Rose, Leo E. 1977. *The Politics of Bhutan*. Cornell University Press: Ithaca, New York.

Sinha, A.C. 1990. "The Indian North-East Frontier and the Nepalese Immigrants." *Himalayan Environment and Culture*. Rustomji and Ramble, eds. Indus Publishing Company: New Delhi.

-- 1991. *Bhutan: Ethnic Identity and National Dilemma*. Reliance Publishing House: New Delhi.

Subba, Tanka B. 1992. *Ethnicity, State and Development: A Case Study of the Gorkhaland Movement in Darjeeling*. Vikas Publishing House: New Delhi.

*Sunday Despatch*. 28 March 1993. "Bhutan Dubs Refugees Illegal Economic Migrants." (Kathmandu): 3 (35): 1.

Timsina, Suman Raj. 1992. *Nepali Community in India*. Manak Publications: Delhi.

White, J. Claude. 1992 (first published 1909). *Sikkim and Bhutan*. A. Sagar Book House: New Delhi.

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# Impact Monitoring of a Small Hydel Project in the Solu-Khumbu District, Nepal

## (With a special regard to ecological impact)

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Population growth, increasing urbanization, and especially degradation of forest resources force Nepal to think about its energy supply. Traditional resources such as fuelwood, agricultural waste and animal dung are by far the most important sources, providing about 95 per cent of the total energy consumed (Sharma et al. 1991). Up to 1991 only about 9 per cent of the population had access to electricity and about half of all domestic connections were concentrated in the Kathmandu Valley. But Nepal, with its more than 6000 rivers and streams crisscrossing the mountain areas, seems to have the best prerequisite for hydropower utilization. The theoretical hydropower potential is estimated at 83,000 MW for the whole country (ITECO 1992:2), but the current installed capacity is only 230 MW (Sharma et al. 1991). The quoted hydropower potential is based on run-off during the rainy season and therefore a realistic estimation of the potential must be assumed to be much lower. Large hydropower plants, such as the planned and controversial Arun III project, supply mainly people in urbanized regions, whereas more and more small and micro hydels are constructed which mostly provide electricity to rural areas. His Majesty's Government (HMG) has been promoting the



implementation of small hydroelectric power plants in the remote areas since the 1960s. The main aim is to create an alternative and constant energy source to diminish the degradation of forests and the import of kerosene, both of which heavily erode natural as well as financial resources. Small hydels are also intended to promote business and small industry in order to reduce emigration and the relative poverty of mountain areas.

### Salleri Electricity Utilization Project (SELUP)

In this context the Swiss Development Cooperation together with HMG initiated the Salleri Chialsa Small Hydel (2 x 180 kW) situated in the Solu Khumbu district. A key factor for the location of the small hydel was the wool dyeing factory in Chialsa, which was to be electrified. The power plant is a classic run-of-the-river scheme, using the water of the Solu Khola. SELUP was further intended to serve as a potential model for prospective small hydels by carefully integrating everything experienced in its implementation, management and impact in other similar projects (ITECO 1990). A very comprehensive internal reporting system was established (Program Monitoring). But little was known about the acceptance of the new energy, about its impact on the society and economy of the region, or about whether electricity can really diminish pressure on forest resources. Therefore, a detailed study (Impact Monitoring) of ecological and socio-economic changes resulting from the electrification of the area was required by SDC. The Impact Monitoring Study, conducted by a social anthropologist and a geographer, included two field studies of two and a half months in total (Ott, Wymann 1993).

### Project Area

The whole supply area covers around 60 km$^2$ in the Solu Khola Valley and comprises 20 settlements, including Salleri, the rapidly growing district capital, with 6,000-7,000 inhabitants. Up to 1992, when the study was conducted, some 400 houses had been connected to the electricity supply grid and with the extension of the supply grid a target number of 750-800 connections is anticipated. With an elevation range of 2,000-2,800 m, the project area lies in the temperate to cold temperate zone with severe winters and humid summers.

The name Salleri (*sallā* means 'pine' in Nepali) refers to the composition of the natural vegetation and the previous abundance of forest. It seems that the major decrease in forest land started only around 30-40 years ago with the founding of Salleri and the resulting need for firewood and timber. The trees along the main trail were cut, whereas the forests above the traditional Sherpa settlements (e.g., Chhunakpo, Sherga, Bagam) were less affected (Fig. 1). Today extensively forested slopes can still be found only in the northern part of the valley. But the firewood supply situation is not as critical as in many

other areas of Nepal. With the founding of the district capital in 1961 rapid changes have also been taking place in society. A constantly growing number of government staff, who are totally dependent on market supply and on the local infrastructure, has led to booming settlements and to a flourishing local market. These new income possibilities have attracted new immigrants. Today the population is very heterogenous: Sherpa families - who traditionally control the resources on land and forests - Tamang, Kami, and Newar traders - who have been living here more or less dependent on the Sherpa landowners - and new immigrants.

Thus today's economy of the region is based on agriculture, forestry, trade, handicrafts and temporary migration. Generally, by Nepali standards people are relatively well situated.

## Methodology

A multi-method approach, derived from the experiences of the Impact Monitoring Project LJRP/IHDP(INFRAS 1991), was judged appropriate to investigate the complex impacts of the availability of electricity and to distinguish them from general development trends as far as possible. The methodology combined quantitative as well as qualitative analysis and mapping. This enabled us to take full advantage of all available information. 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.

In a household survey 250 house owners were interviewed concerning their socio-economic status. Out of these families 83 were selected, based on a rough wealth ranking, for a detailed survey on their energy consumption patterns.

Methodological difficulties arose when trying to evaluate the impacts of the new energy on the ecology, especially on forest resources, because 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 provided information on this aspect.

## Results of the investigation

### 1. Energy consumption patterns

Subsequently only a few aspects of the whole study can be dicussed: the ecological impact of the new energy and some effects on socio-economic conditions. But first we have to look at the energy consumption pattern.

Electricity for lighting is accepted one hundred percent, regardless of wealth, ethnicity, occupation, education or age. Whereas only about a third of the households interviewed use the new energy as a partial substitute for firewood for cooking, utilization of the new energy for purposes other than



lighting, such as cooking or heating, is not a question of acceptance but rather of promoting or impeding factors, such as affordability, technical know-how and necessity due to a difficult firewood supply situation in some areas.

When getting a supply of firewood is difficult, families are ready to look for alternatives. By contrast, people who have few problems obtaining traditional energy are not keen to change their habits, especially if their economy is based mainly on agriculture. For them it is much more difficult to get the cash to pay for electricity and the necessary infrastructure than it is to use their labour for collecting firewood (see Fig. 2).

Thus it is not surprising that the substitution of electricity for firewood is limited to areas with a difficult firewood supply situation. In this area even 60% of the families utilize the new energy for cooking. However, only a partial substitution occurs by using *bijulī ḍekcī* (a low wattage cooker), rice cookers, or even heating plates. But there is a trend towards replacing the traditional energy.

### 2. Ecological Impact

At the moment electricity retards deforestation by about 3 to 4 years, but does not stop it. If substitution takes place at the expected rate in future, the process of forest depletion could be slowed down even more, but with the limited capacity of the small hydel it will never be possible for it to fully substitute firewood, and it is even questionable if a balance of deforestation and revegetation can be reached. There is also a danger that the savings of *dāurā* (firewood) are being consumed by the new houses built in the area. In the last 8 years the number of houses increased by 26%, using timber for construction and increasing the demand for firewood. Unfortunately, no baseline data on forest resources are available to really quantify deforestation and revegetation.

But local improvements in the surroundings of villages such as Salleri, Naya Bazar, and Phaplu, where the firewood supply situation has to be decribed as difficult, and a general decrease in the pressure on forest resources can be expected. The same can be said for the surroundings of Chialsa, an old Tibetan refugee camp, where the dying of wool has been electrified and where improvements in the forest are already visible.

### 3. Impact of electrification on socio-economic conditions

The economic situation has not changed much as a result of the new energy. Energy is in great demand to artificially prolong daytime, as it brings with it greater flexibility in the allocation of time. Women are admitted to a greater amount of housework (cleaning, farming) and new productive activities (teashops, small shops) that are perceived as improving living conditions in the long run. But a major change from the consumptive to the productive use of electricity - and thus an implementation of small-scale or cottage industry - has not yet taken place. The Sherpa tradition of migrating is enforced by insufficient employment and education opportunities in Salleri. Well-off Sherpas today prefer to invest money in Kathmandu and are only partially interested in local entrepreneurship. On the other side, poor families from different ethnic groups and low Hindu castes do not seem normally to fall

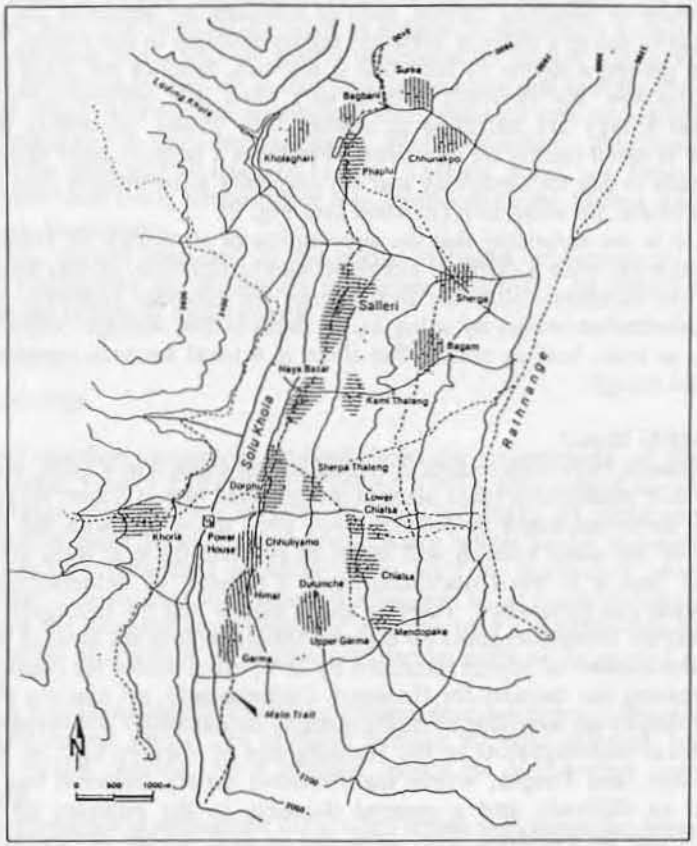


*Figure 1: The project area [Ott, Wymann 1993]*

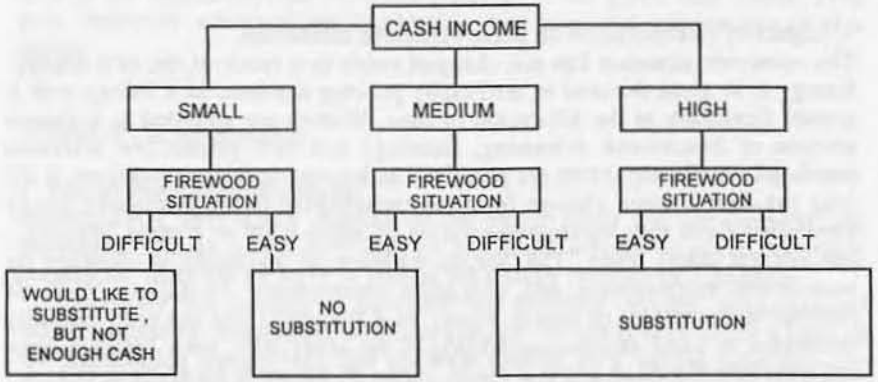


*Figure 2: The decision-making process for replacing firewood for purposes other than ligthing [Ott, Wymann 1993]*



below the minimum subsistence level, but they have no surplus money for economic projects, therefore the potential "agents of change" are located in the economic middle stratum of Newar traders and immigrants who are totally involved and dependent on the new cash economy. The lack of start-up capital, the lack of a market, and high transportation costs are still the main problems that hamper production. Without an adequate basic infrastructure, the implementation of electricity cannot induce significant change, but only promotes general economic and social development processes.

**References:**

INFRAS, 1991. "Impact Monitoring Project LJRP/IHDP." In: *Impact Status Report.*

ITECO, 1990. *Salleri Electricity Utilisation Project (SELUP) Feasibility Study. Economic Evaluation of the Present Scheme, the proposed Plant Completion and Grid Extention.* Affoltern a/Albis.

ITECO, 1992. "The Salleri Chialsa Venture in Nepal." Extract from the SKAT Publication. In: *Village Electrification.* Affoltern a/Albis.

Ott, C. and Wymann, S. 1993. *Salleri Electricity Utilisation Project. Impact Status Report 1992.* Bern.

Sharma, S., Shakya, M., Bhattarai, L. and Rimal, S. 1991. *An Assessment of the Energy Sector in Nepal, Implication for the Planning and Management of Rural Energy.* ICIMOD MIT Series No. 9. Kathmandu.