Are Small Hydels an Answer to Eliminate Deforestation? Some Ideas from an Impact Monitoring of a Small Hydel in Salleri, Solu Khumbu

Susanne Wymann von Dach and Cordula Ott,
Institute of Geography and Group for Development and Environment, University of Berne,
Hallerstrasse 12, 3012 Berne, Switzerland

1. INTRODUCTION

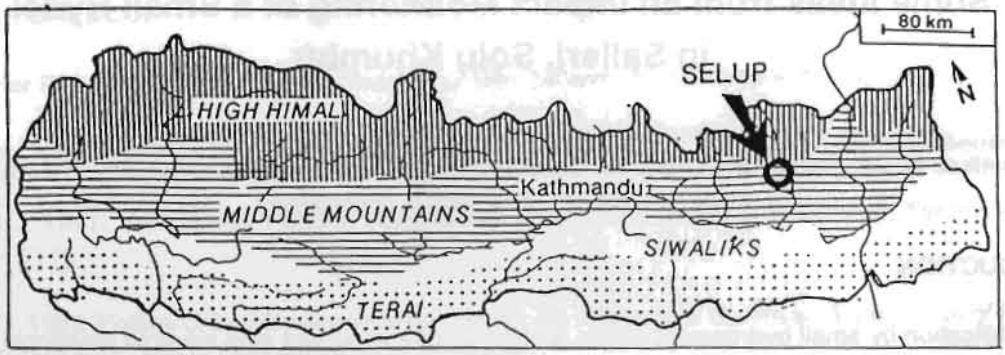
Rural electrification by small hydropower plants is seen as one important step towards development in rural areas and therefore evokes many expectations. Local people as well as Governments wish and expect that electricity will reduce unemployment, outmigration, modernize their standard of living and reduce the pressure on resources, particularly by reducing forest degradation (Aitken, 1991). Expectations are high, but little research has been carried out to study the real impacts of electrification and the acceptance of electricity by the people. In this context, SDC (Swiss Development Cooperation) set up an impact monitoring program in the Salleri Utilization Project in the Solu Khumbu area of Nepal, to evaluate the impacts of a small hydel on the society, economy, and environment. In this paper findings from an 1992 impact investigation (Ott, 1993) are presented. Special emphasis is placed on the environmental aspect of small hydels and especially on the question whether small hydels could eliminate deforestation.

2. SALLERI ELECTRICITY UTILIZATION PROJECT

The Salleri Utilization Project (SELUP) was initiated by the SDC (Swiss Development Cooperation) in cooperation with HMG (His Majesty's Government). It is situated near the Salleri Village Development Community, in Solu Khumbu, eastern Nepal. Besides the electrification of the district capital, a key factor for the location of the small hydel was the wool dying factory in Chialsa, a Tibetan refugee camp, which was to be electrified. The power plant is a classic run-of-the-river scheme, using water from the Solu Khola river. Its capacity amounts to a total of 400 kW (ITECO, 1992).

The whole supply area covers about 60 km^2 in the Solu Khola Valley and is comprised of 20 settlements, including the rapidly growing district capital, with a total of about 6,000 - 7,000 inhabitants (Figure 1). Up to 1992, when the study was conducted, some 400 houses had been electrified. Today, 8 years after initiation of the small hydropower plant, about 700 houses are supplied with the new form of energy. With an elevation range of 2,000 - 2,800 m, the project area lies in the temperate zone with severe winters and humid summers. The name of Salleri (salla means 'pine' in Nepali) refers to the composition of the natural vegetation and the previously abundant forest. It appears that the major decrease in forest land was associated with the development of Salleri and the resulting demands for firewood and timber around 30 - 40 years ago. The forests above the traditional Sherpa settlements were less affected by this demand, and the current revegetation status is reasonably good. Extensively forested slopes can still be found in the northern part of the valley, but overall the firewood supply situation is not as critical as in many other areas of Nepal, such as that found in the Jhikhu Khola watershed. Since the founding of the district capital in 1961, rapid changes have also been taking place in the community. A constantly growing government staff, who are totally dependent on market supplies and on the local infrastructure, has led to booming settlements and created a flourishing local market. These new income possibilities have attracted new immigrants, mainly from the south. Thus, the

economy of the region today is very dynamic and is not only based on agriculture but also on trade, handicrafts and temporary migration.



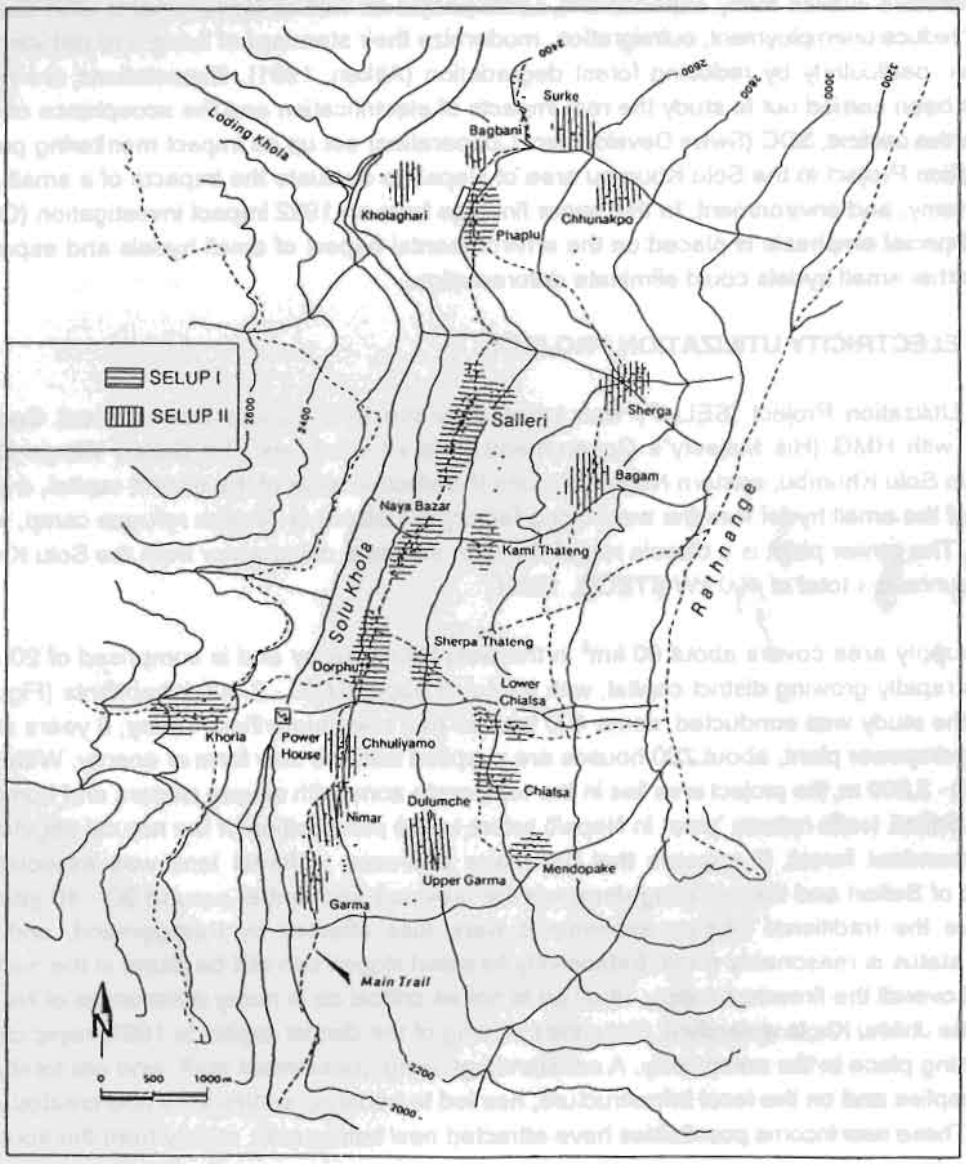


Figure 1. Location of the Salleri Electricity Utilization Project, in Solu Khumbu District, Nepal.

The business survey showed that the total number of businesses including teashops, shops, small cottage industry, etc. amounts to about 220 and the age breakdown of businesses in the most dynamic settlements of Salleri and Naya Bazar reveals that nearly 50% of them were only started in the last five years.

3. METHODOLOGY USED IN THE IMPACT MONITORING STUDY

The methodology combined quantitative as well as qualitative analysis and mapping. It allowed for constant cross-checking and provided a reliable data base for a time series analysis of an impact monitoring study to be carried out in the future. During the 2.5 months fieldwork a household survey was conducted and 250 house owners were interviewed to establish their socio-economic status in the community. Out of these families 83 were selected, based on a rough wealth ranking, for a detailed survey to determine their energy consumption patterns. Methodological difficulties arose when trying to evaluate the impacts of electrification on the environment, especially on forest resources. For quantitative ecological studies long-term investigations with detailed baseline studies are mandatory, but were not possible in the given time frame. Thus only indirectly surveyed and qualitative data was used to provide information on this topic.

3.1. Energy Consumption Pattern

Table 1 shows how electricity is used by the households. The percentage can be regarded as representative for the area electrified in 1992. Electricity for lighting was accepted by one hundred percent of the inhabitants, independent of wealth, ethnicity, occupation or age. About a third of the sampled households use the new energy for cooking purposes, but except for 4 families, electricity only partially takes the place of firewood. For example, the subsidized bijuli dekchi (a low 450-watt cooker) has been sold 70 times, but it can never totally replace cooking with fire, because frying is not possible with it. Heating as understood in a western context is not known traditionally in Sclu. Fire is used for cooking and heating at the same time. Thus only 14% of the households interviewed light fires only for heating purposes. With the new energy source electrical heaters have been installed. In this case electricity promotes new needs that were not present earlier. The utilization of electricity by businesses is summarized in Table 2. Concentrating on the potential of firewood saving, we considered only some of the businesses such as the carpet factory, bakery, saunas, teashops and lodges. The great potential of using electricity for cooking in teashops is still not fully realized, because only 26% of all teashop owners use electricity for purposes other than lighting.

Table 1. Electricity consumption patterns by the households.

	Lighting		Cooking		Heating		Electrical Appliances	
	#	%	#	%	#	%	#	%
Firewood	2	2.2	86	95.6	12	13.3	-	-
Kerosene	0	0	0	0	0	0	-	-
Electricity	90	100	32	35.5	10	11.1	74	82.2

Setup I, 90 households

In this context it would be interesting to analyze the factors which could promote or impede the substitution of firewood with electricity. We found mainly two factors which have influenced the decision to use electricity for cooking (Figure 2): wealth and cash income, and the firewood situation. The combination of these two factors shows that there are people who would like to substitute firewood but could not afford the relatively high

investment in appliances and the running costs. On the other hand there are relatively well off people who do not 'yet' consider changing their energy source.

Table 2. Utilization of electricity by businesses.

ELECTRIFIED BUSINESSES

Business	No
Mill	6
Paper Industry	2
Furniture	1
Carpet Factory / Chialsa	1
Video Projection	6
Photo-copy	2
Bakery	1
Sauna / Hotel	1
Photo colour lab	1
Printing press	1

PARTIALLY ELECTRIFIED BUSINESSES

Radio-Watch repair	3
Hair dresser	1
Teashop + Lodges	19
Taylor	3

ELECTRIFIED ONLY FOR LIGHTING

Goldsmith	2
Dental service	1
Taylor	1
Teashop	72
Shop	59

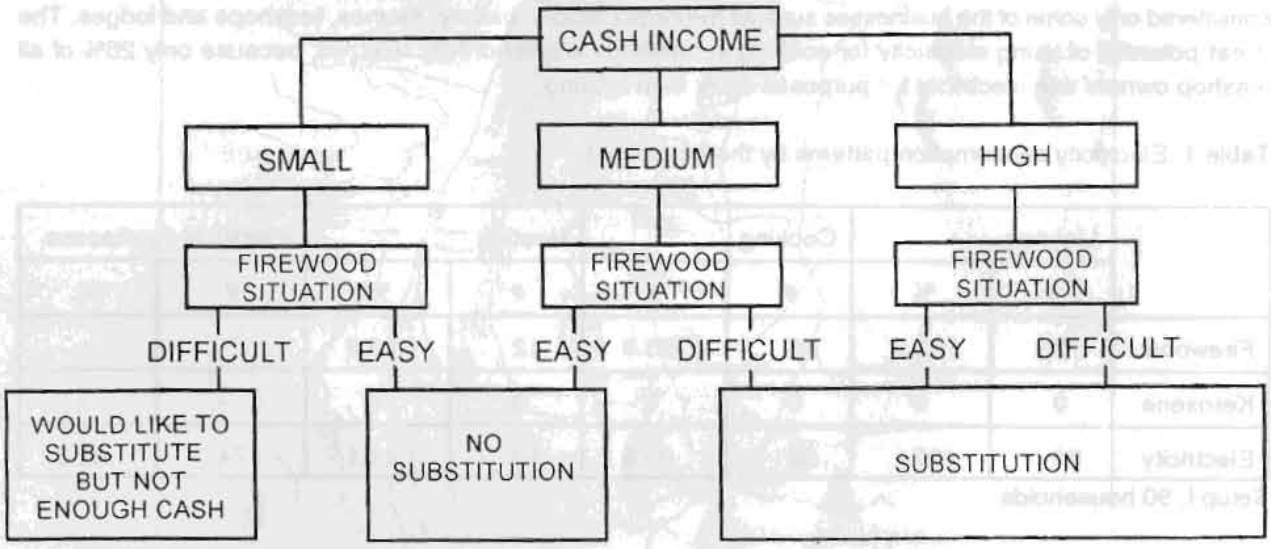


Figure 2. The decision-making-process for substituting firewood with electricity.

Looking closer at the firewood situation (Figure 3) we can roughly divide the region into three areas. People living in the old traditional Sherpa villages (Surke, Sherga, Bagam, etc.) have good access to firewood, because they own the nearby forests, their economy is mainly based on agriculture, and they have relatively little exposure to innovations. In two areas the supply of firewood is perceived to be difficult for different reasons. People in the dynamic settlements along the main trail mainly have to purchase firewood, while people in the south and in Kholaghari suffer from the low quality and quantity of forest in the lower part of the watershed. To evaluate this we should also take into consideration that people in Salleri and its surroundings are relatively wealthy compared to many other parts of Nepal, but the majority of the population (55%) has a small disposable cash income less than 15,000 Rs. For them electricity for cooking is not affordable, since they already spend considerable amounts of their income for lighting and running appliances (about 10% of their income). More than 1800 Rs. is spent per year on electricity for partial cooking with the low wattage cooker. In other areas of Nepal many more people have to be included into this group of people who suffer from a difficult firewood supply and cannot afford electricity.

3.2. Electrification and Environment

Some firewood can be saved due to electrification in the Solu area. A household using a low wattage cooker can save 30-50 % of the traditionally required firewood. Thus actual saving of firewood can slow down the deforestation rate by 2 to 3 years. That means that in 2 to 3 years the firewood need would be the same again as today's firewood requirements without electrification. If we make the assumption that each of the roughly 600 connected households in the area will in future regularly cook with the low wattage cooker, the maximum firewood saving would amount to one third of the current actual consumption. More substitution cannot take place because the output capacity of the two turbine group is not sufficient to support a greater substitution rate.

The firewood saving by businesses especially for the paper and wool dying factories are remarkable. Estimations show that the wool dying facilities in Chialsa consumed about 83 t of firewood per year, which equals the firewood consumption of about 20 households over a full year.

In contrast electricity does not only help to save firewood, it might also be a factor in increasing the demand of wood. Even if electrification was mentioned only as one of many forces promoting the expansion of settlement, we cannot neglect the increasing demand for new households and therefore for timber and firewood. The annual house building rate is 3 %. The demand for timber for the construction of 30 new houses (2-storey Sherpa houses) annually is equivalent to the firewood needs of about 600 households for one month. In addition, daily consumption by newly established households aggravates the firewood situation.

Unfortunately, no baseline survey has been carried out on the availability of the forest resources and it is therefore difficult to define the balance between clearing and revegetation for a sustainable use of the forest. It is difficult to determine the impact and savings of electrification on the forest. Since the natural conditions for revegetation in this humid and temperate climate are good, we suggest that a combination and further promotion of alternative energy is needed. Also adequate management of the forests, with local community participation would be the best solution and may even lead to a stabilization of this natural resource.

The other positive environmental effect of electrification is the replacement of kerosene and batteries. Public health has thereby improved. In addition, the consumption of batteries for radios and torches has been reduced drastically. Before electrification a household consumed 3.7 batteries a month, and for all the 700 electrified households this represents a savings of 31,000 batteries.

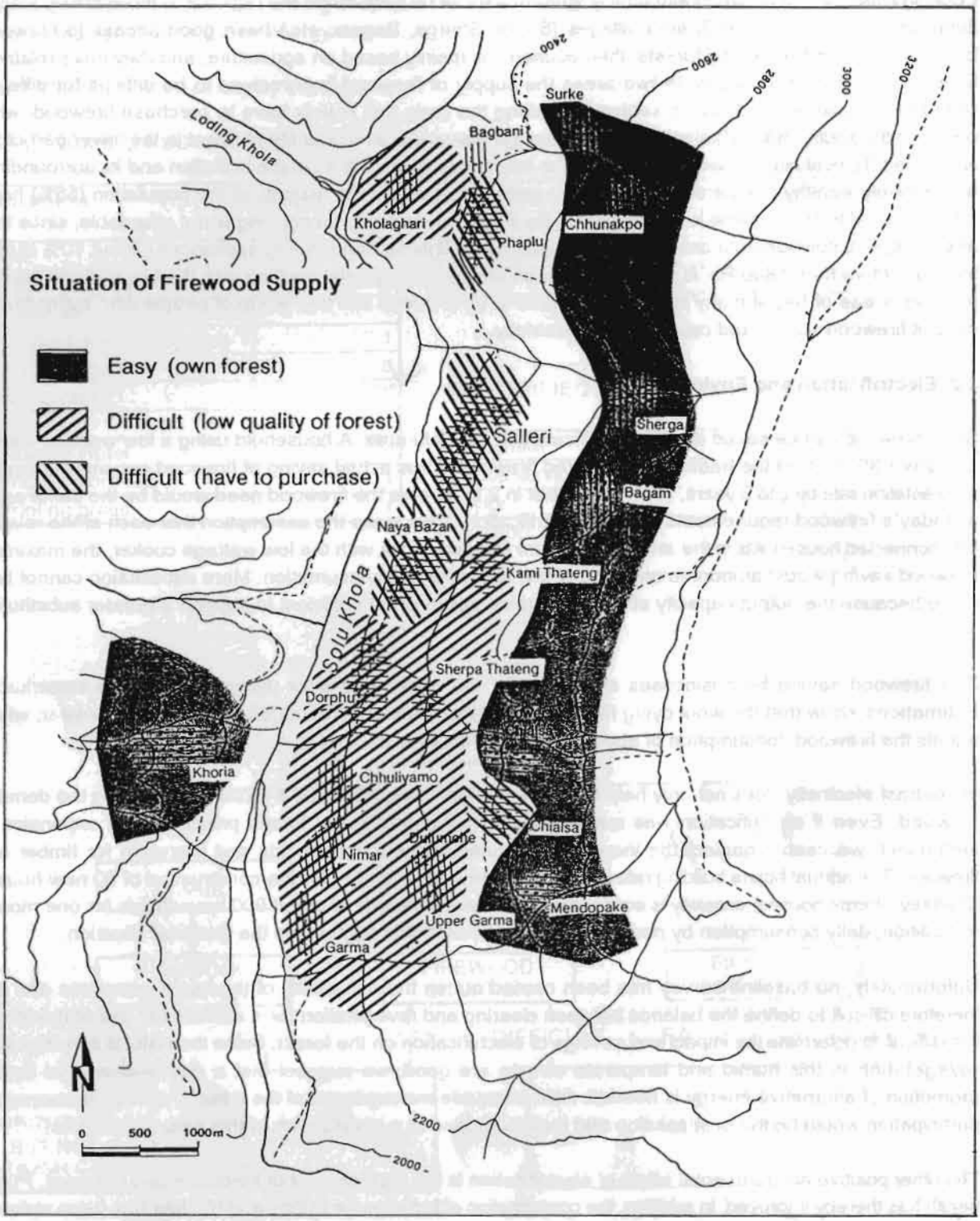


Figure 3. Firewood supply situation in the project area.

4. CONCLUSIONS

There is an obvious connection between electrification and high expectations for development. As shown in this paper local realities do determine the utilization of electricity and the impact of the new energy (Figure 4) on the forest resources.

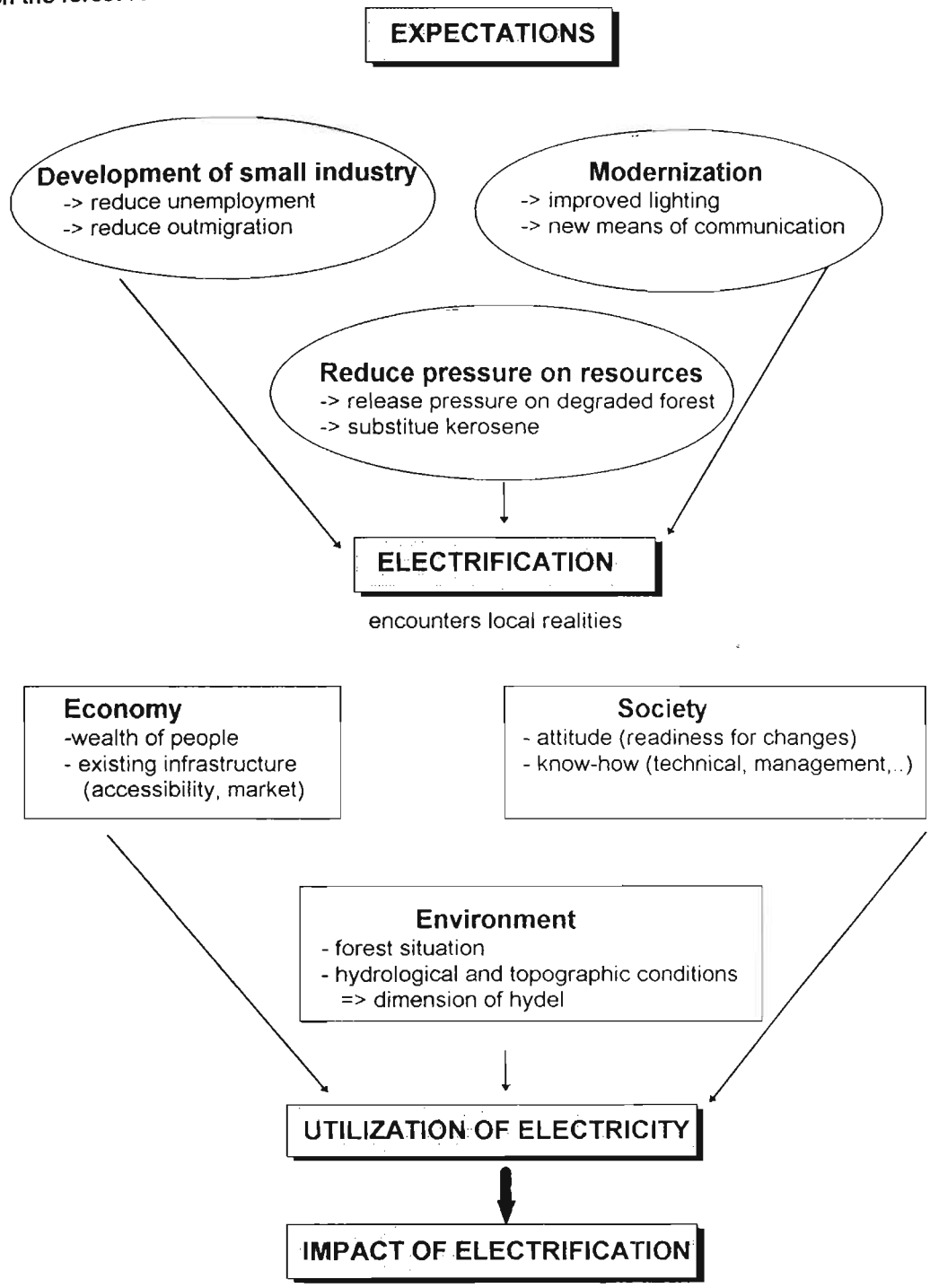


Figure 4. Rural electrification: expectations and realities.

Therefore, the following criteria need to be considered in order to assure a successful substitution of firewood by rural electrification from small hydropower plants:

1. For small hydropower plants (the run-of-the river scheme) the discharge has to be relatively constant during the year. In Nepal only rivers with a glacial run-off regime are therefore suitable. That means we have to exclude many parts of Nepal where rivers are not fed by glaciers (Siwaliks, lower Middle Hills).

2. The local society has to be relatively wealthy, equipped with some technical knowledge, and must have possibilities of off-farm employment. Without this people cannot afford the necessary investments for appliances and the running costs. As long as people cannot convert saved labour from reduced collection of firewood into cash income, they have no other choice than using firewood.

3. The output capacity of the small hydropower plants has to be big enough to allow a substantial substitution of firewood.

4. The firewood situation must be limiting. As long as firewood collecting is not too difficult and the investments and the running costs are relatively high people keep their traditional fuelwood energy supply and this means: innovations need time.

Coming back to the introductory question of whether small hydels can eliminate deforestation we conclude that they can only mitigate, but not stop the pressure on forest resources. Therefore we suggest that:

1. Rural electrification and improved community-based forest management have to be combined to attain sustainable forest use.

2. The propagation of alternatives to electrical cooking such as firewood-efficient stoves and solar cookers should be continued.

3. In the long term stand-alone units of small hydro-power plants should be connected to a network and whenever possible connected finally to the national grid to balance peak load.

Even if small hydels do not seem to contribute a major part to the reduction of deforestation, we cannot ignore the other very important impacts of rural electrification on society and economy. The potential to increase the standard of living of the local society is especially important but cannot readily be quantified. Electric light in houses and streets symbolizes'modernization' and development in which everyone wants to be included (Ott, 1993).

5. REFERENCES

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