Sustainable Renewable Energy Development of a Remote Community in Nepal

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Abstract

This paper describes the process used in the development of two villages in the remote Humla region of Nepal. The process includes both reducing the deforestation and improving the living standard and health of the local people. Specifically, it implements pit latrines, smokeless stoves and electric lighting. The lighting is powered by either Pico hydro systems or by solar photovoltaic systems.

1 INTRODUCTION

Remote and mountainous areas of Nepal offer a living that is at the best subsistence living, but since the population has reached close to the carrying capacity of the land, for many people their existence is near miserable with little hope. This can be understood from the practice in some areas, of not naming the children until 5 years old (figure 1), as they are so unlikely to survive that long.

Figure 1. Young girl with a solar panel.

In order to provide hope for near destitute communities, the intention is to provide appropriate development at low cost in a sustainable and appropriate manner. The development should be locally based and replicable, so that it is not only a one off project, but the lessons learnt can be applied to other communities also. The sustainability and appropriateness are not easily determined in advance, except by experience and long term evaluation of the projects (e.g. 5-10 years).

Two villages were chosen for an integrated development of pit latrines, smokeless stoves and electric lighting. The nearest town to the villages is Simikot (figure 2), in the Humla district, some 15 days walk from the nearest road, but it has an airfield (if it is still operational after a recent terrorist attack). The chosen villages of Chauganphaya and Kholsi are one days walk north of Simikot.

The villages of Chauganphaya and Kholsi are similar in that they have about 60 homes at 2500m altitude, with a population around 500-600 people. The residents are of the Takuri caste (the same caste as the current line of kings of Nepal), but are very poor with an estimated average income of around $30-50US per annum. It is thought that no one from these villages has ever achieved a “School Leaving Certificate” (SLC) (equivalent to “O” levels or “school certificate”), and hence opportunities in life are rare. The approximate lifespan is thought to be 40-44 years, with subsistence agriculture as the main livlihood. There is usually no sugar in the homes as it is too expensive. Some commercial activity is performed, such as sales of firewood and some agricultural sales, some portering, and trading in Chinese/Tibetan products – especially goats.

As an example of the present state of development, at Chauganphaya, for the 60 homes, there are approximately only 5 pit latrines, 2 or 3 smokeless stoves in poor condition, no water supply and no electric lights.

An office has been set up to service the installations, to provide training and to provide a source for further development in the area. One of the jobs available in the office was for a general assistant, yet despite the desperate level of poverty, both villages (but presumably men only) refused to apply, as that type of work is seen as beneath their caste.

Figure 2. The town of Simikot, Humla in remote west Nepal.

2 PROJECT DETAILS

At Kholsi, as there is adequate water, a 1kW Pico hydro system is being installed. This is by far the cheapest way of providing electrical power to a village and the system is manufactured in Nepal. At Chauganphaya, due to the lack of water, a hydro system was not possible, hence a photovoltaic system is being installed. This consists of four 75W panels. Whereas the photovoltaic panels are imported from neighbouring India, the control equipment, batteries etc are locally available and the solar tracker (figure 7) is locally designed and manufactured.

The main purpose of the electrification is to provide night lighting. Not only is the quality of the light better than given out by burning pine resin, there is no smoke. Providing a smokeless environment inside the house is one of the major health aims of this project.

The solar tracker has been designed without electronics nor a battery. The solar PV system batteries will only have a depth of discharge (DOD) of a maximum of 20%, and hence should have a life of 8-10 years. The batteries are inside the houses and kept at 10-15C in a box insulated with locally available pine needles. The solar panels have a design life of 20 years. The system comprises of four 75W BP Solar panels and four 1W white LED lights per house.

Traditionally, lighting at night is effected by burning pine resin. However, this is very smoky and also the resin collection may damage the trees. The concept here is to provide an electric system to power white light emitting diode lamps (WLEDs) in the homes. These lamps have been developed locally and two 1Watt white LED lamps will acceptably light the single room houses. Consequently, 500 houses could be lit from a 1kW Pico hydro generator. In this case there will be four lamps per house. Voltage regulation is using a ballast load. Normally, the ballast load is an air heater, but in this case, a large 500 liter insulated water tank is being used as the ballast load. The aim is that the water will be warmed, promoting both washing and also reducing the need for firewood for boiling foods, especially rice. Other than for lighting, no other use of the electricity is allowed.

The Pico hydro system is about 1km away from the village being electrified, hence to reduce wiring losses and allow the use of thin wire, the output from the Pico hydro will be stepped up to 650Vrms with a transformer, transmitted along buried, armoured cable and then stepped down again to 220Vrms.

For protection against man, beast and nature, armoured underground cables are used for the transmission of power from the Pico hydro site to the village over a distance of about 1km. It is buried 1m deep to be below the frozen earth in winter. The village is divided into 3 clusters of about 20 homes, each cluster having one transformer, an ac-dc rectifier for the lighting circuit. Small armoured wires, laid underground, are used for lighting power distribution within each cluster. Each house has four 1Watt white LED lights. The Pico hydro system ballast load (about 700W) is used to warm water at a central point in the village, in order to encourage washing. Since typically the water is very cold (2 °C) and cleanliness is not much understood or appreciated, some people may not wash for up to several years.

Although the problems of this community are manifold, only some of the problems are addressed in this project. The most obvious feature of the landscape in figure 2 is the lack of trees. Hence the shortage of firewood for cooking and space heating is a major difficulty. To assist in reducing the need for firewood, an improved stove was developed. By incorporating a chimney, the smoke that filled houses from the open interior cooking fires was eliminated. This introduces health benefits, which have been improved by providing a water tank on the side of the stove to warm water for washing. Washing very regularly is not performed often due to the lack of understanding of hygiene and as the water temperature may be near freezing. Hence providing some warm water may assist in encouraging washing (figure 3).

Figure 3. If the water is cold - one way to get a warm wash.

Since the villagers are very poor, the stoves (figure 4 right) must be provided at a subsidised price. The subsidy is 50%, but is arranged so that the subsidy is only available if a pit latrine (figure 4 left) is built. The usual toileting practice is to use the open ground. This spreads many diseases as people and animals come into contact with the human waste. Hence a health campaign is conducted first, explaining the need for a pit latrine and its correct use, with washing oneself afterwards, and the offer of a subsidy if one is built to the proscribed standard.

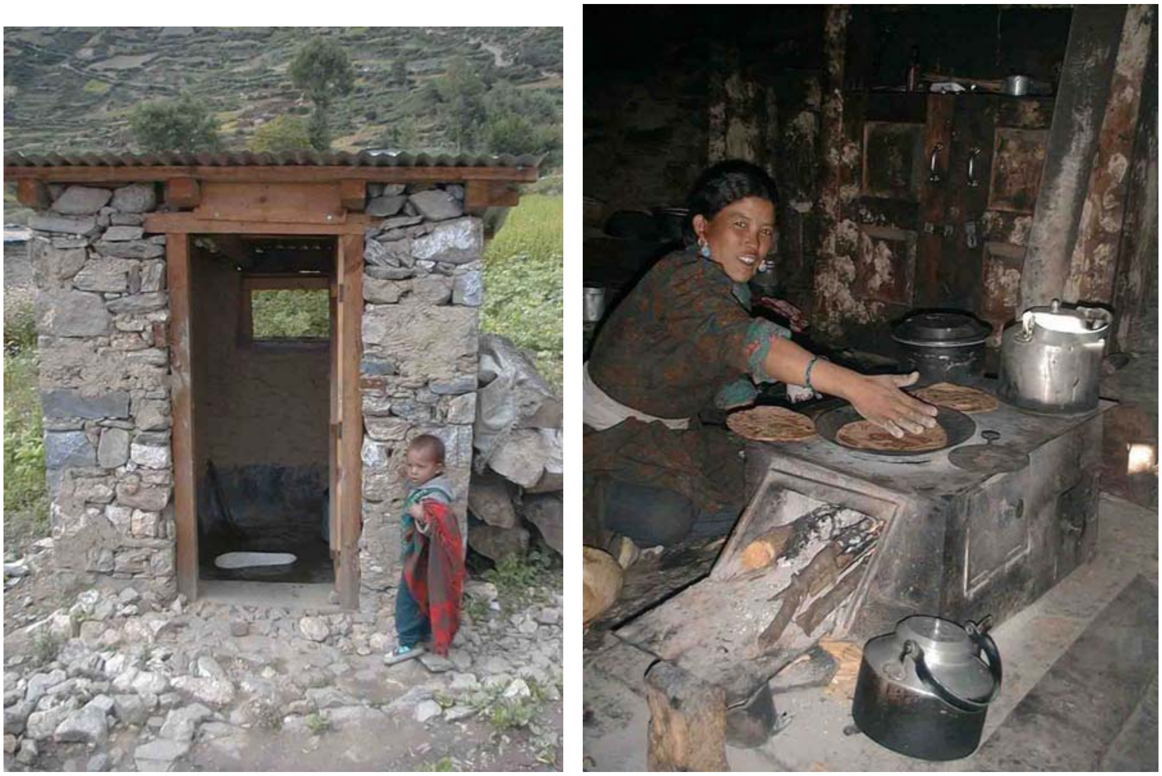

Figure 4. Left: pit latrine built to obtain stove subsidy. Right: smokeless stove – but it is difficult to persuade people to close the door to increase the efficiency.

The smokeless stove is designed quite specifically to meet local cooking habits and due to its specialised design, it has been built from steel. Since steel is not a locally available commodity, the stove has been built to have a 10-15 year life.

Sustainability has been interpreted here as only using local material or, if not available, long life material. Since cement is very expensive (brought in by helicopter only), no cement is used, but instead wood and stones.

When possible, family planning lessons are offered to the women by a female teacher, but to find suitable female teachers willing to work in remote areas is difficult. To be able to choose to limit the number of mouths to feed in any family (figure 5) and to reduce the toll on the women's bodies is valuable knowledge.

3 STAGES OF THE DEVELOPMENT PROCESS

Considerable effort needs to be put in to ensure a development process functions. It can be compared to the effort in Australia that has been required to ensure that houses are basically energy efficient – a simple result requires decades of effort and the obstacles are not usually obvious in advance. The process adopted here has been borne out of nearly a decade of experience and is by no means fool proof or complete, but it seems to avoid a range of problems. The stages are listed below.

i. Consultation

a. Consultation with elders (figure 5) (if possible women also but often not possible due to a patriarchal society). The main questions are:
   - what needs do you have?,
   - what has been done before?,
   - where was it performed, when, by whom?
   - what is its performance and if it failed why did it fail?

b. The needs are categorised according to the locally determined priority and some research/test requirements determined. The requirements in order of descending priority are usually lighting, smokeless stoves, pit latrines and drinking water.

ii. Budgeting

In order to involve the local population in the project, an agreement is drawn up to participate in the project contributing both finance and labour (usually approximately 40-50%). Due to the difficulty and hence high costs of transport in these remote areas, the contribution from the local population is calculated discounting the transport costs. Even with the internationally low labour costs, 15 days walking carrying steel or carrying it by helicopter is relatively expensive.

Figure 5. Consultation and community education with village members

iii. Sponsorship

The remainder of the costs need to be raised by sponsorship. This process is a matter of writing proposals, performing presentations to international sponsors etc.

iv. Implementation

The timing of the project implementation is according to the agricultural season and the weather. For example, when it is time to plant the staple crop (e.g. wheat) all hands are required and virtually no other work can be performed. Once the snow arrives, then many of the villages are locked in, and so are any development workers. Similarly, in other areas, the monsoon time is a period of many and huge landslides, blocking roads and paths for weeks.

As the project commences, in each village, two people are chosen by the elders (usually a man and a woman) to be trained in basic maintenance. The other requirement is that they are fit enough get to the project office, requiring one days walk

v. Operational Rules

The rules are made by the elders and project people together. It is not usually done at the beginning of the project, as the end is usually too far away to be realistic. This relates to a solely agricultural community which has never had to do long term, non agricultural, planning.

vi. Handing Over and Commissioning

At the end of the project, when it is functioning successfully and the village trained technicians seem to be able to perform their tasks, then the project is formally handed over to the village. The local project staff will check fortnightly and visit the sites to ensure that all is well and functioning as intended. Many, if not most, development projects fail shortly after the original builders leave due to lack of experience with the likely problems, hence regular visits for several years are necessary.

vii. Running Checks

The fortnightly check also is used to evaluate the effectiveness of the development work. In this case, the solar tracker, Pico hydro, smokeless stove and pit latrines are being evaluated.

viii. Baseline Comparison

In the early part of the project, a baseline survey is conducted to allow for comparisons in the fields of energy, hygiene, physical condition, social behaviour (e.g. free time, rising time – both men and women), health condition of children under 5, and every child bearing age woman weighed and checked for infection. There are 3 people involved in this baseline survey – the manager of the survey, the nurse, and the motivator (who must be a local person).

Figure 6. Family planning will help to reduce the number of mouths to feed. A smokeless stove and electric lighting reduces the amount of smoke and hence reduces respiratory and eye health problems.

Figure 7. Locally designed and made solar tracker

4 OPERATION IN AN UNSTABLE DEVELOPING COUNTRY

15 days walk through territory not all held by the government can be avoided by a one hour aeroplane flight. However, Nepal is mountainous and delays due to real or imagined bad weather are common. At these times it is necessary to wait at the airport from sunrise to nightfall on the runway in case the flight will leave this week. I understand that the weather can be miraculously improved by a payment in US dollars to a flight official. After a delay of one week at the airport, a 15 day trek may seem more appealing, but unrequested assistance on the way may lighten one's load to the point that one has nothing to transport anymore, the load having been taking to somewhere entirely different. Of course, walking or working at night is often impossible due to a curfew.

The reliability of the development work may have immediate political implications, as local development minded, non government, activists may take exception to any failures, and, if you are fortunate, simply deport you from their area. Consequently, there is an added incentive to do a good job and to convince, not only the proposed beneficiaries of the benefits, but the larger community as well.

5 CONCLUSION AND DISCUSSION

Providing hope to a community is one of the ways to improve not only the living standard, but also develop a stable and happy society, without people feeling the need to have recourse to violent action. This particular project is operating in a remote and harsh area of Nepal with a combined set of objectives to improve the people's health, to reduce the need for firewood and indirectly via lighting to encourage the development of education. At a school with a nearby photovoltaic lighting installation, after 10 months of operation, the teacher commented that the students had better notes now. Whether this process can be self sustaining is unclear. At the present it is subsidised, both to assist the acceptance of the technology and also to induce more hygiene through the construction of pit latrines and clean drinking water.

Only time will tell how significant the benefits are and indeed what the benefits are. But when there is a sudden increase in the number of children under 5 years old, when grandparents are older than 40 years, when there are few widows of the age of 20, when people have the energy and inclination to improve themselves, then we will know it has made some progress.