PINTHALI MICRO-HYDRO PROJECT
NEPAL

A SUSTAINABLE LIVELIHOODS CASE STUDY

February 2002

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The project was co-ordinated and designed by Dr Rona Wilkinson and Mr Stephen Ward, of ITC.

Picture on front cover: panoramic view of Pinthali village, the case study site

EXECUTIVE SUMMARY

This case study of a micro-hydro project in Nepal aims to increase knowledge of how the Sustainable Livelihoods (SL) approach and framework might be applied to infrastructure projects, specifically energy supply interventions. It is aimed at helping policy-makers and energy specialists to understand the SL approach, its relevance and potential advantages. As part of the same study project, funded by the UK Department for International Development (DfID), a parallel case study addresses a similar micro-hydro project in Kenya. The SL approach was developed and has been applied successfully in natural resource based projects. Its particular relevance to energy projects, along with the practicalities of applying it, has still to be ascertained. Obviously, energy infrastructure projects are likely to have a significant impact on people's livelihoods, and the nature and magnitude of this impact is the question the studies seek to address. Thus they are essentially SL reviews, looking at energy interventions through 'a livelihoods lens' as a guide to future interventions.

The Pinthali micro-hydro project, which has been established for several years, was not implemented using an SL approach. The holistic approach adopted was, however, very similar, embodying many of the same principles and practices. As such, it serves as a good indication of how an SL approach to an energy intervention would impact on livelihoods. The study begins with a review of the SL approach and framework and the need for its application in the energy sector. Background to Nepal, the development of micro-hydro in the country, the community of Pinthali and the implementing NGO (REDP) is followed by an overview of the specific project. The case study then employs a range of participatory techniques to evaluate the impact the project has had on livelihoods, using the concepts and language of the SL approach. A 'what-if' discussion attempts to identify the differences an SL approach would have resulted in, with particular reference to poverty alleviation. Finally, the lessons learned from the intervention are noted.

Overall, the micro-hydro intervention and associated activities had a positive impact on livelihoods in Pinthali. It was not, however, the provision of electrical and motive power that had the greatest effect. Additional irrigation water, as a direct result of infrastructural work for water supply to the turbine, allowed an increase in agricultural production that boosted people's incomes via increased sales of cash crop garlic. Having said this, the provision of electric light, apart from providing social benefits, permitted people to spend more time tending livestock, resulting in increased dairy production and a further positive effect on incomes. As a result of increased financial assets, the community's vulnerability has been reduced. Associated project activities have, moreover, impacted positively upon education, resource conservation, social cohesion and well being.

Despite the holistic and integrated approach to the project, the area where the impact has been least positive is in finding productive end-uses for power from the micro-hydro scheme. The community only utilises around 50% of the available power, mainly for lighting. The problem has been in identifying and accessing markets that would encourage productive activities to flourish. The local 'internal' market within the community remains relatively cash poor: a traditional subsistence economy where people are used to making rather than purchasing goods they need. Urban markets, meanwhile, are distant and difficult to access. Moreover, they are served with goods from other sources at prices that are hard to compete with. The single post-hydro entrepreneurial venture in Pinthali, a sawmill for making furniture,

was unable to sell its produce at even the cost of production and rapidly failed. Hence, though people have trained in a variety of skills and income generating activities, there has been a lack of viable market opportunities identified in the course of the project: people's newfound skills are inappropriate and unused. The need to identify viable productive end-uses for the power produced by energy interventions, and provide appropriate training and support as part of a holistic SL approach, is then one principal lesson learned from the case study of this project.

ABBREVIATIONS

ADBN	Agricultural Development Bank of Nepal
CEF	Community Energy Fund
CFFG	Community Forest Functional Group
COs	Community Organisations
DDC	District Development Committee
DEF	District Energy Fund
DEN	District Energy Network
DFID	British Government, Department for International Development
DREMC	District Rural Energy Management Committee
FGs	Functional Groups
HMGN	His Majesty's Government of Nepal
ITDG	Intermediate Technology Development Group
IUDD	DfID's Infrastructure and Urban Development Department
MHFG	Micro-Hydro Functional Group
MHP	Micro-Hydro Plant
NGOs	Non-Governmental Organisations
PIPs	Policies, Institutions and Processes
PPP	Pico Power Pack
REDP	Rural Energy Development Programme
REDS	Rural Energy Development Section
REMREC	Resource Management and Rural Empowerment Centre
SL	Sustainable Livelihood
UNDP	United Nations Development Programme
VDC	Village Development Committee

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1 BACKGROUND AND INTRODUCTION

1.1 Sustainable Livelihoods Approach and Framework

The Sustainable Livelihoods (SL) approach stems from the belief that at the heart of development lies the livelihoods of people. This approach is, therefore, people-centred and focused on broad-based support for the economic development of communities. It is designed to build on and succeed previous top-down approaches, such as the integrated rural development of the 1970s, and is distinct from sectoral approaches.

The SL concept is holistic. When analysing a situation with a view to making intervention decisions, it encompasses all aspects of livelihoods. There are factors in people's internal and external environment that cause problems but also create opportunities. Understanding such situations via the SL approach is intended to enable the implementation of more effective programmes, particularly of course those aimed at poverty alleviation.

The SL approach is a way of thinking about the objectives, scope and priorities for development. A specific livelihoods framework and objectives have been developed to assist project implementation. SL is a way of putting people at the centre of development, thereby increasing the long-term effectiveness of any assistance.

Livelihood is defined as 'the capabilities, assets (including both material and social resources) and activities required for a means of living'. A livelihood is sustainable when it 'can cope with and recover from stresses and shocks and maintain and enhance its capabilities and assets both now and into the future, while not undermining the resource base'.[1]

In practice, an SL approach means attempting to categorise livelihood into a set of assets, namely human assets, natural assets, financial assets, social assets and physical assets. Generating additional income, increasing well-being, assuring a more sustainable natural resource base and reducing vulnerability should, then, enhance livelihood outcomes. The SL approach views vulnerability in terms of shocks, trends and seasonality. Amid all these factors, the workings of policies, institutions and processes (PIPS) are also taken into account.

The SL framework assumes that increases in assets will serve to reduce vulnerability and enhance livelihoods. When a community or a single family is at risk, the level of vulnerability and the ability to cope largely depends on the value of its set of assets and the institutional support available.

1.2 Need for Application of the SL Approach in the Energy Sector

At both the policy and programme levels, the energy sector of Nepal is currently considered in isolation from livelihoods. The 9th 5-year plan (1997-2002) presents sectoral policies and programmes. It does not, however, present the policies and programmes for an 'energy sector' - in which all sources of energy might be addressed. Instead, the plan presents components of the energy sector under headings of `Infrastructure', 'Electricity' and 'Science and Technology and Alternative Energy'.

Only about 15% of the population has access to electricity and the government recognises consumption as an indicator of economic development. While electricity is considered in

[1] The Department for International Development (DFID) (1999), Sustainable *Livelihood Guidance Sheets.* DFID, London UK

terms of Infrastructure, however, other sources of energy are treated separately. Firewood, agricultural residue and biogas, for example, are linked with 'Science and Technology', concentrating on technical aspects and potentially missing the fact that the magnitude and manner of their use is also a development indicator.

At the programme level too, there is little evidence that energy is considered in a holistic way. There is no focus, for example, on developing the energy sector in order to improve incomes and well being, protect the environment, conserve resources or reduce vulnerability.

In the complex web of factors that sustain life, energy plays a profound and vital role. The SL approach would, therefore, view it is as imperative for policies and programmes to consider energy as one of the key elements contributing to sustainable livelihoods in a community. It should not be considered in isolation from other such elements.

During the process of collection, management and use of traditional energy resources, or during the planning, implementation, operation and maintenance of modern energy services, there are inevitably impacts on livelihoods in a society. The contention is that adopting an SL approach helps ensure that a greater proportion of such impacts are positive.

1.3 The Case Study and REDP

This study is a part of the DFID funded Disseminating Approaches to Sustainable Livelihood Project, conducting comparative micro-hydro case studies in Kenya and Nepal using the Sustainable Livelihoods Approach. This study revisits Pinthali Village and its Daunekhola micro-hydro project. Implementation of the project began in January 1997 through the auspices of the Rural Energy Development Programme (REDP). Pinthali was selected as the subject of this Nepali case study on the basis of its relevance and potential contribution to the DFID project.

The REDP is a joint initiative of His Majesty's Government of Nepal and United Nations Development Programme. It assists rural communities to establish local energy systems and develop productive end-uses that generate income. The REDP takes a very community-based approach, identifying mobilisation as a precondition for assistance. The focus is then on:

- organisational development;
- skill enhancement;
- capital formation;
- technology promotion;
- empowerment of women;
- and environmental management.

1.4 Purpose of Case Study

The case study was in effect an SL review of the Daunekhola micro-hydro project. The reasons for preparing the case study were:

- To identify the impact of the micro-hydro project on the livelihoods of members of the Pinthali community
- To identify if there were any ways in which the project could have been modified to increase the impact on livelihoods
- To provide a practical example of how SL can be applied to energy projects, and to provide a basis for an SL and energy training workshop in Nepal
- To provide a practical example, using SL terms and reference points, of the impact an energy intervention can have on livelihoods

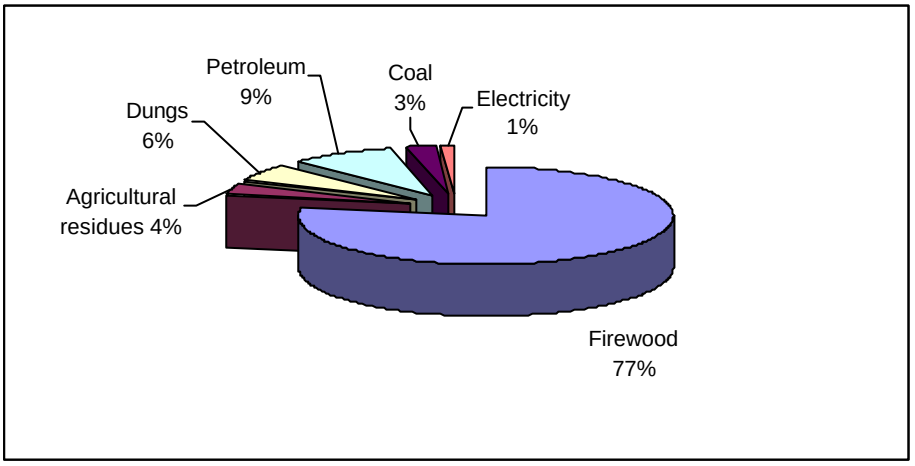
2 CASE STUDY BACKGROUND

2.1 Energy Scenario and Background to MHP Development in Nepal

Like many developing countries, the energy consumption pattern in Nepal is characterised by the use of biomass as the main source of energy. Per capita energy consumption is about 15GJ, compared to, say, the UK at around 159GJ. Nepal has very little coal and no viable reserves of oil or gas. Commercial sources of energy, such as electricity and petroleum products, are inaccessible or unaffordable to the poorer sections of the society. Hence, the vast majority of people rely on the traditional fuels, wood, crop residues and animal waste.

Traditional sources, then, dominate the energy sector. The breakdown of sources of energy supply in Nepal is shown in figure 1, below. This shows that modern commercial fuels make up only 13% of the total.

Figure 1. Sources of Energy in Nepal



Harnessing energy from falling water has been practiced in the hilly regions of Nepal for hundreds of years. Traditionally, streams were diverted and the potential energy released by diverting water to a lower level was used to rotate a grinding stone. These agro-processing water wheel schemes are known as ghatta and are still popular in rural areas. It is estimated that more than 40,000 ghatta units are installed, an example of indigenous appropriate technology.

Meanwhile, micro-hydro has become the main source of electricity in remote areas. In this context, a hydro-powered electricity generating unit of up to 100 kW output is defined as a 'micro-hydro'. Though the use of this technology started in the early 1960s, it only became popular from the mid-80s when the government began to provide subsidies. At first, new-style micro-hydro plants (MHPs) were used primarily as sources of mechanical power for agro-processing. An increase in demand for electricity, particularly for lighting, has meant that the majority of new schemes have become hydroelectric. There are now an estimated 2,000 MHPs in Nepal.

Generation of electricity via decentralised MHPs has become an attractive solution to the limitations of the national grid. The main obstacle to extending the grid is low population densities in the mountains with associated high connection costs. The proliferation of MHP technology in Nepal can be attributed mainly to the poor prospect of the grid reaching mountainous and remote areas in the near future. Government subsidy, partially covering the costs of micro-hydro schemes, has given the technology significant impetus.

Research has shown that electricity supply through the use of MHPs reduces drudgery and improves the livelihoods of poor people. The availability of electrical power enables the establishment of small and micro-enterprises. Electric lighting, meanwhile, helps in household chores and with children's education. The use of micro-hydro electricity can significantly reduce the firewood and kerosene a community requires (Sikles, 1999).

High dependence upon firewood as the primary source of energy for cooking and space heating has put great pressure on national forests (see figure 1). A large part of the wood harvested goes to the rural kitchen, where it is burned using inefficient stoves for cooking food and animal feed. The annual rate of deforestation in Nepal is estimated at 2.1 %.

2.2 Rural Energy Development Programme

The REDP initiative began in August 1996. It has the twin goals of improving rural livelihoods and preserving the environment through the promotion of rural energy systems, with micro-hydro as the principal entry point. REDP has, however, also promoted various other rural energy technologies, including biogas, solar photovoltaic systems and improved cooking stoves.

Social mobilisation is an integral part of energy projects implemented by the REDP. During this process in Pinthali, as many as 6 Community Organisations (COs) consisting of all male members and five COs consisting of all female members were organised. COs are responsible for savings mobilisation, adult education and other development activities. Functional groups are formed to work in sectoral areas, such as forestry or MHP.

Generally, when the REDP enters a district, its officials first study all the Village Development Committees (VDCs – Local Authorities) to identify possible areas of intervention. In the process, 10 to 15 VDCs are selected. A pre-feasibility survey is conducted, including a ranking of the 'best' VDCs. This is submitted to District Development Committee (DDC), which normally makes the final selection of a few VDCs for programme initiation.

Once the VDC is decided upon, REDP and its partner organisations carry out an awareness and social mobilisation programme prior to installation of the MHP. In this way, the community is fully ready to accept and manage the MHP. It takes time to get COs matured to form the Micro-hydro Functional Group (MHFG). REDP's experience suggests that this mobilisation may take from 6 months to a year, depending on the awareness level, ethnic mix, social diversity and economic situation of the community.

In the case of Pinthali, an initial mass meeting was held to inform all the villagers about the project. COs were formed and a cleanliness (public health) campaign begun. The 'social mobiliser' lived in the village and monitored progress. When the COs were well established, functional groups were formed. The MHFG handles the MHP project.

Training in a variety of income generating activities took place alongside the process of installing the MHP. Typically, REDP then assesses the potential for the development of parallel renewable energy systems in the community. Although the entry point of REDP is provision of renewable energy via micro-hydro, it's overall objective is to foster broad-based sustainable community development.

2.3 Selection of Case Study Site

From a number of possibilities, Pinthali was selected as the case study site after much in-depth discussion. Site selection criteria were developed, including access to data, valuable lessons, poverty aims, less publicity, more than 50 households, influence on PIPs and

location. Different scores (weight) were given to criteria based on their importance. The MHPs, namely Biruwa of Shyanja, Ghandruk of Kaski district and Pinthali of Kabhrepalanchok district, were all visited by ITDG staff. The sites were then evaluated according to the criteria. REDP's more holistic approach to implementation in Pinthali, going well beyond the technical installation of an MHP, made the project appropriate for SL study.

2.4 Overview of Community

Pinthali is located in Mangaltar VDC, 27 km from the town of Dhulikhel, which is the district headquarters of Kapvrepalanchok district. Kapvrepalanchok district is located east of Kathmandu. It is bordered by Ramechap and Dolakha in the east, Kathmandu, Bhaktapur and Lalitpur in the West, Sidhupalchowk in the North and Sinduli and Makwanpur in the South. Kapvrepalanchok district is divided into as many as 87 Village Development Committees (VDCs) and three municipalities - Banepa, Dhulikhel and Panauti.

Figure 2. Map showing location of case study site

From Kathmandu, it is about a two-hour drive followed by thirty minutes steep uphill walk to Pinthali village. With as many as 118 households are perched upon a hill, Pinthali has a population of 709 people (354 male and 355 female), all of whom belong to the Tamang (Lama) ethnic group. The literacy rate in Pinthali is around 43%. Shree Mahakali Devi Karma Daya Primary School has around 170 pupils. While 8.1 % of the population are children of less than 5 years, 27.7 % are of school going age, and 7.0 % are more than 60 years old.

As in other hill districts of Nepal, the energy consumption pattern of people in Kapvrepalanchok district reveals biomass as the main source of household energy. According to REDP's Kabhre District Energy situation report, as much as 85% of the total energy consumed in the district consists of firewood. Thence, agricultural residue contributes 9%, petroleum products 5% and electricity a mere 1%.

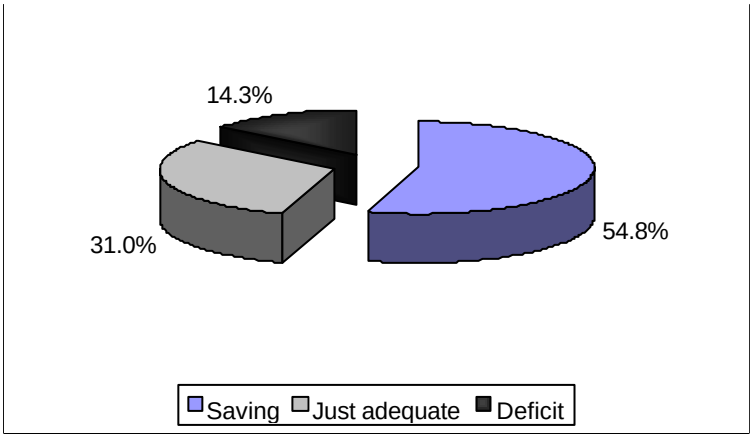
Figure 3. A Buddhist Monastery at Pinthali

The Banepa-Bardibas highway runs through the foothills of Pinthali village, alongside the Roshi River. Before the highway, it took a whole day to reach Pinthali from Kathmandu, driving up to Dapche village and walking. Road construction began after REDP started work in Pinthali. The highway, which is still under construction, has provided villagers with income and employment opportunities. Many find jobs as labourers, while a few families have set up teashops along the highway, catering to construction workers. Villagers are aware that this is a temporary source of employment.

As far back as 1960, a canal was constructed to bring drinking water to Pinthali. Elders remember the difficulty villagers had getting enough drinking water prior to its construction. The same canal was widened and strengthened to divert water from the stream to the village for the MHP. Water from the tailrace – outlet - of the MHP irrigates all the land below, boosting agricultural production, primarily garlic.

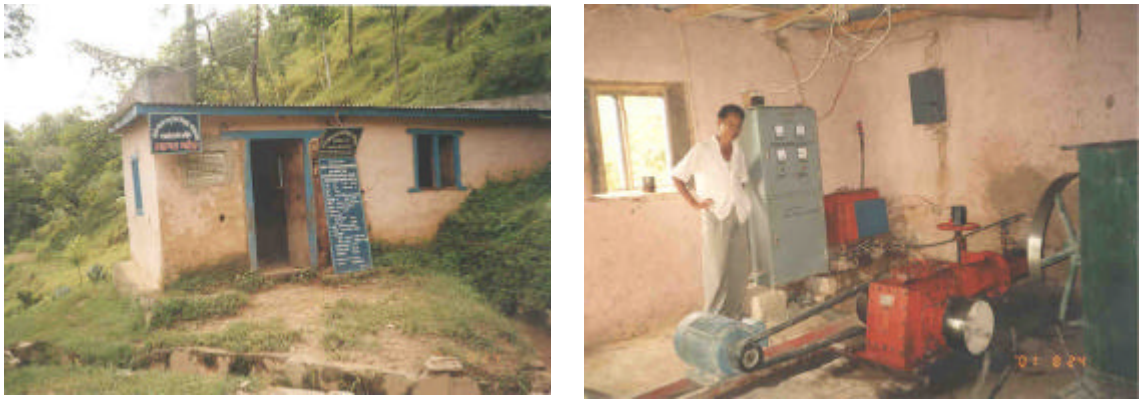
Besides agriculture, the people of Pinthali are skilled in wood carving (Lamapat), masonry, and Thanka painting. Thanka painting is a traditional art form. Paintings are in demand and painters paid well, particularly in Kathmandu. Some Thanka painters already existed in the village when the REDP project was initiated. REDP and VDC trained as many as 25 additional people. Most of the artists are now working in Kathmandu. Villagers are very aware of the 'lure of the city', opportunities for permanent employment being centred in Dhulikhel and Kathmandu.

Figure 4. Food sufficiency of Households



There are significant variations in land-holding and levels of agricultural production between households. An estimated 54.2 % have more than 0.25 hectares of land, while 9.2 % households have less than 0.05 hectares. Likewise, 54.8 % of households produce food surplus to their own requirement, while for 36.7 % agriculture production is just enough to meet their own needs. Around 13% of households cannot meet their annual food demand from their own production.

Figure 5. Micro-hydro powerhouse at Pinthali



The primary source of food for all the households in the community is farming. Food bought from waged labour is the secondary source, contributing 19.2% to, mainly Group C households, which are the poorest wealth group (see section 3). Apart from temporary road construction, priests, drivers and service industry workers are employed outside the village, remitting money to their families.

Although people support a variety of political parties, there is good social unity and co-operation in the community. Despite political difference, they unite for the development of their village. Helping each other during illness and other problems is common. People exchange labour during the peak farming seasons. Moreover, loans are provided to people faced by various emergencies.

2.5 Overview of Micro-Hydro Project

2.5.1 Project Planning and Implementation: The REDP Approach

Rural energy development, natural environment preservation, local economy improvement, capacity building and institutionalisation of rural energy development through social mobilisation are REDP's stated goals. It implements programmes through the DDCs, political bodies with representation from all parts of the district. REDP supports the DDCs in formulating district energy development plans. Thus, energy development has become an integral and important part of the DDC's planning process.

Kapvrepalanchok DDC has created the Rural Energy Development Section (DDC-REDS), which carries out site visits and pre-feasibility studies. In addition, there is a District Energy Committee and a District Energy Fund. A Technical Review Committee is set up at the central level to assess the financial and technical aspects of priority projects. At the village level, REDP supported the formation of the MHFG. The MHFG is responsible for overall management, resource mobilisation and implementation of the project.

Finance for Pinthali MHP came from DDC, VDC, REDP, government subsidy, and a loan from the Agricultural Development Bank of Nepal (ADBN). The community makes its contribution mainly in the form of labour. A Community Energy Fund (CEF) was created and all financial resources are deposited therein. The CEF is managed by the MHFG with the District Energy Advisor (DDC-REDS) acting as co-signatory.

REDP works in partnership with a local NGO, REMREC, to mobilise communities in forming effective COs and FGs. In addition to the MHFG in Pinthali, for instance, there is a Community Forest Functional Group (CFFG). REDP implements its energy plans with the

active participation of the COs and FGs.

The villagers of Pinthali spent many years actively seeking assistance for their MHP initiative, persistence that is evidence of their strong desire and support for the plant. Finally, in 1980, staff from the ADBN arrived in the village to conduct a feasibility study. The project only became a reality once REDP began working in the village, however. Thereafter, community participation in the planning and construction of the project was very high. The villagers displayed a willingness to participate and learn, and took 'ownership' in a psychological sense.

Figure 6. Oil expeller at Pinthali

2.5.2 Technical Specifications of the Micro-Hydro Plant

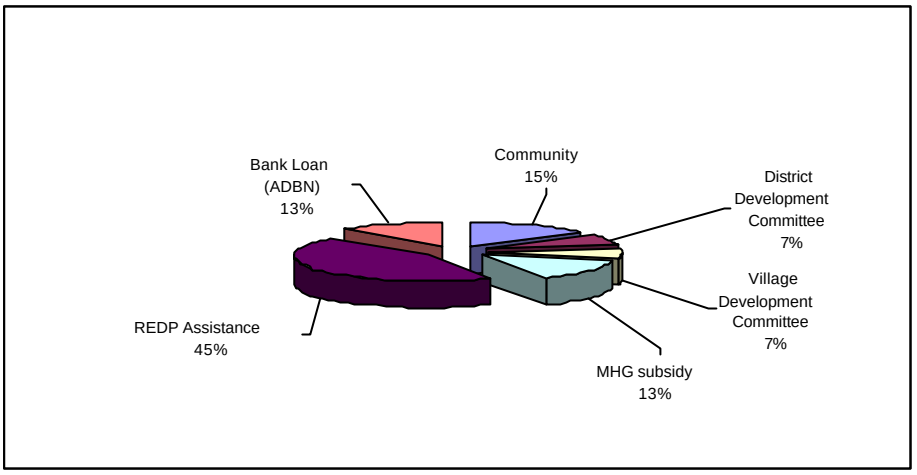
The Pinthali turbine was manufactured by Kathmandu Metal Industry. The MHP has a rice-huller and an oil-expeller in the powerhouse. The MHP has the following technical specifications:

Output capacity:	12 kW
Gross head	39 m
Generator: induction 20 KVA, single phase	220 V
Controller (IGC)	18 kVA
Transmission line	1020 m
Penstock pipe: HDPE (4 kg pressure)	225 mm
Canal length	1.89 km
Length of penstock canal	100 m
Water flow	60 l/s
Tail race canal	1,000 m

2.5.3 MHP Sources of Funding

The breakdown of the sources of funding for the MHP scheme are shown in the figure 7. The total cost was 1,481,513 NRs, giving a per kW cost of 123,460 NRs. Of the community contribution, 43% was a cash contribution, and the remainder came from labour and other contributions in kind.

Figure 7. Sources of funding for MHP



2.5.4 MHP Management

During the 2-year construction phase, the project was supervised by a 22 member (11 men and 11 women) MHFG. The MHFG currently comprises an 11 member executive committee. Five members are women, demonstrating the active role they continue to play in the management of the project. The micro-hydro scheme has recently been registered as a co-operative in which each household will participate as a shareholder. Note that the MHP has repaid the investment of DDC and VDC.

Box 1: Daunekhola MH Co-operative

The Daunekhola Micro Hydro Function Group is now converted into Daunekhola Micro Hydro Co-operative Limited, Mangaltar.

Established on	*: May 5, 2001 (2058/01/22)*
Registration number	*: 640/057/058*
Date of registration	*: July 9, 2001 (2058/03/25)*
Registered by	*: District Co-operative Office, Dhulikhel, Kavre*
Chartered members	*: 25 (Male 18 and Female 7)*
Total members	*: 228 plus DDC and VDC*
Executive member	*: 11 (6 Male and 5 female)*
Total share capital	*: NRs.1,825,000*
Received from the sale of shares	*: 1,600,000*
Received from membership and past savings	*: 225,000*
Working area	*: Mangaltar Ward No. 7 and 9, Pinthali*
Number of shares sold	*: 16,000 @ NRs.100 = 1,600,000*
Total operating capital	*: 205,000*
Total fixed capital	*: NRs 1,620,000*
Chartered Chairperson	*: Mr. Bhoj Bahadur Lama*

There are 2 turbine operators, who together earn Rs 1,500 per month. Their primary duties are to run the MHP, collect the electricity tariff and maintain the canal. During 2001, income from electricity was Rs 3,560 per month. The huller and expeller have been leased for Rs20,000 per annum. Mr. Neem Raj Lama, one of the turbine operators, is the leaseholder.

3 CASE STUDY METHODOLOGY AND IMPLEMENTATION

3.1 General

Methodology consistent with the SL approach was used to conduct the case study. The SL approach offers the flexibility to employ a variety of research methods, with the objective of making the study as holistic and broad-based as possible. Therefore, both qualitative as well as quantitative research methods were used to obtain information. In December 2000, a workshop was held in Kathmandu to launch the study. All key study members of the study team participated. The workshop developed a stakeholder analysis and a project plan (see annex 1 for a copy of research plan).

Before finalising Daunekhola Micro-hydro Demonstration Scheme in Pinthali village as the case study site, a short visit to the REDP field office in Dhulikhel was made. The purpose was to collect additional information about the micro-hydro scheme in particular and about REDP activities in Pinthali in general.

As per the project plan, a pre-test of the survey questionnaire was conducted. The questionnaire was designed to ascertain household-level information regarding socio-economic indicators, particularly those related to energy consumption, food sufficiency, income, and income generating activities.

3.2 Survey Sample

Out of the total 118 households, a 33% sample was selected by applying stratified sampling procedure. Food sufficiency based on landholding was the basis for stratification. Households were divided into three groups: A, B, and C. Those with more than 5 ropanis of agricultural land were classified as A, those with less than one ropani as C. Those that fell between these limits were categorised as B. A ropani is a Nepali measure of area, corresponding to 0.05 ha. All economic groups were represented proportionately in the sample. Since Pinthali has a homogenous population, the representation of ethnic groups was not a issue.

3.3 Field Survey Preparation

Before the study team left for field, an orientation meeting was held in ITDG's Office, to familiarise all of the study team with the SL approach. The enumerators and field research team members jointly finalised the field visit plan. During the meeting, both the checklists for the focus group discussion and the household questionnaire were revisited and thoroughly discussed.

The case study team consisted of:

Dr. Govind Nepal (Team leader)
Mr. Alok Rajouria (Institutional expert)
Mrs. Karuna Bajracharya (Sociologist/Gender expert)
Mr. Min Bikram Malla (Socio-economist)
Mr. Top Kant Parajuli (Senior Technician)
Mr. Matrika Sharma, Mr. Bidur Sharma and Mr. Gyan Bahadur Lama (support personnel)

The team spent four days in the field conducting household surveys, key informant surveys and focus group discussions. The REDP District Energy Advisor for Kavrepalanchok district as well as the social mobiliser, who had worked in Pinthali for the initial three years of MHP construction, installation and operation, were also with the team during the field survey. The presence of REDP officials was felt important because:

- They made entry in the village comfortable and facilitated acceptance;
- They provided indispensable background information; and
- They were able to observe the study process.

3.4 Fieldwork and Tools

The following tools were employed in the field survey:

- A structured questionnaire was used to conduct the household survey.

Figure 8. *Questionnaire survey*

- Two focus group discussions were held. The first focused on the MHP and livelihoods issues. The second involved women in discussions on gender issues and the MHP.

Figure 9. Focus group discussion

- Key informant interviews were conducted with the VDC Chairman, the Secretary of the Micro-hydro Management Committee, the senior MHP operator, the sawmill owner, the community mobiliser, the REDP district advisor, and village elders.

- Observation and photographs - all the team members were instructed in techniques of observation prior to the field visit. Strategic photographs of relevant subjects were taken to provide a visual depiction of the village and the MHP.

4 CASE STUDY RESULTS

4.1 General

This section presents the findings of the case study, covering the various components of SL. The impact of the MHP in Pinthali on livelihoods is presented. Furthermore, there is an attempt to draw a picture of the community based on what might have happened had the MHP been implemented using the SL approach. From that analysis, practical suggestions are made that could lead to more positive livelihood impacts for the beneficiaries.

4.2 Assets

The study of livelihood assets seeks to gain an accurate and realistic understanding of people's strengths (assets or capital endowments) and how they endeavour to convert these into positive livelihood outcomes. The approach is founded on the belief that people require a range of assets to achieve positive livelihood outcomes; no single category of assets on its own is sufficient to yield all the many and varied livelihood outcomes that people seek.

4.2.1 Social Assets

Social assets are defined, for the purpose of the SL approach, as the social resources upon which people draw in pursuit of their livelihood objectives. These social resources are developed through interactions, membership of formal groups, and relationship of trust. Though social assets are somewhat intangible and difficult to measure, they are felt to be important primarily because:

- They can help improve the management of common resources and infrastructure;
- People can draw on them to help ensure survival in times of vulnerability;
- They contribute to people's feelings of well-being by enhancing their sense of identity, security, honour and belonging.

Villagers worked very hard, co-operating well, during the MHP installation. This has served to greatly increase social unity. Moreover, the experience of working closely together on the project has made people aware of the potential benefits. The various functional groups have become sources of ideas for community development activities. Due to improved unity, there has been an increase in mutual help among the community members.

Improved social unity in the wake of project implementation is demonstrated by the fact that people meet together more often. Formal meetings allow a broader and deeper exchange of views. Such meetings are either directly related to the MHP or issues that have emerged due to the holistic nature of the project. Evening meetings have been made more feasible by the electric lighting provided from the MHP.

Personal conflicts and personality clashes are often resolved in meetings and group decisions are respected. At present, conflicts and faction-fighting are rare. The causes of any arguments are most often relatively trivial and easily resolved in a relevant group forum. Misunderstandings typically concern issues such as irrigation water distribution and stray farm animals destroying others' fields.

The villagers have increased access to outside news from radio and TV sets. Not only do they report a more entertaining, comfortable and happy life, they are patently better informed. Village understanding of national and international events has increased significantly since

MHP installation. Largely as a function of the REDP intervention as a whole, people are very aware of the aspects of community life that they wish to change.

The advent of electricity has had a pronounced affect on the cultural and spiritual life of the village. Previously, villagers could not find sufficient time to perform rituals as often as they would have liked. The daylight hours were – and are - taken up with agricultural work. The prospect of gathering in the evenings for ill-lit events was often inconvenient and uninviting. These days, villagers feel easy and comfortable engaging in cultural activities under electric light. Lamas are happy to perform cultural rites and ceremonies in such conditions. Despite the arrival of modern entertainment – TV, video, keyboards etc – villagers claim not to have forsaken traditional activities. They still organise folk dances, singing and outdoor games.

Before the MHP, women did not have their own organisations and their participation in community meetings was zero. That situation has changed, with the formation of women's groups and women's involvement in discussions and decision-making. One women's group has implemented a savings and credit programme. Thus, women can get a loan to initiate income-generating activities or for emergencies from their own organisation. A women's group also manages the forest nursery. Women have the taken the opportunity presented by community development activities associated with the MHP project to adopt leadership roles. They have learned to make their voices heard. They report being highly satisfied with this outcome of the project and are striving to make their groups more effective and sustainable.

Women, indeed all community members, report more time for productive off–farm work. Furthermore, there has been increased involvement of women in social activities. According to their own accounts, the project has served to increase their personal as well as collective confidence. They are more capable of taking decisions that affect their lives directly.

Despite the overall positive influence that the project appears to have had on social assets, some negative effects in lifestyle are reported following the MHP installation. Children have started to demand luxury goods, such as TVs and cassette players. The youth are reluctant to wear traditional clothes, craving fashionable clothes of the sort they see on TV. Parents report that some children are virtually 'addicted to TV' and pay less attention to their studies.

In general, however, both child and adult education are seen to be improving. It is much more feasible and convenient to run non-formal education (NFE) classes under electric light in the evening. Most children, meanwhile, find it easier to study by electric light and are thought to be benefiting educationally.

4.2.2 Financial Assets

In the context of the SL framework, financial assets are defined as the financial resources people use to achieve their livelihood objectives. Financial assets are particularly important because money can readily be converted into other assets. Alternatively, financial assets can be used to directly achieve a desired livelihood outcome.

Before the MHP, there was no institutional financial system. Acute poverty meant that there was no money-lender resident in the village, a function of low demand – or rather, perhaps, a perceived community inability to repay. Hence, people had to trek to neighbouring villages to find a money-lender. The interest rate they obtained was typically very high, as much as 36%, meaning that the borrower was subject to exploitation.

With the implementation of the REDP approach, improved food security has conserved cash income earned from other sources. Community savings and credit groups have been formed. Members are depositing regular amounts into savings funds. This situation is felt to have significantly reduced the financial problems of the community. New avenues for investment

have been created. Members can take a loan for a three-month period at a relatively favourable interest rate of 18%.

Among other entrepreneurial initiatives, loans have been taken to instigate goat keeping ventures, for buying fertiliser, and to begin or extend garlic farming activities. Investments have resulted in diversified and increased agricultural production, especially with respect to the high-value garlic crop. Lama Pat carving and Thanka painting have proved to be sources of increased cash earnings.

Box 2: A Tale of Two Trees

Pinthali is an example of how communal thinking can work to everyone's advantage. Because the whole community abided by the 'rules of the game', a relatively large development fund was created from little seed money.

About 15 years ago, two big pine trees fell in the village. The villagers sold the timber for Rs10,000 and created a community fund. Members could take a short-term loan; one month at 4 % interest rate. The loan was disbursed on the 18th day of each month and the recovery was scheduled for the same date a month hence, before 12 O'clock, midday. The recovery rule was very strict. If someone did not repay a loan with interest before 12 o'clock and paid instead between 12 and 1 O'clock, the borrower had to pay an additional 2 % interest as a fine. After 1 O'clock the fine rose to 5 %. And if the borrower had not paid by the evening, community-fund representatives would go to that person's home and impound livestock or goods. Via this strict, self-regulated finance scheme, the community were able to increase the capital-base of the fund very significantly. In fact, Rs 60,000 could be allocated to the local primary school, Rs17,000 to the Higher Secondary School, Rs 40,000 to canal work, Rs 5,000 to financing a police post, Rs 2,000 to Chautara (resting places for head-loaders), and Rs 89,500 to MHP project. Even now, the community has Rs 45,000 in its fund.

Overall, the increased financial assets that have resulted from the various community income conserving and generating activities have been very helpful during times of hardship or emergency. The practice of saving has increased, and within the community the perception is that they are now more financially secure. People are able to finance income generating activities with their own money. Prior to the REDP intervention, this was not possible on anything approaching the same scale.

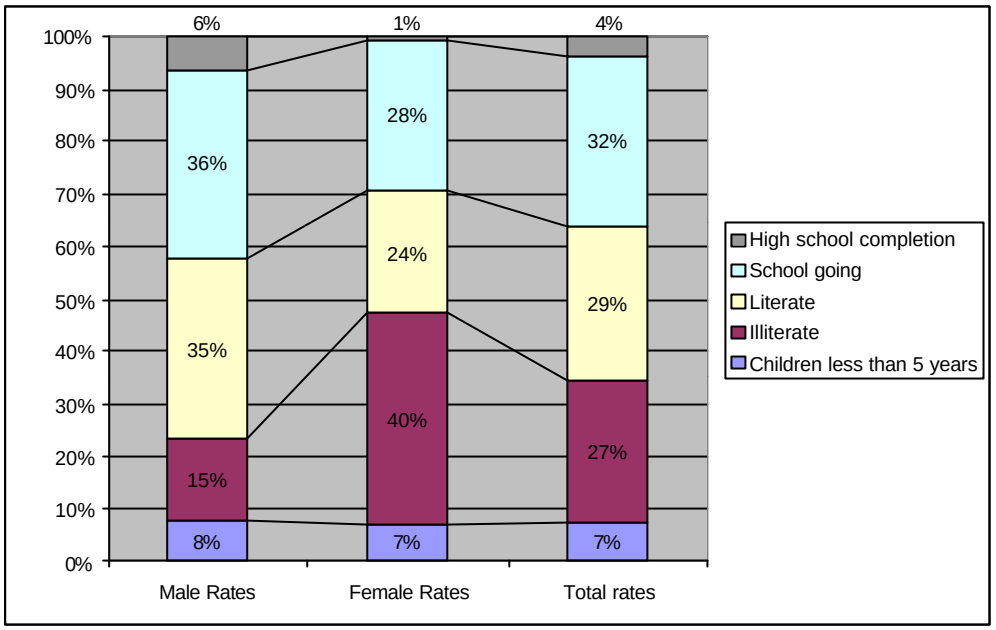
4.2.3 Human Assets

Human assets are the skills, knowledge, capacity to work and good health that together enable people to pursue different livelihood strategies to achieve their livelihood objectives.

i) Education

There has been a significant improvement in the literacy rate in the community. In response to an increased awareness and demand, NFE adult evening classes have become a feature of village life, a development made easier by electric lighting. Nevertheless, the overall rate of community illiteracy remains quite high at 27.1%. Furthermore, there is a marked gender difference, with less females taking advantage of the opportunity to attend classes. Thus, the rate of illiteracy among females, 40.2%, is high compared with 15.5% for males.

Figure 10. Education Status in the Community



Child education status is increasing. Of the 6 to14 years age group, all the boys go to school, while 84.8% of girls attend. The high school drop-out rate is very high, however. There is no high school in the immediate area of Pinthali village. Pupils have to walk more than 1 hour to reach a high school. Thus, most of the children give up their education at primary level. Only 3.7% of villagers have completed high school, the majority of them being male.

Figure 11. Primary school children in Pinthali

Language problems also affect the rate of enrolment and the drop-out rate. As all textbooks are in Nepali, schooling is difficult for Tamang children. Furthermore, there are said to be insufficient desks and benches, a lack of teaching materials, poor provision of drinking water and only one toilet at the high school.

ii) Health and Sanitation

A health post, located about three kilometres from Pinthali village, serves the community. One important source of ill-health are waterborne diseases. Respiratory problems, caused by

smoke from burning biomass fuels for cooking and heating, are also a significant risk.

With the introduction of MHP associated REDP programmes, community awareness of health and sanitation issues was boosted. There has been a noticeable improvement in the household and community sanitary conditions. The latrine construction rate is still not adequate, however. Overall, the following developments are of note:

- With electric lighting, women spend more time cleaning the house in the evening.
- The renovation of taps has helped people avoid drinking contaminated water.
- Due to fear of attacks by tigers, villagers used to keep their goats inside the house. Electric lighting makes such attacks unlikely. Hence, goats can be kept in separate shed, which appears to have a positive impact on people's health.
- There has been a calculated 72.1 % reduction in kerosene use. This has led to the reduction of smoke and health-damaging particles in houses.
- A new system of sweeping roads and public places, carried out by Functional Groups on a rotation basis, helps keep the village clean and reduces disease risks.

iii) Skills and Training

Within the community there is a mix of traditional and modern – or newly developed - skills. Traditional skills include bamboo-basket and straw-mat weaving, making Namlo (straps for head loaders) and Syakoo (bamboo umbrellas), Thanka painting, tailoring, producing incense sticks (dhup), and cloth weaving. Thanka painting and producing incense sticks have both increased with the provision of training. Modern skills include driving, acting as a trekking guide, poultry farming, mushroom growing, and working as a technician.

Figure 12. Local religious crafts

REDP programmes provided training in Thanka painting, cloth weaving, mushroom and poultry farming. Apart from Thanka painting, however, the other acquired skills are not in use because there is no market for the output. Moreover, necessary inputs proved difficult to source. Villagers plan to make use of their new skills in the near future. Once the Banepa-Bardibash highway is complete, they hope inputs will be more readily obtainable and there will be a viable conduit to take goods to market.

4.2.4 Physical Assets

Physical assets are the basic infrastructure and the physical goods that support livelihoods. Basic infrastructure includes transportation, communication, energy, drinking water and sanitation systems. The other components of physical assets include items that enhance income, household goods and utensils, tools and equipment.

i) Basic infrastructure and water supply

The MHP canal has increased the irrigation water available to the community. In fact, the irrigation system is the principal physical asset that has helped people to achieve food security and generate income, via increased agricultural production.

Before the MHP intervention, people drank canal water directly. As a consequence, in 1997, some died of cholera. With financial support from the VDC fund and using monies generated by the Forestry Group, the community has constructed 2 drinking water pipelines. While 2 taps are not sufficient for 118 households, they have made life easier and safer. Villagers are aware of the relation between the availability of safe potable water and the fall in the occurrence of water-borne diseases. A new drinking water project is expected very soon.

Figure 13. *One of the two taps in the community*

The MHP fund has helped the school to make benches for its students, providing children with a better environment for their education. The need for a higher secondary school in the village is being voiced by many members of the community.

The village does not have any modern communication systems. As they now have electricity, it would be possible to install a VHF radio. Other alternatives, in this communication age, might include a satellite telephone system.

The provision of electricity has not contributed to cooking and space heating energy. The problem of an inadequate supply of firewood for these purposes persists. Until the fruits of the community forestry project mature, continuing shortages are likely.

There is no feeder road from Pinthali to the Banepa- Bardibas highway. This deficit is a barrier to new income generating projects, which can not easily bring in necessary materials or send produce to potential markets in urban centres.

ii) Energy sources

All households use firewood and agriculture residue as their primary sources of energy. Firewood is used for domestic cooking, while agriculture residue is mostly used in making feed, Kudo, for livestock and preparing Khuwa (condensed milk). Firewood is collected from private and community forests. It takes about 6 hours to gather 35 Kg - a bhari. Average annual firewood and agriculture residue use per household is about 2,434 kg and 793 kg, respectively.

Kerosene is used by 100% of households for starting wood fires and in lamps. These days, lamps are used mainly when a problem occurs with the MHP power supply. Kerosene is bought at nearby market centres. In the main, it is easily available but supply is not totally reliable. Availability depends on transport considerations and the market situation. Though the price of kerosene fluctuates considerably, it is invariably an expensive commodity. At the time of this study, it cost about Rs22 per litre. Average annual kerosene use is about 15 litres per household, compared to 53 litres before the MHP. Thus, average annual household expenditure on kerosene is about Rs330.

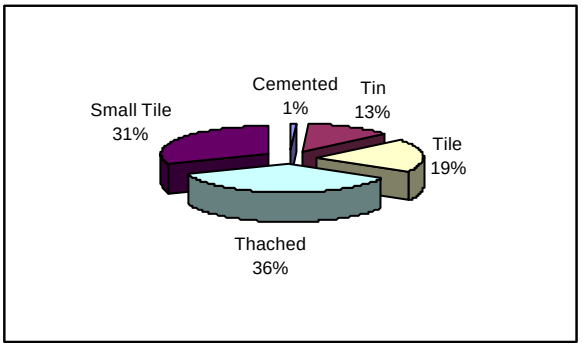
Apart from dry-cell batteries, micro-hydro is the only source of electricity in the community. At present, peak per household electricity use ranges from 25 to 150 watts. Most households use two 25 Watt bulbs as lighting. Average monthly electricity tariff payments are Rs44.1, Rs31.4 and Rs25.9 for Group A, Group B and Group C households respectively
.
Electricity is used for powering TVs, operating mills, running cooling fans, playing radios and radio-cassettes. Dry-cell batteries are used in some radios/radio-cassettes and torches. Cassette players and radios are owned by 18.3 % households, while only 3.3% have fans and TVs. Most of the electrical goods belong to Group A households. Group C households do not generally have the financial assets to afford such goods.

Apart from the MHP and a water mill, there is no other renewable energy use in the community. Diesel is used to fuel the engine for a grain-milling machine.

iii) Housing

There are a number of different roofing materials employed for housing in Pinthali - cement sheets, tin, thatch, and tiles. In fact, only one house with cement sheets was found and it belonged to a member of Group A. Cement sheets, tin and tile are regarded as prestigious materials, symbols of wealth. Most (35.8%) houses have thatched roofs. Small tiles (30.8%) and tile (19.2%) are viewed as steps up the 'status ladder'. Most houses belonging to Group C households (81.8%) have traditional thatched roofs.

Figure 14. Types of Household Roof in the Community



iv) Market

As Pinthali has a largely subsistence economy, there is a very limited 'internal' village market for labour, goods or services. Potential external markets are located far from the village. Buying and selling activities are limited to dairy products and garlic. There is no substantial cash market in paddy (rice) and grains. Due to the market access problem, garlic growers

are not able to obtain a good price for their produce. Much is expected of the Banepa-Bardibas highway in terms of providing access to markets.

Prior to the MHP installation, villagers had to walk long distances to purchase necessary goods. Now, however, two small shops have been opened in the villages and the need to venture further is reduced. Apart from these shops, there are no formal markets in the village. A co-operative takes its milk to the roadside to sell to diary firms. In the case of ginger, middlemen come to the village at harvest time to buy it at low prices.

Box 3: Market Problems

Following the installation of Daunekhola MHP, 55-year-old Sarki Singh Lama established his sawmill in Pinthali. This was potentially an important end-use for hydro-power. Sarki Singh Lama bought some new and some second-hand sawmill equipment, paying out Rs 26,000. He bought in timber from outside the village at a cost of Rs15,000. Then he proceeded to make furniture and tried to sell it. But he could not charge even the cost price of production in Pinthali because villagers were either unable or unwilling to pay. He could not sell the furniture in Dhulikhel, the nearest market centre, because the cost of transport made his furniture more expensive than that already on sale. Ultimately, Sarki Singh Lama had to close his business, incurring heavy losses. One of the unforeseen factors that affected his business was the opening of the new highway. Far from providing Sarki Singh Lama with a ready conduit for importing materials and exporting his furniture to urban markets, the highway made the import of furniture from urban areas to the Pinthali cheaper. Sarki Singh Lama could not compete.

This story indicates that, unless local entrepreneurs are fully aware of the market situation pertaining to their intended produce, including of course knowledge of the competition, they will lose out. Access to hydro-power did not make the sawmill viable. Assuming that infrastructural developments, like the highway, will bring an advantage to local businesses is very risky. As Sarki Singh Lama found to his cost, such developments cut both ways.

v) Income-enhancing goods

People in Pinthali use traditional technology for agriculture and livestock farming. Their basic tools include Halo, Kodalo, Hasiya, Bancharo, Doko and Namlo – hoes, axes, shovels etc. Soap-making and sawmills were using 'modern' raw materials and equipment, purchased from outside the village.

vi) Consumer goods

People generally listen to the radio as a source of information. Since the advent of electricity, 4 households have bought TV sets. Likewise, 22 households currently have cassette players. People have also started to use electric irons and fans.

4.2.5 Natural Assets

Natural assets is the term used for resources such as land, forests, water, air and biodiversity. The rate of change of these assets is closely related to the idea of sustainability. Any assessment of natural assets should, therefore, take into account types of natural resource, access to them, and changes in quality and quantity over time. A local forest, for example, is a natural asset for a community. People will extract firewood, wild food and perhaps medicinal herbs. If the rate of extraction exceeds the rate of replacement, however, the ecosystem of the forest will change. Thence, there will come a day when people will not

find enough firewood, wild animals will become scarce and plant species will disappear.

Before the MHP intervention, natural assets were not given much consideration in Pinthali. The tacit assumption was that they were either inexhaustible or that there was little people could do to sustain them. Following the REDP intervention, there a number of initiatives are being taken to preserve and even augment natural assets:

- There has been an attempt to protect the canal from landslides, a frequent phenomenon. Remedial – 'civil engineering' – methods have, though, met with limited success.

- The Community Forest Users' Group is active in forest conservation and re-planting. In 2000, they received a District Award from the District Forest Office.

- A tree nursery, established when the MHP installation started, is producing viable seedlings for planting out.

- Improved irrigation has benefited cropland and cropping intensity has increased.

On the whole, the MHP and associated project interventions have had a positive impact on the natural assets of the area. Attempts are being made to ensure the natural environment is made sustainable for future generations. There was no significant change observed in the use of firewood and agriculture residue after the installation of MHP, however. Hydro-power has not replaced traditional energy sources, but rather augmented then to improve the quality of people's lives and provide new opportunities.

4.3 Livelihood Strategies

4.3.1 Agricultural Activities

Agricultural productivity has been much increased via irrigation. More crops are grown and more animals kept. Improved horticultural techniques and the increased use of compost have compounded improvements in agricultural production. Garlic, potatoes, maize, paddy, mustard, black gram (Methi) and Dhaniya (a spice) are the main crops.

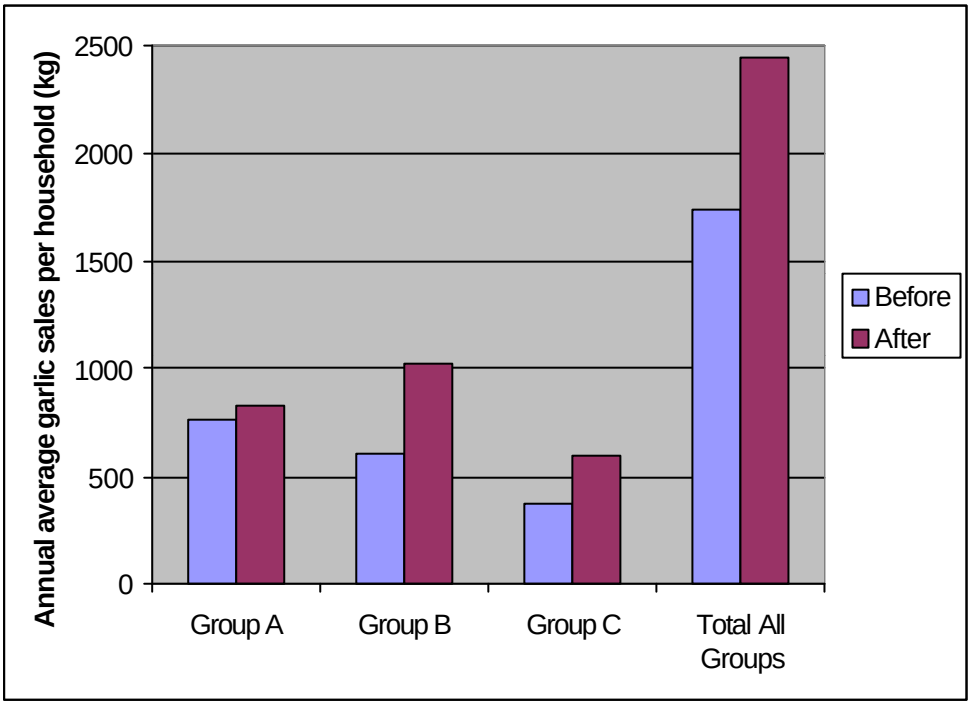
4.3.2 Cash Crops

Garlic, the principal cash crop, has been grown in Pinthali for generations. Irrigation has increased the amount and quality. Improved information on markets, has helped villagers to derive more income from sales.

At present, households sell on average 864 kg of garlic per annum, compared to 649 kg before the MHP. Moreover, before the installation only 81% of households sold garlic. This has risen to 90.5%. The price varies widely from Rs12.50 to 25.00 per kilogram. Though it is not always the case, farmers currently obtain a reasonable price. Also, rather than having to take it to market, as was the case in the past, traders now come to farms to buy the garlic.

Figure 15. Traditional garlic drying

Figure 16. Annual Garlic Sales (Kg. per Household)



4.3.3 Livestock Farming

Increased livestock keeping has begun to generate cash income. Keeping more animals more productively is a function of the market being reasonably accessible, more time for livestock care, and the availability of loans. Buffalo milk, ghee and goat are the main products. Before the MHP, only 2.4% households sold milk. These days the figure is 11.9 %. Milk sales average around 1,037 litres per household, compared to 800 litres in the past. Farmers receive from Rs12 to18 per litre.

The MHP project has given farmers more time to care for their livestock, particularly the milk-giving buffaloes. Electric light means they can work, according to choice, in the early morning or in the late evening. The arrival of the Banepa-Bardibash highway means that they have no problem accessing a market for milk, whereas before farmers could only find local outlets for ghee. Average daily income from selling milk is around Rs50 per household.

Figure 17. Goats and Buffaloes kept in Pinthali

4.3.4 Off-Farm economic activities

Pinthali people have been involved in Thanka painting for many years. Prior to the project intervention, however, it was regarded only as a tradition and not undertaken as commercial activity. Following training courses in improved techniques and marketing, Thanka painting has become one of the main sources of community income. REDP has helped establish links with Kathmandu Mahaguthi (a religious institution) to market Thanka, Khadi and Dhup (incense products) from Pinthali.

Some villagers work as labourers on the construction of Banepa-Bardibash highway.

Electric light allows shops in the village to remain open later into the evening, increasing their business. The availability of loans from the local saving and credit groups has allowed shop owners to expand.

4.4 Livelihood Priorities and Outcomes

4.4.1 Priorities

Villagers list their livelihood priorities, which would have positive impacts on livelihood outcomes in the community, as:

- Food security;
- Cash crop production (income generation);
- Education and vocational training;
- Communication with the outside world;
- Road connection to market centres;
- Health facilities.

Pinthali was a traditional community, largely isolated from markets and rather stagnating in terms of economic development. The MHP intervention, together with social mobilisation and income generation activities, has had multi-faceted impacts on the community livelihoods. The project has produced changes in economic, social, cultural and psychological aspects of the community. These have markedly affected livelihood outcomes.

4.4.2 Outcomes

Improved livelihood outcomes can be categorised as: more income; increased well-being; reduced vulnerability; enhanced food security, better health and sanitation, reduced

drudgery, and increased monetisation of business transactions. For Pinthali, some of the key outcomes are considered below.

Food security

Food security is the undisputed top priority expressed by people in Pinthali. In the past, agricultural output for the majority of households was insufficient to produce enough food for a family of 6 persons and food shortages were common. Today, with irrigation, only 11 out of 118 households face problems with food security.

Increased well-being

Electricity, which the community has craved for decades, has boosted people's confidence and self-respect. Together, enhanced social unity, better food security, reduced vulnerability and more income generating opportunities have contributed to increased well-being. People feel 'greater dignity' because they have electricity; there is a sense of pride in the village, which is consequently cleaner and better cared for. Extra 'leisure' time has given people the opportunity to attend NFE classes and participate in Functional Group meetings

Children are happier and more effective studying under electric light. Kerosene lamps provide dim light and produce smoke, discouraging them from their homework. Kerosene lamps could not be given to younger children because of the risk of fire, particularly in traditional houses with thatched roofs, which are those inhabited by the poorest section of the community.

Reduced drudgery

Villagers used to spend a lot of time, money and resources trying to procure kerosene. Electric light has reduced dependence on kerosene and women are able to do housework in the evenings. People are happy to perform other household functions too, such as processing maize and garlic. Women's drudgery and the time expended in oil expelling and rice husking has decreased following installation of the MHP-powered rice huller and oil expeller.

Increase in economic activities and income

Essentially, growth in economic activities and income is due to improved irrigation. The area cultivated for cash-crop garlic production has reportedly grown by 7.5 hectares. This boosts annual garlic production by an estimated 7.5 tonnes. In turn, this generates additional income of around Rs 175,000 per year. Average annual per capita cash income in the community has increased from Rs 2,419 to Rs 4,102.

One of the key changes in the livelihood strategies was the gradual monetisation of village dealings. Previously, trade had been mainly bartering agricultural produce. Formation of COs provided the opportunity for people to save money. The formalisation of savings and credit schemes, providing loans at reasonable rates, motivated villagers to increasingly use cash.

Installation of mechanical agro-processing equipment has saved people a lot of time. This they have used for engaging in other productive work, such as livestock farming, which has increased income through milk sales.

4.5 Vulnerability Context

4.5.1 Seasonality and trends

During planting and harvesting time, villagers are obviously very busy. At such times, they are preoccupied with agricultural work, leaving little time for other livelihood activities. The winter season is, then, considered best for engaging in off-farm activities. Then, it is easier to mobilise the community. Hence, winter is when NFE classes and community meetings are mostly held.

Food production, food availability, labour availability and the occurrence of diseases all vary according to the season. Such variations have a direct impact on household expenditure patterns, producing fluctuations in livelihood strategies and outcomes. In Pinthali, irrigation helps smooth seasonal affects and hence reduces vulnerability.

In many households, living conditions and sanitation are not yet of a standard that would promote good health. Households are vulnerable to livelihood shocks associated with members becoming ill. In the first instance, almost all members contribute to food production. Any shortfall in self-sufficiency must be made up by purchasing food. Secondly, with no village clinic, illness means people have to spend money to travel to obtain advice and medicines. In cases of illness, therefore, households are often obliged to take bridging loans in order to cope.

During the monsoon, surface run-off water engulfs already overloaded drainage channels. Flooding creates field erosion, water logging, landslides and problems with mosquitoes. Not infrequently, landslides block the canal and the electricity supply is interrupted. The demand for maintenance and repair, at the same time as people are busy with agricultural activities, is a hardship.

Floodwater contaminating the source can render the village's new drinking water supply unsafe. Though they are not as serious as before the supply was installed, incidences of diarrhoea, jaundice, dysentery and typhoid remain relatively high during the rainy season.

The availability of fodder for livestock is also seasonal, with a potential short-fall in winter. A consequent decline in milk production affects the income of dairy farmers.

There is a seasonal effect on business activity, market accessibility and prices. During the crop-harvesting period, a surplus of products such as rice and maize often means that a low market value is placed upon them. Disease problems in garlic and a low agricultural output attributed to a to lack of modern techniques are other problems.

Access to external markets is very difficult in the rainy season due to floods and landslides blocking tracks. People stock-up with household items before the beginning of the monsoon. Likewise, they prepare reserves of firewood. Use of firewood is highest during the winter season, corresponding happily with when it is most available, though overall shortage remains a problem.

4.5.2 Shocks

As discussed, illness is one of the main shocks experienced by households. The community is prone to diarrhoea, dysentery, pneumonia, typhoid, worms and cholera. People are becoming more aware of the causes of disease and of prevention strategies, though affording treatment remains a problem. Overall, however, community health is improving with child mortality, for example, in decline. Apart from infectious diseases, respiratory problems due to smoke are quite common. The incidence of burns is declining due to the use of

electric light rather than kerosene lamps.

Dependence on kerosene used to leave the community vulnerable to shocks caused by price variation and availability. Electric light from the MHP has reduced such vulnerability.

While Pinthali has limited interaction with the wider world and is hence cushioned somewhat from macro-economic effects, those villagers working outside the community are susceptible to their impact. Should they lose heir jobs, the community would obviously be deprived of a source of income. Furthermore, unemployed, they would generally return to the village, where there is often not enough productive work to support them. Most labourers, drivers, guides and Thanka painters, anyway, return to the village at planting and harvest time.

4.5.3 Vulnerable groups

Certain categories of households in the community are perceived to be more vulnerable to shocks, trends and seasonal events that affect livelihoods. These mainly include:

- The chronically sick and the elderly.
- The poor - about 9.3% of households are prone to food insecurity and are highly vulnerable to market fluctuations, crop diseases and failure.
- Widows with children to look after and few resources.
- Large families have a narrower margin for coping, resources being spread thinner.
- Unemployed youths are a significant vulnerable group as they make up a large percentage of the community.
- The ‘middle class’ - about 35.6% of households remain vulnerable to extreme weather effects, experiencing food shortages associated with drought or flooding.

4.6 Policies, Institutions and Processes

While the impact of the REDP intervention on the existing Policies, Institutions and Processes (PIPs) related to community is subtle, the impact of PIPs on the MHP intervention is substantial.

There has been a change in the process of governance within the community as a result of the project. Democratisation and participation have increased. Before the project, leadership rested with a handful of senior - all male - members of the community. People followed the edicts of these elders with little argument. Following the process of social mobilisation, group formation and increased participation, people have been more involved in decision-making processes. They now feel more confident in speaking out and challenging traditional leaders.

The REDP methodology discourages the same individual from becoming chairperson of more than one group or committee. A large number of the people have thus been given the opportunity to adopt leadership roles, thereby building the capacity of the community.
Along with the development of participation and leadership capacity, people believe that there has been an improvement in overall accountability. It should be said, however, that accountability was not a major problem before the REDP intervention. The community have experienced few problems with public officers, for example.

4.6.1 Institutions

Various institutions within and outside the community have provided support for the energy intervention, participated in the governance of the project and in shaping its environment. The institutions within the community include the MHFG, the savings and credit group, the community forestry users group, lama groups, and the exchange of labour network. Among the outside organisations are the REDP, ADBN, REMREC, VDC, DDC, DEC, DEF and the District Energy Network. Below are the activities of institutions not already defined in the study, presented in order to clarify the institutional context impacting on the project.

- District Rural Energy Management Committee was created by DDC for day-to-day operation of DDC REDS. DREMC decisions are presented at DDC meetings for endorsement.

- Rural Energy Development Section was established by DDC in line with the Local Governance Act 1999. REDS is a sectoral unit, attending to all matters related to rural energy promotion in the district. Though DDC REDS is the first sectoral unit within DDC, it is envisaged that others will follow.

- District Energy Committee has been created to guide programme implementation at district level and to provide critical linkages for a holistic development approach. DEC also facilitates the decentralised energy planning process. Government agencies and the ADBN are represented in DEC.

- District Energy Fund has been established to channel financial resources to rural energy development activities. DEF is a revolving fund from which communities and private entrepreneurs are eligible to take credit for installing rural energy systems. DDC REDS manages the fund on behalf of the DDC.

- District Energy Network is the forum of the DDC that focuses on experience sharing, consolidation and dissemination of energy policy, strategy and approaches. It also functions as a lobby group for the promotion of decentralised rural energy development in Nepal.

- Lama groups exist to administer to the spiritual needs of the community. Apart from their traditional spiritual role, however, Lama scholars and elders provide support, guidance and advise on various secular aspects of community life.

4.6.2 Policies and Processes

There are many regulations, entitlements, policies and laws that influence the livelihood outcomes of Pinthali. The capacity and working efficiency of the VDC increased markedly following the introduction of the Local Governance Act. Managaltar VDC played a supportive role in the implementation, operation and maintenance of the MHP. Likewise, the VDC has assisted other development activities of the community, water supply and road construction, for example. Unsurprisingly perhaps, most villagers are not fully aware of government policies and process. They are more concerned with the role of the MHP management committee and community function groups.

During project formulation, the community did experience some difficulties with government policies and procedure. The main problem they noted, however, was the long process of arranging for a loan from ADBN.

With respect to issues where the community believe there is a need for policy change, the 'misuse' of water by neighbouring villages is high on the agenda. Pinthali residents express the need for an 'adequate authority' to enforce 'rules' and sanction offenders. There is also a feeling that MHP operators need refresher training and that there should be a contact person to advise on technical problems, alongside an accessible venue for repair work.

4.7 Coping Strategies

Most households plan to cope with food shortages by borrowing money. This strategy is the same now as it was before the REDP project. The use of savings to cope with such situations was, however, found to be greater after the MHP installation, indicating people have more savings to draw on. In case of extreme need, Group A households might sell land, while members of Group C households are more likely to temporarily migrate to urban centres to take employment.

4.7 Supposing a Sustainable Livelihoods Energy Intervention

This section of the study is speculation. It focuses on a 'what if' scenario: What if Daunekhola MHP had been implanted as part of a SL approach? REDP's holistic approach, however, has many features in common with SL. UNDP also believes in the SL approach and has its own version of an SL framework. REDP methodology probably had its genesis in UNDP's SL approach. There is evidently much commonality, particularly in the participatory approach adopted in planning and implementation, capacity building and seeking productive end-uses for generated power. Clearly then, no vast differences in results might have been expected had DFID's SL approach and framework been applied. Nevertheless, there are *some* differences between the two approaches.

The holistic approach of REDP takes MHP as an entry point and mobilises the community to achieve their priorities, which may or may not have links with MHP. Involvement in community forestry, support to water supply projects and training for micro-enterprises that do not require energy input are some instances of REDP initiatives that do not have a direct link with MHP.

The DFID SL approach, by contrast, provides guidelines and tools for analysing the livelihood situation before project intervention. This is achieved by 'dissecting the whole picture' into the various components of the livelihood framework, while considering their inter-relation. This done, the aim is to increase the quantity, quality and diversity of SL outcomes. In turn, this is brought about by promoting the positive effects and minimising the potential adverse effects of intervention on various types of assets. Widening the choices of livelihood options is designed to result in coping strategies capable of dealing with shocks and thus reducing vulnerability.

The SL approach would give equal attention to the backward and forward linkages of the energy project. It would seek to maximise the impact of each activity on the livelihood outcomes. Thus, employing an SL approach, one might expect an increased positive impact on the livelihood outcomes of the project. Though it may appear as something of a 'wish-list', it is worth assessing where an SL approach might have significantly altered the outcomes of the energy intervention.

4.7.1 Vulnerability

An SL approach would have focused on reducing vulnerability, which might be expected to have resulted in:

- Introducing appropriate preventative solutions, such as the strategic planting of suitable species that would serve to prevent soil erosion in order to reduce the frequency and impact of landslides on the irrigation/MHP channel;
- Improved management of the drinking water system to further reduce risk of diseases;
- Greater attention to measures that would ensure better prices for agricultural products;
- More effort to establish broad-based and assured sources of income.

4.7.2 Physical assets

Physical assets, such as the water canal, electrical transmission poles, power house and access road, might have received greater attention, ensuring they were more durable and resistant to accident damage. A higher standard of operation and maintenance work would have been prioritised. The community has demonstrated its independent capacity to sustain the project by replacing the failing wooden transmission line poles with steel poles.

4.7.3 Human resource development

More appropriate training would have been provided according to need, market, interest and the capacity of the community. This would be expected to result in more directed and profitable income generating activities. Attention to markets would, indeed, have been one critical area for more attention under an SL approach.

4.7.4 Allocation of benefits

If possible, an SL approach would foster even greater participation. With attention given to diversifying energy and income sources, an effort would have been made to ensure an equitable distribution of benefits. This might have meant, for example, that electricity tariffs were differentiated. As the situation stands, better-off households pay the same price per unit of electricity. Put another way, the poor are paying a larger proportion of their income for electric lighting. This situation might have been reconsidered, possibly using a similar categorisation of households to that made in this study as a guide for tariff differentiation

4.8 Constraints to Achieving Community Priorities

Food security, social development, infrastructure development and the greater income generating opportunities are priorities of people in Pinthali. MHP has contributed to food security through the supply of more irrigation water, an infrastructural development. Similarly, the MHP project has enhanced social interaction through communal organisation and mobilisation. Apart from electric lighting allowing increased dairy production, however, MHP has not had a significant positive impact on income generating activities. The sawmill initiative failed, lacking a market prepared to pay for the furniture produced. This survey of the project site has identified the following constraints.

4.8.1 Information

People do not have appropriate information about viable end-uses for electricity or mechanical micro-hydro power. Development advisors involved in the project tend to expound the theoretical, technical possibilities. They do not focus on options appropriate to the locality. Hence, villagers do not have 'full information' on market opportunities and constraints and receive little assistance in this vital area. Entrepreneurial decisions based on inadequate information are, in all probability, doomed to failure.

4.8.2 Entrepreneurial capability

Linked to the preceding point, the lack of entrepreneurial capability in Pinthali is manifest. The sawmill has proved the only serious attempt to develop a productive new industry. Is there a dearth of opportunities for new business activities in Pinthali? Or does the entrepreneurial spirit need to be nurtured, with training in business planning and management provided? Non-government and government development agencies may not be the best organisations to promote and support entrepreneurship. Is the quality, indeed, something that can be taught? Such questions not withstanding, it remains clear that the lack of entrepreneurial skills is one limiting factor on enhancing livelihood outcomes in Pinthali.

4.8.3 Markets

Another major problem is that Pinthali is far from market centres. The village itself has a subsistence economy where, constrained by income and following tradition, people tend to make rather than purchase goods. Hence, there is little or no local market for any production arising from the application of electrical or mechanical power from the MHP. To compound this local constraint, as the history of the sawmill illustrates, urban markets are quite 'sophisticated', probably benefiting from mass production technologies. Penetrating such markets may be an insurmountable challenge for new village-level industries.

4.8.4 Social Infrastructure

Pinthali is still without a secondary school, a health post or telephone connection. Drinking water supply and sanitation systems remain inadequate

4.8.5 Motivation

The failure of various ventures and of training to result in improved livelihood outcomes has had a negative impact on the community. Poultry farming failed because feed was unavailable on the local market and that brought in from Dhulikhel was too expensive. Similarly, mushroom farming failed because seed could not be sourced affordably. Those who participated in cloth-weaving training are unable to exploit their newfound skills due to the lack of demand. Meanwhile, garlic farmers are facing new crop diseases, which threaten their livelihoods. Psychologically, villagers feel – if not defeated – then severely discouraged.

The question may be whether the village economy is intrinsically – inescapably – constrained by external factors to remain at subsistence levels? Do viable income-generating possibilities exist? Can accessible markets be found and people provided with the necessary training and support in order to be able to compete?

4.9 Community Observations on Livelihoods

Despite the constraints noted, the REDP approach has certainly ensured that Pinthali MHP has been successful to a significant degree. The project has brought more sustainable benefits to the community than where MHPs have been installed without support. Inevitably of course, there is acknowledged room for improvement. Evaluation reveals that the

provision of institutional support and training cannot guarantee optimisation of livelihood outcomes on a sustainable basis. Below are some observations from the community itself:

- At present poor canal maintenance limits available electricity; it cannot carry the designed flow of 60 litres per second. The 118 households use on average 53.8 watts each. Hence, only 6.3 of a possible 12 kW is used. The provision of more electricity could be designed to reduce consumption of other energy sources. The supply of hot water or heat-storage cooking, for example, could reduce firewood consumption.

- Even though the MHP is not generating full power, there is surplus electricity – even at peak consumption times, evenings and early mornings. Villagers are anxious that productive end-uses should be found for this power. They are keen to participate in training directed towards income generation, particularly during the farming 'off-season'. Unfortunately, as discussed, they do not have information on viable products and markets.

- The community wishes to work towards empowerment and full ownership of the project and end dependence on external support.

- All training, education and awareness training should be carried out in the local language to ensure understanding, particularly of women and children. During this case study it was noted that, while women understood the questionnaire survey, they were unable to respond in the Nepali language.

- Turbine operators need refresher training and back-up operators should also be trained.

- NFE should be promoted more strongly and courses run at times designed to fit in with people's other livelihood activities.

- As part of its exit strategy, REDP has helped the community to register the project as a co-operative. The legal and administrative issues involved in running a co-operative are not fully understood by the community, however.

4.10 Summary of Pinthali livelihood components before and after energy intervention

The table below shows a summary of the livelihoods review, using the structure of the SL framework. It shows the impact of the intervention, an approximate assessment of the situation before the intervention, and then speculation about the possible improvements that could be made under the SL model.

SL Component	Situation Before Intervention	Impact of Intervention	Possible Improvements under SL Model
VULNERABILTY Shocks	• Food shortages • Contaminated water caused diseases • Landslides on canal not repaired • Social conflict was a common problem	• Better food security • Less waterborne diseases • Social mobilisation for repair • Conflict resolution in meetings	• More attention given to social cohesion and mobilisation, particularly to further improve water supply and mitigate landslide problems
Trends and seasonality	• Flooding/market access • Food shortages and price hikes • Firewood scarcity • Increased out-migration for jobs	• Food security improved. • Decrease in out-migration rate • Firewood situation improving	• Flood damage prevention. • Diversification of energy sources
ASSETS Human assets	• High illiteracy • Limited vocational skills • High unemployment	• Increased literacy rate • Skill enhancement	• Training according to needs provided in local language • Identification of markets for products and labour; training in appropriate skills
Financial assets	• No local opportunity for saving or loans • High interest rates from moneylenders • Dependence on agriculture • Income from working outside the village	• Saving and credit scheme • Increased financial security	• Diversification of sources of income through small-scale manufacturing and cottage industries
Physical assets	• Poorly maintained irrigation canal • Primary school with inadequate furniture • Poor village shops	• Better canal maintenance • School furnished • Better shops, opening longer • Electricity for lighting	• Well maintained canal • School development plan • Increased enterprise
Social assets	• Little participation of women in decision-making • No formal committees • Dominant VDC • Leadership by few elders	• Increased participation of women • Formation of functional groups • Shift in power to community • Diversified leadership	• Increase in shift of power to the community; further empowerment of women
Natural resources	• Decreasing forest area • Landslides • Under utilisation natural resources	• Nursery producing seedlings • Conservation and planting • Improved landslide prevention • Harnessing hydro power	• Tree plantation in landslide prone areas • Protection measures around MHP structures • Fodder tree planting • Better use of resources
PIPs Institutions	• No effective linkage between Community, VDC, DDC, ADBN etc	• Linkage and support increased	• Better co-ordination of linkages
Processes	• Community decision making dominated by men from high-income status group •	• Broadening of decision-making base to include all member of the community	• Similar outputs would have been achieved

Policies	• Macro: Subsidies (RET) • De-licensing for MHP • Forest policy	• Sustainable Development and Rural Livelihoods Policy • DDC and VDC-investment	• Policies promoting better allocation effects and more meaningful participation
LIVELIHOOD STRATEGIES	• Garlic production only by a few, richer, households • Firewood collection • Subsistence farming • Making clothes only for domestic use • Water collection (unhygienic water) • Out-migration for wage earning • Thanka painting	• Garlic production by most households • Community forestry • More income from farming • Commercial weaving potential • Limited tap water available • More employment on-farm • Improved Thanka painting	• Diversification of energy and income sources • Electricity tariff differentiated to ensure equity
LIVELIHOOD OUTCOME	• Expenditure to procure energy needs. • Unsustainable use of livelihood assets • High vulnerability.	• Increased well-being • Reduced vulnerability • More sustainable use of assets	• Livelihood outcomes would have been better achieved.
Income	• Less income • Dependence on subsistence agriculture • Only traditional income generating skills Constrained marketing opportunities • Lack of time to care livestock	• More income • Increased cash crop production. • Increased Thanka painting • Markets still limited • Increased dairy production	• Technical and managerial skill promotion for enterprise development • Market development
Well being	• Hard labour and many hours spent on grinding work by women	• Decreased drudgery, due to milling facility • Electric light reduces drudgery and makes study easier	• Similar outputs might be achieved
Food Security	• Poor food security	• Increased food security due to • Irrigation facility	• Similar outputs might be achieved
Vulnerability	• Food shortages and disease	• Reduced vulnerability	• Off-farm income would have raised
Sustainable use of resource base	• Use of firewood • High use of dry-cell batteries	• Increased forestry • Reduced use of batteries	• Similar outputs might be achieved

5 LESSONS LEARNED

Daunekhola MHP is an outcome of a combined effort by the local community, HMGN, local government and REDP. It represents the fulfilment of a decade-long dream for Pinthali. The MHP project is being managed by a highly motivated community with continued support from a dedicated development agency. The lessons learned from project experience include:

- The commitment of the community to a project that addresses their identified and expressed needs is critical.
- Energy planning should consider associated and 'spin-off' effects. The use of MHP canal water for irrigation generated additional positive livelihood outcomes in Pinthali.
- The development of a formal community capacity, to respond, for example, to routine maintenance tasks and shocks, as well as instigate development activities, is vital.
- Likely changes in the external environment should be considered when planning energy infrastructure projects, particularly as such projects tend to have a long operational life. In the case of Pinthali, the construction of Banepa-Bardibas road was not taken into account, though it proved to have a significant effect on community livelihoods.
- Selection of the size of plant should be based on a realistic projection of demand – part of an integrated community development plan. In Pinthali, the MHP runs at only around 50% capacity. A surplus capacity in such installations could be supplied at low or no-cost to stimulate the development of local industries.
- Identifying and implementing productive end-uses for power can be more difficult than the installation of energy generating hardware itself, as has been apparent in Pinthali. This aspect should be given more consideration. It involves assessing the availability of raw materials, associated technologies, entrepreneurial capacity and markets, for example.

End note

At this stage, the overall livelihood strategy for Pinthali community could beneficially focus on consolidating livelihood assets with a view to diversification. As with the Livelihoods Framework, the following suggestions are interlinked. There is a need to focus attention on enhancing natural assets. Landslide and flood prevention measures, based on forestry and complementary planting technologies, including fodder trees, will help secure other assets.

Once the MHP and irrigation canal is protected from damage and a viable maintenance programme has been established, the community can begin to look at making better use of the power available – the surplus 'energy capital' that presently lies idle. In this regard, two complementary activities suggest themselves. There is a need to identify and access new markets, both for existing and potential produce. The community might mobilise its significant social capital to further develop appropriate human assets. Entrepreneurial, marketing and other business skills are evidently necessary and the community needs to source training options for selected members.

A second – complementary measure – would be to establish an institutional scheme to provide power to new enterprises. This might involve discounting charges, at least in the establishing stages. One strategy for sharing future benefits, might be for Daunekhola Micro-Hydro Co-operative to consider becoming an active stakeholder in such enterprises, trading power for shares.

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ANNEXES

Annex 1 - Table of SL Indicators and Tools

Livelihood Components	Component Indicators	Tools to be Used for Data/information Collection
6.1.1.1.1 Livelihood Outcomes		
Reduced Vulnerability	• Access to energy services • Food security • More sources of income • Credit availability • Support from associated organisation/groups • Social cohesion/harmony	Interview with Households with Structured Questionnaire Discuss with local organisations, NGO, CBOs
Improved Food security	• Drying • Cold storage • Irrigation/pumping • Agro-Processing for storage	Observation/ PRA
More income	• Micro-enterprises/Small industries • Increased agricultural production • Value added to exports • Employment opportunities • Financial services	PRA Household surveys
More sustainability of NR base	• Reduced pressure on forests affecting -water supply -landslides -erosion and loss of top soil Protection of wildlife	PRA
Increased well being	• Less insecurity • Less stress and drudgery • Labour saving • Communication system • Entertainment choices • Health -vaccines, -smoke reduction -better lighting, less eye strain • Education -lighting for homework • More money • more self esteem • Low desired work-leisure ratio	Household interview
Gender Balance	• Reduced time to discharge gender roles (Fetching water/ Collecting firewood/Cooking/ hauling and	Focused Group Discussion with women Household survey

	grinding/ managing better the seasonal agricultural products • Membership in Users' committees • Increased possibility of earning from energy/ light induced micro economic activities • Gender relations	
6.1.1.1.2 Assets		
Human	• Type of labour (Skilled/unskilled) • Level of education and skills • Level of indigenous knowledge • Training • Level of awareness • Working positions	• Key Informant survey and Household survey
Physical	• Educational infrastructure • Transport system • Communication system • Water supply and sanitation system • Recreation centres • Manufacturing and service centres • Equipment/ tools and other producer goods • Goods for Personal /community recreation and comforts and shelter • Energy systems	• Key informant survey/observation
Social	• Values, norms and beliefs (ICS) • Existing traditional organisations and structures (build on these-don't create new ones) • Existing organised groups and social networks • Kinship networks • Cultural ties • Level of interactions/participation and corporations • Gender balance • Social inclusion/exclusion	PRA and socio-anthropological inquiry
Financial	• Access to loans (formal and informal) • Remittance/pensions • Access to subsidies • Equity • Market infrastructure • Institutions • Fundraisers and fundraising (people and organisations)	• Policy review • Discussion with entrepreneurs, financial institutions and concerned organisations/agencies
Natural	• Water resource	• PRA

	• Solar resource • Topography and climatic resource • Wind resource • Land (cultivated and cultivable) resource • Forest/bio-mass resources	• Discussion with resource user groups
6.1.1.1.3 PIPS		
Policies	• Policies regarding the ownership and basic uses and productive uses of energy resources • Policies regarding tax, subsidy and credit and pricing of energy services • Policies related to energy end-uses • Policies regarding governance • National level sectoral policies	• Policy review from secondary sources • Discussion with concerned organisations/agencies
Institutions	• Informal cultural groups • Utility (buying and selling) • Financial institutions • Service centres • Community based organisations (management)/NGOs • Forums (lobbying) • Local government	• Key Informant Survey • Focus Group discussions
Processes	• Nature of authority and decision making structures • Governance/ style of policy implementation • Public consultation	• PRA • Household survey