Role of Micro Hydropower Plants in Local Development:

A Case of Two Villages in Sankhuwasabha District, Nepal

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List of Acronyms

AT	Appropriate Technology
DDC	District Development Committee
kW	Kilo-Watt
MSE	Micro and Small Enterprises
REDP	Rural Energy Development Programme
RERL	Renewable Energy for Rural Livelihoods
Rs.	Nepalese Rupees
UN	United Nations
UNDP	United Nations Development Programme
VDC	Village Development Committee
W	Watt

Abstract

Micro hydropower plants, a form of Appropriate Technology, have become an important source of renewable energy for the rural poor. Electricity from these plants effect the daily life-habits of households and also foster the birth of some new enterprises. This research papers assesses, using ethnographic methodology, how electricity access changes the livelihoods assets of the rural poor. It also explores what kinds of new enterprises have been established since the plants were established.

Relevance to Development Studies

This research paper contributes to current theoretical debates on livelihoods diversification by examining changes in livelihoods assets. It also challenges some of the existing theoretical debates on Appropriate Technology by examining its limitations. It critically assesses the electricity-growth relationship and its effect on local development.

Keywords

Appropriate Technology, assets, diversification, entrepreneurship, livelihoods approach, micro hydropower, MSEs.

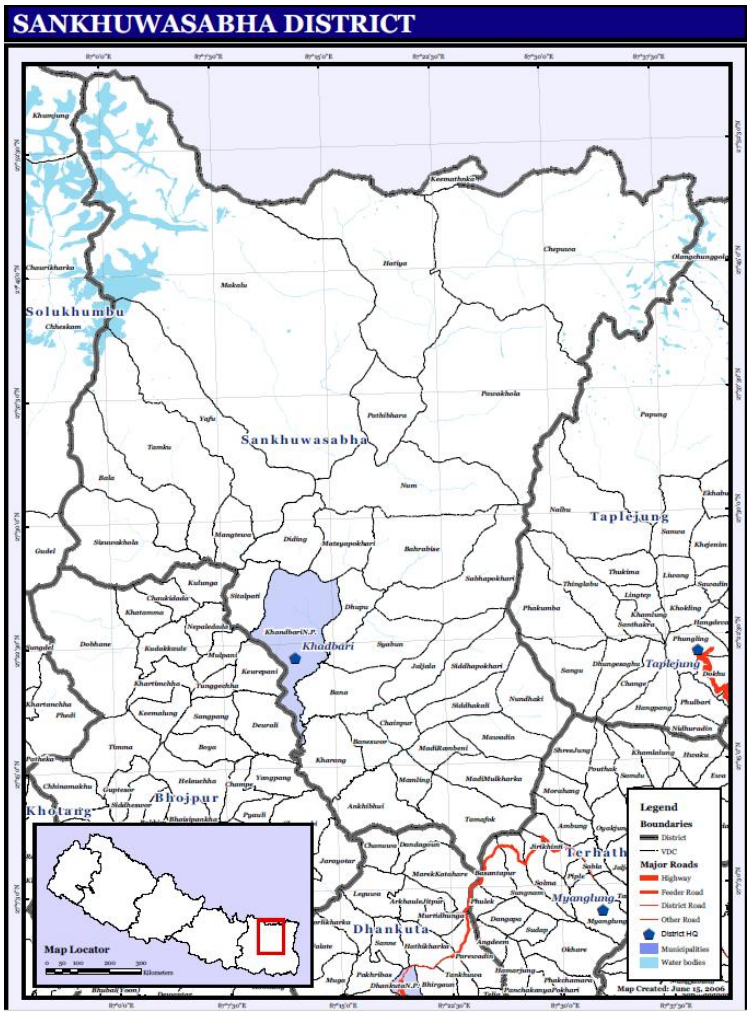
Chapter 1
Introduction

This research paper will study how electricity generated from micro hydropower stations affects life-habits and entrepreneurship in the villages of Yangsijung and Barabise in Sankhuwasabha district, Nepal. From this point on, Yangsijung will be referred to as Site I and Barabise will be Site II. This study will address, using ethnographic methodology, the gap in existing literature linking micro hydropower and local development. Current literature is limited to very superficial treatment of the impact of micro hydropower on the life-habits and entrepreneurs in the beneficiary communities, and tend to focus more on the organizational aspects of running a successful micro hydropower plant (Sovacool et al., 2011). This study is the result of living with the people in the study sites and experiencing life first-hand, and through numerous conversations and interviews that took place in settings that cannot always be considered formal interview sessions. How addition of this Appropriate Technology affects local development, especially its impact on entrepreneurs and the daily lives of individuals in the villages, will be analyzed in this research paper.

The Government of Nepal, with support from the UNDP and the World Bank, has invested around 35 million US Dollars towards establishment of micro hydropower plants and capacity development of beneficiaries of those plants (Legros et al., 2011). The micro hydropower plants in the two research sites in Sankhuwasabha also received some of those funds and support programs. Impact reports from the UNDP provide data to represent the overall achievements of the Rural Energy Development Programme (REDP) that address goals set within the Millennium Development Goals framework. Micro hydropower projects established in the research area have well organized management structures and revenue collection mechanisms. The research district is known for having a high level of agricultural activity so it would be interesting to see how electricity plays a role in agricultural productivity.

Scholarly works are limited to the impact of micro hydropower on gender relations and assessments of the REDP program as a whole (Mahat, 2004; Gippener et al., 2012). There is a significant absence of ethnographic research that might construct a clear picture of how electricity from micro hydropower affects life habits of beneficiary households and entrepreneurs in Sankhuwasabha. If electricity is an important part of achieving local development, availability of electricity should be able to spur changes in both in the life-habits of households that strengthen livelihoods assets and have a positive impact on entrepreneurship. Therefore there is a gap that can addressed by formulating a clear analysis that links fieldwork and existing theoretical frameworks.

Map 1.1
Map of Sankhuwasabha District



Source: http://www.un.org.np/maps/district-maps/eastern/Sankhuwasabha.pdf

1.1 Objectives and Research Questions

This research aims to find how the use of Appropriate Technology, the addition of a micro hydropower station and subsequently access to electricity, leads to increase in economic activity and change in life habits. This research paper will explore out how the micro hydropower stations in the communities are set up and maintained. It will find out what jobs the micro hydropower station in the community directly creates. The most important object will be to find out what kind of entrepreneurial activities have been set up because they could use the electricity generated by the micro hydropower stations in their communities. It will also inquire how these power plants were set up.

The main research question this research will answer is: In what ways does the availability of electricity from micro hydropower stations affect life-habits and entrepreneurial activity? The following sub questions help to further answer the main question:

- How are the micro hydropower stations set up?
- What are the changes in life-habits and their impact on livelihood assets?
- What is the impact on entrepreneurship? What is the effect on:
    - New start-ups
    - Job creation
    - Business upgrading
    - Demand for new products

1.2 Research Methodology and Limitations

This research was conducted using ethnographic methodology which was mainly qualitative in nature. Secondary data on the research area is slim but similar studies done in other parts of the country were key resources for this research. However, the bulk of the data presented in this paper comes from primary data collection- through interviews and first-hand observations and participating in village life.

My gatekeepers to the communities were two former members of parliament from Sankhuwasabha who lived in Kathmandu but were now involved in the hydropower sector. Primary data collection was done over a period of a little over two weeks in July and August of 2012. Data for this research was collected using purposive sampling methods, primarily relying on snowball sampling methods. The two members of parliament introduced me to a school teacher in Site I and he in turn introduced me to other members of the village and a community mobilizer. The community mobilizer then introduced me to the manager of the micro hydropower plant in Site II.

Interviews were conducted among 22 households in Sites I and II who had access to electricity to gauge and understand the kinds of life changes that had come about since the introduction of electricity from the power plants. 2 households that chose not to use the electricity were also interviewed in Site I to understand how not having electricity had affected them. This study also interviewed entrepreneurs at both research sites in order to see how availability and access of electricity created new jobs, led to possible process upgrades, and more importantly creation of new enterprises. This study interviewed 2 staff members employed directly by the micro hydropower plants, 4 general store owners, a chicken farmer, an entrepreneur with a cable television business, an owner of a beauty salon, and two owners of agro-processing mills in the two sites, and 2 school teachers. Table 1.1 a list of the interviewees.

Table 1.1 Interviewees

Interviewee	Number
Households	22
Power plant employees	2
General Store Owner	4
Chicken Farmer	1
Cable Business Owner	1
Mill Owners	2
School Teachers	2

Since the backbone of the study is its ethnographic methodology, living in and with the community was crucial to gain access to the community members. The first day or so was spent mostly walking around the villages getting to know a few people. There was a great level of curiosity among the residents because they were not used to seeing an outsider walking around in hiking boots toting a notebook. Crang and Cook (2007:43) mention that it is easier to conduct fieldwork if the researcher can blend in and not stand out in the crowd, for example a photographer at a wedding. Having a neutral stance while observing the members of the community would mean that I hold a negative stance towards them (Crang and Cook, 2007:46). Rather than approaching households for interviews directly, I introduced myself to them and spoke of what I was doing in their village. If they offered me tea or a snack, I never declined, which helped to establish a stronger connection with those who would later be my interviewees.

During the meeting with two former members of parliament I had been told that informing the locals about my research objectives was key to gaining access because they would not be honest with me unless I was honest with them. I was able to gain access to Site I through a teacher in the local primary school who was also the community's de facto leader. In both sites it was possible to meet roughly ten percent of the households. All the households approached for interviews were welcoming and interviews and observations regarding change in life habits were conducted in informal settings like during the morning meal together, or in the kitchen during the preparation of a meal, and in one case during a ceremony to celebrate the birth of a new born child in the family. The respondents were always willing to have their names used, however since most respondents in Site share one of two family names, this research paper will only use first names and also a middle name if two people have the same first name.

A community mobilizer who worked on behalf of the UNDP before the setup of the micro hydropower plants was also interviewed to understand the process of building a new power plant. Two school teachers were also interviewed to understand any effect electricity may have had on school children. UNDP reports on the REDP program were important for secondary

data. Literature on similar studies done in Nepal and abroad on micro hydropower plants also helped to understand the situation in the research sites better.

One of the limitations of this research is that it was not possible to visit a planned third research site where the micro hydropower plant had failed. Num, the failed site, is a two day walking distance from Khandbari, where the nearest motor road is. Although there is a road that goes all the way to Num the monsoon rains had damaged the roads and it was a task that I was not prepared to take after almost two weeks of physical activity. Data from the failed site could have led to a richer analysis when compared to findings in the two sites that I was able to visit. Another limitation was the amount of time spent in the two sites. Ethnographic studies require lengthy and repeated visits to properly understand the society in transition. The following figures 1.1 and 1.2 are helpful to understand the difficulty of access to the research district. Appendix B describes some of the physical challenges of doing research in rural Nepal.

Figure 1.1
The 'road' to Site I

Figure 1.2
A woman being carried to the nearest hospital on the damaged road leading to Site II.

Source: Fieldwork

Chapter 2
Appropriate Technology, Life-Habits, and Entrepreneurship

2.1 Introduction

Micro hydropower, a form of Appropriate Technology, has been touted as a renewable source of energy that serves the rural poor who would otherwise not have access to the grid. Not only has electricity generated from micro hydropower plants been used to light the homes of people who had previously been ignored by utility companies but it has also created a space for entrepreneurs to start new businesses that would previously have been unthinkable. The impact of electricity from micro hydropower is well documented in recent studies done throughout the world with most attention going to sustainable management of power plants, impact on climate change mitigation, and their role in empowerment of women. Local development in rural Nepalese communities has been a challenge for as long as development agencies have worked in the country. A geographically dispersed population, difficult geography, and a government with limited capacity have meant that things have moved slowly. Most communities still continue to survive on subsistence farming and levels of migration to cities in India and the Middle East is high. The impact of electricity in rural life is already known to be positive but its specific impact on entrepreneurs on whether to start a business or not depends on whether the appropriate technology can keep up with the entrepreneur's needs. If the improvement of infrastructure means increased development through jobs and increased productivity, Sankhuwasabha should be able to do well in the future. A relatively safe political environment has allowed some room for growth and the addition of electricity should mean that growth will follow and people's lives will change for the better. Increase in livelihood capitals should imply that a place should become more attractive for entrepreneurs who are willing to invest in the community leading to diversification of livelihoods and the ability to compete with neighboring towns and localities.

2.2 Appropriate Technology

Appropriate technology, known initially as 'intermediate technology,' a term coined by E.F. Schumacher to describe technologies that were designed to suit the needs of the users, almost rejecting the idea of one-size-fits-all (Zelenika and Pearce, 2011). Schumacher (1973) says that people in the West use technology that make their lives more stressful than those of people in poorer countries because technologies reduce one task but increase another. Appropriate Technology, from Schumacher (in Buitenhuis et al., 2010), are described as "those technologies that are easily and economically utilized from readily available resources by local communities to meet their needs". It must also comply with "the environmental, cultural, economic, and educational resource constraints of the local community" (ibid). Although Appropriate

Technology began as a movement in the developed world, inspired to some extent by Schumacher's leaning towards Buddhist philosophy, its ramifications on the developing world has greater importance (Wicklein, 1998 ; Zelenika and Pearce, 2011). Schumacher championed development of technology that was led by demand for innovation to meet the users' needs although the design may seem simple and lack complexity (Chambers in Zelenika and Pearce, 2011; Schumacher, 1973). Wicklein and Kachmer (2001) also note that Appropriate Technology should be able to create jobs and stimulate growth locally.

The aim of Appropriate Technology 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 (Evans et al. in Zelenika and Pearce, 2011). Wicklein (1998) says Appropriate Technology should be able to operate independently from other systems and must be able to involve the larger community it serves while maintaining the impression that it is a sign of modernity. In addition to Wicklein's criteria for Appropriate Technology, the Appropriate Technology Sourcebook from Village Earth (2012) lists some and most of them are more practical like that they should be affordable even to individual families and small groups of families. In complement to Wicklein's (1998) criteria 'individual vs collective technology,' the Sourcebook (2012) states that technology should and can bring people together to improve their community. It also notes that Appropriate Technology should work without doing harm to the environment (ibid.).

2.3 Livelihoods Approaches

Chambers and Conway (1992) say: "a livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the long and short term". Ellis and Freeman (2005). note that in the 'approach' "resources are referred to as 'assets' or 'capitals"' They name human capital, physical capital, financial capital, natural capital, and social capital as those that are parts of the framework (ibid.). Livelihoods approach is less top down development intervention in the sense that it seeks ways to achieve survival with what 'assets' families and the poor have.

According to Ellis (2000b:10): "(a) livelihood comprises the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household." For poor households one way to increase stability and improve life quality is through livelihood diversification, which Ellis (2000b:15) describes as the process to diversify the number of activities and assets.

The definition of household varies by author but for the purposes of this paper a household is defined as "players committed by choice or custom to act as a unit vis-à-vis the rest of the world"(Stark, Preston in Ellis, 2000b: 18). A household in Sankhuwasabha can be one that lives in one or two adjoining houses but make decisions together because they are related by blood.

Farming versus non-farming diversification will also be discussed in this research paper. It is discussed much in literature and conclusions from the developing world provide some answers as to why the rural poor diversify the way they do (Barrett et al., 2001; Rahut and Scharf, 2012). The kind of non-farm activities that households are involved in depends on the asset base of the household as the poor invest in low-return non-farming activities while the relatively better-off tend work in higher return activities (Rahut and Scharf, 2012). Also, Barrett et al. found in their review of literature from Africa that diversification in non-farm activities led to an increase in earnings (2001).

2.4 Link Between Infrastructure and Development

Although it might appear to be common-sense that governments need to invest in infrastructure to improve the lives of their citizens it is easier said than done. Governments in the developing world lack the capacity and capability to invest in infrastructure that would be considered a part of everyday life in the developed world. Provision of electricity to the rural poor has made some leaps in Nepal through the implementation of renewable energy programs with donor support but whether the benefits really outweigh the costs is one that can be contested. Since the involvement of the lending institutions and donors is so high it comes as a surprise that the World Bank's level of satisfaction of its investments in rural electrification projects is much lower than its other projects (World Bank in Cook, 2011: 304). Cook (2011) mentions that other debates aside, the most clear link between infrastructure is with rise in productivity. When enterprises have access to electricity entrepreneurs will invest in other activities and similarly in rural areas there can be a diversification in activities that eventually impact productivity (Cook, 2011: 305).

There is a lively discussion among scholars with some suggesting that infrastructure's effects on productivity can be lengthy and costly and others with studies that suggest that infrastructure is important in low income countries for growth (in Cook, 2011: 305). Also, the long run contribution of electricity to income generation leading to a rise in demand for more energy suggests a virtuous circle that can benefit the rural poor (Peters et al., 2009). A broad literature analysis by Ozturk (2010)concludes that role of electricity in growth can be limiting, so shocks make growth more vulnerable. Chaurey et al. (2004), however, argue that electricity from renewable sources need to be applied to income generation or they cannot influence change in living standards.

2.5 Entrepreneurship

Berner et al.'s (2008: 1) "anthropological slum walk" reveals two distinctive types of entrepreneurs in the developing world. 'Survivalist' entrepreneurs who undertake a small business venture of their choosing that requires very little capital to begin, meaning low entry barriers, usually have minimal or no skills to seek regular employment (Rogerson in Berner et al., 2008: 5) . Survivalists tend to be primarily women who seek to supplement the steady incomes of other family members, and these entrepreneurs usually deal in goods or

products that can be easily bartered or consumed in the case of a shock or stress to their income (ibid.).

'Growth-oriented entrepreneurs' usually tend to be family enterprises that are more of a risk-taking variety and for them it is more difficult to get started because access to finance can act as one of the barriers to entry (Berner et al., 2008:7). They are often male and tend to specialize in terms of what goods and services they sell. Their ability to micro-accumulate is probably the most important distinction between them and survivalist entrepreneurs (ibid.).

The concept of entrepreneurship and typology of entrepreneurs is crucial because this research paper will aim to find out how availability to electricity affects entrepreneurs. Whether access and availability of electricity to the villagers gave the entrepreneurs in the communities a more stable environment to begin a new enterprise or to take greater risks will be something that needs closer attention. This analysis of kinds of entrepreneurs is important to this research because this study would like to find out if the communities under investigation are headed down a slippery slope or are becoming part of a 'virtuous circle.'

Berner at al. (2012:389) argue that survivalist entrepreneurs lack the motivation to expand their business and in contrast to growth-oriented entrepreneurs they tend to have low or no income to support their business, and much of the responsibility of running a survivalist enterprise in the household is delegated to female members who also have to participate more than men in household work. Another distinction made by Berner et al. (ibid.) is that smaller firms have a harder time getting access to finance because and even when finance is available they tend to get micro-finance which is not well suited for growth oriented entrepreneurs.

Growth of MSEs in developing countries had been the issue of debate in both the academic and development circles. Whether development organizations should continue to support enterprises that have low rates of graduation from the informal to the formal sector is another issue that is a frequent topic of debates. Nichter and Goldmark (2009) suggest that firms in developing countries "lack both profitable business opportunities and capabilities such as skills, resources, and technology." Rather than being forward-looking and looking for opportunities to grow, MSEs in developing countries are more focused on survival (Nichter and Goldmark, 2009:1460). Ozgen and Minsky (2007: 51) postulate that opportunity recognition in rural entrepreneurship is an important factor because how local factors like human resources interact with national frameworks. According to Ozgen and Minsky (2007: 53), three capitals: human, socio-cultural and environmental, with the national framework play an important role in helping entrepreneurs find opportunities in rural areas.

Already constrained by growth rates as low as 3 percent, newer MSEs in developing countries tend to be one-person firms that start in vast numbers during low levels of economic activity and tend to end up working in sectors with low returns (Mead and Liedholm, 1998, Nichter and Goldmark, 2009). Education, work experience, and gender can be limiting factors for entrepreneurs; characteristics of the firm like firm age, the formality-informality conundrum, and finance are factors associated with growth of firms (Nichter and Goldmark, 2009).

Nichter and Goldmark (2009: 1460) also suggest roles that development practitioners can play in helping enterprises succeed. Programs that work in enterprise development tend to focus on multiple areas to help entrepreneurs and there is no one "winning formula" organizations should be more focused on what they would like to achieve (Nichter, 2009: 1460). Nichter's (2009) segmentation of entrepreneurs into latent-gazelle and survivalist entrepreneurs provide a good segue into Berner et al's (2008) typology of entrepreneurs in the developing world.

The proposition to make markets work for the poor does provide some feelers into the arena on how making markets work can create new entrepreneurs and consumers who can benefit from cheaper products (Meyer-Stamer, 2006: 30). A key aspect is to analyze market failure using barriers to entry in the market (ibid: 31).

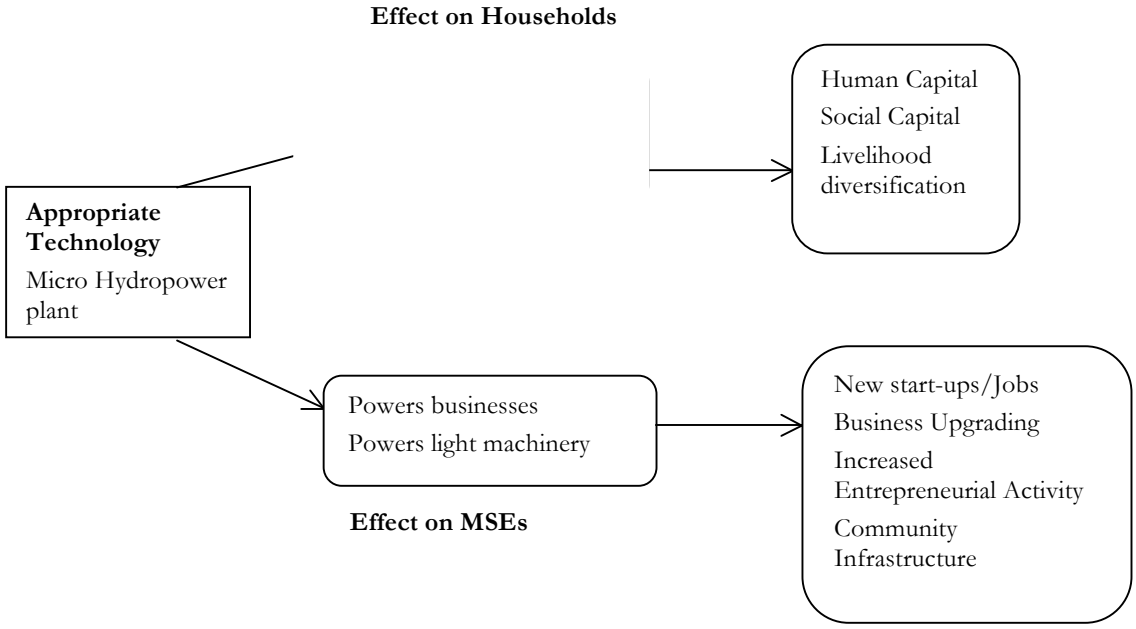
2.6 Community Economic Development

Due to the reduced role of the state in planning its economy due to structural adjustment it is increasingly falling in to the hands of the communities to shape their own economic future (Helmsing, 2003). As the rural poor are increasingly involved in a greater number of activities as a coping mechanism Helmsing (2003: 71) proposes that community economic development should aim to improve the living conditions in a community through promotion of self-employment and stimulating a sense of community. As more people move to diversify their sources of income, Helmsing (2003: 70) notes it is likely that the rich in rural areas will invest surplus income in trade and industry. Development of micro enterprises to facilitate the growth of the community is a key aspect of community economic development and Helmsing (2003: 71) 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.

2.7 Analytical Framework

This research will analyze how Appropriate Technology in the form of micro hydro power plans effect the life-habits and entrepreneurship in these two villages. The effects on households will be analysed through the lens of livelihoods approaches paying particular attention to the effect on assets and diversification strategies. The role of the power plant, and the electricity produced from it, in job creation, business upgrading, and new start-ups will be analyzed using theories on entrepreneurship, and infrastructure and development.

Figure 2.1
Analytical Framework



Chapter 3
Appropriate Technology and Micro Hydropower in Sankhuwasabha

3.1 Introduction

Nepal, over the last four decades, has made great strides in adopting decentralized forms of energy. Micro hydropower plants that rely on fast-flowing streams with minimum infrastructure and small investments, compared to large power plants that require large sums of capital and have major impact on the environment, have been able to meet some of the energy needs of hundreds of rural communities throughout the mountains of Nepal. A system that generates between 1 kilo-Watt and 100 kilo-Watts is termed as a micro hydropower system (Pokharel et al. 2008). See Figure 3.1. Although water wheels have been used in the past to reduce drudgery like grinding grains and milling oil, generation of electricity for individual localities goes back to 1962 when a 5kW set was installed by the Swiss and estimates show that up to 2003, over 2500 micro hydro systems have been set up and 2065 were still in operation (Nepal Micro Hydropower Association, 2012; Pokharel et al., 2008). The Government of Nepal established the Rural Energy Promotion Centre in 1996 with assistance from UNDP to streamline its efforts to promote new micro hydropower systems or provide assistance to existing ones (Nepal Micro Hydropower Association, 2012).

Micro hydropower has been a favorite of donors and international lending institutions like the Asian Development Bank because it has greater reach to people in rural, isolated communities and has a greater involvement of the private sector. Since extending the grid is costly and not cost-effective, due to lack of market efficiency or lack of ability of users to pay, micro hydro can be set up with minimal subsidies from the government and the private sector or the community can take charge within a short period of time (Barnes and Floor, 1996; Yadoo and Cruickshank 2010).

The best way to deliver appropriate technology and to manage distribution of electricity from in rural areas has been discussed much in the academic literature (Grieve, 2004; Wicklein, 1998; Yadoo and Cruickshank, 2010). The role of micro hydropower in climate change adaptation and community mobilization in Nepal has also been studied recently (Gippner et al., 2012). Cromwell has analysed that transferring technology in the micro hydro-power sector works differently when handled by private firms and by the government and concluded that the private sector can be more efficient and effective than the government(1992).

A micro hydropower station is one that generates electricity between 1kW and 100 kW (Chhetri et al. 2009: 571). (100 Watts of electricity is enough power to power up to five compact fluorescent light bulbs). 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. Examples of micro hydropower stations in Bolivia

show that survival of micro hydropower projects depend on a number of factors, like the management's ability to learn and adapt from experience (Drinkwaard et al., 2010). Lessons from Africa show that in order to serve electricity demands that are spread out geographically, it may be a better option to establish independent grids that extend the national grid (Pigaht and vad der Plas, 2009).

They have demonstrated to be an effective way to combat poverty and strengthen communities that are susceptible to climate change (Gippner et al. 2012). They have found popularity in donor-led interventions as topics of climate change and sustainable energy climb higher in the agendas of the developed world. Examples from Bolivia have shown that the role of the government in the success of micro hydropower development is crucial to success and sustainability and the government can actually play a negative role in order to push its own agenda (Drinkwaard et al., 2010). It has also been found to empower women and increase their involvement in income generating activities (Gippner et al., 2012). Micro hydropower has also shown to reduce to some degree reliance on firewood, fossil fuels and batteries and to have improved access to communication technologies in the beneficiary communities (ibid.).

Private sector run projects have been documented in Rwanda where securing a high degree of local participation and availability of finance from banks were crucial to their success (Pigaht and van der Plas 2009). 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 and Karky, 2002).

Nepal has a long history with micro hydropower stations. The Swiss cooperation agency installed a 5kW plant near Kathmandu in 1962 (Nepal Micro Hydropower Development Association, 2012). Since there have been around 2500 such plants installed around the country although not all of them fit the "micro hydro" designation. Much of the electricity generated has been done to provide household electrification, agricultural hulling, and pumping water. The Intermediate Technology Group (now Practical Action) was crucial in transforming traditional water wheels into electricity generating power plants.

The failure by the government to introduce large power generation plants was added incentive to invest in micro hydro (Mahapatra, 2001). Ambitious projects like Arun III were proposed to make Nepal electricity self-sufficient but due to various political mishaps this never materialized, which meant rural electrification became a distant reality without micro hydropower. In 1985, the government decided to deregulate the micro hydro energy sector by deciding not to levy taxes (Mahapatra, 2001). Projects up to 100 kW were provided subsidies and soft loans through the Agriculture Development Bank to foster the growth of the sector and to encourage private sector players to take charge (ibid). At one point the government even agreed to subsidize start up costs up to two thirds of the total costs (ibid.). Experts say that this move by the government made the sector attractive to private investors who had previously been reluctant to invest in it.

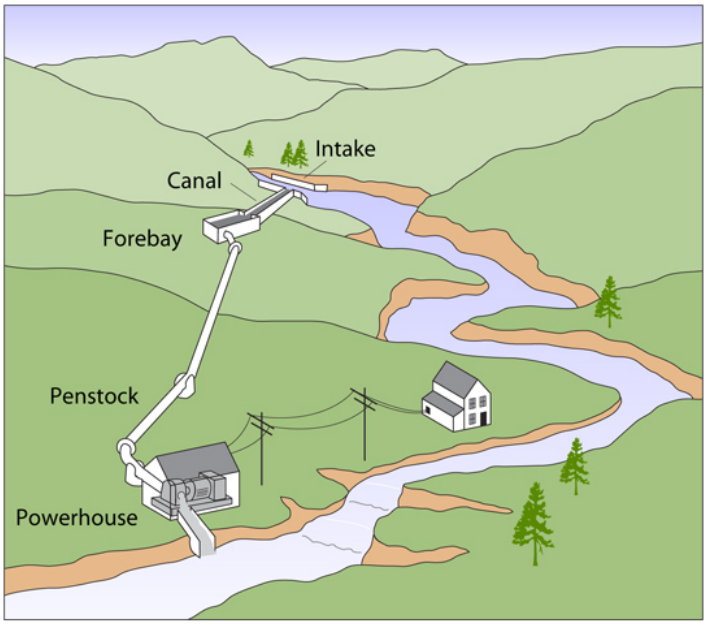
The Government of Nepal established the Alternative Energy Promotion Centre in 1996 and the UNDP set up, with the Ministry of Energy, the Rural

Energy Development Programme (REDP), which is now known as the Renewable Energy for Rural Livelihood Programme. These two programmes have been fundamental in stimulating the setup of more micro hydropower plants in Nepal. The REDP is now active in 25 of the 75 districts (REDP, 2008). The REDP claims that 7.6 MW of electricity has been developed reaching 76,000 households throughout the country (REDP, 2008). REDP has worked in phases setting goals beginning with a pilot programme in 5 districts (ibid). According to REDP, by June 2003, there were around 120 micro hydro programmes.

There have been a number of major developments in Appropriate Technology that have supported the growth of micro hydropower plants in Nepal and elsewhere. Intermediate Technology Development Group, now known as Practical Action, has been a key actor in working in developing countries to develop solutions that have benefited the micro hydro sector. In the 1960, the Swiss government helped to establish Balaju Yantra Shala, a manufacturing facility, that was designed specifically to produce devices and machinery for Nepal's agricultural sector. It also produced the first micro hydro generators used in Nepal (Nepal Micro Hydropower Association, 2012). Some of Practical Action's work areas help to elucidate its role in AT.

As the rural poor consume low amounts of electricity and the cost of getting a connection can be cost-intensive, Practical Action came up with a number of solutions to help overcome these obstacles. The initial costs of wiring a house that receives power can be an impediment to even setting up wiring so Practical Action came up with appropriate technology solutions in the form of wiring harnesses that are easier and cheaper to set up (Practical Action, 2005). This design makes distribution safer as all the components of distribution and switches are in one unit and can even be set up in thatched houses (ibid.). Electronic current cut-out devices were developed in Nepal to turn off the power when the voltage became too high measuring the change in voltage than the change in temperature (Practical Action, 2005). Low voltage cookers developed in Nepal allow rural families to use power from renewable energy sources like micro hydropower because these sources cannot run regular electric cookers at the same time. As people in one community tend to cook their meals at around the same time regular cookers would not be a sustainable piece of technology, so these low voltage cookers have been designed keeping the users' context in mind (Practical Action, 2005). Low voltage cookers have three distinct advantages: they can be used during off peak hours to use the excess voltage in the system; they reduce dependency on fuel wood for cooking; and since they are smokeless they can reduce harm caused by smoky cookers.

Figure 3.1
A Micro Hydropower Plant



In this microhydropower system, water is diverted into the penstock. Some generators can be placed directly into the stream.

Source: http://energy.gov/energysaver/articles/microhydropower-systems

3.2 How the Micro Hydropower Plants Were Set Up

The first part of this chapter concerns the planning and construction of the two micro hydropower plants. The community leaders at Site I had made a number of efforts in the past years to set up a micro hydropower plant in their village but every effort had failed because they were either short on funding or the Maoist conflict that lasted for a decade until 2006 meant a construction project could not go ahead without paying significant protection fees to the Maoist rebels. A Russian philanthropist, who built a bridge that leads to Site I, was interested in funding a power plant but gave up after having a bad experience with the Maoist rebels and paying them money for not blowing up his bridge. At the end of the conflict, the community again applied to the energy department of the district development committee and were told that the government would bear, courtesy of REDP, 82% of the costs which amounted to Rs. 2,900,000.[1] The DDC bore Rs. 200,000 and the village

[1] 1 Euro= Rs. 107 in June 2012. Source: http://laxmi.laxmibank.com/Individual/Rates/Exchange%20Rates.aspx?m=985uz2YQZ84=

development committee gave Rs. 400,000. In addition to that they also lobbied the local members of parliament to donate money, and two of them gave Rs. 50,000 each. The local branch of the Ministry of Forestry and Soil Conservation provided 105 units of gabion wire to construct a channel for the power plant. The REDP also sent a community mobilizer to help start neighborhood savings groups to also raise funding for the project. The mobilizer's job was also to ensure that everyone in the community had the opportunity to voice their concerns and ensure unanimous decision-making in the group. Once the funds were in place, Appropriate Engineering Company, from Butwal was recruited to supply the mechanical equipment. In addition to contributing Rs. 1000 to the construction fund, each family also had to send one family member to work at the construction site. Failure to send a family member would incur a fine of Rs. 100. Construction was finished by May 2008. Appropriate Engineering also sent technicians to trains locals to do house wiring and install the electric poles.

In Site II, the process was very much similar to that in Site I. REDP, through the DDC, provided Rs. 3,875,000. Since Site II is at the confluence of three village development committees, the three VDCs gave Rs. 332,000 each. During the construction phase, the REDP also sent a community mobilizer to Site II to establish neighborhood savings group like those in Site I. At Site II, they charged a fine of Rs. 250 to any family that failed to send a member to work on the construction site. It took 51 days to construct the plant and it started operations in August 2010. One major difference between Site I and Site II is the revenue collection models use.

In Site I, the management committee set a cap on usage at 100 W, enough to operate 5 compact fluorescent light bulbs and installed a circuit breaker in case a consumer tried to use more than the allotted 100 W. In Site II, the original model for usage and fee collection was the same as Site I until July of 2012. Consumers in Site II decided to switch to a pay what you use model when there were frequent power outages because of alleged theft and overuse. The decision was to install meters that would measure usage. A flat fee of Rs. 80 was levied on usage up to 20 units and usage above 20 units incurred a fee at the rate of Rs. 10 per unit.

Chapter 4
Changes in Life-Habits and Livelihood Assets

4.1 Introduction

This chapter contains findings from fieldwork conducted on effects of micro hydropower projects on the life-habits and livelihoods assets of households in Sites I and II. The direct effects on life habits that were identified during the fieldwork will be discussed and analysed. Changes in daily activities and reduction in use of fossil fuels, strengthening of livelihoods assets, and improvement in capitals will be described and assessed using literature on livelihoods. This chapter will also venture into what specific areas of life in the beneficiary localities have specifically changed or improved with the addition of electricity.

4.2 Reduction on Drudgery

In Site I, households are primarily farmers. Farming activity can be divided into two distinct areas for almost all households. Cardamom, the main source of cash, requires only a few months of labor a year, especially during the weeding and harvesting process. The other activities revolve around growing corn, millet, and potatoes for self-consumption. Each household may also have squash, beans, and lentils because there are no markets available to purchase vegetables. Every household also keeps animals like cows, goats and chickens. So a lot of time, mostly for the women, goes into fetching fodder for the cows and goats. One major change for the women, who already have a lot to do, has been the new electric powered mill in the village.

Nepali women reportedly spend 12 hours on household chores so the introduction of mills in the villages has meant women would have normally had to wake up in the early hours to grind the corn have more time to rest (REDP in Bastakoti: 27). This seems to concur with my personal observations. The family I was staying with in Site I had two women, a mother and daughter pair, who awoke well before the male members of the household and began the day's chores. Typically their mornings began at 5 AM and I never saw them sit still until they went to bed around 10 PM. Besides working in the kitchen and feeding their livestock, the two women spent much of their time working on their fields and their relatives' fields.

Mahat (2004: 9) notes that women in rural Nepal spend between two and four hours daily to process grain. If women, both adults and female children, did not spend the first few hours of the day grinding corn would mean no lunch on the table before the rest of the family headed out to school or to the fields. The arrival of the mill has meant that they can just make a weekly trip to the mill that is in the center of the village. One elderly man remarked how women in the village now wake up later, because when he was young, women

would have gotten kicked out of their homes if they woke up as late as women still did.

The hardship now associated with milling was getting the grains from the home to the mill and back. Both in Site I and II, most households lived within 20 minutes of the mill so in comparison to spending 2-3 hours on a stone mill, walking that distance means a significant reduction in drudgery for women compared to spending long hours leaning over a stone mill. This reflects a significant impact on the human capital of households and specifically women. Mahat (2004: 12) notes a possibility in her gender analysis matrix that reduction in drudgery means increased possibilities for women to engage in income-generating activities. However, these possibilities are still limited because both sites did not have any significant change in women's participation in productive activities. There were no women's literacy classes where adult women could study in the time saved from drudgery. There was also little evidence to suggest that women were involved in entrepreneurial activity now that they had more time. Only one entrepreneur in Site II had taken up hairdressing as a profession but it should be noted that she was already working in non-farming activities before the arrival of electricity.

The ability to mill their produce in an electric-run mill rather than at home has multiple implications in terms of protecting their assets. One important effect is on the health of these women who have to spend less time doing back-breaking work on a stone mill which can be both tiring and causes physical pain. This in turn leads to an improvement in their human capital (Ellis, 2000a: 296). A few extra hours of rest means they can be more productive on the farm or spend more time with their family. This also brings into focus the fact that reduction in drudgery means the metabolic energy of women is no longer unseen(Cecelski in Mahat, 2004: 9). The use of electric mills in a program-wide analysis by the UNDP shows that households saved on average 240 hours each year (Legros et al., 2012: 45). Electricity for women has significant meaning because it means an improvement in activities that are not compensated, like child-care (Cook, 2011). However, reduction in drudgery has not necessarily meant growth in other areas.

In Site I, I visited a family where a young woman was using a giant wooden pestle to pound rice into flour. When asked if she did this regularly, she mentioned that she was doing only because the rice was to be later used as an offering to God to celebrate the birth of a niece. After the arrival of the electric mill, she noted she no longer had to worry about milling grains at home except on special occasions.

The livelihoods framework so far has been adamant about how rural livelihoods operate. The livelihoods framework has been widely adopted by development practitioners throughout the world and their credo has been a call for diversification by the rural poor. Barrett et al. (2001: 315) even go so far as to say: "(d)iversification is the norm". When one is to consider the reduction in drudgery the strengthening on a human asset, one would expect there would be a pull to diversify. Even Mahat (2004) notes that this saved time would allow women to pursue other things but this research shows otherwise. Besides being able to rest more, there has been no effort on part of the households to actually increase their sphere of diversification.

Ellis (2000b: 55) posits that households will diversify out of choice or out of necessity. Diversification out of necessity is usually in response to distress and diversification out of choice is what it is: a proactive action to reduce future risks (ibid.). Diversification has become this infallible pillar in livelihoods scholarship because there is lack of empirical research into whether the rural poor do actually stop diversifying when a certain aspect of their need has been met and they would rather pursue other needs. This research, although it is merely a scratch on the surface, shows that it is possible that the rural poor may actually opt out of diversifying even when opportunities exist. Since the arrival of electricity three years ago, Site I has seen no actual growth in electricity use for major commercial purposes other than household consumption and related activities. The families in Site I are just glad that they have light when they flick their switch and can eat food without having to process it for hours. There is definitely a strengthening of assets but not a diversification of livelihoods. Since households now have more free time and rest there are opportunities for individuals and households to diversify their livelihoods and to evaluate their risk strategies. But personal observation is that since one aspect of the needs is taken care of, there is no imperative desire on their behalf to exploit wants. This leads us to the assumption that there may be unfulfilled needs but an absence of wants in Site I.

4.3 Extended Hours of Light and Reduction in Kerosene Use

In the two localities studied the impact of electricity becomes visible as darkness fall. Neighboring villages are no longer visible in the dark and the areas under study come alive with the sounds of radios. Children study under light bulbs and adults gather around radios and televisions. On the way to Site I, a person walking along talked about how he could see the lights in Site I and feel a bit of envy because he and his family had to spend hours in the darkness at night[2].

Electricity has had an impact on a number of life-habits discussed earlier and there is a sense of pride among the residents who stated that when they applied to the government for funds to build a power station their main concern was having electricity at home, they did not think about what would happen once they received it. Naina, a resident of Site I, remarked:

> Before electricity we were in the darkness, but now we feel like we have joined the rest of the world.[3].

This statement is a strong affirmation of one of the criteria set for AT (Wicklein, 1998). Just this immeasurable sense of being not left out from the rest of the world is enough for the residents to feel a bit of satisfaction each time they flick on a light bulb switch. The impact on human capital from being

[2] Conversation with resident of Bihibare: 25/07/2012.

[3] Personal interview: 26/07/2012.

able to feel connected to the rest of the world means a greater capacity to participate in productive activities that would have previously not been possible.

In addition to reduction in drudgery, a result of electricity has been change in use of kerosene by households in the two research sites. Since the power supply from the power plants is reliable and is shut down only in case of a flood in the river or a downed power line the beneficiaries have had to rely less and less on kerosene for lighting purposes. Not only did kerosene purchase deplete the villager's already low cash savings but it also had a negative effect on the health of children who studied by the light from kerosene lamps[4]. Most families reported that they only kept kerosene at home as a reserve in the case of accidental power outage during the monsoon season when the river tends to flood and interrupt power generation. Lakpa's family would purchase up to 3 liters of kerosene a month to light home before the micro hydropower plant was opened. Not only was the kerosene expensive but it had to be carried all the way from a market town an hour's walk away.

In Site II, kerosene is easily available due to road access during the dry months but the residents have to pay a premium over the market price because it is usually carried by traders who have a monopoly on ferrying goods from the nearest petrol station, which is 4 hours away. He also spoke of using bamboo torches with a kerosene-soaked rag to get around the village at night in the past. Since getting access to electricity, families tend to buy portable lanterns with LED lights that can be carried around easily. One member of the community proudly showed all his rechargeable lanterns and flashlights when asked what he used to walk around at night. An added benefit of using less kerosene has been that the risk of fires have been reduced. From this it is apparent that there is an increased sense of security to walk about at night.

Lakpa, a school teacher, spoke of how some students had almost burned their homes to the ground when the tipped over the kerosene lantern over while falling asleep studying late into the night[5]. Kerosene lanterns are not the most efficient at producing light, because the wicks used are old and tend to smoke a lot so this can only be seen as a benefit to the micro hydropower users.

Since a household can save from reduced kerosene use, it means that cash can be utilized to purchase rechargeable lanterns and flashlights that not only last a lot longer but are also safe and have no adverse health effects. Charging rechargeable light sources cost a lot less, so a household can save more cash in either the savings schemes or at home than spend money on kerosene. During this research, interviews with each household revealed that they owned at least one rechargeable lantern or flashlight. Reduced use of kerosene again relates to an impact on the human and financial capitals in both sites (Ellis, 2000b). Since

[4] Price of kerosene per liter= Rs. 93 with 1 Euro= Rs. 107 in June 2012. Source: http://www.nepalnews.com/home/index.php/news/1/19579-noc-hikes-prices-of-diesel-and-kerosene-by-rs-4.html

[5] Personal interview: 29/07/2012

financial capital can be used either for saving or for consumption, money saved from the purchasing kerosene can be significant. Legros et al. (2011:43) 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. This is consistent with what this research found.

Sapana, a resident of Site I said:

> In the past we used a liter of kerosene each week but now we can manage with that same amount for 3 to 4 months. Each time we ran out of kerosene we had to walk 4 hours to Chainpur.[6]

In addition to reduction in fuel consumption, there is also more sense of physical security at night from drunks.Another respondent, Laxmi said:

> Having light at night means we can walk around without fear. [7]

Reduction in kerosene use is an important start towards a reduction in fossil fuel use. However, there has been a no effort to introduce other services that complement electricity availability to reduce fossil fuel consumption. Almost all households in both Site I and Site II rely on firewood for cooking. Most households had cellphones and radios and televisions for entertainment but none had low-wattage cookers. This finding is consistent 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. The lack of institutional arrangements to encourage use of new cooking methods is apparent here. One of the respondents told me that they were not planning to give up fuel wood for cooking anytime soon because there was no alternative available at that point. When I mentioned the low-wattage cookers to them, they had never heard of them even though they are available elsewhere in the country (Practical Action, 2005).

4.4 Access to Newer Technology

Site I feels as close to anywhere in the world as it is far. Television dishes are a common site atop most homes and every young person in town seems to have a close attachment to their cellphone as any young person in the West. Almost every household visited in both Sites I and II owned at least one television, and nearly every adult member of the family owned a cellphone. According to them, this was unimaginable before the availability of electricity because even charging a cellphone would have required expensive solar panels that only a few could afford. So, if there was need to make a phone call, residents often had to walk to Khandbari, the nearest large town, to make a single phone call, a roundtrip walk takes the entire day.

The proliferation of cellphones is also very high in Site I, however televisions are still a rarity. Only families with regular cash income, like school

[6] Personal interview, 27/07/2012

[7] Personal interview, 28/07/2012

teachers, enjoyed having a television at home. Some other families besides the teachers also owned television, where young children had compelled their parents to buy one. A young woman revealed that she often went to a friend's house and wanted to move to a big city like Kathmandu when she saw attractive young women on television shows who drove cars and did not get their clothes dirty working in the fields. This young woman was listening to music throughout the entire conversation. However, her mother had no idea what movies were and claimed she never watched the television. In Site II, where almost every family owned a television, spending evenings watching the news and soap operas was a common activity. Since access to newspapers is limited, most dailies are published in Kathmandu and only reach the larger towns like Khandbari and are brought daily by air, news from radio and television is an important source of information for those living in both research sites. Often in the evenings, families left their radios blaring evening newscasts. One villager spoke of how he felt closer to the world because he could now listen to the news on agriculture and farming issues.

Since cellphones and radios draw very little power from the power plant users in both sites were not deterred by cost of usage. Since Site I does not have a cap on electricity use except on the amount of power drawn from the system, users often had their radios on until they went to sleep.

With the advent of cellphones a benefit for farmers has been the immediate availability of market prices for their cardamom produce. Since prices fluctuate based on commodity markets in India, the same quantity may fetch different prices throughout the day. This aspect of usage of electricity is important because "access to information may be obtained by investment in a radio or in education" and now with cell phones means having greater choices in terms of where and when to sell their crop of cardamom (Chambers and Conway, 1992:8).

With increased interaction with and increased access to technology, there has also been change in terms of goods consumed in both research sites. Shopkeepers have seen a drastic rise in sale of mobile phone top-ups. Hem Raj Wanim, a storeowner in Site II, sold up to Rs. 20, 000 worth of mobile phone top-ups in a month. Subash, also in Site II, sold around Rs.120, 000 in a month. Similarly, the demand for rechargeable flashlights and lanterns has also gone up significantly.

4.5 Impact on Education

The impact of electricity from the micro hydropower plants on education has become apparent even though the two sites have only had the power plants for short period of time. Govind, the principal of a secondary school in site II spoke of how his school was not attracting students from surrounding villages and there was a rise in overall attendance. Lakpa, a teacher at the primary school in Site I said:

> In the past parents kids would not show up for school if they hadn't finished their homework. Now the attendance is much better. In the past (before electricity) parents used to prevent their kids from studying late at night because it used up kerosene and was also a safety hazard, but now with electricity kids can study late into the night, especially during examinations.[8]

Legros et al. (2011:35) at UNDP found that in households who had electricity, children spent longer hours on homework and reading than in non-electrified households. Households with electricity spent twice as much as non-electrified households on school supplies and school expenditures (ibid). Improvement in rural lighting increases the chances of education 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" (Gibson and Olivia, 2009 in Cook, 2011:308). This is possibly a long term effect of improved access to education because unless opportunities exist in the two villages, youth, regardless of education level, will attempt to migrate to an urban area or go abroad for employment when household income is not adequate. Of the two sites, Site I would need to provide improved education facilities that could provide students room to attain education that could enhance their capabilities for improved livelihoods (Chambers and Conway, 1992:22)

The school in Site I received a desktop computer and a printer from a resident but they were rarely able to use that because the power would come on only when the school let out for the day. One of the school teachers did use the computer even during the off hours but when I visited the school, the computer was not working and nobody had any idea as to why it was out of order. However, in Site II, things were a bit more positive. The school there had more computers and students were given regular access to it. Although they lacked internet connectivity in the school, the students and teachers made regular use of it. The principal of the school noted that they even had a photocopier in the school, so it was much easier for them to publish/print exam questions in the town rather than having to walk 5 hours to Khadbari.

The impact on school attendance and the schools ability to make use of electronic equipment to enhance their teaching capabilities is noteworthy. Ellis (2000b:43) calls public education a vital mechanism to ensure development of human capital. The differences between Site I and Site II in terms of education are important. Site I has only a primary school and upon completion they usually walk to a secondary school an hour away each way. Those who can afford it send their children to larger towns like Chainpur and Dharan to finish schooling. In comparison, Site II has a school until the 12th grade. Since it is a larger town and is the commercial center for surrounding villages, Site II has greater room to expand their services for students.

[8] Personal interview, 29/07/2012.

4.6 Savings Groups

One interesting and long-lasting impact of the setup of the micro hydropower plants has been the set-up of savings groups in both research sites. Before the power plants were constructed, REDP sent community mobilization workers to both sites to establish neighborhood savings groups that would collect funds to help bear some of the initial costs. Having electricity allows people to diversify their income source to build what assets they have (Bastakoti, 2006: 33). Set up and successful running of savings group show that households not only have improved each community's financial capital but also improve their assets. Savings groups in both Sites represent assets that households can access in time of need as credit (Ellis, 2000b: 34).

In Site I, 8 neighboring savings groups were established. Each savings group was further divided into groups for women and men. All men and women in the village contributed Rs.50 to their respective savings groups. The money was then loaned out to a member of the group and fees were levied if a member made late payments. This money was loaned out at an interest rate of 24%. During the period of the study visit, the savings groups were in the process of merging all the groups into one savings cooperative that had been registered recently with the local government.

In Site II, there were 9 savings groups, and like in Site I each group had women and men divisions. The amount contributed by each member depended on the savings group. Men's savings groups met each month deposited Rs. 100 each month and the women's groups met every two weeks and deposited Rs. 50. Each month the money was loaned out for a period of 3 months. Men paid 18% and women paid 12% interest to the savings group for the money borrowed. Similarly, the savings group loaned out the entire amount to a member in need. By saving their money, although a small amount, in savings groups provides household members, both male and female, the ability to borrow cash reducing the need to sell other assets like jewellery or livestock. Savings groups also allow households to strengthen their portfolio of tangible stores and the interest earner, although little, can be considered a gain from their asset (Chambers and Conway, 1992).

Although these savings groups have allowed households to access finance during times of crisis, one counterintuitive result has been that households also access these assets when a family member needs money to go abroad as a migrant worker (Ellis, 2000b: 42). Although migration is a diversification strategy on part of the household, use of savings to finance migration, which may or may not be financially beneficial has the counter effect of reducing the financial asset of a household.

4.7 Those Who Opted Not to Get Electricity

There were four households in Site I that opted not to receive electricity because they said the monthly dues were too much for them to pay each month and were also not able to contribute labor during the construction process. They all belonged to an extended family and were hesitant to speak in the beginning and later on the elderly mother of the family spoke that they did not feel like cooperating with the rest of the village because they could not go

to work during the construction phase and felt left out. When I spoke to others in the village about that household, they spoke of that family as always the odd ones out because they often chose not to participate with the rest.

However, this is inconsistent with what Appropriate Technology is supposed to be. One of the its tenets is that it should involve the local community during the design and implementation (Practical Action, 2005). Although this family did sign up initially to help during the construction phase, they stopped going to help and eventually decided not to get an electricity connection because they felt they could not afford the monthly dues.

It is important to note the role of agency here. The livelihoods framework's emphasis on making decisions in a group means that independent voices tend to be unheard or silenced by the majority. Although working in groups has its benefits, the overemphasis on groups undermines the individual's agency and choices.

One respondent (not a member of this family) had said that the monthly dues were the same as the price of two eggs in the store[9]. However, for this family it was too much. This family, which is obviously disadvantaged relative to other families in Site I shows that there are some limitations to what Carr in Zelenika and Pearce (2011: 15) propose that the primary role of the Appropriate Technology is to allow space for the disadvantaged to participate in development processes. Although the majority of village has the opportunity to participate these four families have not been incorporated to take advantage of something that was meant to be for everyone. This is a major shortcoming on the management committee and local government's part because these households not only cannot have the same benefit as everyone else but they may also get left out of future development projects.

4.8 Conclusion

Evidence from the two sites show that electricity is capable of spurring changes in the life habits of households. The changes have come about quickly and the respondents felt that these changes have made a difference in their lives. However, this research found that although there had been changes in life habits, the impact on diversification of livelihoods is novel than what was expected. It was contrary to what livelihoods analysis holds sacred: poor households will diversify as there is no other way out.

Non-farm diversification is difficult because Barett et al. (2001: 323) argue that in rural areas there is a lack of purchasing power among the households. However, if residents of Site I are satisfied with existing conditions then it is not necessary that they want to diversify even if diversification is difficult. One of the contributing factors can be that both Site I and Site II have large number of households involved in cardamom farming. Cardamom, which requires laborious work only some months of the year has helped farmers in the two research sites reduce the amount of time they actually invest in farm

[9] Personal interview, 28/07/2012.

activities to have sufficient income, and in Site II where there is a higher incidence of households that are not involved in farming at all. Since Site II serves as a weekly market for neighboring villages they have greater opportunities to diversify in non-farming activities. Evidence from Africa in Barett et al. (2001) suggest that areas with higher agricultural productivity may lead to more diversification in non-farm activities. Although both Site I and II have households with good income from cardamom farming, residents of Site I did not seem too keen to diversify in non-farm activities. The new resource available to them, electricity, was simply a need satisfier and not necessarily a creator of new wants.

Chapter 5
Impact on Entrepreneurship

5.1 Introduction

Micro hydropower plants have to some degree been successful at creating some jobs, like those who manage the pumps, and engineers and machinists who manufacture and maintain the plants. Since management committee members of the plants work on a voluntary basis, they receive no compensation. Employees of UNDP and REDP are compensated by their own employers, and work in multiple sites, so their employment is difficult to attribute to individual sites. Therefore, it is necessary to study to what degree micro hydropower stations have in increasing or creating jobs. It is also necessary to study enterprises that have come up after electricity was introduced.

5.2 Direct Job Creation

Although one would think that a typical impact of addition of electricity would lead to solid creation of jobs, the impact has so far be nominal. In Site I, a full time micro hydropower operator has been given employment. He's still a young person, still in school, and has received a short training in Dhankuta on the running of the power plant. He has no formal training in maintenance of the power plant. Sujan, the operator, receives a monthly salary of Rs. 5750[10] per month and works all seven days of the week and also has a place to sleep at the power station. It seemed the management of the power plant were quite flexible to his work attitude because there were days the power did not come on exactly at the designated time of 6 PM. When asked someone in the village told me that the operator was working in the fields and would probably get to the power plant later than usual.

Some young men were given training during the installation phase of the power plant, like setting up power lines and wiring houses. However, they were not given any form of training to maintain or make repairs to the power plant.

The situation is slightly different in Site II where there are three staff employed directly by the power plant. Two of them are operators who receive a payment of Rs. 6000 per month and one person is the manager of the plant who is paid Rs. 5000 each month. Geeta the manager of the plant also performs summary repairs and was visibly busy because he was interviewed while he was on call to repair a broken power line at the local police station. Subedi also has another job as an officer in the Village Development

[10] For the sake of context: monthly charges in Site I for electricity use is equal to Rs. 60 which is the same as the price of two eggs. So Rs. 5750 is equivalent to around 190 eggs.

Committee, but he was asked on by the power plant management committee as he led the project from the beginning. Subedi and his two colleagues were also charged with installing new electricity meters when the village switched from an unlimited use model to a pay as a use format. For each installation they charged 200 rupees. None of the staff members received any formal training, much of what they did came from experience. The three also performed minor repairs to the power plant when necessary.

This part of the study shows that having a power plant does not necessarily lead and increase in 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. As noted earlier, in Site II, the manager of the power plant also worked at the local government office. The two operators in Site II also worked on their own farms and the operator in Site I was a full time student as well as a farm hand for hire. Jobs of individuals who work for the REDP and the company that manufactured the power plants cannot be attributed to those used in the research areas because they also work on other projects throughout Nepal.

In Site I, the long term impact of training given during the construction phase was not visible. Although local youth had been trained to wire houses and set up electric poles, their training was not extended beyond that. One reason for these youths not being able to use the skills they learned to be the lack of growth in terms of businesses that use electricity. Since the number of households has not increased since the introduction of electricity, the only choice left for these youth is to either continue working on the farm or to migrate to work in unrelated sectors.

5.3 Impact on Entrepreneurs

The impact of electricity from micro hydropower on entrepreneurs and enterprises in the two sites are worth comparison because although both sites benefit from electricity, the ways in which electricity is distributed is different. Other contributing factors to difference is the presence of rural, subsistence farming households in Site I whereas Site II is a mix of farming households as well as entrepreneurs for whom farming is a secondary source of income. Since Site II is also the administrative and education center for the area, there is a greater presence of those working at government offices. Site II also serves as the weekly market for villages that are within an hour's distance from it, so the demand for products and services from entrepreneurs is high compared to the virtually non-existent situation in Site I.

The impact of electricity on entrepreneurs and entrepreneurship in the two research sites are different and possibly correspond to the previously existing business environment in the two sites. In site I, the impact on entrepreneurship can at best be called minimal. The number of enterprises that benefit from electricity are three in number. A furniture factory that was set up using money granted by the Energy Department of the District Development Committee. The aforementioned mill was also set up using funds provided by

the Department. Rather than just giving the money to an entrepreneur, the power plant management committee decided to loan the money out to interested entrepreneurs in the village and the money that was returned went into the common fund of the management committee. One entrepreneur has set up a chicken farm out of his own costs. Lakpa, a 22-year-old entrepreneur worked on a chicken farm in Malaysia raised capital from his family to start the farm. Since chickens require 24-hours of light, Lakpa 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. Lakpa spoke of how he would like to use a heater if he were allowed to draw more power than the current 100 W set by the micro hydro management committee, that way he could raise chicken even in the winter months. By setting up a chicken farm, Lakpa has, to some degree, increased the locals' access to meat because free-range 'local' chicken tend cost up to three times the price of 'broiler' chickens raised by Lakpa. Lakpa said:

> "I am able to earn 90,000 rupees in profits in my own village so I no logner want 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. I am actually thinking of giving up farming to focus entirely on animals and chicken farming."[11]

There is however another side to Lakpa's story that is limiting his growth. During an informal conversation where the newly-elected chairman of the micro hydropower management committee was present, Lakpa brought up the issue of being allowed to use more power than the allotted 100 W/per household in order to use an electric heater so he could keep his chickens warm during the winter months. Until that point Lakpa had been only able to keep chickens for 9 months of the year because the winter months are too cold. I asked the chairman why the committee had so far not allowed entrepreneurs to use more electricity. The chairman's response was that they were afraid that the plant may not be able to sustain the extra load demanded by heaters which use a lot of energy. My impression from this meeting was that for the management committee and those in the village keeping the electricity supply consistent and uninterrupted was their primary concern. From the point of view of the management committee it seems logical that they want to keep the system alive and running but for the entrepreneur it is demotivating that they cannot expand their business because the infrastructure is not able to keep up with his/her demands. Appropriate Technology, with all its promises of suiting the needs of its users struggles at this point.

One key drawback of Appropriate Technology, the micro hydropower plant, here is that as the needs of users change, the technology itself, although designed with the users in mind, is not able to be adapted by the users themselves. In fact, the management committee was too scared to run the power plant to full capacity let alone users draw more power like the chicken farmer. The management, which is accountable to the whole village, is cautious against taking steps that would endanger the interests of others. This is where the virtue of Appropriate Technology also becomes its drawback. Zelenika and

[11] Personal interview, 28/07/2012.

Pearce (2011) suggest that institutional support is necessary to ensure that there is a continuous feedback structure in place. In fact, after the initial construction and review phase, there were no government officials who visited the sites to check on new developments and receive feedback.

The chicken farmer saw the opportunity to sell his product throughout the year but was constrained by the lack of capabilities, namely resources and technology, that Nichter and Goldmark (2009: 1457) say is necessary for an entrepreneur to take advantage of opportunities that might exist. Even though the chicken farm cannot be expanded to take advantage for demand of chicken during the winter months, it still provides a form of employment and livelihood diversification for Lakpa and his young wife (Nichter et al, 2009: 1460). Besides the availability of electricity to expand his business, Lakpa also has the location of Site I working against him because enterprises in rural areas tend to have much lower chances of survival compared to urban MSEs (Mead and Liedholm, 1998: 66). Since Site I is rural in nature, Lakpa will have a much harder time expanding his business as his chickens serve a limited market and it is also expensive to purchase inputs such as chicken feed, which has to be carried by porters for four hours.

Mead and Liedholm (1998) point to evidence from Africa that firms that start small tended to survive more than their larger counterparts implying that small size is not necessarily a handicap for the firm. The chicken farm does have a good position in the village in terms of competition but there is very little space for it to grow in terms of number of consumers in the village. Everyone in the village seemed to know he sold chickens and that they were cheaper than the free-range variety that were sold at the weekly markets an hour away. Lakpa, the farmer, even spoke of discontinuing farming parts of his land because income from his chickens was enough to support him and his wife and to pay off the personal loans raised to start the farm. From his interview, it is clear that Lakpa is more interested in building a family in the village and he is happy with what he has. His work experience in Malaysia was a difficult but fruitful one because he was able to learn poultry farming and does not wish to go back to Malaysia. Although he lived in a modest hut he said he could not be happier anywhere else.

The mill in Site I is run by three teachers from the local primary school. Lakpa Tarbu, a co-owner of the mill spoke of how it was difficult for people to come forward when the funds to set up the mill were first handed over to the micro hydro management committee. The three school teachers were thrust with the responsibility of managing the mill when no one else in the village wanted to take responsibility. Rs. 120,000, the initial cost to start the mill and the furniture plant was given as a grant from the District Government and this fund was in turn loaned out to these 4 school teachers who repay the management committee Rs. 400 a month. They charge Rs. 1.5 per kilo of grain ground. The 4 school teachers said that they make barely enough to buy tools and replace parts but hoped to pay off the amount they had borrowed to purchase their equipment. They paid no taxes on their earnings, however, they kept very detailed records of their income because much of their customers were using their services on credit and repaid them at the end of each calendar month. This mill runs more like a service to the community than an enterprise

because the mill is run at the convenience of the teachers on Wednesday afternoons when the school lets out early for a half holiday. The observations from the mill share something with the chicken farmer. The mill is good as it is for the village. It is of a capacity that can support and service the needs of the village. The owners of the mill saw their business more as a service they could offer to the community than they could make money out of. Although it is a profit-making enterprise, this business serves to improve the living conditions in the community, hence contributing to community economic development, by reducing drudgery for women referred to earlier in this research paper (Helmsing, 2003: 71).

The furniture factory in Site I that was set up using a part of the funds received from the District government was closed during this research visit. Since there wasn't work available throughout the year, the owner of the furniture often travelled to the neighboring town to use his skills in furniture making. The furniture factor was financed under the same model as the mill and the owner had been able to repay the entire amount within 2 years of receiving the loan from the management committee.

The only store in town was also closed when I first visited. The owner was sleeping upstairs, as the store is on the ground floor of the owner's home. When he finally got around to opening the store, it turned out to contain the very basic amenities a person in a rural village may need and can afford. There was a large stockpile of bottled beer, biscuits, and rice. The store also sold candies and chips that I saw children come in to buy often. Alcohol and mobile phone top-ups were the biggest selling items in the store. Mobile top ups sold up to a tune of Rs. 25,000 each month. Mingma and his father ran the store together. Mingma had just returned from the Middle-East, working there as a migrant worker, and was in the process of returning, waiting for his visa to get approved in Kathmandu. Their monthly sales were around Rs. 100,000 each month. They did keep records of their monthly sales but did not pay taxes and were not registered with government. Alongside the store, they also have a farm and keep animals.

Enterprises and entrepreneurship in Site II are of a very different variety compared to that in Site II. Not only there are a lot more businesses in Site II than Site I, but business that have been set up or have been able to upgrade due to the availability of electricity is noteworthy. A short walk through the main market street quickly reveals what kinds of business have sprung up that rely directly on electricity. A mobile phone store, a photo store, a ladies' hair salon and numerous stores selling electrical supplies serve clients in the village and from neighboring villages. Businesses in Site II are primarily in operation to serve clients that come there each Monday for the weekly *haat* (market). Unlike Site I, where there are only a few entrepreneurs it has quite a few of them catering not just to the locals but also to the weekly shoppers who come for goods and services.

One entrepreneur with a strong presence right in the center of the market with his hands in multiple activities is 28-year old Subash. His last name was heard over and over again interviewing other entrepreneurs in the area because Subash's siblings and cousins. Subash's primary business is a store selling a

myriad of products: televisions, radios, rechargeable lanterns, alcohol, biscuits, etc. Subash also ran a cable television service that has around 100 customers.

This cable television station employs 2 full time staff that have basic training in running the station, setting up the cable service for new subscribers, and making repairs. The cable business is a registered enterprise and Subash pays taxes to the government. Subash was able to secure a loan from a bank to start his cable business. Access to finance is crucial to because entrepreneurs are limited in terms of business opportunities if they do not have access to adequate and low-interest financing (Ozgen and Minsky, 2007: 61). Although his cable business has been barely breaking even, it does concur with "giving access to electricity will spread to the development of other types of investment" (Cook, 2011: 305). However, it is necessary to note that Subash had access to finance which was available because he already had significant business experience and is part of a wealthy business clan that includes the president of the local chamber of commerce. In addition to the cable business, Subash also runs the local branch of Western Union.

Berner et al.'s (2012) typology would suggest that Subash is a typical survivalist entrepreneur because he's involved in multiple business ventures to minimize risk but there are other factors like his ability to access to finance and desire to reinvest surplus income into expanding his existing businesses suggest that he could be classified as a growth-oriented entrepreneur. Besides access to finance, Subash also has the size and location of Site II working in his favour because rather than diversify in farming, he can focus on non-farming diversification because of market size which not only serves Site II but surrounding villages.

Dinesh, Subash's older brother, owns and operates a mill in Site II. His family built the mill around 25 years ago but he's been running it for the last decade. He charges Rs. 1.20 per kilo using the electric motor and 0.50 per kilo to use the water wheel mill. After receiving access to electricity from the micro hydropower plant Dinesh has been able to upgrade his existing mill. The upgraded mill is capable of processing four times as much grain as his previous water-run system, that means his customers have to spend far less time waiting in line. By having access to electricity Dinesh has invested in new inputs to improve his production process which concurs with Cook (2011: 305). Also, this is a crucial step towards toward solving what Cook (2011: 309)calls the "underlying dilemma of rural enterprises" that fail to recognize the opportunity to invest in machinery that can, with lower cost, replace human labor.

Dinesh also has the location of Site II working in favor of him because it being a market town attracts people not only from villages close by but also those from further away on the weekly market days. On the weekly market day electricity is provided throughout the day, so Dinesh can process grain all day. Although the mill has been operation for around 25 years, it was started by his father, the owner is the sole employee of the firm. Although Mead and Liedholm (1998:64) cite data from previous research that firms with 2-5 workers have higher returns than one person firms, if there is a lack of scale in terms of number of customers who come to process their grain. Dinesh is able to make around Rs. 30,000 in profit each month comfortably without assistance from anyone else and has been able to survive without closing once.

Laxmi, who ran a hotel with her husband in Site II, also ran a hair salon that was open only on Mondays. She decided to get the training when she heard that there was going to be electricity available from the new micro hydropower plant. She has a number of machines that rely on electricity. It was hard to run the business because the machines drew a lot of power and the 100 W cap did not help. Since the change in rules on how much power a consumer can use, she has been able to serve a lot more clients. She said since power is not available throughout the day she has a waiting list of clients who would like to use her services. Laxmi made a profit of around Rs. 7000 a month. She said there is an increased demand from women who want hairstyles of people they see on television but her ability to work full time is hampered by the fact that she does not have electricity access all day. This corresponds with Ozgen and Minsky (2007:61) that increase in infrastructure investment leads to new demand which means creation of new opportunity for the entrepreneur. Although Laxmi managed a hotel besides running the hair salon. Mead and Liedholm's (1998:64) state that women entrepreneurs tend to operate a narrow set of activities and tend to be based out of the home, which fits Laxmi's profile. Laxmi's business is also a good example of a survivalist enterprise because it fits the ease of entry, run part-time, and of diversification strategy requirements of Berner et al.'s (2012: 387) typology. Appropriate Technology is serving this entrepreneur well because she has limited room for growth and even if she does want to grow the increased number of hours of electricity should fulfil her demand.

The lack of continuous supply of electricity was a limiting factor according to all the entrepreneurs in Site II. Although they were happier now that they free to decide how much energy they could use without the 100 W cap, they still felt that that not having electricity throughout the day kept their businesses from growing. Subash mentioned:

> People in the market could watch television during the day instead of playing cards.[12]

The generator at Site II did plan to expand the number of hours it served its consumers from 12 to 20 hours which would help ease some of those concerns. Also, the power plant was not being run at full capacity. Of the full capacity of 25 kW, the power plant during the field visit was producing because 18-20 kW. Geeta, the manager of the plant, said that the level of demand was lower than generation capacity which means if there was a rise in demand from businesses, the power plant could increase to fill the gap.

5.4 Appropriate Technology and Entrepreneurship Mismatch

As presented in the analysis above, AT technology has major shortcomings in terms of adaptability to suit the needs of entrepreneurs. Appropriate Technology is in fact a utopian idea of sorts when designed to benefit a wider array of people. While micro hydropower does fit AT's criteria that it be

[12] Personal Interview: 02/08/2012

designed to suit the needs of its users, it has some major drawbacks when there is need to expand. Observations from this research show that those in charge of management of the power plants are hesitant when it comes to expanding the uses of electricity. Also, if the role of the government is crucial in terms of end usage. There was a lack of government involvement after the initial set up and assessment of the power plants. If the power plants cannot be expanded in the future, they reflect on the fact that AT is "appropriate" only up to a certain point. Lighting bulbs and grinding grain does have great implications on life habits, but what would the scenario look like if an entrepreneur wanted to set up a large food processing plant to bag and distribute products to serve neighboring villages? The power plant committee would either have to dismantle and purchase a larger plant or add another one to complement the existing plant. Both options are not economically feasible.

Appropriate Technology promises to be unique and be able to be adapted to suit the needs of its users, it has some severe restrictions because it fails to consider that needs can change over time and not all needs are equal. Several factors that elucidate the shortcomings of AT in terms of not being able to match the progressing needs of its beneficiaries will be discussed.

From the analysis on impact of electricity from micro hydropower plants on the daily life-habits of the residents it is clear that Appropriate Technology can foster changes that lead to stronger livelihoods. The ability to turn on a light bulb in the evening has important implications on the assets of the residents because, as presented, 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.

It meets Schumacher's (1973: 167) definition that Appropriate Technology is able to be more productive at lower costs than what an industrial scale technology would cost. 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. Another benefit of having electricity has been that it has allowed for the introduction of other technology like mills and computers.

Zelenika and Pearce (2011) propose that price of AT should match the purchasing power of the beneficiaries. Although government and donor funding to construct the plants was a major share to help the two communities it is evident that AT systems are harder to alter when there is lack of government funding. In Site I, for now, the demand for electricity is close to what is required to meet basic needs. In case the demand from entrepreneurs were to go up, there is no mechanism to ensure that their demands would be met. The lack of visits from government officials and planners means that there is a missing feedback mechanism as named by Zelenika and Pearce (2011). My impression was that the projects were left to their own devices after the construction and initial review. Since ownership by the users is such a crucial aspect of Appropriate Technology, it limits directions the power plants can grow because they do not have sufficient knowledge and resources to expand on their own. The owners, the households of the two sites are left to shoot in the dark since they have no guidance once they become owners of the

plants. Without the channels to provide a continuous level of feedback to donors there is no apparatus in place to ensure that their perpetually changing needs are addressed with effective policy.

5.5 Conclusion

This chapter helps to illustrate the kinds of enterprises that have come up that use electricity. It also discussed the limits enterprises face when Appropriate Technology cannot adapt to the needs of its users. Infrastructure and market size are important as shown by the differences between Site I and Site II. Electricity has had some impact on entrepreneurs: it has allowed businesses in Site II to add new services and to upgrade. The impact on Site I is minimal, almost non-existent.

Chapter 6
A Win or a Loss? Conclusions and Implications

This research paper studied the impact of electricity from micro hydropower plants, an Appropriate Technology, on the daily life habits of households and on entrepreneurship. The research looked at aspects of changes through the lens of the livelihoods frameworks and how electricity has made an impact on the five capitals and on diversification of livelihoods. This paper also studied the impact of electricity on entrepreneurship, examining the kinds of enterprises that had emerged that utilized electricity. The impact on direct job creation, demand for new products and services, and business upgrading was also studied.

Electricity is a crucial element in fostering local development. Micro hydropower stations, a form of Appropriate Technology, have allowed poorer regions of the world to transform their lives by using a piece of technology that is suited to their needs. Appropriate Technology is an attempt to move away from replicating technology that already exists in the developed world and to adapt technology, or sometimes even build it from scratch, to meet the needs of those living in the developing world. This study argues that electricity from micro hydropower plants have had significant impact in terms of altering the life habits of households in the two research sites but the impact on entrepreneurship is minimal. This research also argues how Appropriate Technology tends to fumble when the needs of the users change over time and provides evidence in support of this argument.

Ethnographic methodology has been the backbone of this research paper. There is a lack of ethnographic studies that focus on the electricity and local development relationship. Scholarship has primarily been limited to measuring the impact on productivity, which means a large part of the story is being left out. Much of this study was conducted using semi-structured interviews in rural Sankhuwasabha district in Nepal. Spending the research period walking around the villages, speaking to people to identify what had changed since the arrival of electricity, to identify changes in life-habits gave the research direction. Spending time in the homes of local families, purchasing products from shops, these were all ways to strike up conversations that later led to collecting data from the respondents.

Micro hydropower plants have had a major impact on the life-habits of households in the two sites but the impact on entrepreneurship is minimal at best. Households have been able to take advantage of the extended hours of lighting, women have more time to relax because they no longer have to grind grain on traditional mills, and school attendance is higher now because students have more light to study in the evenings. There has also been a reduction in use of kerosene for lighting. These improvements have had some impact on the assets of the households in the two sites. However, the impact on entrepreneurship has been minimal. Newer services like cable television and

milling have been introduced by entrepreneurs but the level of job creation from the power plant in essentially nil. There is some new demand for complementary products like electronics and mobile phone top-ups.

One of the interesting findings of this study contributes to what we know about livelihood diversification strategies of the rural poor. Previous scholarship has been reinforcing diversification as the only way for the rural poor to deal with changes in their assets and risks but the findings of this paper suggest that it is not necessarily so. Just because women have more free time to relax because they do not have to manually process grain does not mean that they will invest that time to diversify their assets in other areas. A lack of markets may also be a contributing factor to slow diversification in non-farming activities but evidence suggests that they we simply satisfied that they no longer had to be involved in back-breaking work. Also, households felt that electricity had satisfied a need that was unfulfilled in the past, but it wasn't necessary that they wanted to do more with this resource to diversify their livelihoods.

Another key finding challenged the existing understanding of Appropriate Technology and the notion of it being adapted to suit the needs of its users. Evidence from this research shows that Appropriate Technology becomes less appropriate when the needs of its users change. Although this limitation has been discussed in previous theoretical deliberations but there was no evidence to support this (Zelenika and Pearce, 2011). Constructing a piece of technology and handing it over is easier than ensuring that its users can learn and expand as their needs change. This paper challenged that simply handing over Appropriate Technology without putting in a place for a feedback system that ensures continuous development can lead to a dead-end. Also, the lack of information about complementary products like low-wattage cookers that actually use electricity needs to be wide-spread. 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.

The analysis presented in this paper is qualitative in nature. It is possible that also including a quantitative approach could have led to stronger conclusions to support the findings. A stronger quantitative method combined with qualitative data collection could help to further the discussion on the link between Appropriate Technology and local development.

This research open room for discussion on how we perceive the needs of the rural poor. Development planners, donors and the government have for made some attempts like handing over decision-making to the beneficiaries themselves but the lack of an efficient and effective system that follows up rather than gives a Band-Aid and bids goodbye is necessary. Limited capacity of government, donors' agenda-setting and the rural poor's resignation to poor accountability have meant that the rural poor are often compelled to accept what they are given.

From this research it is clear that what households present as their needs is subjective to what they think 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. By influencing changes, however small, in the daily lives of the rural poor electricity, when

easily accessible, can be a long-lasting satisfier towards the fulfillment of basic needs. Other infrastructures that can complement the needs like safe water, roads, health facilities are possibly more imperative for the rural poor than industry that use electricity.

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Appendices

Appendix A: Interview Questions

Households:

- What has been the biggest change in your life since you got electricity?
- What electrical appliances do you use?
- Do you use kerosene for lighting?
- How much kerosene do you consume per week?
- How do you process your grains?
- How often do you use the mill?
- Do you participate in the savings group? How much do you save each time?
- What work do your family members do besides farming?

Entrepreneurs:

- When did you open your business?
- Is it registered? Do you pay taxes?
- Do you keep written business records?
- Do you have paid staff?
- Has this been a profitable business so far?
- Have you made upgrades since electricity was available?

Micro hydropower Management Committee member:

- When was this plant set up?
- How was it funded?
- How was it constructed?

Micro Hydropower plant Manager:

- Do you have any formal training to operate the plant?
- Do you perform repairs?
- How much do you get paid?
- 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?
- How has your school benefitted since the arrival of electricity?

Appendix B: Physical Challenges of Doing The Research

At this point it is necessary to talk about the sheer remoteness of two sites that were possible to visit during the period of study.

Site I, Yangsijung, took two days to reach. The first day involved flying from Kathmandu to a remote mountain airport. An hour's walk from the airport in blistering heat took me to a river crossing by boat, which was leaking water continuously during the 5 minute ride. Upon crossing the river, I took probably one of the most scary car rides in my life. The hour-long ride was supposed to get me to Chainpur, a town en route to Site I, but the roads were so bad that the driver told me and the other passengers that we'd have to walk the rest of the 4 kilometers to town. My two informants had told me in Kathmandu that I should spend my first night at a hotel in a town called Pokari, which is a two hour walk from Chainpur. So from the point I got out of the car, I walked for close to three hours in the mud with two heavy packs on me. That night I slept in a dingy 'hotel' where I happened to meet a local politician from a village near Yangsijung who also happened to be passing through town. He was able to provide me with the phone number of the family I was supposed to be staying with. I had been unable to get in touch with that family previously. This was a very difficult day for me but it also gave me some idea as to how difficult life is in these parts of the country where most things are not as predictable as in the Netherlands. The next morning, I set out on a nearly five hour walk to Site I. I had been told that it would take me three hours but the locals' perception of distance and time is different than I am used to.

The journey from Site I to Site II took two full days not counting the one day I had to take to rest half way because the first day was especially taxing. Images 2 and 3 show the poor conditions of roads. After the five hour walk from Yangsijung to Chainpur I took a taxi heading to the river because I had to get to Khandbari which is halfway to Site II. In the taxi, I met two men who were headed to a micro hydropower station that they ran. They offered me to come along because that turned out to be one of the biggest mistakes I made during the whole study visit. The walk to the road from their power plant took two and a half hours, I'd been told it'd take 40 minutes, and by the end of the walk I was worn out from the heat and dehydration. I made it safely to Khandbari and rested the next day before walking another 6 hours to get to Site II in Barabise.

Besides having to walk long hours to get to the research sites it is also apt to mention that the roads were not always the most stress-free to walk on. The monsoon made everything slippery and since most walk paths were laid in

stone it was hard not to slip at least half a dozen times in a day. Also, the walking paths are almost never clearly marked so it was possible to get lost easily, which thankfully did not happen to me because I managed to find someone to walk with, two of whom I paid to show me the way and carry my pack. Leeches and infected sores from leech bites were bothersome but never amounted to beyond that.