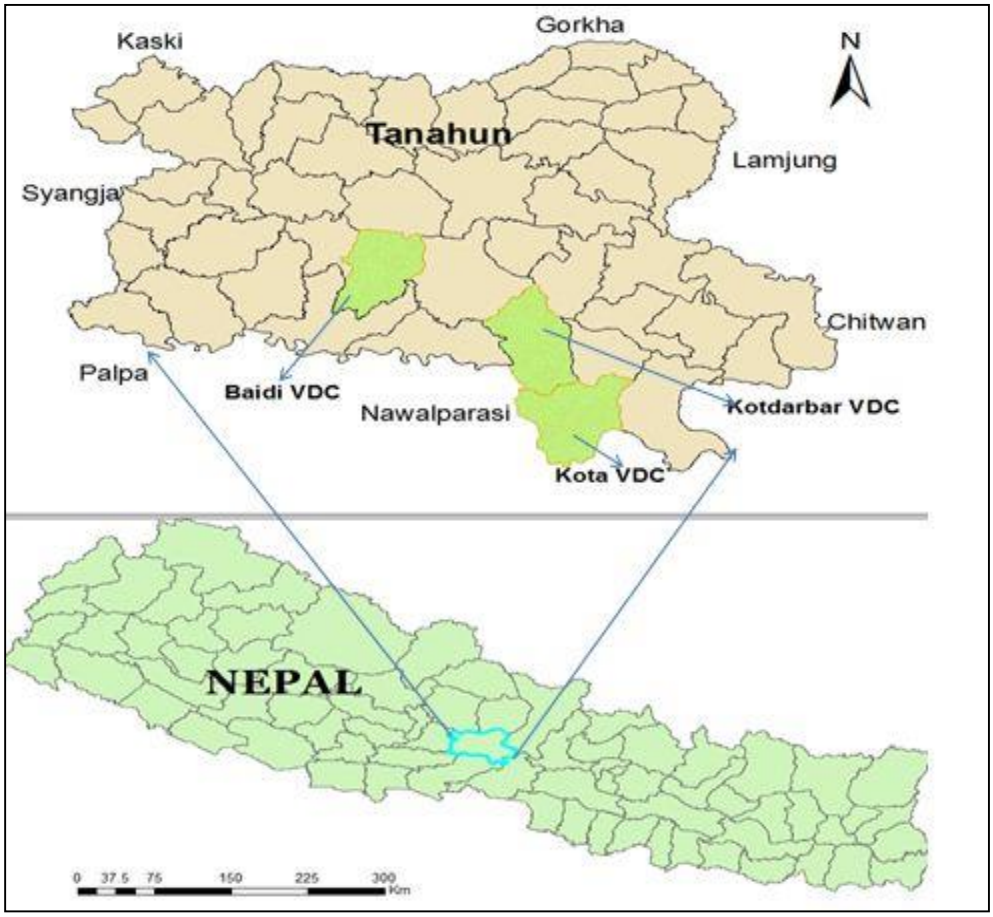


Figure 4. Map of Tanahun district.

The basic reason for selecting the study site can be justified on the ground that it meets criteria of MHP installation. In addition, RETs program has been started in this district for more than 15 years, so it can be considered as very good area for studying perception. Research includes VDCs; Kota and Kotdarbar and Baidi in rural setting. Furthermore, VDCs were also selected according to varying plant size and distance from headquarters (Damauli) of Tanahun district.

Sampling Design

Standard formulations were used for calculating parameters associated with statistical samples and populations (kenkel, 1996). In general, the Gutman scale and Likert Scale were used in questionnaire. Gutman Scale was used to obtain basic information consisting of binary Value 1 for “Yes” answer and 2 for “No” answer. The Likert scale expressed a range of values for the given answers (see Appendix E).

The study was done within the time frame of 6 months which includes data collection period from July 2013 to September 2013. Each micro hydro project forms homogenous population, as a population becomes more homogeneous, any given sample size would be more statistically powerful (Creswell, 2007). The participants were selected through Stratified random sampling method which proves to be useful for the population divided into subgroups (Halliwell and Gold, 1996). Gender and ethnicity have been chosen as variables which will best stratify the participants given that both factors can play distinct role while discussing access to services. This distinction is particularly important as strict social stratification still exists in developing countries like Nepal (Gupte, 2003). Sample was taken through the total listed study population. Out of the total population, sample size was determined by using 95% level of confidence and 0.05 level of significance.

Sampling for Finite Population, $No= (z^2pqN)/ e^2 (N-1) +z^2pq$

$= 1.96^2*0.5*0.5*706)/0.05^2*(706-1)+1.96^2*0.5*0.5$

$=249.27$ Where N_0=sample size

N= Total Population=706

Z=1.96 at 95% confidence level

P=0.5, q=1-p=0.5

and e=5% or 0.05

Considering time available for field survey total of 200 respondents were taken as sample population and thus proportionally distributed among MHP plant. On the basis of sample, respondents were randomly selected from four power plants.

Table 2

Sample Size for the Study

VDC's	MHP			Sample	Sample %
	Size	Plant	HH		
Kota	23 kW	Barsha Khola(Kota)	245(34.7%)	67=~70	35
Kotdarbar	13kW	Waanza Khola(Kotdubar I)	118(16.7%)	32=~34	17
	14kW	Lima Khola(Kotdubar II)	120(16.9%)	32=~36	18
Baidi	35 kW	Cheranaga khola(Baidi)	223(31.5%)	63=~60	30
Total			706	200	100

(Source: RESDTN, 2013)

Sources of Data

Primary data was collected from the field using structured questionnaires, key informant interviews and focus group discussion. General information regarding history; location of the study area was obtained for various secondary sources. All demographic values were obtained from Central Beaurea of Statistics. The required data was also collected from different governmental and inter-governmental agencies. The major sources include the Rural Energy Policy 2070 B.S, Rural Subsidy Policy 2070 B.S, District Energy Management Initiative (DEMI) report and District Energy Situation Report (DESR). Other information needed during research time were collected from different published and unpublished documents/ publications of AEPC, research papers, journal articles, books, periodicals magazines and other relevant literatures, information from institution such as AEPC, practical action Nepal, RESDTN, The world bank, PEEDA,MoSTE, WECS, REN21 and other related organizations.

Data Collection Techniques and Instruments

As the research focused on mixed method, tools of both qualitative and quantitative approaches were valued. For the quantitative analysis, a structured questionnaire and for exploration of existing situation interviews were carried out.

Household Survey

The researcher used structured questionnaires. Households in three VDCs of Tanahun District were surveyed in order to gather information for the study. The survey identified people's perception by exploring awareness about RETs, satisfaction, acceptance and impact of deployment practices at the, status of RETs, its end use (local economy), contribution to education, and community development.

Key Informants Interview

For obtaining supporting evidences and secondary information interview was also conducted with government appointed mini-grid engineer, Local Development Officer and District Energy and Environment Officer. This interview was done for identifying role of institutions, deployment strategies and government support for rural RET. In addition, interview with mangers and operators of plant was also done. The interview with operator was done to find out technical details whereas manager interviews gave overall details of MHP, its working modality, people participation and perceived impacts. Interview schedule was designed to collect the data.

Focus Group Discussion (FGDs)

Focus group discussion was done in order to get deeper information from the respondents. The strength of FGD relies on allowing the participants to agree or disagree with each other so that it provides an insight into how a group thinks about an issue, about the range of opinions and ideas, and the inconsistencies and variations that exist in a particular community in terms of beliefs and their experiences and practices (ODI, 2009). Therefore purpose of focus group discussion was to gain knowledge about a particular topic or need to interview a group of people directly affected by the issue. Three focus group discussions on each site were done. FGD was stratified according to gender .i.e both male and female which consisted of six to

seven members each was carried out in research area. Both FGDs were carried out with the help of theme incorporate in FGD topic guide. This helped researcher to cross check results.

Data Analysis and Interpretation

After the data was collected through various sources using various data collection techniques and tools, the data was scientifically processed. Quantitative data was presented in terms of percentage and tabular form or charts and was analyzed using descriptive statistics. Moreover, tables, pie charts, bar-diagrams and pictures, photographs, etc. were used to make the analysis and presentation more understandable and easy. In addition inferential statistics were used as it allows us to use these samples to make generalizations about the populations from which the samples were drawn. Statistical tool SPSS was used in my research. As qualitative data need to represent comprehensive scenario of the situation for ample description voices of the participants were given equal priority according to the themes. Both qualitative and quantitative data were combined and presented to sketch the result obtained from the study.

Quality Standards for Quantitative Method

Controlling all possible factors that threaten the research quality is a primary responsibility of every good researcher. Therefore testing of validity and reliability of the instrument is important aspect for data collection and both are used to describe the accuracy and consistency of the data.

Reliability

To find out reliability calculation of Cronbach's alpha was done as it is frequently referred as the alpha coefficient of reliability. This is a measure of the internal consistency among the items and is the average correlation among all the items in question, and is used for multi-item scales (Bryman and Cramer ,1990,p.71

as cited in Cohen, Manion, & Morrison, 2007). Therefore, alpha coefficient of reliability is appropriate for my research and SPSS was used in order to calculate Cronbach's alpha. The formula for alpha is:

$$alpha = nr_{ii}/1 + (n - 1)r_{ii}$$

Where, n = the number of items in the test or survey (e.g. questionnaire) &

r_{ii} = the average of all the inter-item correlations.

For the alpha coefficient the following guidelines can be used:

Table 3

Values of Reliability Scale

Values	Reliability Scale
>0.90	very highly reliable
0.80–0.90	highly reliable
0.70–0.79	Reliable
0.60–0.69	marginally/minimally reliable
0.67 or above<0.60	unacceptably low reliability

Reliability level is acceptable at 0.8, although others suggest that it is acceptable if it is 0.67 or above (Bryman & Cramer, 1990, p.71, as cited in Cohen, Manion, & Morrison, 2007). Cronbach's alpha was calculated for the research which was found to be 0.892. Much focus was given for the selection of the sample size.

Validity

Validity is the extent to which a test measures what it claims to measure. It is vital for a test to be valid in order for the results to be accurately applied and interpreted. Validity is not determined by a single statistic, but by a body of research that demonstrates the relationship between the test and the behavior it is intended to measure (Cherry, n.d.). More specifically, validity depends both on the design and the methods of research. So validity is one of the main concerns that is needed to be

addressed in research. Considering the research, internal validity is maintained by careful research design, subject population, and proper instrumentation. For maintaining external validity, population characteristics and data collection methodology were carefully chosen. So in this research for ensuring content validity items that are rated as strongly relevant by judges were included in the final test. To assess the criterion validity of the test, pilot study was done. Higher the concurrent validity test higher will be validity if not then the research is flawed and needs a redesign (Green, 1955). Therefore focus was given on the degree to which a questionnaire or other measurement appears to reflect the variable it has been designed to measure.

In short Validity and Reliability is concerned with the accuracy and consistency of measurement and is affected by survey design, sample representation and instrumentation. To obtain validity instrument must show that it fairly and comprehensively covers the domain or items that it purports to cover (Cohen et al., 2007). So with a view of ensuring quality focus was given on sample size, instrumentation, and piloting of the study.

Quality Standards for Qualitative Method

As the research contained qualitative approach quality standards of qualitative approach also need to be considered.

Trustworthiness

Maintaining trustworthiness is important aspect of qualitative research, which can be achieved by the researcher by establishing credibility, transferability, dependability, and confirmability in a research (e.g., Krefting, 1991; Sandelowski, 1986, 1993, as cited in Baxter & Jack, 2008).

Credibility. To ensure the credibility of data, triangulation and member checking are the effective tools for research (Baxter & Jack, 2008). For triangulation,

same question was asked to other Key Informants. For the member checking transcribe interview was used as document to check their opinion about respected issues.

Triangulation. Triangulation may be defined as the use of two or more methods of data collection in the study for some aspect of human behavior (Cohen et al., 2007). When it applies to mixed method research investigation associated with one research strategy are cross checked against the results of using a method with the other research strategy. Webb et al. (1996, as cited in Bryman, 2008) say that confidence from a study using a quantitative research strategy can be enhanced by using more than one way of measuring concept so that they can treat such overlapping findings as a triangulation exercise. Thus, research the findings from the quantitative analysis are crosschecked through the findings of qualitative approach to validate the data.

Transferability. Proper explanation of research will make researcher to transfer situation to others (Skenton, 2004). So context of researcher was properly explained to Key informant and other respondents during data collection.
Dependability: In order to address the dependability issue more directly, the processes within the study should be reported in detail, thereby enabling a future researcher to repeat the work, if not necessarily to gain the same results (Skenton, 2004). To prevent any invalid interpretations of my interviews, all interviews were carefully transcribed. To avoid imposing my own meaning upon the phenomenon under study, perspectives of research participants were carefully noted and I consistently tried to understand how they made sense of their experiences. Beside these, member checks, prolonged engagement in the field, persistent observation were used to establish dependability (Cohen et al., 2007).

Confirmability. Confirmability can be achieved by taking precaution to avoid researcher predispositions. So findings emerge from the data were presented with all evidence in front of jury.

Ethical Issues

Various ethical issues come up at every stage of academic work and should be kept in mind while conducting the research, during work stage and during writing stage. During work stage, this study did not create any condition that could harm the participants. Consent was taken before conducting study. Also it tried to maintain privacy and did not ask or took no responses of the questions that troubled them to answer. In addition, during writing stage ethical issues were maintained by avoiding unethical practices like plagiarism.

Schematic Representation of the Methodology Applied for the Study

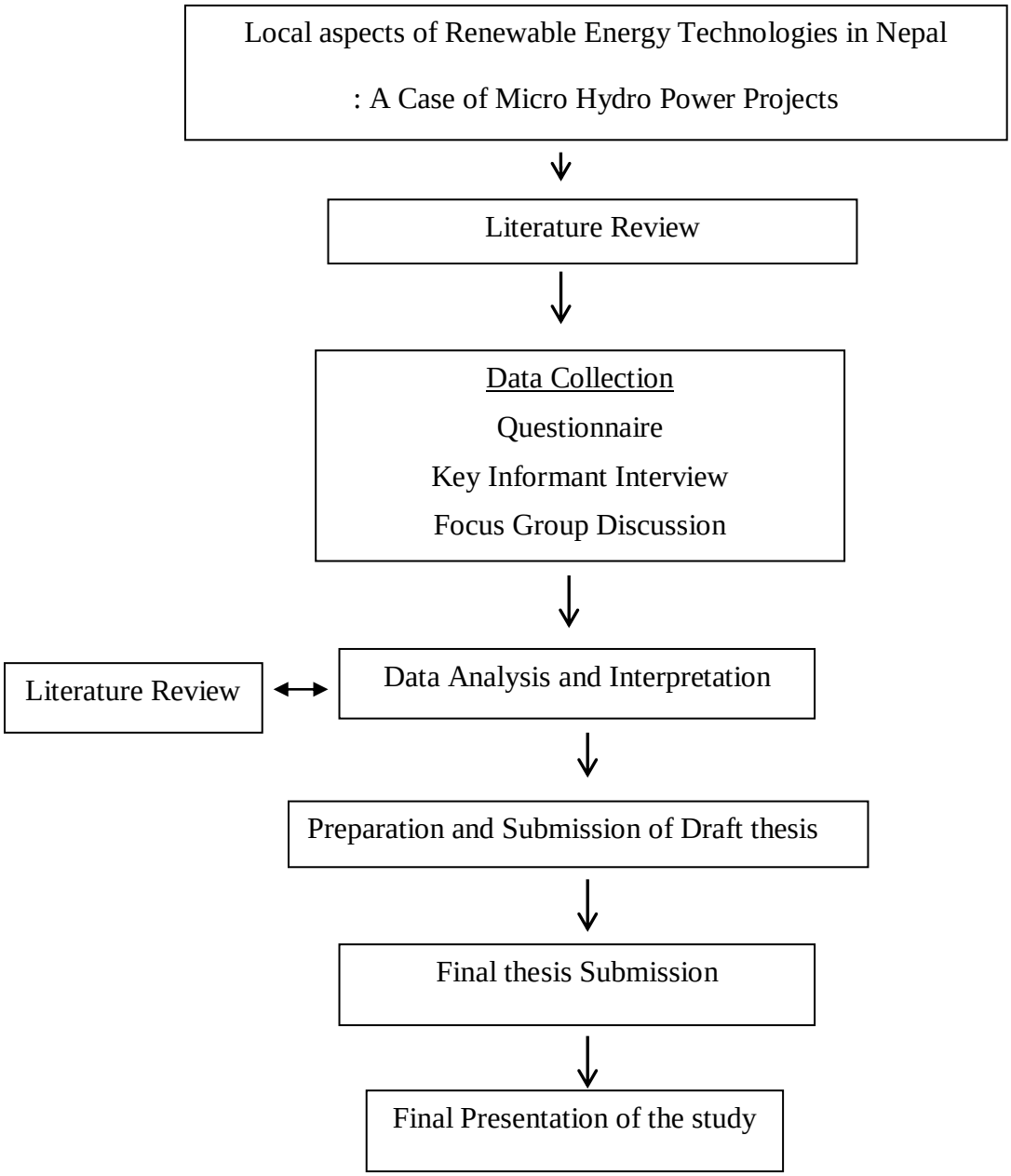


Figure 5. Schematic representation of the Methodology for the Study

Chapter Summary

This chapter has described whole research methodology which began with philosophical standpoint followed by research design and tools, and ultimately concluding with quality standard and ethical consideration. This chapter also talks briefly about the data analysis and interpretation. All explanations and explorations are supported with literature which has made this section academically reliable and authentic. This section has given guidance for primary data collection which is analyzed in next chapter.

CHAPTER IV

DATA PRESENTATION AND ANALYSIS

Chapter Overview

After data collection, next step of the research is to present data and allow further analysis and discuss with the support of literature. Data obtained from survey, interviews, FGD and observations were presented in accordance with the variable defined in all research questions in the previous chapters.

Socio-Demographic Information of Respondents

Socio-Demographic information plays an important role to find out what particular group thinks about the particular issue. Hence socio demographic indicators like age, sex, education, ethnicity and income source were considered as importance indicators in the study.

Age and Sex of Respondents

CBS (2011) has defined population according to different age groups in which a population under the age of 15 is considered young and population aged 65 and above is considered old (p. 15). In addition, age group of below 15 is considered as children; 15-45 is considered to be young, 45-60 is considered to be adult and above 60 is considered as older people in the study. Children of 0-15 age group were not interviewed as their role in understanding and development of renewable energy was not felt distinct. Remaining age groups were taken in consideration as opinions were important in terms of perception, both involvement and perceived impacts. Table below reveals the relationship between age and sex of respondents.

Table 4.

Age and sex of the respondents (N=200)

Age of the Respondents	Sex of the respondents		Total
	Male	Female	
0-15	0	0	0
15-30	15	16	31
30-45	30	32	62
45-60	42	23	65
60 and above	23	19	42
Total	110	90	200

(Source: Field Survey, 2013)

Overall researcher tried to stratify this research by using age and gender. Equal participation of male and female was main focus of this study so approximately equal numbers of them were surveyed. Among them majority were in age range of 30-45 and 45-60 as they are most active group of people (CBS, 2012).

Family Size of Respondents

The table shows the family size of the respondents. Majority of the respondents had extended family size with an average family size of 5.74 which is similar to that of average family size of Tanahun district which is 5.67 (DDC, 2067, p. 3).

Table 5.

Family Size of respondents (N=200)

Family Members	**Frequency**	**%**
Less than 5	38	16.5
5-7	59	25.7
7-9	74	32.2
10 and above	29	12.6

(Source: Field Survey, 2013)

Education

Overall literacy rate (for population aged 5 years and above) is 65.9% in Nepal with male literacy rate of 75.1% compared to female literacy rate of 57.4% (CBS 2011).To know about educational status, the respondents were differentiated into four main groups, i.e. illiterate (those who cannot read and write), below class 5, above class 5 and above SLC. Majority of the respondents who questioned during this study were found to be those who could not read and write, followed by below class 5 and other remaining categories shared similar status as study was done in rural area. The educational status of the respondents in district is 71.97% (CBS, 2012).

Table 6.

Educational Status of Respondents (N=200)

Literacy	Households	
	No. of Respondents	%
Illiterate	84	42
Below Class 5	52	26
Class to SLC	32	16
Above SLC	32	16
Total	200	100

Source: Field Survey, 2013

Ethnicity

There are 125 caste /ethnic groups reported in Nepal and among them, Chhetri is the largest caste/ethnic group having 16.6% of the total population followed by Brahman-Hill, 12.2%, Magar 7.1% Tamang 5.8%, Newar 5.0% (CBS, 2011). The major ethinic groups of district is found to be Gurung and Magar (DDC Tanahun, 2067).The ethnic groups in the surveyed VDC were Brahmins, Chhetris, Newars, Gurung, Tamang, Ale, Rai and others include Sunar, Bishwa Karma, Nepali and Pariyar. Gurung/Magars/Tamang/Ale/Rai (53%) dominated all other ethnic groups in surveyed VDCs.

Table 7.

Ethical Groups of Respondents (N=200)

Ethnical groups	Households	
	Frequency	%
Brahmin and Chhetri	58	29
Newar	9	4.5
Gurung/Magar/Tamang/ Ale/ Rai	106	53
Others (Sunar, Bishwa Karma, Nepali, Pariyar)	27	13.5
Total	200	100

(Source: Field Survey, 2013)

Income Source

The socio-demographical analysis indicated that personal factors such as respondent's age, gender and employment status were important in shaping several of people beliefs on renewable energy (Wright, 2008). The table shows occupation of respondents.

Table 8.

Occupation of Respondents

Occupation	Household	
	Frequency	%
Agriculture	170	41.9
Business	44	10.9
Wages	25	6.2
Service/Pension	47	11.6
Remittance	78	19.3
Others	41	10.1
Total	405	100

(Source: Field Survey, 2013)

Respondents reported mainly six types of occupation as major occupations. Agriculture was found to be major occupation of respondents followed by remittance similar to that of national report which indicates major economic source of the households is agriculture (CBS, 2011).

People's Perception on RETs

People's perception on RETs was dealt in the study with the help of indicators like understanding and level of knowledge, satisfaction and willingness to pay.

Understanding of RETs and Level of Knowledge

The table below illustrates people's response on awareness about RETs. In studied MHP majority of respondents were aware about RETs where 20.5% do not know about it.

Table 9.

Response for Understanding About RETs (N=200)

Micro hydro Plants	Do you know RETs?	
	Yes	**No**
Kota	58	12
Kotdubar I	31	4
Kotdubar II	26	10
Baidi	44	15
Total	159	41
%	79.5	20.5

(Source: Field Survey, 2013)

In regard to question posed for familiarity of RETs types, the multiple responses given are shown in table below:

Table 10.

Familiarity of Types of RETs (N=159)

Familiarity of Types of RETs	Response	
	Frequency	%
Solar	151	26.2
Biogas	105	18.2
ICS	89	15.5
MHP	180	31.3
Others	51	8.9
Total	576	100

(Source: Field Survey, 2013)

Majority of the respondents i.e. 31.3% were familiar to MHP. It might be due to the fact that respondents were MHP energy users. Apart from MHP, respondents were aware about solar (26.2%) followed by Biogas (18.2%) and ICS (15.5%) and 8.9% were familiar with other technologies like solar cookers and solar pump. ICS is

getting its popularity as Tanahun district has been proposed as an Indoor Air pollution free district (DDC Tanahun, 2067 B.S). To get knowledge on everything a proper information source is needed. Out of 159 people who know about RETs, all of them got information mainly from their relatives or neighbors. As families and neighbors are the first things that come in contact with a person so knowledge got transferred from these links. Local promoters, media and government organization/INGOs also played important role in promoting RETs in research sites which is depicted below:

Table 11

Information Source of RETs (N=159)

Information source of RETs	Response	
	Frequency	%
Relatives/Neighbors	93	58.5
Local Promoter	25	15.73
Government Organizations/INGOs	12	7.5
Media	25	15.7
Others	4	2.5
Total	159	100

(Source: Field Survey, 2013)

The table below shows level of respondent's knowledge on renewable energy technology installed in their houses. Majority of the respondents .i.e. 62.5% of respondents did not have basic knowledge of MHP and its working modality. In addition, table shows decreasing trend in percentage as it moves towards higher level with 28% response on some broad general knowledge and lastly no any expertise on MHP.

Table 12.

Level of Knowledge of MHP (N=200)

Level of Knowledge	Response	
	Frequency	%
No knowledge	125	62.5
Some broad general knowledge	56	28
Relevant knowledge in one or two specific areas	17	8.5
Relevant knowledge in number of specific areas	2	1
Total	200	100

(Source: Field Survey, 2013)

The villagers had no knowledge of proper operation of the MHP though they were using it for more than 10 years in average. Though DDC/DEES were supposed to create awareness at pre-construction phase of MHP only a few of them happened to know (Field, FGD, 2013). Handful of active men had some of the knowledge of renewable energy technologies but women did not know simple operation modality of MHP as they were not involved in MHP project activities (FGD; field, 2013).

Satisfaction

From the survey it was found that respondents in two micro hydro plants (Kotdurbar II and Baidi) believed that energy provided helped to meet the needs of HHs, whereas respondents of Kotdurbar I believed that energy provided was not sufficient to meet the needs. On the other hand people in Kota had no particular feeling as equal number of people shared two different opinions. From the table below it is clear that 51.5% believed on energy provided by MHP whereas 48.5% believed that MHP did not meet loads of HHs.

Table 13

Response on Energy Meeting Needs (N=200)

Does power meet needs?	Yes		No	
	Frequency	%	Frequency	%
Kota	35	17.5	35	17.5
Kotdubar I	14	7	21	10.5
Kotdubar II	21	10.5	15	7.5
Baidi	33	16.5	26	13
Total	103	51.5	97	48.5

(Source: Field Survey, 2013)

Among the different loads, lamp was ranked as most important load that was met by the system followed by telephone (Mobile). TV and radio were found to be least ranked in terms of load met by system which can be seen from table below:

Table 14

Ranking of Types of Load meets by System

Ranking	Radio	TV	Lamps	Telephone
Very Important	2	2	197	0
Important	7	7	2	16
Moderately Important	11	11	0	171
Less Important	180	180	1	13
Total	200	200	200	200

(Source: Field Survey, 2013)

Expectation before installation of MHP was very high in the research area (FGD, 2013). In addition, people had quite good impression regarding MHP as majority of the respondents claimed that their expectations were met. The reason behind is they were provided with electricity at the time when they could not even dream of getting connected to national grid at least for next 20 years (Field, FGD,

2013). But there were bunch of people who had disappointments regarding power factor. The figure below shows the level of satisfaction of MHP users with the MHP Plants. People of Kotdubar were found to be more satisfied with both Plants (Kotdubar I and Kotdurbar II) whereas dissatisfaction level in Plants of Kota and Baidi was found to be higher. This may be due to fact that plants I and II of Kotdurbar were of recent establishment compared to that of remaining two (DESR, 2007). But from overall point of view it is clear that majority of the respondents were dissatisfied with its load, as power factor was seen as one of most dissatisfying factor in MHP area (Field, FGD, 2013).

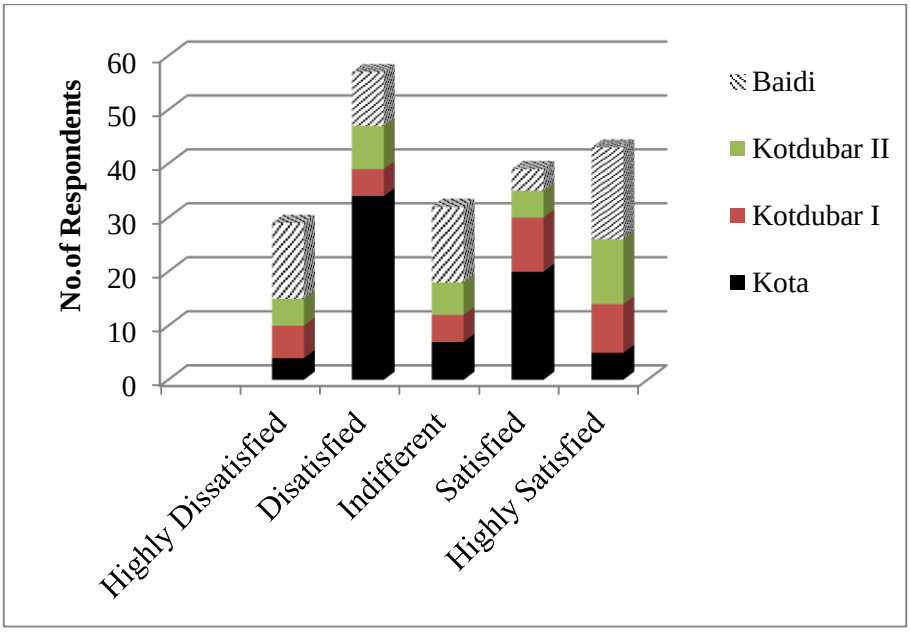


Figure 6. Level of satisfaction of MHP users in terms of power factor (Source: Field Survey, 2013).

Power has been insufficient for the communities. The powerhouses should provide electricity 24 hours a day and is expected to give power smoothly. Because of low load factor in afternoon, the powerhouse shut down for six hours during the day. It is well known that power factor differs in monsoon and dry season. But lack of power in monsoon depicts clear scenario of MHP at the present condition. According to the female participants of FGD Kota;

"The main reason behind lack of power is technical problem as no mechanism of ensuring performance has been done in the past. MHP where we invested so much of money and effort, during starting phase had a generator that was malfunctioned. It was found only after official visit from central level, that company gave us old generator by polishing it with new colour. It clearly shows the advantage of monitoring. But after that there are no any visits of official. As MHP is aging (11 years) its efficiency no doubt decreases but it's really disappointing to see at this peak period it's hard to light one bulb in house. If we look at the neighboring community MHP it's been just 6 years of operation and has same problems."

This shows lack of technical capability to handle the technical failures which often hampers the technology. In addition, statement given by male in Kotdurbar added managerial delinquency to the MHP project which is reflected in his saying

"In addition to technical shortcomings of MHP, managerial problem is also one which hits the list. Power shortage became prominent just after 3 years of operation but committee approved to extend number of household due to which we are now facing severe power constraints. In addition to lack of support from government organization, installing company is to be blamed for as community people could not manage it all and had left problem ."

Decision of the committee to increase household despite limited power supply shows managerial delinquency. Therefore, the sharing of issues on power factor as described by local people suggests that problems range from technical to managerial aspect. On the one hand, haphazard household extension and on the other hand no concerns towards power problems are some of the managerial issue shared by respondents. Lack of proper technical support has also created power deficiency

problems. So regarding service given by technician for repair maintenance of MHP plant majority of respondents are dissatisfied which is be depicted in the figure given below.

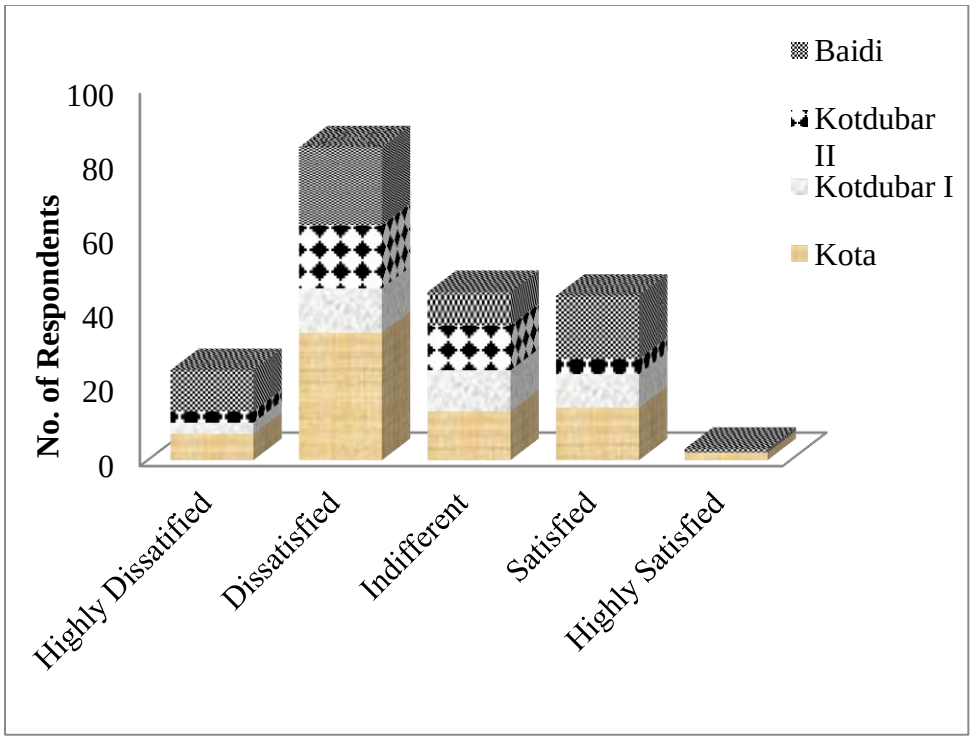


Figure 7. Satisfaction on service given by technician (N=200) (Source: Field Survey, 2013).

The main reason behind the dissatisfaction is lack of skilled human power and trained manpower in the MHP areas. EES provides training to both managers and operators before the start of project. The role of Operator is to oversee the day-to-day activities of the micro-hydro project, and is responsible for the repair and maintenance of all equipment and manger is supposed to manage all the financial, technical and social details of the MHP community (DEMI, 2012).So management and technical problems are only solved by manager and operator but they have very limited knowledge to solve all the problems (Personal interview, Operator 2013). Operators are mainly responsible for covered basic wiring, pipe connections, water flow measurement and most of the necessary repairs and maintenance on their equipment and if there is a problem with the generator, turbines, or control switch, then they have

to hire an expert technician from urban areas for repair and maintenance, who usually takes minimum 3-4 days to one week to reach for service (KII, Manager Kota, 2013). According to participants of Kota, there has been an incidence when a technician arrived after a month of MHP malfunctioned (FGD, Kota, 2013). In addition, some people also claimed that they are compelled to live in a dark even for the simple problem due to absence of operators. Thus irregularity in job has created more problems leading towards havoc on MHP community as each time they have to train another person for operators as some of them leaves the job (FGD, 2013). Reason behind this was found to be dissatisfaction with their remuneration (KII, Operator 2013),as they have to spend their maximum hour of time at powerhouse with little amount of salary and have to disregard other important works of their livelihood as quoted by one of the operator working at particular area.

> *"It's been 11 years I am appointed in this job and I have to spend approximately whole day at powerhouse. Though I have been working here from starting of MHP my salary has not increased. It is quite difficult for me to manage my economic condition within this salary and have to disregard other economic activities where I can easily earn better than this. Because of salary issues two operators had already left MHP and have eloped to Arabs."(KII, Operator Kota, 2013)*

Though hiring an expert is expensive, users are not left with other option if they do not want to face further problem. Lacks of support of government and poor service from technician have created dissatisfaction among MHP user group in terms of technical assistance. To resolve the issues sometimes they try to fix mechanical problems locally but it leads to further complication. In addition, limited participation of local people makes it more difficult to produce good human power for

management. Furthermore, no provision of institutional and technical support after one year guarantee check has made situation worst. On this matter one active MHP male member said

> *"After one year guarantee check the installer did not show up. When we complain this to regional center they say that they will be conducting monitoring soon and major's issues will also be resolved. But I do not remember a single time in these 11 years when this has taken place. In addition, from other MHP communities I have heard that regional center should monitor and help community to fix the problems but here monitoring has become out of question."*

As the powerhouse provides electricity 24 hours a day, it is expected that the operators monitoring the powerhouse work in shifts to ensure that the system is running smoothly, but limited knowledge to operator requires other technician to be hired. Also lack of trained human power to fix problems at community level has created more dissatisfaction to the users. The reason behind dissatisfaction on technical assistance is due lack of refresher training to the operator and training to local people about MHP and working modality. Lack of training has bought such scenario in research area, as Smith1994 said that funded MHP are only monitored for their financial perspective with little incentive to enhance the technical capacity of the village (as cited in Rijal 2002).

Willing to pay for RETs

Despite their dissatisfaction to MHP power factor and indifference in technical assistance provided by key actors, 56.5% of respondents are willing to pay for RETs. On the other hand 43.5% of people do not want to spend their money on RETs.

Table 15

Willingness in paying for RETs (N=200)

Willingness in Paying for RETs	Response	
	Frequency	%
Yes	113	56.5
No	87	43.5
Total	200	100

(Source: Field Survey, 2013)

The reason behind positive future prospects of RETs in particular area is due to the fact that some of these projects are proposed to connect with min-grid in near future giving more hopes to local people (FGD, Kota and Baidi, 2013). On the other side of story there were few respondents in Baidi who expressed their extreme view about future upgrading and willing to pay for it. One of the respondents of Baidi claimed:

> *"I had solar installed beforehand to MHP in my household as by that period MHP plant of this VDC was not extended. After availability of MHP power I was compelled to switch to MHP because neither SHS provided me with enough power load, nor services when malfunctioned. In addition, after having problems with battery, official from regional centers did not provide me with any help regarding repair and managing it. So I joined micro hydro line to overcome short comings. But my scenario did not change even after changing the technology. My household does not have enough load to light two to three bulbs, how can we expect it to have more end uses. Furthermore, when MHP plant has any problems we have to wait for few weeks to a month for its transmission again. So neither do I want to upgrade my RETs neither system in future, nor am I willing to pay for it."*

Prior RET users are more disappointed and are not willing to pay for it which can be seen from bar diagram below.

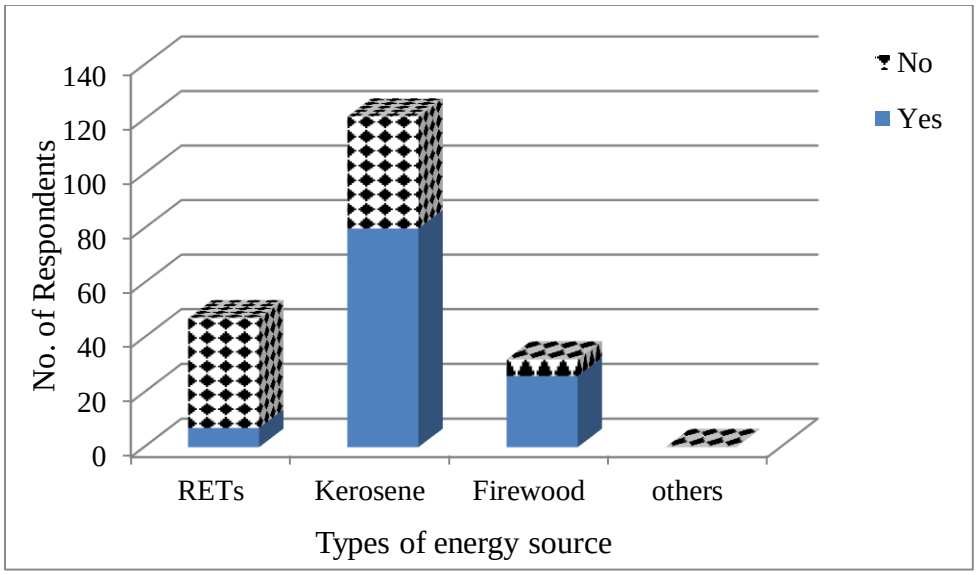


Figure 8. Willing to pay for RETs of different energy sources (N=200) (Source: Field Survey, 2013).

Despite all these dissatisfactions people still want to upgrade their RETs system. The major reason behind willingness to upgrade RETs system is lack of national grid connection in the study area.

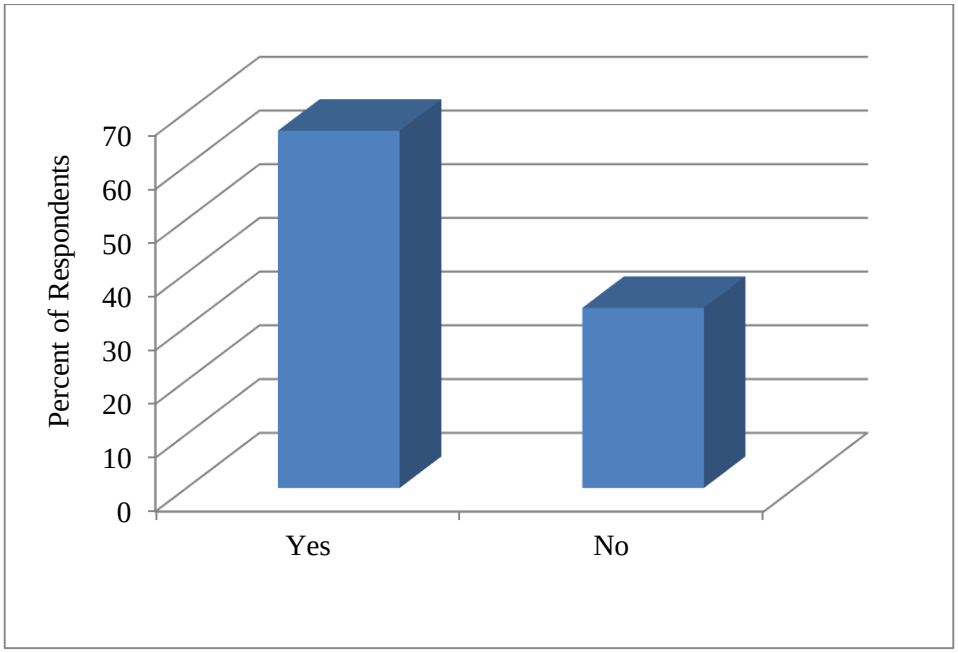


Figure 9. Response on future upgrading of RETs (Source: Field Survey, 2013)

The ability to turn on a light bulb in the evening has important implications for the future upgrading of RETs as possibility of extending national grid is minimal for next 5 years. In addition, in context of Nepal renewable energy development is holistic approach applied for community development which has found great acceptance among the local people (Zahid, 2011).This may be reason due to which despite of all the issues RETs still finding an acceptance in people life.

Participation and Engagement

Participation and engagement of the people's on MHP activities was studied in terms of ownership perceived by local participation and involvement in MHP activities.

Ownership Perceived in Terms of Local Participation

Participation is in terms of MHP activities. Participation is in terms of MHP activities are presented in the table below:

Table 16

Participation in MHP Activities in Terms of Age Group (N=200)

Age Category	Involvement with MHP activities			
	Yes		No	
	Frequency	%	Frequency	%
0-15	0	0	0	0
15-30	19	61.29	12	38.7
30-45	22	35.48	40	64.51
45-60	18	27.69	47	72.3
60 and above	10	23.8	32	76.19

(Source: Field Survey, 2013)

In terms of age group participation, no proper involvement was found in MHP activities. On the others hand, in terms of participation, males are found to be more

active in MHP meeting and repair and maintenance activities. Male members of community have concern for MHP activities and are highly involved in financial and decision making level (Field FGD, 2013).

Table 17

Participation in MHP activities in Terms of Gender (N=200)

Gender	Involvement with MHP activities			
	Yes		No	
	Frequency	%	Frequency	%
Male	49	44.95	61	55.45
Female	20	22.22	70	77.77

(Source: Field Survey, 2013)

Majority of female are aloof of participation and lack simple knowledge on MHP and its uses. In addition, they are highly dependent on male members of house for any difficulty and information related to energy. Few of them showed their interest to participate but there was lack of support from community.

> *"MHP doesn't allow many members for participation in the programs and meeting called for. Very limited people are allowed to do so in which majority of them are males. Only those female who are member of user committee are called in meetings. Specially, people from distant area are disregarded in such meeting and even if they put their voices it often remains unheard."(One women participating in FGD, Baidi, field, 2013)."*

Participation observed according to VDCs also showed similar story which is shown in the table below. Though manager of MHP in Kota (who is female), claimed active participation (KII, Kota, 2013), survey showed different story.

Table 18

Gender and Type of Involvement in MHP (N=200)

Micro Hydro Plants	Type of Involvement			
	Active Member (%)		Passive Member (%)	
	Male	Female	Male	Female
Kota	20	8.5	28.5	42.85
Kotdubar I	34.28	2.86	34.28	28.57
Kotdubar II	22.22	2.77	36.11	38.88
Baidi	18.6	8.47	33.8	38.98
Total	22.5	6.5	32.5	38.5

(Source*:* Field Survey, 2013)

In every site, no proper participation of both males and females was found. Such lack of participation may have resulted due to the lack of support from community. They are not being able to participate as claimed below by one of the members in FGD of Kotdurbar II:

> *"MHP does not have proper orientation regarding meetings. So, majority of us do not participate as we are busy in our works and have to manage time. Also the invitation is called before the day so sometimes message does not reach us and when asked, we are blamed for disinterest. In addition, limited numbers are only called in programs and meeting as more people will have many things to say so it may create some kind of dispute regarding decision making.*

This can be clearly verified as majority of respondents believe that intermediate frequency of meeting takes place in study area.

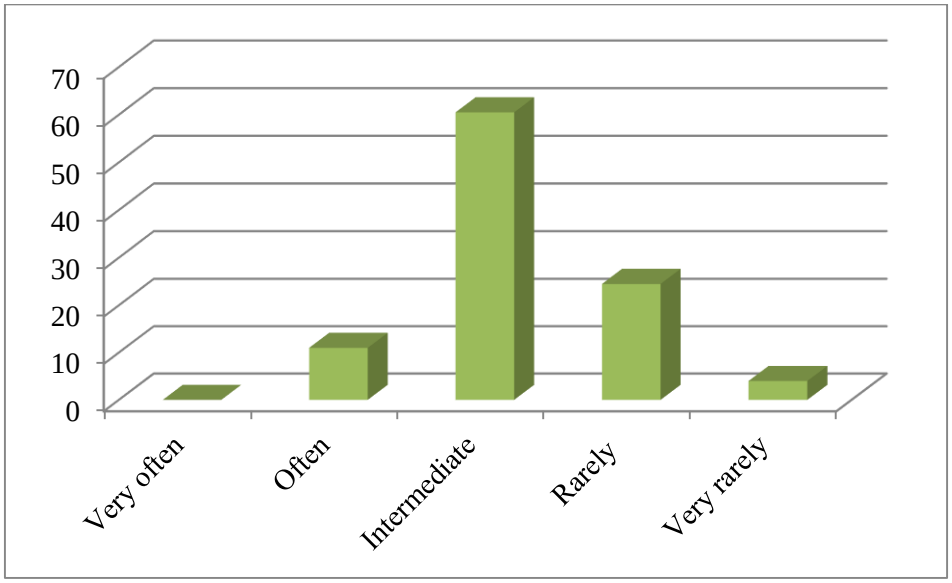


Figure 10. Frequency of meeting (N=200) (Source: Field Survey, 2013)

As participant in FGD expressed their voices often remain unheard this goes parallel with what has been found in survey. Level of fairness in terms of opinions was found to be low as significant number of people have said that their voices are not heard.

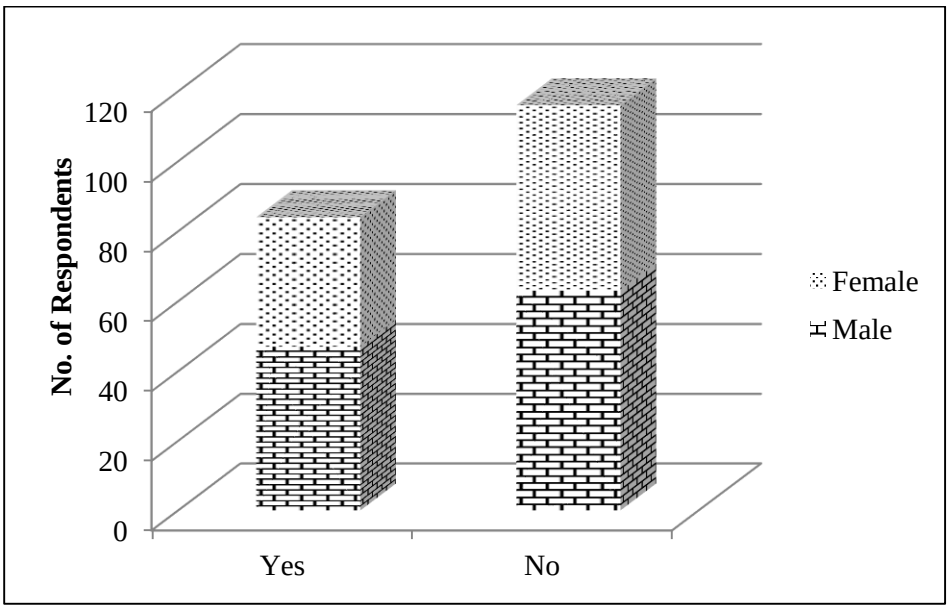


Figure 11. Response on Voices Heard in Meeting (N=200) (Source: Field Survey, 2013)

Lack of regular meeting and lack of fairness in meeting has certainly played vital role in lack of proper participation of people in MHP activities. Lack of female participation shared by respondents may be due to the lack of encouragement given by community. Gupte (2003) identified that women are those who are most directly impacted by hydro installation, but are rarely present in participatory process. As Rural Energy 2007 reports, "women have been identified as one of the most vulnerable groups and their empowerment has been highlighted as one of the six basic principles of REDP community mobilization process" (p.10). But REDP developed projects like Kota does not have proper women mobilization mechanism. This has hindered the community mobilization process and is ensured by no proper mechanism of participation in the research area.

Involvement in repair and maintenance activities. Frequency of the problems and involvement of people in repair and maintenance has been shown here under.

Table 19

Response on Frequency of Problems in MHP

Frequency of Problems	Micro hydro Plants			
	Kota (%)	Kotdubar I (%)	Kotdubar II (%)	Baidi
Very Often	94.2	97.14	100	98.3
Often	2.8	2.8	0	0
Intermediate	1.42	0	0	0
Rarely	1.42	0	0	0
Very Rarely	0	0	0	1.69

(Source: Field Survey, 2013)

Problems in MHP sites occur frequently which clearly depicts technical difficulty of study area. Problems range from technical problem to natural disaster. The table below gives clear picture of some problems that MHPs are constantly facing.

Table 20

Multiple Response to Types of Problems (N=200)

Problems	Responses	
	N	%
Flood	96	48
Lack of Water	35	8.80
Lightening hit	0	0
Technical Problems	200	100
Others	38	19

(Source: Field Survey, 2013)

Technical problems range from simple operating hassle to malfunction of major machineries. Problems include falling of poles, problems in transmission lines, failure of major parts of MHP etc. In addition, there were other problems like moral hazards. For instance, Kota at the first phase of operation got malfunctioned generator which was colored in order to show it was new (field, FGD, 2013).

To explore involvement of local people in repair and maintenance, respondents were asked whether they were involved in repair and maintenance of MHP and most of the respondents expressed that they were not involved, only 17.4% claimed their involvement.

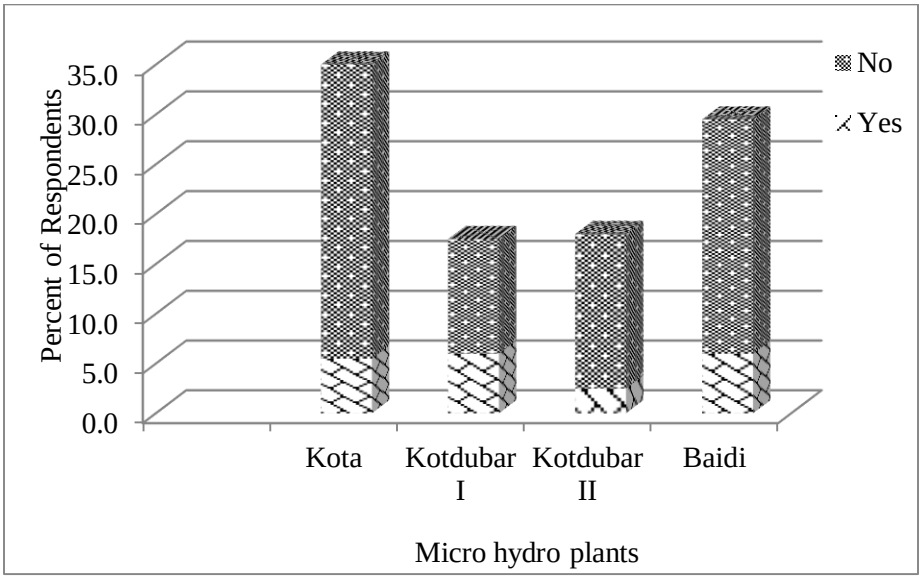


Figure 12. Involvement in Repair and Maintenance of MHP (N=200) (Source: Field Survey, 2013).

When respondents were asked for reasons for not being involved in repair and maintenance most of them expressed lack of idea and training in technical matter. One of the male members of FGD expressed;

> *"In the entire village there is no one who can help in repair and maintenance of MHP. Operators know few things but are unable to help in numerous cases. Neither are we provided with any training nor any expert at the local level. Few young people are interested to take training but lack of training has resulted in lack of involvement in repairing MHP. It's not that we have not tried, but it did not work. So we are compelled to hire expensive technician who takes days to week to come and fix the problem."*

The major reason behind the lack of participation is lack of knowledge of MHP and it working modality. As discussed by the study there was lack of basic understanding of RETs by community though they were using it from long time. Response on training provided clearly depicts lack of training provided by the

regional and central level to the local level. This may be one of the probable reasons regarding the frequent occurrence of problems.

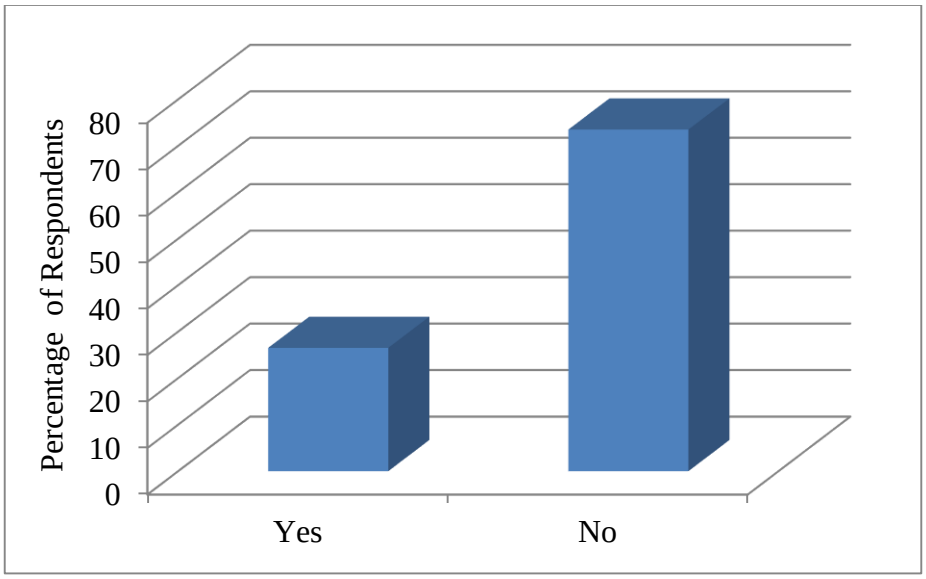


Figure 13. Trainings to the Local People (Source: Field Survey, 2013).

The major hindrance of participation was seen to be absence of managerial, technical aspects. As no proper trainings and capacity building opportunities were provided to the local people, this has led to the condition where MHP users do not have sufficient knowledge to expand their horizon .When the management structure of micro hydropower projects is not clear, this can lead to communication gaps, especially if the management is based far from the rural setting (Kim & Karky, 2002). So lack of sufficient knowledge and resources limits the growth of power plants as rural people do not have knowledge and resources to expand on their own.

Changes Perceived by People

Changes perceived by people People's perception on RETs was dealt in terms of end use available in the study area, job opportunities created, reduction in drudgery and changes in education.

End Use and Other Additional Programs

Though end uses like mills, poultry, shop (local shops, electric shops) has been proposed during implementing period of Micro hydro (RESC, 2007), very few of them were found to be in existence. This can be verified by the below table illustrating existing end uses on research area.

Table 21

Availability of End Uses of RETs in Research Area

End uses	Micro hydro Plants				Total	
	Kota	Kotdubar I	Kotdubar II	Baidi	Frequency	%
Shop	15	6	12	7	40	20
Saw mill	0	4	2	1	7	3.5
Water mill	1	0	0	0	1	0.5
Agriculture Entrepreneur	6	3	1	10	20	10
Poultry	4	2	0	0	6	3
No end uses	43	19	21	38	121	60.5
Others	1	1	0	3	5	2.5

Source: Field Survey, 2013

60.5% of respondents said that there are no end uses available in the study area. The main reason behind no proper end uses is unavailability of power required. The impacts of electricity from micro hydropower on end use in the studied sites are worth comparing although these sites benefit from electricity. In Kota, the impact on entrepreneurship can at best be called minimal. The number of enterprises in Kota was two and Kotdurbar I was one that benefit from electricity. Kota included chicken farming and grinding mill whereas in Kotdurbar I there was saw mill. One 22-year-

old entrepreneur who worked in a chicken farm in Malaysia raised capital from his family to start the farm. Since chickens require 24-hours of light, he is able to raise chickens for 9 months of the year. He cannot keep chickens in the winter because the power from the plant cannot support a heater. So he wants more power so that he can use a heater.

> *"I can earn 30,000 rupees per month in profits in my village if I will be provided with enough power to operate my chicken farm. By doing this I no longer have to go back to Malaysia, because the work there is harder and the savings are smaller. I can just stay here and earn less but have a more relaxed family life. But because of this power shortage I am thinking about giving it entirely and going back again to Malaysia."*

Setting up such farms will not only increase economy of locals but also will increase access to locally produced foods and materials which will be many times cheaper than materials taken from urban areas like Dhodeni (Nawalparasi). However there is another side of the story that is limiting his growth. During FGD with MHP committee where the newly elected Manager of the micro hydropower management committee was asked to clarify, the chairman responded that they were afraid plant may not be able to sustain the extra load demanded by heaters which use a lot of energy.

> *"At the moment plant is not able to even hold daily loads without any additional load factor. So foremost concern for the management committee is to maintain electricity and supply consistently .We cannot simply give more power to anyone because it will make MHP future uncertain."*

The grinding mill in Kota is run by an individual in the locality. It's been more than 7 years the mill has been operated. Before development of Micro hydro the mill was operated by diesel but after installation of the plant, power was given to mill too as an end use activity.

> *"The mill is good for the village as we need it on regular basis. But power of MHP is inadequate to support mill, because of which we are compelled to use diesel which does not make earnings easy as huge amount of our income has to be invested in buying and transporting diesel to concerned area."*

End users in Kotdurbar I thought is little different, shared similar story. Furniture factory set up in the site using a part of the funds received from the District government was closed during this research visit. Since there was not much power available, the owner of the furniture often closed it. The owner claimed that

> *"Not only me there are lot of other people facing similar difficulties and are not operating their factories at present because of load factor. Haphazard increase in HHs without noting future power consequences has bought this issue. Being monsoon period, it is the time when the power plant has to run with full capacity. But it's even hard to light one bulb in house at night time. So how can we expect it to run mills?"*

Though they have to pay additional amount different from plant to plant (for eg. 800 rupees for operating like saw mill and grinding mill in Kotddurbar) as they have taken 3 phase line, still they do not have sufficient power. In addition saw mill can only operate from 12 pm to 3 pm and grinding mill operate from 3-6 pm. Baidi also has a similar story. It is the oldest MHP for the research site and no any end uses was found to be existence.

"It's been 2 months power plant has been closed due to technical problems. It is not a new thing for us. Last year also we faced similar problems twice. So we cannot expect other activities, can we?"

The sharing of respondent projects clear scenario of entrepreneurship in the research site. End users are frustrated due to power hindrance. But few small scale shopkeeper were happy regarding internal saving credit facilities in the communities as it had helped for economical upliftment of the community (Field, FGD, 2013). This is similar to what Mead & Liedholm (1998) pointed through the evidence from Africa that firms that started small tended to survive more than their larger counterparts implying that small size is not necessarily a handicap for the firm. Similarly, the programs like ICS, latrines and water supply are operating in MHP area; only few of them are functional though. Also access to saving and credit facilities has boosted entrepreneurs access to finance which is crucial because entrepreneurs are limited in terms of business opportunities if they do not have access to adequate and low-interest financing (Ozgen & Minsky, 2007,P. 61). It is necessary for an entrepreneur to take advantage of opportunities that might exist (Nichter & Goldmark, 2009, p. 1457). But the villagers lack of knowledge on fund received from the District government for end users has constrained capabilities, resources and technology.

Jobs/ Opportunities creation

Not many of the people have been employed by micro hydro itself. In addition, no proper end users have restricted employment opportunities at particular VDC. 48% of people said that employment is created by project whereas 52% believed project has failed to create employment opportunities to local people.

Table 22

Response of Employment created by the Projects (N=200)

Employment Created	**Response**	
	Frequency	**%**
Yes	96	48
No	104	52
Total	200	100

(Source: Field Survey, 2013)

The impact of creation of jobs in all sites was found to be nominal. Direct creation of jobs is for operators and managers only. The operators oversee the day-to-day activities of the micro-hydro project, and are responsible for the repair and maintenance of all equipment. On the other hand mangers are appointed for keeping all the records, finances and meeting.

Table 23

Creation of New Knowledge and Opportunities in Communities (N=200)

Creation of New Knowledge ar Opportunities	Response	
	Frequency	%
Yes	78	39
No	122	61
Total	200	100

(Source: Field Survey, 2013)

Similarly, 61% of the people believed that, no knowledge and opportunities were created in communities whereas 39% believed that some new knowledge and opportunities have been created from MHP. It is apparent that, MHP has created opportunities, but has failed to sustain over the longer period of time. This can be verified by the fact that management committee were too scared to run the power

plant to full capacity and let users draw more power like the example of chicken farmer in Kota. This might be the reason that management committee is being cautious as taking such steps would endanger interest of others and finally the future of MHP. Furthermore, people of particular VDC believed that there has been lack of institutional support in this issue as management committee was not able to handle such issue (Field, FGD, 2013). Zelenika and Pearce (2011) suggest that institutional support is necessary to ensure that there is a continuous feedback structure in place but in studied site, after the initial construction and review phase, there were no government officials who visited the sites to check on new developments and receive feedback (KII with Manager, 2013).

Reduction in Drudgery

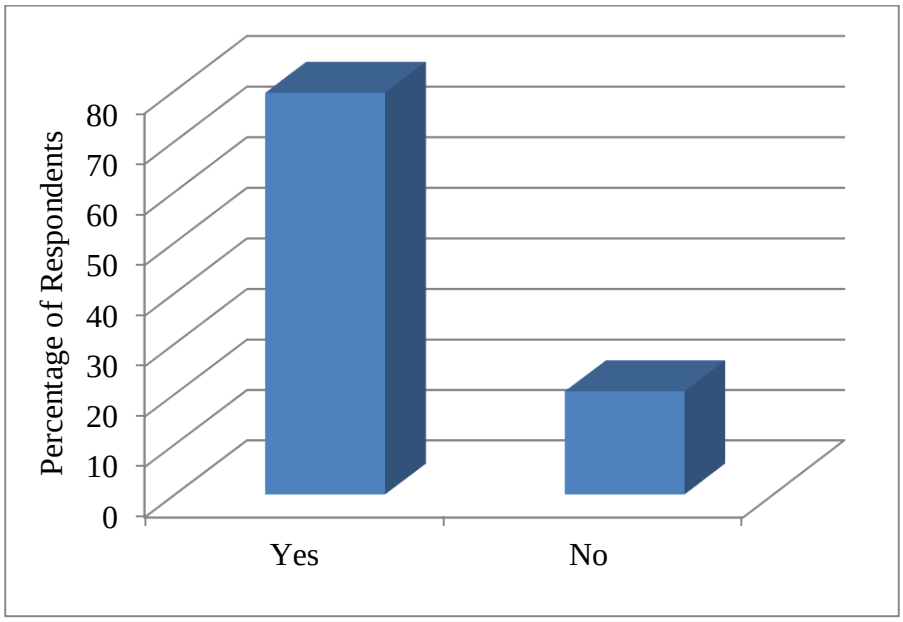


Figure 14. Response on Reduction in Drudgery due to MHP (Source: Field Survey, 2013).

There was found to be reduction in drudgery in the livelihood in the study area. Majority of respondents are dependent on agriculture as occupation with rice, wheat and millet being major crops which are limited to self-consumption.

Establishment of grinding mill from electricity generated from MHP has certainly reduced time for grinding crops. Nevertheless it has helped in reduction of use of kerosene which in turn has also reduced time and effort of local people because they have to travel around 3 hours to the nearest town to buy kerosene (Field FGD, 2013).

Furthermore, there have been efforts to introduce other services that complement availability of electricity to reduce fossil fuel consumption. Almost all households in research site are using advanced technologies like biogas and ICS. The government provides good institutional arrangements to encourage use of new cooking methods like ICS which is apparent in the study area. In addition, this program has been spreading from Kota and Baidi to other VDCs of Tanahun district. AEPC with its donor organizations has planned to make Tanahun district indoor air pollution free district by installation of ICS and other biomass technologies by 2016 (DEMI, 2012).

Education

The impact of electricity from the micro hydropower plants on education should have become apparent as the sites had the power plants for this period of time but it was found unclear. Majority of respondents felt no difference in education scale before and after MHP installation.

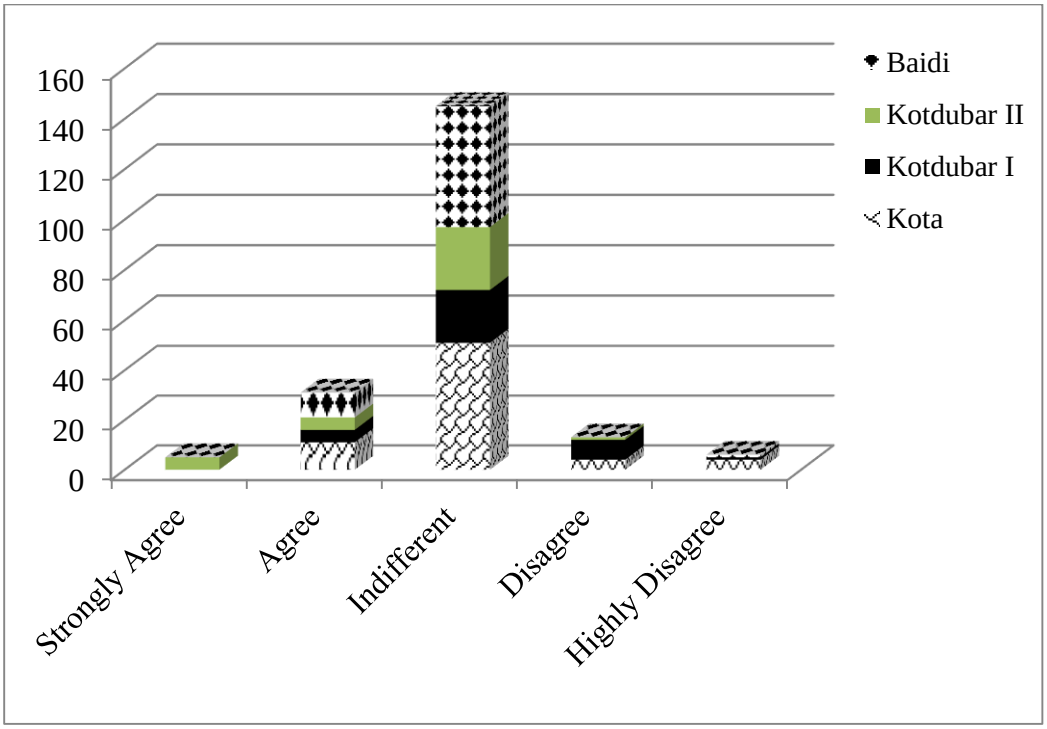


Figure 15. Response on increase in education scale after installation of MHP.

(Source: Field Survey, 2013)

Though local people have such opinion, Principal of school of Kota described how school was attracting students from surrounding villages and said there was a rise in overall attendance. He further claimed:

> *"We can see clear ascending trend of schooling children percent in present time. In the past, kids would not show up for school if they had not finished their homework and had lots of work to do in home. But now the condition has become lot better and attendance has also risen dramatically. In the past (before electricity) parents used to prevent their kids from studying late because of loads of work they had to perform the following day. In addition, at night kerosene was consumed quickly resulting in economic burden and safety hazard was also associated. But at present because of electricity their work load has been reduced giving lots of time to focus on study. Moreover, now*

with electricity kids can study late into the night, especially during examinations."

In contrast to the view of principal, another farmer from same village expressed that electricity from plant has not been able to minimize their working loads and also has severe power issues specially in night time. He assured

"*Expect for the starting three years there has been severe load problem which has constrained the rate of development of the village. This is monsoon season so it is obvious that power load should be sufficient to fulfill daily needs. But you can see single bulb is not being able to lite up. In such scenario how can we expect our working hours to be diminished and how can children can study at night? I am a layman, so I do not know about performance and attendance issues. But from my household and my children I can clearly see that the environment for children to read before and after the installation of plant has not change''.*

This view can be clearly depicted by the view of other respondents, where majority, that is, 52% claimed that RETs is not used for studying at night whereas remaining said otherwise.

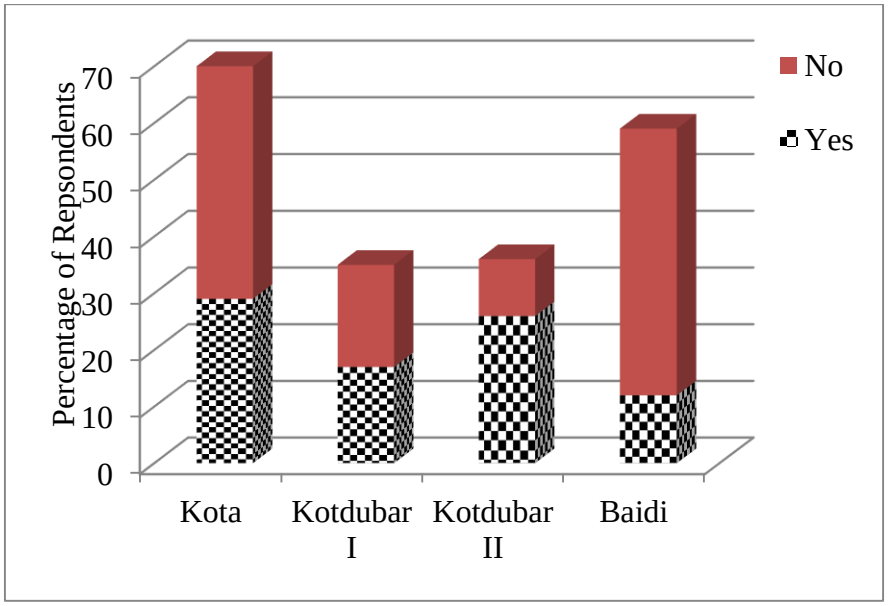


Figure 16. Use of RETs for studying at night according to MHP (N=200) (Source: Field Survey, 2013).

From the figure above it is found that, only plants of Kotdurbar have competitive response towards RETs for studying at night in comparison to that of Kota and Baidi where respondents are not using it for study. The plants at Kotdurbar are recent in comparison to those of remaining two. This might have affected performance of Plants at night giving enough light to study at night time. Nevertheless majority of population said that RETs light are not used for studying at night.

On the other hand, Principal of school of Kotdurbar I in his personal interview gave different view regarding how his school was attracting students from surrounding villages and how there was a rise in overall attendance. He further claimed:

> *"This school was established before than when the VDC got electrified. So it is really hard to identify whether there is direct impact on it. But it is sure that the availability of energy does have some impact on attendance as people are nowadays becoming aware about children's education.*

Of the two sites, Kordurbar II provides improved education facilities that could provide students with some room to attain education. Improved education facilities could enhance their capabilities for improved livelihoods (Chambers & Conway, 1992, p. 22) The school in Kota has a desktop computer from DDC but they were rarely able to use it because of the power and also none of the student are given any access to it. However, in Kotdurbar I, things were a bit more positive as the school principal said that they had more computers and students were given regular access to it (Personal interview, Kotdurbar II, 2013). Although they lacked other

facilities like internet connectivity in the school, the students and teachers made regular use of it. This may have had positive impact on school attendance as they can enhance their teaching capabilities by making use of this electronic equipment. But study sites lack proper infrastructure for schooling and both sites have only a primary school and upon completion of primary schooling the local people have to walk for hours and cross risky rivers to get to a secondary school. Those who can afford it send their children to larger towns like Dhodeni and Damauli to finish schooling.

The impact of electricity from the micro hydropower plants on education should have become apparent as both the sites only had the power plants for this period of time but it was very hard to get appropriate result on it. People at research area did not feel particular impact of electricity from micro hydro, though academia felt encouraging impact on level of attendance and better results in their studies. It may be due to increased opportunities to do their homework and read during the evening hours as majority of respondents use electricity to study at night (Field Survey, 2013). Ellis (2000) calls public education a vital mechanism to ensure development of human capital (p. 43) but until and unless opportunities exist in the villages, youths, regardless of education level, will attempt to migrate to an urban area or go abroad for employment when household income is not adequate. This can be seen from the income source of respondents, as after agriculture (with 41.9%) people's income source is remittance (with 19.3%) which vividly shows number of youth migrating outside country despite their education level (Field Survey, 2013).

Chapter Summary

All primary data collected from respondents were presented and analyzed with the help of the related literature. Overall, people are aware about RETS but lack broad knowledge regarding technology and its working modality. People's dissatisfaction towards MHP was mainly in terms of power factor and technical assistance and was found varying accordingly. In terms of participation, local people involvement in MHP activities was found to be minimal and gender gap was also found. The problems observed ranged from managerial to technical. Changes in livelihood were also found to be constrained by managerial and technical details. Every theme in this chapter was concluded with small conclusions that represent the status of the study.

CHAPTER V

SUMMARY OF FINDINGS, DISCUSSION, CONCLUSION AND IMPLICATIONS

Chapter Overview

This chapter contains the findings that were identified from people's perception on micro-hydropower projects, local level involvement and impacts of hydropower projects on the life habits and livelihoods of four MHP projects in three VDCs of Tanahun District of Nepal. The result identified during the fieldwork has also been discussed and analyzed in this chapter. Understanding and level of knowledge of MHP, their satisfaction, and ownership in terms of local people involvement in MHP activities, and strengthening of livelihoods in respect to changes perceived education ,economy and community development have been described and assessed using literature on livelihoods. Similarly, themes are drawn applying to relevant theories and critical analysis. Furthermore the chapter concludes with importance of institutions for proper development of MHP in Nepal. It also signifies that impacts of electricity from MHP can foster changes in livelihood but it depends on factors like managerial and technical aspects. This chapter also acknowledges how this study can be useful for sustainable promotion of RETs, policy makers and open new window for other researchers.

Findings and Data Triangulation

The objective of this study was to find out the people's perception on four micro-hydro projects of three VDCs of Tanahun district in Nepal. These aspects were studied as evaluated by the people, their engagement on RETs and change perceived

on local level. For this, study has identified institutional set up and role of actors of RETs sector in Nepal, deployment strategies, its effectiveness, people's participation, acceptance, engagement and socio-economic condition thereby it impacts on local level of RETs based on assessment of local people. The findings of research have been presented according to the research questions. Furthermore data from quantitative and qualitative information are also triangulated.

General Information of Respondents

Majority of the respondents were of age range 45-60 and 30-45 though other age ranges were also surveyed. Out of 200 respondents, 110 were male and 90 of them were female. The average family size of the respondents was 5.74. 42 % of respondents were those who could not read and write, 26 % of them were below class of 5 and 16% each of class 5 to SLC and above SLC. As Gurung, Magar constitute major ethnic group of survey VDCs (VDC profile Tanahun), majority of respondents .i.e. 53 % surveyed were Gurung, Magar, Tamang, Ale, Rai following 29% of Brahmin and Chhetri , 13.5 % of others and only few that 4.5 % of Newar. Major income source or occupation was found to be agriculture (41.9%) and then it was followed by remittance (19.3%). Some people were also found to be engaged in service/pension and business while few of them were found to be engaged on wages also.

Perception of People Regarding Micro Hydro

To find out perception of local people towards RETs, indicators like understanding satisfaction and willingness to pay were used in household survey. According to the research results of survey, 79.5% of people were found to known about RETs and its types and 20.5% did not have any. Knowledge among the types of RETs MHP, Solar, Biogas and ICS were found to be more familiar. Information

source of RETs were mainly relatives or neighbours. Similarly regarding the level of knowledge, 62.5% of people said that they have no knowledge of RETs, whereas 28% replied that they have some board general knowledge of RETs. Similarly very few people claimed they have very good knowledge on RETs which is also depicted from data of 8.5% of people having relevant knowledge in one or two specific areas and 1% having relevant knowledge in number of specific areas. These findings coincide with the result of FGD and show that though local people know about different types of RETs but they lack broad knowledge regarding the RETs and its working modality. This signifies lack of awareness programs and training to the local people at the study area.

Regarding satisfaction of the MHP users, 51.5% people believe that energy provided meet loads of HHs whereas 48.5% believe that MHP does not meet loads. The major load factor in the research area was found to be lamps followed by telephone (mobile) and then radio and television. Level of satisfaction was found varying with MHP projects. Comparatively plants with recent development like Kotdurbar I and II have higher level of satisfaction than that of Kota and Baidi. Overall it was found that 29% of the people are highly dissatisfied with MHP and 57% of people are dissatisfied whereas 43% are highly satisfied and 39% are satisfied with MHP. This result coincides with the result of FGD as local people are not satisfied with MHP. The main reasons are power factor and the lack of technical assistance as it has been found that technical problems associated is main reason for such power failures and shortages. In addition, lack of institutional support has been found to be main reason for such response from the respondents. Issue of technical delinquency in focus group discussion verifies result of survey in which 84% of people are dissatisfied with service given by technicians and 24% people are highly

dissatisfied. On the other hand, 45% people do not have particular feeling about the issue and 44 % of people are satisfied, whereas 3% people are found to be highly satisfied.

Despite their dissatisfaction on MHP power factor and institutional support 56.5 % are still willing to pay for renewable energy, while 43.5% do not want to spend their money on this technology. 40% of respondents who were using RETs before did not want to invest in renewable energy again. This coincides with the findings of FGD where it was interesting to find that previous users of RETs held quite negative opinion towards investing their earning for installation of RETs again. Nevertheless 60 % of people still want to upgrade their system whereas the remaining does not.

Involvement of Local People in Micro Hydro Activities

Local people's involvement in MHP activities was found to be minimal in study area. In terms of gender, male participation was found to be higher. In all MHP projects surveyed, comparatively males were found to be more active. In addition, in terms of repair and maintenance of MHP most of respondents expressed that they were not involved in particular activities. Only 17.4% of respondents claimed their involvement. In addition, lack of proper mechanism, irregularity and lack of fairness as expressed by respondents showed managerial delinquency of study area. Furthermore, flood and technical problems were found to be of frequent. This was found to be consistent with the result of KII and FGD, as managerial problems and technical problem were more apparent. Managerial problems range from irregularity in meeting and lack of fairness in terms of inclusion in meetings. Technical problems range from simple operating hassle to malfunction of major machineries. These include generators problems, problems in belts, etc.

Changes Perceived by Local People After Installation of Micro Hydro

No any end use has been reported by respondents as 60.5% of the respondents said that there are no any end users of MHP Projects. In project wise distribution, Kota and Baidi(comparatively old MHP) had majority of respondent who expressed no end uses. Furthermore, 48% of people said employment has been created by project whereas 52% believed project failed to create employment opportunities to local people. In terms of responded in creating new knowledge and opportunities, 39% believed in creation of new knowledge and opportunities in community, whereas 61% of people response that no any knowledge has been created. This result aligned with the sharing of respondent in FGD where very few end uses were found to be in existence. In addition, entrepreneurship in the research site was found constrained due to power hindrance.

Reduction of drudgery was one of the positive results that was found from MHP where 79% of respondents believed that there has been reduction of work load due to power available. This result aligns with result of FGD where respondents believed that there has been reduction of work like travelling far to buy kerosene and grinding crops. In addition, introduction of services like ICS after establishment of MHP has complemented electricity available.

52% of respondents claimed that MHP electricity is not used for studying at night. Because of this reason the impact felt by people in education was quite unclear as people think that there was no difference in education scale before and after. 72% of respondents claimed indifference in education scale before and after. The result aligned with result of FGD as impact of electricity was not felt distinct by local people though academia felt encouraging result on attendance and better results in their studies.

Discussion of Findings

The result identified after the fieldwork has been discussed below using sustainable Livelihood framework. Understanding/level of knowledge of MHP, their satisfaction, ownership in terms of local people involvement in MHP activities and changes perceived in education, economy and community development was critically analyzed using the theory.

People's Perception on Micro Hydro as a Source of Energy

Perception of people on MHP was studied in terms of their understanding, satisfaction and willingness to pay.

Basic understanding of micro hydro. Respondents lacking basic knowledge of micro hydro operation and its working modality and technical details depict absence of awareness program of RETs in particular VDCs. Though DDC/DEES claimed to have such program at pre-construction phase, effect is found to be very minimal. It may be due to reason that projects were left to their own after the construction and initial review. Since ownership by the users is such a crucial aspect of community driven micro hydro projects, it limits directions of the power plants because they do not have sufficient knowledge and resources to expand on their own. Without the channels to provide a continuous level of feedback there is no apparatus in place to ensure that their perpetually changing needs are addressed with effective policy (Shrestha, 2012).

Satisfaction. In the research area people are not satisfied with micro-hydro and its services. The main reason was due to power factor which was not enough for local people. This statement is a strong negation of one of the criteria set for the appropriate technologies (Wicklein, 1998). Though this technology gives immeasurable sense of satisfaction for not being left out from the rest of the world

each time they flick on a light bulb switch, but it is not found to be enough to the villagers as they crave for more facilities and technical support to sustain this technology. On this condition either power plan committee have to dismantle and purchase power from adjoining VDC or have to install larger plants to complement the existing plant which cannot be guaranteed to be economically feasible. Nevertheless, they are freed from cumbersome job of carrying kerosene oil but still compelled to use poor quality lights.

Willingness to pay. No any proper technical facilities have led to average satisfaction of MHP users among local people as provided by result. Development of micro enterprises to facilitate the growth of the community is a key aspect of community economic development and Helmsing (2003), outlines that "credit, training and technical assistance and marketing" should be the key aspects of developing a micro-enterprise program as most rural actors tend to run into low productivity problems due to lack of markets, low asset base, and skills (p.71). Despite all dissatisfaction with this technology local people's willingness to pay for renewable energy technology suggests that they believe in these technologies. In context of Nepal renewable energy development is holistic approach applied for community development which has found great acceptance among the local people (Zahid, 2011). This contrasts at the point where users have already experienced other RETs and are not provided with good facilities and leading rejecting renewable energy for future.

Local People's Involvement in Micro Hydro Development

Ownership by users is crucial aspect of community driven projects (Shrestha.V, 2012) which can see in terms of their involvement in technical, financial support given by local people.

Involved with MHP activities. Wright (2008) believes that according to socio-demographic characteristics, older men were more likely to support local ownership than younger men, although this difference was only observed before the participation process. Moreover no proper participation in any MHP activities was observed in study site. Though private sector run projects have been documented in securing a high degree of local participation and availability of finance from banks were crucial to their success (Pigaht & van der Plas, 2009) it was not found in this case. Lack of involvement towards MHP activities and technical support from local community clearly shows managerial delinquency in terms of their roles in mobilizing local people in MHP activities. When the management structure of micro hydropower projects is not clear, this can lead to communication gaps, especially if the management is based far from the rural setting (Kim & Karky, 2002). Absence of proper managerial, technical and other training also may have led to this scenario as lack of sufficient knowledge and resources limits direction of growth of the power plants as rural people do not have knowledge and resources to expand on their own. So without proper managerial skill simply handing over such technologies without putting in a place for a feedback system that ensures continuous development can lead to a dead-end (Shrestha, 2012).

Changes in Livelihood

Changes in livelihood were studied in terms of end uses and economy experienced by people, jobs/employment created, reduction and drudgery and effect on education.

End uses and economy. Electricity from renewable sources needs to be applied to income generation or they cannot influence change in living standards (Chaurey et al., 2004). However majority of respondents claimed that lack of

prominent end uses described lack of observed effect of electricity on life habits and livelihood. The main reason behind such finding was lack of power required which in turn is the result of poor technical aspect of MHP. Lack of proper monitoring and evaluation of technical details can also be considered as other culprit as after the initial construction and review phase, there were no government officials who visited the sites to check on new developments and receive feedback**.** Constructing a piece of technology and handing it over is easier than ensuring that its users can learn and expand as their needs change (Shrestha, 2012). So government parties like DDC/ DEES have handled the projects to community without ensuring proper technical, managerial capacity of local people. As Zelenika and Pearce (2011) have suggested that institutional support is necessary to ensure that there is a continuous feedback structure in place, proper support and feedback is also necessary for MHP to achieve ownership as well as technical, financial and business skills leading to sustainability of the micro hydro schemes.

Creation of jobs/employment. Economic benefits are stated in multiple ways such as saving from the expenses of kerosene lamps as well as creating opportunities for new enterprises and activities (Shrestha, 2012). Wicklein and Kachmer (2001) also note that Appropriate Technology (mentioned as micro hydro) should be able to create jobs and stimulate growth locally. Although one would think that a typical impact of addition of electricity would lead to solid creation of jobs (Shrestha V, 2012) but the impact so far is nominal in the research site. Study done on particular VDCs shows that having a power plant does not necessarily lead and increase the number of jobs created directly. This is consistent with what Cherni et al. (2009) have found in Cuba where job creation and rise in household income were minimal from off-grid electrification technologies. However the availability of electricity at study

sites has triggered new projects such as water supply project, ICS installation projects etc.

Reduction in drudgery. Evans et al. say that ,one of the aims of renewable technologies is to replace traditional technology, that may be labour intensive and inefficient, with technology that saves labour but is also cheaper than something that requires high levels of capital (as cited in Zelenika & Pearce, 2011). Majority of respondents are dependent on agriculture as occupation with rice, wheat and millet being major crops which is basically for self-consumption. So establishment of grinding mill from electricity generated from MHP has certainly reduced time for grinding crops. It is reported that women reportedly spend 12 hours on household chores but introduction of mills in village have prevented women to wake up early to grind the corn and have more time to rest (REDP, as cited in Bastakoti, p. 27). This is found to be consistent as women claimed that mills have made it easier for them to grind crops. But this aspect of MHP is also constrained by the power factor. Nevertheless it has helped in the reduction of use of kerosene which in turn has also reduced time and effort for local people as they have to travel around 3 hours to reach the nearest town to buy kerosene. In the study done by Legros et al. (2011) it was found that micro hydropower beneficiary households on average use 6 liters of kerosene per year in contrast to 25 liters used by families that do not have access to electricity (p. 43). This is consistent with the finding of this research that reduction in kerosene use is an important start towards the reduction in fossil fuel use.

Furthermore, there have been efforts to introduce other services that complement electricity availability to reduce fossil fuel consumption. Almost all households in research site depend on firewood for cooking but they are using advanced technologies like biogas and ICS as well. This finding is aligned with

Townsend (2000) who found that modern fuels are used more for novel uses but fuels like wood tend to be used for traditional uses like cooking. But it was heartbreaking to find that majority of the biogas installed were not working due to technical delinquency. ICS installation was found to be in good pace as it is priority program of government with good institutional arrangements to encourage people to use new cooking methods like improved cooking stoves.

Impacts on education. Legros et al. (2011) at UNDP found that in households which had electricity, children spent longer hours on homework and reading than in non- electrified households (p. 35). Households with electricity spent twice as much as non- electrified households on school supplies and school expenditures (ibid). The impact of electricity from the micro hydropower plants on education was not so clear though studied sites have been electrified for long period. But increase in level of attendance according to academia surely shows encouraging and better trend. It may be due to increased opportunities to do their homework and read during the evening hours as majority of respondents use electricity to study at night. Gibson & Olivia, 2009, believe that improvement in rural lighting increases the chances of educational possibilities which "would help remove the bottleneck of failure to get an urban job by raising skills and increase prospects of rural non-farm employment" (as cited in Cook, 2011, p. 308). But this can be taken possibly as a long term effect of improved access to education because unless opportunities exist in the villages, youth, regardless of educational level, will attempt to migrate to an urban area or go abroad for employment when household income is not adequate.

Institutional Support of MHP Development in Tanahun

All kinds of institutions in Tanahun have been identified at the national level, regional level and community level. At the national level Alternative Energy

Promotion Center (AEPC) supports implementation of renewable energy under different relevant ministries. In addition, many donor organizations are also found to be supporting implementation of renewable energy center (KII EEO, Field 2013). With activities like renewable energy policy formulation, planning and facilitating the implementation of the policies/plans, AEPC is also responsible for the delivery of subsidies and financial assistance for off-grid Rural Electrification and also monitoring, evaluation and quality control during the process of electrification projects (KII, Minigrid Engineer, 2013). At district level "District Energy and Environment Unit of Tanahun" helps in coordination, planning, local resource mobilization and day to day district operations with various partner and mobilizing support organizations (SOs), financial institutions, and the private sectors. The community mobilization functions include the dissemination of information, helping communities develop action plans, accessing resources from various sources and monitoring local level work and these are performed by local non-governmental organizations (NGOs) (KII, EEO, Field 2013). But in the research area no regular monitoring and evaluation was found. In addition private sector firms such as the Rural Energy Services Centre (RESC) e.g. RESDTN in Tanahun should provide technical support services to communities for feasibility studies and installation, operation and maintenance of RE systems (KII, Minigrid Engineer, 2013).

Though various organizations are working at central, regional and community level, services and supports provided by them to the local level ware felt minimal. At the central level AEPC claims to provide all the necessary support but lacks continuous support at the community level which is needed for proper functioning of MHP. The study also showed lack of visits from government officials and planners which means that there is a missing feedback mechanism as named by Zelenika &

Pearce (2011). As all micro hydro studied are community owned, it may limit the direction of growth of the power plants because they do not have sufficient knowledge and resources to expand on their own. This is where institutional support is necessary. The technology which is installed with all its promises of suiting the needs of its users was found to be struggling. Although it was designed with the users in mind, it is not well adapted by the users themselves. Lack of official supports after the initial construction and review phase checks new developments which left the locals to act on their own. Without the channels to provide a continuous level of feedback to locally owned micro hydro there is no apparatus in place to ensure that their perpetually changing needs are addressed with effective policy (Shrestha V, 2012).

Conclusion

The study was conducted in two stages. Based on the findings several conclusions were drawn. In this section the researcher presents conclusion with appropriate linkage of quantitative and qualitative information.

Lack of information and awareness program to local people was found in the study area. In addition, evidence from this research shows that the technology becomes less appropriate when the needs of its users change. Therefore the findings challenged the existing understanding of micro hydro and the notion of it being adapted to suit the needs of its users as prior to the installation lighting bulb in the village was just a condition, now they have broader demands and needs. Furthermore, donors and government should make choices available to the rural poor to take advantage of tools that can supplement the needs of the rural households.

From this research it is clear that what households present as their needs is subjective to what they think and is shaped by the way they perceive development.

For a rural farmer the ability to access services that reduce the space that exists between rural and urban life is what electricity addresses. Influencing small changes in the daily lives of the rural poor people by electricity when easily accessible can be a long lasting satisfier towards the fulfillment of their needs. Furthermore the infrastructures development that complements the needs like safe water, ICS promotion, roads, and health facilities are possibly more imperative for the rural poor than industry that uses electricity.

No proper involvement towards MHP activities clearly shows managerial and technical delinquencies of study areas. Without proper involvement of local people it is impossible to strengthen the capacity of micro hydro and its impacts on community. So it clearly signifies the lack of trainings to empower and mobilize local people. Constructing a piece of technology and handing it over is easier than ensuring that its users can learn and expand as their needs change (Shrestha, 2012) .So simply handing over the technologies to the local communities without giving proper guidance can lead to dead end.

The changes perceived from micro hydropower plants on the daily life habits of the residents shows that MHP can foster changes that lead to stronger livelihoods. The ability to turn on a light bulb in the evening has important implications as they can reduce consumption of kerosene, spend more hours studying, and have more hours of light in the evening. By powering light machinery, electricity has been able to reduce drudgery for women and has allowed women to rest longer. But these factors were found to be highly depending upon ownership and managerial and technical details. If these details fail to execute properly it will surely have negative impact on people and their perception, as RETs should to be more productive at lower costs than what an industrial scale technology would cost (Schumacher's ,1973, p.

167). Although the initial cost of setting up a micro hydropower is considerably high, it is lower than what it would cost to extend the grid to these remote locations, benefit of having electricity involves the introduction to other technology like mills, computers and development of other technologies.

Overall, from the research area it was found that limited efforts of government and support from donors to the rural people for poor accountability have compelled them to accept what they are given. Lack of proper guidance from the institutions have left them misguided , misled and eventually leading to many problems since they have no guidance once they become owner of the plants. Development planners, donors and the government have made some attempts like handing over decision-making to the beneficiaries themselves but there is lack of an efficient and effective system that follows up rather creates complicated situation leading towards unsustainable projects and finally affecting development.

Implications

A stronger quantitative method combined with qualitative data collection could help to further the discussion on the link between technology and local development (Shrestha, 2012) .Therefore analysis presented in this study is mixed in nature. The study tried to find out the perception of local people on micro development effecting their livelihood and life habit influenced by four MHP of three VDCs of Tanahun District of Nepal which was evaluated by the people paying particular attention to the their perception on its usage, ownership, involvement, benefit sharing, creating opportunities and changes perceived on economy and education with the Sustainable Livelihood Approach.

Technology has been seen as catalyst for any kind of development, renewable energy technology not being different from it. The researcher had believed that local

community not being able to expand themselves due to lack of guidance was in accordance with the research findings. However, study has flicked new learning regarding factors that contribute towards renewable energy acceptance in local people. The presumption of researcher regarding the acceptance of micro hydro was found in different perspective. However, it was found that managerial and technical constraints are found to be major challenge in micro hydro operation which was directly related to shortcoming of local development. Thus study entails how proper institutional feedback mechanism can give spark to the community to have different kinds of development.

General Implication

Proper monitoring and evaluation of the projects should be done on regular basis to trace flaws and scams in this field. Other existing renewable technologies like ICS and biogas plants should be monitored for its well-functioning. Therefore, efforts of sustaining projects within community with local resources should be encouraged as energy related technology directly affects life habits and livelihoods. Lastly,the programs and policies should not only be documented but also has to be disseminated and properly implemented and need to have sustainable focal point.

Specific Implication

The outcome of this study will be helpful for the policy makers to introduce proper monitoring and evaluation of projects. Furthermore, sustaining projects within the local community with local resources should be one of the priorities as energy related technology is directly affecting life habits and livelihood of local people. Refresher of awareness and capacity building programs should be done as rural people cannot expand their horizon on their own regarding technological matter.

Proper human power development through trainings and repair station should be encouraged.

As main objective of social research is to seek community or local development, this research of its own kind also talks about renewable energy and community development so the finding of this research also can open new windows for other researchers who want to work on the similar fields using other methodological options. Different kinds of perception that different societies holds regarding micro hydro resulted due to various factors like satisfaction, ownership and impacts perceived might be helpful to create basis for studies at national level studies finally giving new arena to study sustainability of such projects. Furthermore, this study has pointed out that simply handing over this technology to community without putting a room for a feedback for continuous development of projects can lead to dead end.

Chapter Summary

After primary the data obtained from field was analyzed in previous chapter, in this chapter findings of the data were triangulated and were discussed with relevant literatures according to the theme of the study. Theoretical standpoint also helped to draw theme. Thus output of whole research work was presented in this chapter with proper concluding remarks and some implications.

REFERENCES

AEPC/RESDTN. (2012). *District Energy Managment Initiative, Kota.* Damauli: Rural Empowerment Service Damauli Tanahun Nepal/ Alternative Energy Promotion Center.

Al-Baharna. (1987). Energy assessment of Bahrain. *Energy*, *12*(1), 59-65.

Alternative Energy Promotion Center. (2012, November). Retrieved from AEPC Website http://www.aepc.np

Alternative Energy Promotion Center. (2010, November). Retrieved from AEPC Website: http://www.aepc.np

Alternative Energy Promotion Center. (2011). *About AEPC.* Retrieved from http://www.aepc.gov.np/index.php?option=com_content&view=category&layout=blog&id=62&Itemid=87/

Alternative Energy Promotion Centre (AEPC). (2006). *Rural energy policy.* Lalitpur, Nepal: AEPC, MoEn.

Alternative Energy Promotion SecotorC. (2010). *Renewable energy subsidy delivery mechanism.* Lalitpur, Nepal: AEPC, MoEn.

Armitage, A. (2007*). Mutual research designs: Redefining mixed methods research design*. Ethiopia: Anglia Ruskin University.

Barrett, S. (2005). *Understanding the importance of environmental education: Examination of I love a clean San Diego, a local environmental nonprofit.* Retrieved from

http://www.learningace.com/doc/751371/fe02562ca3b8ecfe6ba93d3f28e0edfd/barrett_sabrina/

Bastakoti, B. P. (2006). The electricity-livelihood nexus: Some higllights from the Andhikhola Hydroelectric and Rural Electrification Centre (AHREC). *Energy for Sustainable Development, 10*(3), 26-35.

Basyal, T. B. (2008, July 3). For promotion of renewable energy. *The Rising Nepal*, p. 4.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, *13*(4), 544-559.

Beatty, J.E., Leigh, J., & Dean, K.L.,(2009). Philosophy Rediscovered: Exploring the Connections Between Teaching Philosophies, Educational Philosophies, and Philosophy. *Journal of Management Education, 33(1), pp.99-114.* DOI 10.1177/1052562907310557.London, Sage.

Burton, J., & Holland, R. (1983). Micro hydro power as and energy source of rural Colombia. *Approproate Technology, 10*(3), 25-27.

Callon, M. (1986). *Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc Bay*. London: Oxford University Press.

Carvajal, G. J. (2008). *Rural electrification with aid of decentralized renewable energy – An impact study on the livelihood capitals of the end users andsustainability of the solar home system component of the IDTR electrification.* Netherlands: University of Nijmegen.

CBS. (2011). *Final result of population and housing census 2011-Major highlights.* Kathmandu: Central Bureau of Statistics, National Planning Commison Secretariate.

Chambers, R., & Conway, G. R. (1992). Sustainable rural livelihoods: Practical concepts for the 21st century. *Sustainable Rural Livelihoods* [IDS Discussion Paper 296].

Cherry, K. (n.d.). *Nursing research serie. Essentials of science: Methods, appraisal and utilization*. Retrieved from http://nursingpathways.kp.org/scal/research/resources/researchseries/docs/Part12_DataCollection-ValidityAndReliability.pdf

Cherni, J. A., & Yinnu, H. (2009). Energy and policy providing for sustainable rural livelihoods in remote locations-the case of Cuda. *Geoforum, 40*(4), 645-654.

Chhetri, A. B., Pokharel, G. R., & Islam, M. R. (2009). Sustainability of micro-hydro systems- A case study. *Energy and Environment, 20*(4), 567-585.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in educationg* (5th ed.). London: Routledge.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approach.* California, CA: Sage.

DDC Tanahun. (2067 B.S). *District profle Tanahun.* Damauli: District Development Committee, Tanahun.

ekantipur. (2012, January 19). *Load-shedding goes up to 14 hours a day*. Retrieved from *ekantipur.com*

Ellis, F. (1999). Rural livelihood diversity in developing countries: Evidence and policy implications. *Natural Resource Perspectives.* Oxford: Oxford University Press.

Ellis, F. (2000). *Rural livelihood and diversity in developing countries.* Oxford: Oxford University Press.

Ellis, F., & Freeman, H. A. (2005). Conceptual framework and overview of themes. In F. Ellis & H. A. de Freeman (Eds.). *Rural livelihoods and poeverty reduction policies* (pp. 44-15). Oxford: Oxford University Press.

GoN. (2011). *Program, scaling-up renewable energy-investment plan for Nepal.* Kathmandu: Author.

Governement of Nepal/Ministry of Finance. (2012). *Economic survey of FY 2011/2012.* Kathmandu: Author.

Green, C. D. (1955, February 18). Classics in the history of psychology: Construct validity in psychological tests. *Psychological Bulletin, 52*(52). Retrieved from http://psychclassics.yorku.ca/Cronbach/construct.htm

Gupte, M. (2003). Reexamining participatory environmental policy: social and gender dimension. *Society and Natural Resources, 25*(2), 327-334.

Helmsing, A. (2003). Local economic developemt: New generations of actors, policies and instruments for Africs. *Public Administration and Development, 23*(1), 67-76.

International Energy Agency. (2007). *Renewables in global energy supply*. Washington, DC: Government Printing Office.

Karky, K., & Kim, C. (2002 B.S). *Water resources use in the annapurna conservation area: Case study of micro-hydro management in Sikles and Chhomrong.* Kathmandu: ICIMOD.

Kleinpeter, M. (1995). *Energy planning and policy.* England: John Wiley and Sons.

Legros, G., Rijal, K., & B, S. (2011). *Decentralized energy access ad the millennium development goals: An analysis of the development benfits micro-hydropower in rural Nepal.* New YorK: UNDP.

Lewis, J., & Wiser, R. (2005). Fostering a renewable energy technolgogy industry: An international comparison of wind industry policy support mechanisms. *Journal of Environmental and Energy*, 10(2), 25-35.

Maskey, R. K., & Khimananda, K. (2013). *RE practices in Nepal-micro hydro tecnology.* Kathmandu: Practical Action.

Mead, D. C., & Liedholm, C. (1998). The dynamics of micro and small enterprises in developing countries. *World Development*, 3(3), 61-74.

Morgan, D. L. (2007). Paradigms lost and pragmatism regained: Methodological implications of combining qualitative and quantitative methods. *Journal of Mixed Methods Research, 1*(1), 48-76. doi: 10.1177/2345678906292462

Munasinghe, M. (1990). Policy issues in energy demand managment and conservation. In A.V. Desai (Ed.), *Sustainable development a new agenda*(29-88). CA:Sage Publications.

Nichter, S., & L, G. (2009). Small firm growth in developing countries. *World Development, 37*(9), 1453-1464.

NRC. (2008). *Improved cook stove: Environment friendly appropriate technology for healthy life in rural areas of Nepal.* Kathmandu: National Resource Center for Non Formal Education.

ODI. (2009, Janurary). *ODI Research Tool publications.* Retrieved from http://www.odi.org.uk/publications/5695-focus-group-discussion

Ozgen, E., & B, D. M. (2007). Opportunity recognition in rural entrepreneurship in developing countries. *Internal Journal of Entrepreneurship, 11*, 49-73.

Pradhan, P. K., & Pradhan, B. (2006). *Environment and natural resources: Concept, methods, planning & management*. Kathmandu: Quest Publication.

Pigaht, M., & R, J. v. (2009). Innovative private micro-hydro power development in Rwanda. *Energy Policy, 37*(11), 4753-4760.

REDP. (2007). *Impact and its contribution in achieving MDGs: Assessment of rural energy development programme.* Lalitpur: Rural Energy Development Programme.

REN21. (2012). *Global status report:* Retrieved from http://www.ren21.net/Portals/97/documents/GSR/GSR2011_Master18.pdf

REST. (2007). *Status of HP /MHP plants in Tanahun.* Damauli: DDC/AEPC.

Rijal, K. (1986). Resource potential and economic evaluation of bio-gas utilization in Nepal. *Energy, 11*(6), 545-550.

Rijal, K. (2000). Mini and micro hydro development: Status, issues and strategies for the hindu kush himalayan region. *A Journal of Enginnering*, 9-18.

Samuhik Abhiyan. (2011). *Impact of mini gri electrification.* Kamalpokhari, Kathmandu: Alternative Energy Promotion Center.

Schumacher, E. (1973). *Small is beautiful.* London: Blond and Briggs.

Seliger, H. W., & Shohamy, E. (1989). *Second language research methods*. Oxford: Oxford University Press.

Serpa, P., & Zilles, R. (2007). The diffusion of photovoltaic technology in traditional communities: the contribution of applied anthropology. *Energy for Sustainable Development, 11*(1), 78-81.

Shrestha, A. (2010). *Prospects of biogas in terms of socio-economic and environmental benefits to rural community of nepal: a case of biogas project in gaikhur vdc of gorkha district.* Kathmandu: College of Applied Science.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, 63–75.

Shrestha, R. (1997). *Energy Planning and Policies in Nepal.* Hongkong.

Shrestha, V. (2012). *Role of micro hydropower plants in local development: the case of two villages in Sankhuwasabha Distric*t. The Hague: International Institute of Social Studies.

Sinclair, A. J. (2003). Assessing the impacts of micro hydro developement in the Kullo District, Himachal pradesh, India. *Mountain Research and Development*. New delhi: JERAD.

Singh, M. L. (2005). *Understanding research methodology.* Kathmandu: National Book Centre, Bhotahity .

Smith, N. P. A. (1994). Key factors for the success of village hydroelectric programs. *Renewable Energy, 5*(5-8), 1453-1460.

Stanford encyclopedia of philosophy. (2005). Retrieved from http://plato.stanford.edu/entries/epistemology/

Townsen, A. (2000). *Energy access, energy demand and the information defict in energy services for the world's poor.* Washington, DC: World Bank.

Upadhayay, S. (2009). *Evaluating the effectiveness of Microhydro in Nepal.* United States of America: San Jose State University.

UNEP. (2007). Nepal: Issues and options in the energy sector: World Bank Energy Sector Assessment Program. Kathmandu: Author.

Wisklein, C. R., & C, J. K. (2001). Philosophical rationale for appropriate technology. *Appropriate Technology for Sustainable Living*, 3-17.

WCED. (1987). *Our common future.* Retrieved from http://upload.wikimedia.org/wikisource/en/d/d7/Our-common-future.pdf

WECS. (2008/09). *Energy secotor synapsis report.* Kathmandu: Water and Energy Commission Secretariat. Retrieved from http://www.wec.gov.np/noticefile/test_1309074425.pdf

Wright, D. D. (2008). *Reconsidering public acceptance of renewable energy technologies: A critical review.* Manchester: Cambridge University Press.

Worth , A., Sheikh, A., & Cresswell, K. M. (2010). Actor-network theory and its role in understanding the implementation of information technology developments in healthcare. *BMC Medical Informatics and Decision Making*, 10-67.

Zachariadis, M. S. (2010). *Exploring critical realism as the theoretical foundation of mixed-method research: evidence from the economics of IS innovations.* Cambridge Judge Business School, University of Cambridge.

Zahid, A. (2011). *Renewable energy: A case study of the Tangin solar PV home system project.* India:*Mountain Research and Developemnt*.

Zelenika, I., & J.M, P. (2011). Barriers to appropriate technology growth in sustainable development. *Journal of Sustainable Development,* 12-22.

APPENDIX A: QUESTIONNAIRE FOR HOUSEHOLD SURVEY

Dear Respondents,

This survey is being undertaken on behalf of the study "Local Aspects of Renewable Energy development in Nepal: A case of people perception on micro hydro development of Tanahun" for Master's program of Environment Education and Sustainable Development Unit of the Kathmandu University, School of Education. Your household has been selected for survey. The Question will take about 20 minutes. All information shared by you will be confidential and only be used for academic purposes. No part of this will be recorded in tape or video. You don't have to be in the survey, but we hope you will agree to answer the questions since your views are really important. If I ask any question you don't want to answer, just let me know and I will go to next question or you can stop the interview at any time.

Do you have any questions? May I begin the interview now?

Thank you

Sajani Kandel

Student/KU

Appendix A: Questionnaire for Household Survey

Questionnaire No…….	Ward No. ……	Date……
Village/Tole……	VDC……	

Section 1: General Information

Name (optional)/ Caste Family Status (FH=01,FM=02)	……	Gender : 1. Male 2. Female Age: ……	
Family Size	1. Female……	2. Male……	3. Total……
Main Occupation	1. Agriculture …… 2. Business……. 3. Wages……. 4. Service ……. 5. Remittance…….. 6. Others		

Section 2: Education

Age	Total	Illiterate (cannot read & write)		Literate (read & write-up to class 5)		Class 6 to SLC		Above SLC	
		M	F	M	F	M	F	M	F
0 – 4									
5 – 14									
15 – 59									
60+									

Section 3: General Knowledge About RETs

No.	Questions	Coding Categories	
3.1	Do you know RETs?	1. Yes 2. No	
	If yes, From where did you got the information about RETs?	☐ Relatives/neighbors ☐ Local promoter ☐ Government organizations/INGOS ☐ media ☐ Other	
3.2	Which type of RETs do you know?	1. Solar 2. Micro hydro 3. Biogas 4. ICS 5. Others(…….)	

3.3	How much knowledge do you have about MHP connected to your household?	1. No knowledge 2. Some broad general knowledge 3. Relevant knowledge in one or two specific areas 4. Relevant knowledge in a number of specific areas 5. An expert in this subject	
	If you donot have any Knowledge why ?(Multiple choice)	1. Installer don't give proper information regarding MHP 2. No experience in performing task 3. A very little experience in performing task 4. Others……	

Section 4: RETs Details

4.1	When did you get connected with MHP?	__ __ yrs	
4.2	Is plant operated for 24 hours?)	Yes No(……hrs)	
4.3	Do you have to pay monthly tariff to MHP consumer Group?	Yes (Amount: .....) 1 No 2	
	What is the tariff collection scheme?	Fixed monthly rate per HH Fixed monthly rate per bulb Fixed monthly rate per watt Fixed amount per unit per month	
4.4	Do you know from where MHP cost was financed? (tick * for appropriate option)	Source / Code / Remarks: Subsidy 1 DDC/ VDC 2 Donations 3 MHP's fund 5 LGCDP 6 Loan (interest rate…) 7 Others…… 8	5
4.5	*If from Loan,* Does annual interest rate affordable?	1. Yes 2. No	
	In how much time you are supposed to pay back the loan?(months)	3mths 6mths 6-12mths	

		>1 years	
	Have you fully repaid the loan?	1. Yes 2. No	
4.6	Did you contribute to finance MHP from your household? How much?	1. Yes 2. No	

Section 5: Satisfaction Level and Willingness to Pay

5.1	Does the power provided to your household meet all your needs?	1. Yes → 5.2 2. No → 5.3	
5.2	Which types of load are met?(Multiple choice) More important=1 (increase number = decrease in importance	**Loads/Utility appliance** / **Order of Importance** Lamps Radio TV Mobile Other uses	
5.3	What are the other energy sources that are used for other needs (eg. Cooking etc)?	……	
5.4	What was your expectation from MHP before connection?	1. Very low 2. low 3. Moderate 4. High 5. Very high	
5.5	Did it meet your expectation?	1. Yes 2. No	
5.6	How satisfied are you the way MHP is working and its load?	Highly dissatisfied Dissatisfied Indifferent Satisfied Highly Satisfied	
5.7	Prior to this RETs which energy source you were dependent on? Why you changed it?	RETs (Specify……) Kerosene Firewood Others…….	
5.8	Do you want to upgrade your RE system?	1. Yes 2. No	
5.9	Are you willing to pay some %, if government will provide others additional energy options?	1. Yes 2. No	

5.10	You want to increase additional facility in your home *If yes specify…* *rank in terms of importance)* *More important=1* *(increase number = decrease in importance)*	1. Yes 2. No ☐ TV ☐ Computer ☐ Telephone /Mobile ☐ Lamps ☐ Others……	
5.11	Do you want to connect NEA grid if provided?	1. Yes 2. No	
5.12	Why?	RETs is expensive RETs doesn't meet my load Hard to Manage No sufficient end uses No proper facilities Others……	

Section 6: Local Involvement in Terms of Management

6.1	Was there any problem with MHP till date?	1. Yes 2. No	
6.2	How often the plant got problems?	1. Very often 2. Often 3. Intermediate 4. Rarely ***5.*** Very Rarely	
6.3	Any past incidence when plant was shut down??	1. Yes 2. No	
6.4	What was the problem??	1. Flood 2. Lack of water 3. Lightening hit 4. Technical problems 5. Others…….	
6.5	Do you help in the repair & maintenance (Technical support) of the MHP?	1. Yes 2. No	
	If no why not?(Multiple choice)	1. Installer don't give proper information regarding repair 2. No experience in performing task 3. A very little experience in performing task 4. Others……	

6.6	Does MHP have repair & maintenance fund?	1. Yes 2. No	
6.7	Do you contribute financially if MHP has any problems If no why?	1. Yes 2. No	
6.8	Are the local people are provided with trainings regarding technical assistance?	1. Yes 2. No	
6..9	Service given by technician is good	1. Strongly Agree 2. Agree 3. Indifferent 4. Disagree 5. Strongly Disagree	
6.10	Do you have any fund for repair and maintenance?	1. Yes 2. No	
6.11	Which part of the system was repaired? *(rank in terms of highly sensitive part)* *More important=1* *(increase = decrease in sensitivity)*	a. Turbine ……. b. Generator …….... c. Lamps …….. d. Switches …….. e. Others ……..	

6.12 Who fixed the problem?

Coding for problem resolved through

Self-maintenance	1
Neighbour's help	2
Solar technician from company	3
Other	4

		Problem resolved Through	Cost of Repair
Turbine	1		
Canal	2		
Lamp/Switches	3		
Other……	4		

Section 7: Local Involvement in Terms of Ownership and Decision Making

7.1	Who owns the Micro-hydro?	1. Community 2. Private 3. Government ***4.*** Others	
7.2	Are you involved with MHP activities? If no why??.....	1. Yes 2. No	
7.3	What type of involvement do you have?	1. Active member 2. Passive member	

7.4	How often meeting takes place for MHP issues?	1. Very often 2. Often 3. Intermediate 4. Rarely 5. Very Rarely	
7.5	Do you ever take leadership in organizing meetings?	1. Very often 2. Often 3. Intermediate 4. Rarely Very Rarely	
7.6	Do you ever make suggestions or give your opinions in MHP meetings? If no Why not?.....	1. Yes 2. No	
7.7	If yes, How often?	1. Very often 2. Often 3. Intermediate 4. Rarely Very Rarely	
7.8	Do you feel your voice is heard during the community meetings?	1. Yes 2. No	
7.9	Are you satisfied with the process of participation in community meetings? Why/Why not?……..	Highly Dissatisfied Dissatisfied Indifferent Satisfied Highly Satisfied	
	What types of contribution do you make for proper functioning of MHP?	…… ……	
7.9	Give your opinion on RETs should be developed in partnership with local communities" (*Ask reason for the ans)……..	Strongly Agree Agree Indifferent Disagree Strongly Disagree	

Section 8: Perceived Impacts of MHP Community

Economy; 8.1

8.11	How long does it take you to get the place electrified through the grid?	__ days__ __ hrs____ mins	
8.12	Do you think RETs provides you free time to get involved in other activities?	1. Yes 2. No	

8.13	If yes, Utilization of free time:	Involved in alternative 1 income generating activities ➔ 9.13 2 Better care of family 3 More time for studying 4 Others (Specify): 5	
8.14	For what other purposes do you use energy from RETS /What are the end uses of power generated? (multiple choice)(* for options)	End use / SHS / MHP / Code Shop / / / 1 Saw mill / / / 2 Water mills / / / 3 Agriculture Entrepreneur / / / 4 Poultry / / / 5 No end uses / / / 6 Others _____ / / / 7	
8.15	Has electricity used from MHP given monetary (Economic) increment?	1. Yes 2. No	
8.16	Do you think other end use is possible in your community	1. Yes 2. No	
8.17	Have RETs projects created employment opportunities to local people? How many people are being employed by mini-grid project?	1. Yes 2. No ……	

Education: 8.2

8.21	What is the condition of education scale of child after installation of RETs in your house	1. Highly improved 2. Improved 3. Indifferent 4. Deteriorated 5. Highly Deteriorated	
8.22	*This may be due to…..*	1. Enough time saving due to availability of energy 2. Electricity is available all the time 3. Access of different technology making education easier 4. No proper energy available at all-time 5. Others (specify)……..	
8.23	Is the RET used for lighting during	1. Yes	

	Study?	2. No	
8.24	Before installation of RET, what was used for studying?	1. Kerosene 2. Candle 3. Jharo 4. Others……..	

Community Development: 8.3

8.31	Has there been any big infrastructure development like roads, public health posts, after the MHP was established? (Specify…….)	1. Yes 2. No	
8.32	Have your new abilities or knowledge given you any new opportunities for work	1. Yes 2. No	
8.33	Do you recommend similar projects in future? Why/why not……	1. Yes 2. No	

अनुसुची कः घरपरिसर सर्वेक्षण प्रश्नावली

आदरणीय सहभागी ,

यो सर्वेक्षण काठमाडौं विश्वविद्यालय, शिक्षा संकायको स्नाकोत्तर तहको वातावरण शिक्षातथादिगो विकास कार्यक्रम अन्तर्गत नविकरणीय उर्जा विकास स्थानीय सरोकार शिर्षकमा भइरहेको हो । यसका लागी हामीले तपाईको घरपरिसर छानेका छौं । तपाइलाई केही प्रश्नहरु सोधिनेछ र यो करिब २० मिनेट लामो हुनेछ । तपाइले दिनुभएको सुचनागोप्य राखिनेछ र यो सुचना शैक्षिक प्रयोजनको लागी मात्र हुनेछ । यो अन्तर्वाताको कुनै श्रव्य वा दृश्य छायाँकन हुने छैन । सर्वेक्षणका लागी तपाइलाई दवावदिइने छैन तर आशा छ तपाइहरु आफ्नो महत्वपूर्ण विचारहरु र प्रश्नका उत्तरहरु दिन सहमतहुनुहुनेछ । यदी तपाइलाई मैले कुनै प्रश्नको उत्तर दिन मन नभएमलाई जानकारी गराउनुहोला , म अर्को प्रश्न सोध्नेछु अथवातपाइले जुनसुकै बेला यो अन्तर्वाता रोक्न सक्नु हुनेछ ।के तपाइसंग कुनै प्रश्नहरु छन् के हामी अन्तर्वाता सुरु गरौं ।

धन्यवाद

सजनी कंडेल

विद्यार्थी

काठमाडौं विश्वविद्यालय

प्रश्नावली क्रम संख्या.....	वडा नं..	मिति.....
गाउँ/ टोल.....	गा. वि. स.....	

भाग १: साधारण / सामान्य सूचना

नाम (एच्छिक)/ थर पारिवारिक अवस्था(परिवार मूली =01, परिवारसदस्य =02)	....	लिंगः १.पुरुष २. महिला :.....	उमेर
पारिवारिक संख्या	१.महिला.....	२.पुरुष.....	३. जम्मा.....
प्रमुख पेशा	१. खेतीपाती कृषी..... २. व्यापार व्यवसाय..... ३. ज्यालादारी ..... ४. सेवा..... ५. वैदेशिक रोजगारी ..... ६. अन्य.....		

भाग २ : शैक्षिक जानकारी

उमेर	जम्मा	निरक्षर लेखपढ गर्न नसक्ने		साक्षर लेखपढ गर्न सक्ने ५ कक्षा सम्म		कक्षा ६ देखी एस. एल. सी प्रवेशिका		एस. एल. सी माथि	
		पुरुष	महिला	पुरुष	महिला	पुरुष	महिला	पुरुष	महिला
० -४									
५- १४									
१५ - ५९									
६० +									

भाग ३: वैकल्पिक उर्जा वारे सामान्य ज्ञान

क्रम संख्या	प्रश्न	सांकेतिक विभाजन	
३.१	के तपाइलाई वैकल्पिक उर्जा भनेको थाहा छ ?	१. छ २. छैन	
	यदी छ भने तपाइले कसरी थाहापाउनुभयो ?	☐ परिवार/ नातागोता/ छिमेकी ☐ स्थानियप्रवर्धक ☐ सरकारी संस्था /गैर सरकारी संस्था ☐ संचार ☐ अन्य	
३.२	यी मध्ये कुन-कुन बैकल्पिक उर्जा तपाइलाईथाहा छ ?	१. सौर्य २. लघु जलविद्युत ३. गोबर ग्याँस ४. सुधारिएको चुल्हो ५. अन्य (.....)	
३.३	के तपाईसंग तपाइको घरमाजोडिएको लघु जल विद्युत आयोजनाको बारे ज्ञान (प्राबिधिक) छ?	१.छैन २.केही सामान्य ज्ञान ३. एक वा दुई विषयमा केही ज्ञान ४. धेरै पक्षमा राम्रो ज्ञान ५. यस विषयमा विशेषज्ञ	

भाग ४ : बैकल्पिक उर्जाको सामान्य जानकारी

४.१	तपाई कहिले लघु जलविद्युत आयोजनामा जोडिनुभयो ?	..... वर्ष	
४.२	लघु जलविद्युत २४ घण्टानै संचालन हुन्छ?	हुन्छ १ हुन्न (.....घण्टा) २	

४.३	तपाइले लघु जल विद्युत समुहलाई मासिक शुल्क तिर्नुपर्छ ? शुल्क तिर्ने तरिका	१. तिर्नुपर्छ (शुल्क .....) २. तिर्नुपर्दैन तोकिएको मासिक दर प्रति घण्टा ..... तोकिएको मासिक दर प्रतिवल्व ..... तोकिएको मासिक दर प्रति वाट ..... तोकिएको मासिक दर प्रति यूनिट	
४.४	लघु जलविद्युतको लागत खर्च कसरीजुटाउनुभएको थियो (उपयुक्त उत्तरका लागि * प्रयोग गर्नुहोस्)	स्रोत / संकेत / कैफियत भरण छुट — 1 जिविस /गाविस — 2 अनुशन — 3 जलविद्युतको कोष — 5 स्थानीय विकासकोष — 6 ऋण (व्याजदर.....) — 7 अन्य..... — 8	५ —
४.५	यदि ऋण भए के वार्षिक ब्याजदर धान्न सकिने छ ?	१. छ २. छैन	
	कति समयमा ऋण तिरेर सकिन्छ ?	१.३ महिना २.६ महिना ३. १२ महिना ४. १ वर्ष भन्दामाथि	
	के ऋण चुताभइसकेको छ ?	१. छ २. छैन	
४.६	तपाइको घरबाट कति सहयोग गर्नु भयो ?	.....	

भाग ५ : आत्मसन्तुष्टि तथा तिर्ने चाहना

५.१	के तपाइको घरमादिइएको उर्जाले तपाइको सम्पूर्ण आवश्यकता पूरा भएको छ ?	१. छ २. छैन	
५.२	कस्तो प्रकारको विद्युतीयभार चलाउन सकिन्छ? (सबैभन्दा महत्वपूर्ण = १(बढ्डो कम= घट्दो महत्व) (उपयुक्त उत्तरका लागि * प्रयोग गर्नुहोस्) बहुवैकल्पिक	भार /उपयोगी उपकरण / महत्वको कम बत्ती रेडियो टि. भि	

		मोबाइल				
		अन्य प्रयोग				
५.३	अन्य आवश्यकताको लागी अन्य कुन-कुन उर्जाको स्रोत प्रयोग गर्नुहुन्छ ?(जस्तै खाना पकाउन)	.....				
५.४	तपाइले लघु जलविद्युत जोड्दा कस्तो आशा गर्नुभएको थियो ?	१.एकदमै कम २. कम ३. ठिकै ४. धेरै ५. एकदमै धेरै				
५.५	के तपाइले गरेको आशा पुरा भएको छ ?	१. छ २. छैन				
५.६	तपाइको लघु जलविद्युतको भार र कार्यक्षमताबाट कतिको सन्तुष्ट हुनुहुन्छ?	१. एकदमै सन्तुष्ट २. सन्तुष्ट ३. ठिकै ४. सन्तुष्ट छैन ५. एकदमै असन्तुष्ट				
५.७	बैकल्पिक उर्जा प्रयोग गर्नु भन्दा पहिले के मा भर पर्नु भएको थियो किन परिवर्तन गर्नुभयो?.....	१. बैकल्पिक उर्जा (उल्लेख गर्नुहोस्.....) २. दाउरा ३. मट्टितेल ४. अन्य.....				
५.८	के यो प्रकियालाई प्रवर्धन गर्ने चाहना छ ?	१. छ २. छैन				
५.९	यदी सरकारले अन्य उर्जाको स्रोत दिएमा तपाइ केही प्रतिशत व्यहोर्ने चाहना छ ?	१. छ २. छैन				
५.१०	तपाइलाई तपाइको घरमा केही सुविधा थप्ने चाहना छ ? यदि छ भने ... महत्व सँग क्रममिलाउनु होला सबैभन्दा महत्वपूर्ण= १बढ्दो कम = घट्दो महत्व)	१. छ २. छैन ☐ टि. भि ☐ कम्प्यूटर ☐ टेलिफोन ☐ बत्ती ☐ अन्य				
५.११	के तपाइलाई ने. वि . प्रा को प्रसारण लाइनमा जोडिने मौका मिले, जोड्ने इच्छा छ ?	१. छ २. छैन				

	यदि छ भने किन?	१. बैकल्पिक उर्जा महंगो छ २. बैकल्पिक उर्जा मेरो भार थेग्न सक्दैन ३. व्यवस्था मिलाउन गाह्रो ४. परीप्रयोग छैन ५. अपुग /अपर्याप्त ६. राम्रो सुविधा छैन ७.अन्य	

भाग ६: व्यवस्थापनमा स्थानियको सहभागिता

६.१	लघु जलविद्युतमाअहिले सम्म कुनै समस्या भएको छ ?	१. छ २. छैन	
६.२	लघु जलविद्युतमा समस्या आउने क्रम कस्तो छ ?	१. धेरै चाडाँ २. चाडैँ ३. ठिकै ४. दुर्लभ ५. एकदमै दुर्लभ	
६.३	विगतमा पूर्ण बन्द भएको घटना छ ?	१. छ २. छैन	
६.४	के समस्या परेको थियो ?	१. बाढी २. पानीको कमी ३. चट्यांग परेर ४. प्राविधिक गडबडी ५. अन्य	
६.५	लघु जलविद्युतमर्मत तथा सम्भारमा तपाई कत्तिको सहयोग गर्नुहुन्छ ?	१.गर्छु २.गर्दिन	
	इदीनभए किन?(बहुवैकल्पिक)	१.जडान गर्दा मर्मत बारे सम्पूर्ण जानकारी नदिइएकोले २.यो काममा अनुभव नभएको ३. एकदम कम जानकारी भएको ४. अन्य	
६.६	के स्थानिय मानिसलाई प्राविधिक सहयोगको लागी तालिम दिइएको छ ?	१. छ २. छैन	
६.७	प्राविधिकले दिने सेवा राम्रो छ भन्ने कुरा मान्नुहुन्छ ?	१. एकदम मान्छु २. मान्छु	

		३. थाहा छैन ४. मान्दिन ५. एकदमै मान्दिन	
६.८	मर्मत तथा सम्भारको लागी कुनै कोष छ ?	१. छ २. छैन	
६.९	लघु जलविद्युतको कुन पुर्जा मर्मत भएको छ ? एकदमै संवेदनशील पूर्जाको आधारमा क्रम मिलाउनु होला सबैभन्दा महत्वपूर्ण =१ (बढ्दो क्रम =घट्दो महत्व)	१. टर्वाइन ..... २. जेनेरेटर ..... ३. बत्ती ..... ४. स्वीच ..... ५.अन्य	

६.९	कसले समस्या निराकरण गऱ्यो ? समस्या समाधानको लागी संकेत				समस्या निराकरणको माध्यम	अन्तर्गको मुल्य
	स्वयं सम्भार		१	टर्वाइन	१		
	छिमेकीको सहयोग		२	कुलो	२		
	सौर्य प्राविधिक		३	बत्ती/ स्वीच	३		
	अन्य		४	अन्य.....	४		

भाग७: स्वामित्व र निर्णयमा स्थानिय सहभागिता

७. १	लघु जलविद्युतकसको स्वामित्वमा छ ?	१. समुदाय २. निजी ३. सरकारी ४. अन्य	
७.२	के तपाइको लघु जलविद्युत कृयाकलापमा संलग्नता छ?	१. छ २. छैन	
७.३	कस्तो प्रकारको संलग्नता छ ?	१. सक्रिय संलग्नता २. निष्क्रय संलग्नता	
७.४	लघु जल बिद्युत सम्बन्धि मुद्दाहरुको बारेमा कत्तिको बैठक हुने गर्छन् ?	१. धेरै चाडों २. चाडों ३. ठिकै ४. दुर्लभ ५. एकदमै दुर्लभ	
७.५	तपाइले संस्थाको बैठकमा अगुवाई गर्नुभएको छ ? कत्तिको सुझाव दिनुहुन्छ ?	१. धेरै पटक २. कहिले काहीं	

		३. ठिकै ४. दुर्लभ ५. एकदमै दुर्लभ	
७.६	के तपाइले बैठकमा आफ्नो सल्लाह तथा सुझाव राख्नु भएको छ ?छ ? यदि छैन/ किन.....	१. छ २. छैन	
७.७	यदि छ भने कत्तिको सुझाव दिनुहुन्छ ?	१. एकदमै धेरै २. धेरै ३. ठिकै ४. दुर्लभ ५. एकदमै दुर्लभ	
७.८	तपाइलाई तपाइको आवाज समुदायको बैठकमा सुनिएको जस्तो लागेको	१. छ २. छैन	
७.९	बैकल्पिक उर्जाको विकासमा स्थानिय समुदायको साझेदारी हुनुपर्छ" तपाइको विचार दिनुहोला (*विचारको लागी कारण सोध्नुहोस).....	१. एकदमै सहमत २. सहमत ३. फरक छैन ४. असहमत ५. एकदमै असहमत	

भाग ८: लघु जलविद्युतले समुदायमा पारेको प्रभाव वा अवधारणा

अर्थतन्त्र, ८.१

८.११	यस क्षेत्रवाट राष्ट्रिय प्रसारनले विद्युतिकरण भएको क्षेत्र पुग्न कति समय लाग्छ ?	.....दिन .....घण्टा..... मिनेट			
८.१२	के लघु जलविद्युतले तपाइको समयमा बचत भई अन्य कृयाकलापमा संलग्न हुन पाउनु भएको छ?	१. छ २. छैन			
८.१३	यदि छ कसरी सदुपयोग गनुहुन्छ ?	१. बैकल्पिक आम्दानीको स्रोतमा संलग्न २. परिवारको राम्रो हेरचाह ३. पढाइमा बढी समय खर्च ४. अन्य (उल्लेख).....			
८.१४	लघु जलविद्युतबाट आएको उर्जालाई तपाइले अन्यकुनै प्रयोजनको लागी प्रयोग गर्नुहुन्छ ? तपाईले जडान गर्नुभएको विद्युतको कस्तो परी प्रयोगहरु छन् बहुवैकल्पिक (उत्तरको लागि * प्रयोग गर्नुहोस्)	प्रयोग	लघु जलविद्युत	संकेत	
		पढाई		१	
		काठ कारखाना		२	
		पानी घट्ट		३	
		कृषी		४	

		कुखुरापालन		५	
		परी प्रयोग छैन		६	
		अन्य_____		७	
८.१५	के लघु जलविद्युतको विद्युतप्रयोगले आर्थिक विकास र बृद्दिमा सहयोग गरेको छ?	१. छ २. छैन			
८.१६	के तपाइलाई यस बिद्युतबाट अरु परी प्रयोग पनि हुन सक्छ जस्तो लागेको छ ?	१. छ २. छैन			
८.१७	के लघु जलविद्युतले स्थानीय रोजगारीको अवसर सिर्जना गरेको छ? हाल सम्म कति जना मानिस मिनी ग्रिडमा रोजगार छन् ?	१. छ २. छैन			

भाग८.२: शिक्षामा योगदान

८.२१	जलविद्युत जडानपछि तपाइको बालबालिकाको शिक्षामा के कस्तो सुधार महशुस गर्नु भएको छ ?	१. धेरै सुधार २. सुधार ३ फरक छैन ४. बिग्रिएको ५. धेरै बिग्रिएको	
८.२२	यसको कारण	१. उर्जाको उपलब्धताले समयको बचत २. विद्युत सँधै उपलब्ध हुनाले ३. प्रविधिमा पहुँचले शिक्षामा सजिलो ४. उचितउर्जा सँधै उपलब्ध नहुनाले ५. अन्य (उल्लेख गर्नुहोस .....)	
८.२३	के जलविद्युत अध्ययानको लागि प्रयोग गरिएको छ ?	१. छ २. छैन	
८.२४	जडान भन्दा पहिले, पढाइको लागी के प्रयोग गर्नुहुन्थ्यो ?	१.मट्टितेल २. मैनबत्ती ३. टुकी ४. अन्य	

भाग८.३:सामुदायिक विकास

८.३१	जलविद्युतको जडान पछी कुनै भौतिक सरंचना जस्तै बाटो, जनस्वास्थ चौकिको विकास भएको छ ? (उल्लेख.....)	१. छ २. छैन	
८.३२	के तपाईलाई उपलब्ध गरीएको बिद्युतले तपाइको नयाँ ज्ञान वा खुवीले तपाइलाई नयाँ अवसर सिर्जना गरेको छ ?	१. छ(उल्लेख)…….. २. छैन	
८.३३	के तपाइ भबिष्यमा पनि यस्ता आयोजनाहरु पुनः संचालन होस भन्ने सिफारिसको चाहना गर्नु हुन्छ? किन गर्नुहुन्छ/ किन गर्नुहुन्न ……	१.गर्छु २.गर्दिन	

APPENDIX B: INTERVIEW CHECKLIST

Key informant	Guiding Question	Proving Question
Micro hydro Plant manager	Can you please brief me on general facts of MHP of this area?	a. When was the MHP established? b. What is the power output of the MHP? c. What was the main purpose of establishing the MHP? d. Is the MHP working according to its goals?
	Can you please tell me about financial details of MHP and other activities?	a. What were the funding sources for the MHP? b. Does it have any outstanding loans? c. Has the MHP made any profit? d. What was the payback period established for the MHP?
Micro hydro Plant manager	Please tell me more about social details of MHP, community involvement in MHP works and its related issues?	a. How many households does the MHP serve currently? b. Does it provide services to schools, hotels or any other commercial facilities? c. Are there any projects in the pipeline to extend the services to the entire village? d. Was the community consulted before establishing the project? e. If yes, what was the response? f. Does the MHP provide energy for both domestic and commercial purposes? g. Are there any local committees established to look after the MHP? h. How do these communities function? i. Do they form community meetings?

		j. How are the villagers mobilized to participate? k. Do members from all ethnic groups participate in the meetings? l. Has there been any incident or differences between ethnic groups because of the race? m. What do you think about involvement of local people in development of RET's? n. Give an example of such involvement?
	Can you please tell me about managerial issues involved in the establishement of MHP?	a. Were there any permits involved during the establishment of the MHP? b. Is there any regulation that the MHP must follow? c. Does MHP have to follow any legal procedure for expanding number of HHs? d. How far is the national grid from the village? e. What will happen to the MHP if the national grid is extended to the village? f. What is the management protocol of the MHP? g. Are the managers/operators hired locally? h. What are the key responsibilities of these managers? i. How much technical assistance do you receive from company who installed MHP?
	What are the impacts that have been seen in this village after the establishment of MHP?	a. Has there been any big infrastructure development like roads, public health posts, and educational institutions after the MHP was

		established? b. Do you think people are satisfied with facilities MHP is providing?
Micro Hydropower plant Operator	What are your responsibilities in MHP?	a. Do you have any formal training to operate the plant? b. Do you perform repairs? c. How much do you get paid? d. Do you have another form of employment besides this?
School Teacher/ Headmaster	What has been the change in school attendance since the households got electricity?	a. How has your school been benefitted since the arrival of electricity? b. Has MHP helped in creating new abilities or knowledge? c. Has this knowledge created new opportunities for work?
Government Appointed Mini-grid Engineer of district (Public servant)	Can you please describe your institution role in the Development of MHP?	a. Please, describe your responsibilities as Mini-grid Engineer of district b. Please, identify the main Environmental, Social and Economic objectives related to the sustainable management of energy for your organization(Please mention the name of the area of interested)
	What is the role of local people in MHP development?	a. Is there role of local people (local people participation) of energy consumer group in the decision making process at the local level
	What kind of services do you provide to MHP after its installation and how long these services are given?	a. Is a provision of regular monitoring of MHP installed after one year guarantee check? b. Does this organization provide services or facilities if there will be

		serious problem in MHP after one year of installation? c. How much do you think RET's deployment is sustainable in this district?
For local development officer	Could you please briefly explain about district developments plan and activities of Tanahun?	a. Could you please discuss about its annual development plan and implementation? b. What kinds of activities are going on at the present context? c. What kind of development activities are prioritized or focused in Tanahun district? What is the estimated annual budget of the district?
	What are the different organizations working for local development in Tanahun?	a. Could you please tell me about organizations working for the development of RET's associated with DDC?
	How has RET/energy been incorporated in local development of this district?	a. Does the district have allocated budget for RET (i.e. ICS/Biogas/Solar) particularly on Micro-hydropower? b. How much is allocated for Micro-hydropower?
	What do you think renewable energy technology has brought any changes in local development	a. What kind of changes have you observed due to energy availability in the particular district? (Kindly focus on Micro hydro)? b. Do you think RETs (focus: Micro-hydro) development has been able to get as much acceptance as any other development projects currently going through?
	Where is the place of public in the development phase of RET in this district?	a. Are they are given priority in terms of opinion and involvement? (focus: Micro-hydro)

For District Energy and Environment Officer:	Does the district have RETs Energy Plan?	a. If yes, how is it integrated in district annual development plan? b. What types of RETs are focused in the district? c. Do you have a micro-hydropower development plan? d. How many micro hydropowers are installed in the district? e. How much budget is allocated for micro-hydropower?
	How is the community involved in Micro-hydropower planning and implementation process? (men/women)	a. How much financial contribution (percentage of labor contribution from local community) is made for common standard of micro-hydropower construction?
	Do you feel that RETs has been accepted by local community?	a. What are the major demands of local community related to RETs ? b. Do you have any preference of RETs you have during your tenure? c. Do you think that Micro-hydropower is popular among local community? Why?
	Are there any changes in people's life due to RETs particularly Micro-Hydropower?	a. What are the major changes of people's lives (women/children/students)? b. What are the recommendations/suggestions for sustainable micro-hydropower development in the district?

APPENDIX C: FOCUS GROUP TOPIC GUIDE

1. What do you think about the Micro hydro project in your VDC?
2. Does MHP provide satisfying performance to meet needs of household?
3. Do you feel involvement/ participation of community or local people is important for proper function of MHP?
4. What kind of support and services are provided by the institution working on this sector in your VDCs? Are you provided with trainings and maintenance tips for good performance
5. Do you think MHP has made positive changes in the areas like
    a. Education
    b. Local economy
    c. Community Development

APPENDIX D: APPENDIX TABLES

Table:

L*evel of Satisfaction of MHP Users in Terms of Power Factor (N=200) (for Figure 6)*

Level of Satisfaction	**Micro hydro plants(Frequency)**			
	Kota (n)	**Kotdurbar I (n)**	**Kotdurbar II(n)**	**Baidi (n)**
Highly Dissatisfied	4	6	5	14
Dissatisfied	34	5	8	10
Indifferent	7	5	6	14
Satisfied	20	10	5	4
Highly Satisfied	5	9	12	17

Source: Field Survey, 2013

Table.

Satisfaction on Service Given by Technician (N=200) (for Figure 7)

Level of Satisfaction	**Micro hydro plants(**				
	Kota (n)	**Kotdurbar I(n)**	**Kotdurbar II(n)**	**Baidi (n)**	**Total (n)**
Highly Dissatisfied	7	3	3	11	24
Dissatisfied	34	12	17	21	84
Indifferent	13	11	12	9	45
Satisfied	14	9	4	17	44
Highly Satisfied	2	0	0	1	3

Source: Field Survey, 2013

Table .

Willing of Different Energy Users Groups to pay for RETs (N=200) (for Figure 8)

Energy User group	**Response(n)**	
	Yes	**No**
RETs	7	40
Kerosene	80	41
Firewood	26	6
Others	0	0

Source: Field Survey, 2013

Table.

Response on Future Upgrading of RETs (for Figure 9)

Future Interest in upgrading RETs	**Frequency**	**%**
Yes	133	66.5
No	67	33.5
Total	200	100

Source: Field Survey, 2013

Table.

Frequency of Meeting (N=200) (For Figure 10)

Frequency of meeting	**Response**	
	Frequency	**%**
Very Often	0	0
Often	22	11.0
Intermediate	121	60.5
Rarely	49	24.5
Very Rarely	8	4.0

Source: Field Survey, 2013

Table

Response on Voices Heard in Meeting (N=200) (for Figure 11)

Gender	**Level of Fairness in Terms of Opinion**	
	Yes	No
Male	47	63
Female	37	53

Source: Field Survey, 2013

Table

Involvement in Repair and Maintenance of MHP (N=200) (for Figure 12)

	Involvement in Repair and Maintenance	
Micro Hydro Plants	**Yes**	**No**
Kota	11	59
Kotdubar I	12	23
Kotdubar II	5	31
Baidi	12	47

Source: Field Survey, 2013

Table
Trainings to the Local People (N=200) (for Figure 13)

Response	**Frequency**	**%**
Yes	53	26.5
No	147	73.5
Total	200	100.0

Source: Field Survey, 2013

Table.

Response on Reduction in Drudgery due to MHP (for Figure 14)

Response	**Frequency**	**%**
Yes	135	67.5
No	65	32.5
Total	200	100.0

Source: Field Survey, 2013

Table

Response on Increase in Education scale after Installation of MHP (For Figure 15)

Increase in Education Scale	Micro hydro Plants			
	Kota	Kotdubar I	Kotdubar II	Baidi
Strongly Agree	0	0	5	0
Agree	11	5	5	10
Indifferent	51	21	25	48
Disagree	4	8	1	0
Highly Disagree	4	1	0	1

Source: Field Survey, 2013

Table

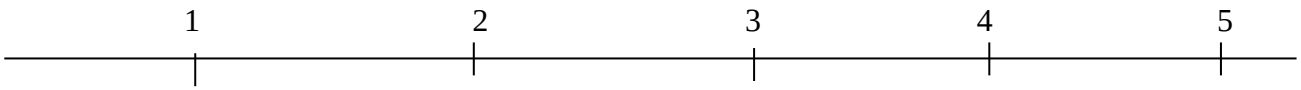
Use of RETs for Studying at Night (N=200) (For Figure 16)

Micro Hydro Plants	Response of RETs for studying at night	
	Yes	No
Kota	29	41
Kotdubar I	17	18
Kotdubar II	26	10
Baidi	12	47

Source: Field Survey, 2013

APPENDIX E: LIKERT SCALE VALUES

Table : The Likert scale expressing a range of values for the given answers



No knowledge	Some broad general knowledge	Relevant knowledge in one or two specific areas	Relevant knowledge in a number of Specific areas	An expert in this subject
Highly Dissatisfied	Dissatisfied	Indifferent	Satisfied	Highly Satisfied
Very Often	Often	Intermediate	Rarely	Very Rarely
No experience in performing task	A little experience in performing task	A lot of experience in performing task	Perform task as part of professic	An expert in performing task
Strongly Agree	Agree	Indifferent	Disagree	Strongly Disagree
Very Low	Low	Moderate	High	Very High

Source: (Author, 2013)

APPENDIX F: SOME PHOTOS OF RESEARCH AREA

Penstock pipe of Kota Barsha Khola MHP

Power House of MHP of Cherranga Khola(Kotdurbar)

Operator performing task of MHP

Access of Digital TV in Kotdurbar on MHP area

Focus Group discussion in Baidi

Focus Group discussion in Kotdurbar

Bulb liting due to power of MHP

ICS in MHP connected House

Survey with one of the Respondents in Baidi

Survey with one of respondents in Kota

KII with Energy Environment Officer of Tanahun

KII with the Manager of Kotdurbar II