10. FACTORS AFFECTING ENERGY SYSTEM TRANSFORMATIONS

The following factors might significantly affect energy system transformations in the context of the HKH region and need further deliberation.

Energy Resources and Technology: Access and Availability

Availability of energy resources and their quality are the prime determinants of energy use behaviour, followed by access to and abundance of a particular source of energy. For example, unavailability of kerosene and LPG (liquid petroleum gas) in the mountains induces people to exploit forest resources, compromising their most efficient economic use (deLucia 1993). This is a consequence of the fact that energy needs cannot be substituted, though there is a possibility of trade-off between labour and energy. Even when available, access to energy may be denied to some of the mountain people due to market and non-market factors, e.g., pricing, finance, and policy. On the one hand, affordability becomes a prime concern in regard to access to high-grade energy resources, on the other, subsidies may preclude supply entities in finance investment in mountain areas which could hamper the process of energy systems' transformation.

Energy and Other Infrastructure: A Complementary Issue

Changes in mountain energetics are necessary, though they are not sufficient to facilitate sustainable environment-friendly development. Other infrastructural develop-

ment activities as well as income-generating activities associated with credit facilities are also crucial (World Bank 1994). At the same time, a decentralised institutional structure and identification of appropriately-designed technology with in-built institutional attributes need to be packaged for intervention in mountain communities.

Energy Services to Exceed Subsistence: Poverty Elimination through Employment Generation

At first, energy services must be ensured for the poor and disadvantaged mountain population to fulfill basic energy requirements. Once access to energy resources are secured for the fulfillment of basic needs, they must be made available to support development. This task is feasible only if energy system transformation is envisaged for improvement of the economic conditions of the poor (Goldemberg et al. 1989; Philips et al. 1995).

Though the exact patterns of energy system transformations may vary, they are, nevertheless, necessary. Efficient energy and related technology-focussed interventions supporting such transformations should be capable of generating employment opportunities by being linked appropriately with income-generating activities in order to reduce poverty.

Mountain Energy Development as Part of the Food, Fuel, Fodder, Fertiliser and Fibre Systems

It is important to understand the overall, food, fuel, fodder, fertiliser and fibre systems (F5) in considering the possibilities for transforming energy systems to support economic development. In the HKH region, F5 systems are intertwined in many ways. For example, the same resource – biomass – can be used as a fuel, fertiliser, or building material (Rijal 1987; Rijal 1991). Similarly, the same technology – a traditional cooking stove – is employed for cooking, space heating, or lighting (ICIMOD 1986). This is not to imply that resources and technologies cannot have competitive or complementary uses. Rather, the relationships and competition for scarce resources – and complementarities in the use of these resources–are quite complex, and understanding these problems as scarce resource endowments is often critical to understanding the possibilities for development that are equitable and sustainable and can be facilitated through cost-effective interventions.

Transforming Animals and Animal Energetics

Animals and animal energetics are important in both subsistence and market-based development phases, the value of the multiple outputs of animal husbandry and how it affects the alleviation of drudgery, increased productivity, and overall livelihood of the household are significant (ILO 1987; Omvedt et. al. 1995). This aspect is dependent on the energy transformation capacity of animals, as they can transform grasses, leaves,

cereals, and so on into various valuable outputs (deLucia 1993). Through this capacity there is a transformation into the stated valuable service and product outputs with significant embodied energy.

Accounting for Gender, Generational and Group Dimensions

Too often in the past, interventions were made without giving attention or priority to the gender, generational, or group aspects. For example, there are cases in which biogas technologies change the value of dung for the highest income households who own cattle. The poor who previously collected dung for fuel are now deprived of this fuel (WECS and CIDA 1991; Overholt 1995; Omvedt 1995; deLucia 1994). Such shortcomings and/or failures caused by ignoring gender, generational, or group dimensions, or by having a myopic single-sector focus can result, for instance, in examining only the labour requirements for household and crop and/or tree production and ignoring the requirements for other activities. This results in failed interventions.

Energy and related technology-focussed interventions must take into account gender, generational, and group dimensions. The work demands of the poor are burdensome, and their productivity is low. Lessening this burden and increasing productivity are essential to poverty alleviation. Hence, the importance of interventions that raise labour productivity. Particular priority must be given to measures that facilitate the increased productivity of the poor, including women. It is also important to understand how access to various energy resources and technologies differs according to class, gender, and generation.

At the same time, dwindling fuelwood reserves force the rural people, particularly women, to spend a significant portion of their time collecting fuelwood. In many areas, scarcity and the high price of fuelwood forces rural people to increase the use of agricultural waste and animal dung, with an obvious detrimental effect on soil fertility.

Energy and Environmental Linkages: Global Concerns

The production and use of energy contributes negatively to the environment. It is widely believed that, if the present trend of energy consumption continues, it will create environmental problems which, in the long run, could become a constraint for economic growth and social well-being.

The most prominent globally recognised problem is that of greenhouse gases. Carbon dioxide, methane, and nitrous oxide, the main greenhouse gases, are emitted mainly from combustion of fossil fuels, deforestation, and biomass burning. Energy is estimated to account for more than half of the global greenhouse gases (PEP Project 1995). The energy-related emission in the HKH is modest if estimated on the regional level, but it is rising at an alarming rate in urban areas. Illustrating this phenomenon are urban centres, such as Kathmandu and Dehra Dun, which have already become some of the most polluted places in the region in terms of fossil fuel-related emissions. The emission

of greenhouse gases caused by deforestation and biomass burning is bound to increase in the event of the economic transformation foreseen for poverty elimination and development of the mountain population, as it will mean an increase in the demand for useful energy (i.e., heat, light, and shaft power).

Population growth is placing extreme pressure on the region's forest resources. This, in turn, contributes to landslides, soil erosion, and flooding, thereby endangering the lives of thousands of people every year. Furthermore, the possibility of substituting fuelwood with commercial fuels in mountain areas is limited, mainly for two reasons. First, fuelwood collection is a subsistence type of non-monetised activity – it is free if the labour cost is not considered. Second, the cost of distribution of commercial fuel is very high. Unless the cost of fuelwood rises considerably, as a result of physical or economic scarcity, this situation is not expected to change; the rural population, for whom per capita income is less than US $ 100, cannot afford to use modern fuels.

The intricate relationship which exists between energy-economy-environment is understood generally. However, there is a lack of knowledge concerning the dynamic linkage among these sectors because of the weak database and lack of analytical capabilities.

Public Health and Poverty Linkages

Of particular concern is the health impact associated with the household use of traditional fuels. This issue has important linkages to the gender and generational aspects. The majority of the people, especially women and children, are seriously affected by exposure to very high concentrations of emissions as a result of cooking with low-grade fuels and with stoves in poorly ventilated environments (deLucia 1993; Rijal 1994). An energy system transformation that reduces health risks as well as poverty must be promoted.

Proper evaluation and understanding of these factors will lead to the development of sustainable energy programmes to promote the energy systems' transformation process in the mountains.