Chapter 3

Presentations and Discussions

Presentations were made on two thematic areas. First, coordinators of the country studies gave brief summaries of the studies on energy use in mountain areas carried out in the HKH Region of four countries, namely, China, India, Nepal, and Pakistan. Second, experts in energy planning were invited to make brief presentations on the energy policies and programmes in mountain areas. Discussions followed on these two thematic areas.

Energy Use in Mountain Areas

The morning session was chaired by **Dr. P. Venkata Ramana**, Dean, Tata Energy Research Institute, New Delhi, India, and **Mr. U Aung Kyau Myint**, Forest Resources' Specialist, ICIMOD, acted as the resource person. Summary presentations of country-specific studies commissioned by ICIMOD were made by **Dr. Kamal Banskota**, Director, Centre for Resource and Environmental Studies (CREST), Nepal, and by **Dr. A. A. Junejo**, Project Coordinator of the Mini-Micro-Hydropower Project, ICIMOD, on behalf of **Dr. M. Abdullah** of Pakistan who was absent.

The afternoon session on 'Energy Use in Mountain Areas' continued with **Mr. Zhang Mi** as the chairman and **Mr. Basanta Shrestha** facilitated the session as a resource person. The first presentation was made by **Mr. Wang Mengjie** of the Chinese Academy of Agricultural Engineering Research and Planning based on the study 'Analysis of Energy Use in Rural and Urban Areas of the HKH Region of China'. Following his presentation, **Professor N. K. Bansal**, who coordinated the study in India, made his presentation.

Following the country presentation, Professor M. N. Islam made a brief presentation on the proposed study in the Chittagong Hill Tracts. He outlined the energy policy objectives of Bangladesh and the suitability of the area-based energy planning method for the Chittagong Hill Tracts (CHT). He emphasised the importance of a database, an assessment of indigenous energy resources and technology and associated environmental impacts, and the need for a Renewable Energy Development Agency to be established under the Ministry of Energy and Mineral Resources, with appropriate institutional arrangements for implementing area-based energy development programmes for the sustainable development of biomass fuels to meet the energy needs of specific areas like the CHT. He also stressed the importance of the participation of the private sector, NGOs, and local institutions in undertaking and implementing energy programmes. Professor M. Islam presented the methodological framework that would be used in carrying out the study on 'Analysis of Energy-use Patterns' in the CHT Region of Bangladesh to be commissioned by ICIMOD.

Fuelwood stored for rainy season, Nepal

Stored fodder, stacking straw in the hills of Nepal

Nepal

Dr. K. Banskota, in his overview of energy supply and demand patterns in Nepal, identified biomass and hydropower as the main sources of domestic energy. Biomass energy primarily included fuelwood, agricultural residue, and animal dung, whereas biomass fuels were land and labour intensive. The supply of fuelwood was mainly from accessible public forests on which there was increasing pressure due to increasing demand for fuelwood. Where shortages were acute, there was increasing reliance on crop residue and animal dung. Energy consumption patterns indicated that fuelwood was the main source of energy in the residential sector. The consumption of total biomass fuels varied across physiographic and development regions (i.e., 370 kg per capita in the eastern *terai* versus 1,700 kg per capita in the western *terai*), depending on availability, accessibility, affordability, and climatic conditions. There was a big gap between the sustainable supply from accessible forests and the demand for fuelwood (5.5 versus 11.5 million metric tonnes in 1994/95). There was no proven commercially feasible reserves of petroleum fuel, natural gas, and coal in the country. His conclusions: a) biomass energy would continue to dominate the future energy scenario; b) households would continue to be the largest energy consuming sector; and c) energy supply constraints remained as a major bottleneck to industrialisation.

There was a variation in the final energy use across the three ecological regions. Only 12 per cent of the total population had access to electricity - 4.5 per cent of the rural population and 89 per cent of the urban population. Almost 45 per cent of the total electricity was consumed in Kathmandu Valley and system losses accounted for 25 per cent. Per capita energy consumption in Nepal ranked as one of the lowest in the Least Developing Countries (LDCs) and was estimated to grow by 2.4 per cent annually. Indigenous production of energy contributed to 92 per cent of the total final energy supply and imports accounted for nearly seven per cent and primarily included petroleum fuels and coal.

The pattern of energy consumption in terms of useful energy indicated that the residential sector had the lowest energy transformation efficiency, while it was highest in the industrial and commercial sectors. This was due to the prevalent energy mix; i.e., sectors in which the use of low-grade energy dominated the energy mix would have low energy transformation efficiency. Thus, improvement in efficiency not only required structural change in the energy mix but also improvement of energy technologies. However, population growth, poverty, low affordability, and poor social infrastructure precluded a massive shift in the energy resource and technology mix. Hence, traditional fuels would continue to dominate the energy scenario in Nepal, though programmes might be geared to improve and increase their renewability and to upgrade the quality of these energy resources.

The presentation emphasised the role that renewable energy technologies would play in reducing drudgery, health hazards, CO_2 emissions, the energy import bill and forest depletion, and, most importantly, how they could be exploited on different scales and sizes to suit local needs and locations. The development of renewable energy technologies had been highly dependent on donor support, with inadequate infrastructure for R&D, fabrication, promotion, and dissemination in place. The government policy had been inconsistent and *ad hoc*, though a serious effort had been made in the Eighth Five-Year Plan to facilitate renewable energy development. The major issues related to the development of renewable energy technologies were: non-acceptance by users; high initial investment costs; non-availability of different designs and non-utilisation of local materials; weak government commitment at the policy level; and the absence of a responsible coordinating institution. Besides these, a number of managerial and marketing aspects hampered the promotion of Renewable Energy Technologies (RETs), e.g., a variation in incentives across different energy technologies; poor research and development programmes, primarily initiated through donor interest

Traditional Dehusker popular in rural mountain areas of Nepal which lacked long-term commitment; inconsistent quality and standardisation as no institution was responsible for standardisation; serious inadequacies in terms of trained manpower to repair and maintain new technologies; poor interaction between designers and end users of the technology; poor coordination between the government, NGOs, and private sectors; and a lack of operation and maintenance support in most of the RETs.

The need to make the energy development policy a separate entity had been recognised since the Fifth Five-Year Plan (1975-80), whereas alternative energy resource development received priority in the Seventh Five-Year Plan (1985-90). The Eighth Five-Year Plan (1992-97) aimed at pursuing the approach further through the increased consumption of electricity and by supporting energy-intensive industries with the development of hydropower; developing alternative and decentralised energy resources as a substitute for imported fuel; and ensuring environmental protection. The Eighth Five-Year Plan fixed the following targets: construction of a power project with an addition of 292.7 MWe; construction of 30,000 more biogas plants; and distribution of an additional 250,000 units of improved cooking stoves. In order to improve the planning capabilities of the energy sector, the WECS carried out energy supply and demand modelling and completed models for the residential, transport, agricultural, industrial, and commercial sectors.

The factors responsible for the poor performance of the energy sector were: government interference in management; lack of trained manpower and over-staffing; lack of standardisation; limited planning; distorted pricing structures and price control (subsidies); and political pressure to supply electricity at less than long-run marginal costs. The government had taken the following steps to improve the economic and allocative efficiency of the energy sector: a) selected opening of markets and greater reliance on market forces; b) increase in the proportional allocation of resources for regional and rural development; c) administrative reforms and civil service staffing policies; d) measures for economic liberalisation; e) transparency in regulation; and f) introduction of investment credit, profit repatriation, and other incentives to mobilise funds from domestic and international sources.

The summary presentation also reviewed the manufacturing capabilities of RETs with a primary focus on micro-hydropower development. The main features highlighted were: a) manufacturers were mostly located in the western *terai* and in Kathmandu; b) local expertise in design and manufacturing capabilities existed but all the agro-processing units or electric generators were imported from India; c) poor literacy and weak management capabilities of village entrepreneurs; d) lack of well-established international markets; and e) poor organisation and management (O&M).

A review of the database for energy was included in the presentation – highlighting the following issues: a) the reliability of energy data was still questionable; b) end-use efficiency matrices for all sectors were weak and needed to be improved through further research; c) the most recent basis for fuelwood estimates was 1979 aerial photographs and thus they might not accurately represent the current situation; d) estimates of the number of irrigation pumps were dubious and their reliability was questionable; e) data on the number of operating transport fleets posed a problem with no official data on the actual fleet in service, hence vehicles were assumed to retire in about 15 years to derive the operating fleet in road transport; and f) biomass energy balances were derived using various consumption surveys carried out in different time-frames, and this could distort the estimation of biomass fuel consumption.

Fuelwood (off-cut of fruit trees) stack ready for sale in Gilgit, Northern areas of Pakistan

Transport of Timber along the Karakoram Highway, Pakistan

The Hindu Kush-Himalayan Region of Pakistan

The presentation on Pakistan started with an overview of the general physiographic and economic situations of Pakistan and the Hindu Kush-Himalayan Region. In the overall assessment of the energy situation in Pakistan, the following were highlighted: a) forests covered 4.8 per cent of the total land area, with 1.12 million hectares of production forest and 3.15 million hectares of protection forest; b) total woodstock was nearly 210 million tonnes with an annual yield of 22 million tonnes, while the consumption estimate was 32 million tonnes, indicating a deficit of 10 million tonnes in 1991, which meant that, unless this trend was averted, Pakistan might lose all of its wood resources by the year 2011; c) crude oil reserves stood at 198 million barrels, natural gas at 21 trillion cu.ft., coal at 1,686 million tonnes, and hydroelectric potential at 30,000 MW; d) the primary commercial energy supply was 36.1 million TOE in FY 1994-95, of which the share of oil was 41.5 per cent, gas 37.2 per cent, and hydroelectricity 15 per cent, out of which 60 per cent of the supply was met by imports at a cost of nearly 1.2 billion dollars.

In the HKH Region of Pakistan, the major energy resources available were as follow: a) total wood biomass standing stock was estimated at 45.24 million tonnes and 13.82 million tonnes in the NWFP and Balochistan, which resulted in a firewood growth per annum of 2.96 and 1.79 million tonnes, respectively, in 1993; b) the NWFP was very rich in hydropower and produced nearly 3,760

Improved cooking and heating stoves fitted with a chimney in the northern areas of Pakistan

MW of electrical power, whereas Balochistan possessed 53 million tonnes of coal reserves and four trillion cu. ft. of natural gas; and c) the NWFP was a net exporter of electrical energy and imported gas and petroleum products from other provinces, while Balochistan was an importer of electricity and oil, but exported natural gas and coal.

Most households in the HKH Region used firewood, agricultural residue, dung cakes, charcoal, kerosene, and electricity. In the NWFP, 90 per cent of the households in urban areas and all the households in rural areas used traditional fuels. In the case of Balochistan, these figures were 93 and 97 per cent, respectively. Of the traditional fuels, fuelwood was used by the majority of households. The type of fuel used was influenced by the expenditure levels of user households. In urban areas, the share of traditional fuels was 77 per cent for low expenditure level users and 34 per cent among high expenditure level households. In rural areas, there was a nominal variation in the use of traditional fuels with household expenditure patterns (i.e., 96 and 92% for low and high expenditure levels, respectively).

Also highlighted were the various environmental problems being experienced in the HKH Region of Pakistan. First, pressure was increasing on the mountain environment because its population growth rate was high compared to the national average (i.e., 3.3% for the NWFP and 7.1% for Balochistan compared to 3.1% for Pakistan). Second, water and soil erosion were becoming vital concerns in the mountains. For example, 90 per cent of the soil degradation in the NWFP and 75 per cent in Balochistan resulted from water erosion, causing an increasing loss of vegetative cover. Next, the principal towns in the HKH Region, Peshawar and Quetta, were experiencing severe air and noise pollution due to vehicles on the road. Large numbers of brick kilns operating in the NWFP and Balochistan used low-grade coal as fuel which emitted substantial amounts of pollutants into the air. Fourth, the excessive use of fuelwood had serious consequences on Pakistan's environment. It was estimated that during a period of 100 years (1880-1980), the forest area decreased to less than half. As a result of deforestation, flooding and siltation had increased. The two main reservoirs (Warsak and Tarbela) were silting up at a high rate, and it was feared that the working life of these reservoirs might be greatly reduced, and this would also have serious consequences on Pakistan's economy. In Balochistan, coal mining was carried out extensively, and this had a serious impact on the environment, e.g., land disturbance, emission of dust, acid mine drainage, and pollution of streams and rivers.

Institutional arrangements, with regard to the energy sector in Pakistan, were described briefly as follow.

- The Planning Commission of the Government was responsible for planning all socioeconomic sectors, including energy. At the provincial level, the Department of Planning and Development was responsible for planning and preparing the annual development programme for each year. In the NWFP, the Sarhad Hydel Development Organisation (SHYDO) had been established recently to carry out energy planning for mountainous areas, in particular the supply of electricity to rural areas from small/medium hydropower plants.

- Marketing and distribution of petroleum products were carried out by oil companies in the private and public sector. Gas companies were transporting and distributing natural gas all over Pakistan including the HKH areas.

- Marketing of fuelwood was carried out by the private sector. About 50,000 private businesses were engaged in marketing fuelwood. In rural areas, household members primarily collected fuelwood for their own consumption.

Plight of solar photovotiac electrification scheme at northern areas of Pakistan due to lack of maintainance.

Different types of improved biomasss stoves demonstrated at an enviromental fair in Peshawar, Pakistan

- The Water and Power Development Authority (WAPDA) was the main agency responsible for the generation, transmission and distribution of electrical energy in most parts of Pakistan, including in the HKH Region.

- The Pakistan Council of Appropriate Technology (PCAT) was engaged in the planning and implementing of decentralised micro-hydroelectric schemes in the hilly areas of the NWFP. The Aga Khan Rural Support Programme was also implementing micro-hydro schemes, mainly in the district of Chitral in the NWFP and in other parts of the northern areas.

- Development and demonstration work on renewable energy resources was being carried out mainly by the research and development organisation of the Government of Pakistan. There were no commercial manufacturers of renewable energy appliances in the HKH Region.

There was a lack of authentic data on the supply and consumption of energy in the commercial, industrial, agricultural, and transport sectors for the HKH Region. Most of the data available related to the domestic sector - that too in aggregate form.

The presentation based on the study in the HKH Region of Pakistan concluded with the following recommendations: a) a comprehensive study should be undertaken on the energy supply and consumption patterns in the selected hilly regions of Pakistan; b) since biomass was expected to remain the most important source of fuel for most households in the region, programmes should be implemented to increase the supply of biomass and its efficient utilisation as a fuel; c) electrical energy was the best option for meeting the energy requirements for lighting and motive power; therefore, decentralised power schemes could be promoted in the HKH Region; and d) local institutions, e.g., district councils, could be involved in planning and implementing energy projects.

Multi-bladed windmill at demonstration site, China

Solar cooking stove popularised in Tibet, China

The Hindu Kush-Himalayan Region of China

Mr. Wang Mengjie began his presentation by saying that the Government of China had been paying serious attention to energy development within the HKH Region and proceeded to describe the approach taken in implementing energy programmes. In China, long-term energy development plans and short-term implementation plans were formulated in line with local conditions. Institutions and management schemes were established at various levels, from the central government to the local government. The role of energy was recognised as crucial for the production sector as well as to fulfill household requirements in the HKH Region of China. The energy consumption was classified as direct or indirect consumption. The consumption of commercial energy was recorded by special agencies involved in the distribution and sale of these fuels, though non-commercial energy consumption was difficult to estimate as these fuels are normally obtained and consumed locally.

The energy resources available in the HKH Region were fuelwood, agricultural residue, animal dung, coal, and hydropower, apart from the tremendous potential for solar energy exploitation. Fuelwood accounted for 40 per cent of the total energy consumption in the HKH Region, amounting to 760 kg per capita. Although a large amount of fuelwood resources were available in relation to the small population within the region, clearly, forest resources were overexploited. This was due to inconvenience in transportation, low efficiency of stoves, and insufficient supply of fuelwood within village communities. It was observed that timber was also used as fuelwood where it was locally available. Estimates suggested that the sustainable fuelwood supply amounted to two-thirds of the demand at the local level in areas where the population pressure was acute. Most of the energy in the HKH Region of China was supplied by state-owned coal, oil, and electricity, while small hydropower, small coal mines, biomass, and solar and geothermal energy were considered ancillary inputs to the energy supply system.

The presentation also touched on the overall situation of energy technologies in the region. The importance given to developing the HKH region by the

Small-scale biomass (agriculture residue) briqquetting machine manufactured and being popularised in rural areas of China

Large-scale biogas plant with boiler suitable for cold climate, China

government was clear, given the establishment of the oil pipeline to Tibet (Xizang), 15 hydropower plants, 14 thermal power plants, 350 micro-hydropower plants, three solar power plants, 60,000 solar cookers, 30,000 m^2 of solar water heaters, and three geothermal power plants. Specifically, the development of solar and geothermal energy would play a crucial role in the development of Tibet (Xizang).

The following were the major findings with regard to the energy sector of the HKH Region in China.

- Energy consumption per capita, development and utilisation of energy technologies, and energy utilisation efficiency were low. Competent management was lacking in the operation of the energy supply system. There was a shortage of energy supply and also a wastage of energy resulting in a greater imbalance in energy supply and demand.

- The costs of coal exploitation, storage, and transport were higher than the national averages, and the limited utilisation of coal was also a problem.

- The present energy development and energy consumption pattern was unsustainable in terms of the energy resource available, funding required, high transportation costs, and environmental protection.

- The government laws, regulations, and policies on energy management, resource management, and environmental protection were suitable for the region and should be implemented.

The presentation also described the goals and implementation strategies with regard to the planning and management of energy integrated construction, improving the energy efficiency of various energy technologies suitable for the region, and the development and utilisation of new energy and renewable energy technologies. The proposed goals of energy planning and management were: a) to formulate an energy development plan of the HKH Region taking the economic development plan and environmental protection into consideration; b) to strengthen energy management, improve the energy supply structure and distribution, increase the proportion of clean energy and quality energy, and carry out industrial reforms to promote the reduction of energy consumption per unit of production value; and c) to strengthen rural energy construction and rural electrification and gradually reduce the over-consumption of biomass fuels. Similarly, the proposed goals for improving energy efficiency were to establish and improve energy-saving management procedures and approval systems as well as relevant policies and regulations in the HKH Region. The goals proposed for the development and utilisation of new and renewable energy were to strengthen the development and utilisation of new and renewable energy sources, improve energy conversion efficiency, reduce the cost of electricity generation, and increase the proportion of renewable energy in the energy supply infrastructure.

Biomass products in Aruanchal Pradesh, India.

Solar home light system installed on the rooftop of a house in Khartungla, Nubra Valley, Ladakh, India.

The *Hindu Kush-Himalayan Region of India*

According to Professor N. K. Bansal, energy planning in India reflected more short-term and medium-term concerns than long-term imperatives with the regime of administered energy prices continuing. New and renewable energy sources were being implemented through the financial institution known as the Indian Renewable Energy Development Agency (IREDA), which acted as a catalyst to accelerate commercialisation of renewable energy sources. The Eighth Plan (1992-97) focussed on the area of renewable energy and mainly on improved cooking stoves and did not significantly emphasize traditional energy sources. Coal and hydro remained the main sources for power generation in the country.

Solar photovoltaic system exhibited in Renewable Energy Technology Exhibition, Arunachal Pradesh, India

The main sources of energy in the HKH Region of India were fuelwood, agricultural waste, and animal dung, since 82 per cent of its population still lived in rural areas with predominantly subsistence economies. Forest cover within the HKH Region was on the decline due to the heavy dependence of the population on forests for fuelwood, though the region's overall forest cover was still 37 per cent compared to the national average of 15 per cent. There was a wide variation of forest cover among the states. For example, the North-Eastern region had very thick forest cover (70-90%) compared to the western and central regions' forest covers of from10-41 per cent.

The low-lying areas of the North-Eastern region (most of it falling within the HKH region) contributed 20 per cent of the country's crude petroleum. No coal reserves were located in Uttarakhand and West Bengal. The total coal reserves found in Assam, Megalaya, Nagaland, and Arunachal Pradesh were estimated at 864.75 million tonnes, out of which 257 million tonnes were proven reserves. Crude oil reserves in Assam and Nagaland were estimated to be 156.5 million tonnes compared to 765 million tonnes in the rest of India. Similarly, proven and balance recoverable reserves of natural gas in Assam and Nagaland were 160.5 bm^3 compared to Indian reserves of 707 bm^3. Even though fossil fuel production in the North-Eastern region contributed significantly to the Indian economy, the region used very little fossil fuel, except for kerosene, in the domestic sector. The consumption of petroleum products in the HKH Region was primarily in the form of high-speed diesel and kerosene, accounting for about three per cent of the consumption of petroleum products in the country as a whole.

The use of renewable energy sources in the HKH Region in India was through a fully subsidised programme of the Ministry of Non-conventional Energy Sources (MNES). The principal programmes were biogas plants and improved cooking stoves, and mainly these were concentrated in low-lying areas. Almost 22 per cent of the households in Himachal Pradesh still used cow dung as fuel for cooking and space heating.

There was a huge gap in the actual demand and consumption of electricity, particularly in the two states of Himachal Pradesh and Jammu and Kashmir (J&K) for which estimated demands were 2,000 and 4,000 million kWh of electricity per annum, respectively, compared to an actual annual consumption of 300 and 400 million kWh per annum, respectively. There was also a marked difference among the states within the HKH Region; for example, in Assam and Meghalaya, the percentage of households with electricity was 19 and 30 per cent, respectively, compared to 87 per cent for Himachal Pradesh. The use of electricity for operating pumpsets to irrigate land was also observed in the HKH Region of India, while no pumpsets had been energised in Mizoram, Nagaland, and Sikkim.

In comparing the energy consumption patterns from 1981 and 1991 within the HKH Region, a distinct pattern emerged: a) the share of commercial fuels was increasing in the domestic sector; b) the share of 'other' biomass fuels was increasing among traditional fuels; and c) the availability of better infrastructural facilities increased the share of commercial fuels.

The presentation identified the following major issues with regard to the energy supply and demand patterns.

- There were constraints in supplying commercial fuels to regions such as the North-East, Lahul Spiti, and Ladakh. More than two-thirds of the total hydro potential of India was to be found in the HKH Region, of which only a fraction had been used for power generation. Part of the reason for this under-utilisation was the fact that the construction and maintenance of long transmission lines, roads, and geological conditions in the hilly regions required enormous investments and long gestation periods, aside from the capital-intensive nature of hydropower projects.

- The availability of data on energy resource availability and consumption patterns was poor. The district-level data were scanty and unpublished.

- Renewable energy sources, particularly biomass and solar, were promising alternative sources to meet the demand.

- Micro- and mini-hydropower systems might be most suitable in the hilly regions to avoid the cost of long transmission and distribution lines.

- Investment in the energy sector had been more or less exclusively reserved for the public sector, though the government had recognised the need for increasing private sector participation in development of the energy sector, particularly in electricity generation, supply, and distribution. Private sector participation was meagre so far.

- Energy policy emphasised the supply strategy to increase national power capacities and increase oil production and imports, while ignoring the demand side of the energy sector, so that the mountain energy system remained on the periphery.

- Power, coal, oil, large hydro, and nuclear sectors were the best organised and, although there was a Ministry to administer renewable energy sources, their efforts were disorganised and lacked innovation.

- There were no manufacturing capabilities for renewable energy devices within the HKH Region, although they existed for wind and solar photovoltaic manufacturing on a national scale.

- The energy supply in the HKH Region could not improve significantly unless efforts were made to harness the hydro potential and renewable energy sources. Technologies for renewable energy sources, particularly biomass, needed to be developed efficiently to utilise these resources.

Identification and Discussion of Issues

<u>Methodological Issues: Database and Planning</u>

Dr. T. S. Papola remarked that, while overview studies of this kind were useful, focus was required to capture the dynamics of change taking place in mountain communities with respect to the various sectors of the economy. In this context, energy-use patterns should be studied in sectors on the verge of transition. For instance, the rapid growth of tourist activities in mountain areas might require substantial and different forms and qualities of energy, thus an enquiry as to how this demand could be met and what type of energy mix was more suitable would be more meaningful. At the same time, the planning of various sectors, such as tourism or agriculture, might also provide an opportunity for energy sector development.

Dr. Papola also said that the establishment of a robust database at the macro-level alone might not convert into effective planning at the micro-level. Because the quantification and estimation of traditional fuels were both cumbersome and varied widely, depending on the technological interventions, it would be more useful to capture the general trends than to try to build a hard-core database. It was not that we did not know anything about energy use in the region, but that we knew far too little. The creation and management of a regional database in the energy supply infrastructure could be considered. However, less expensive methods of generating knowledge might be appropriate for institutions like ICIMOD whose role would be to initiate networking activities and facilitate exchange of data, while energy institutions in the respective countries of the region might consider the establishment of a database.

He also warned against the danger of using data without closer scrutiny and disaggregation. For example, a sizable part of Uttarakhand was in the plains where the use of cow dung was widespread, while there was minimal use of this fuel in the mountains. If we look at average cow-dung use in Uttarakhand, we find that dung contributes about 24 per cent of the total energy consumption, but planning on the basis of this aggregate information would have little relevance for the mountain areas of Uttarakhand. At the same time, establishing a database at the village level would also be expensive.

Mr. Zhang Mi emphasised the need for an energy database, as this would help to formulate suitable energy plans and policies at the local level. Mr. S. L. Shrestha said it was important to identify the types of database requirement that influenced the decision-making process, so that such information could be collected and collated by the national institutions, while ICIMOD could provide a common methodological framework for the countries of the region. Commenting on Dr. Banskota's presentation on Nepal, he said the 'Alternate Energy Promotion Centre (AEPC)' was created under the newly-created Ministry of Science and Technology with a mandate for channelling subsidies and promoting the development of RETs, besides coordinating and monitoring the progress. He also suggested that the development and design of a renewable energy programme in Pakistan should be based on the long-term vision for the sector, and this was missing at present.

Dr. K. Banskota questioned whether energy planning in mountain areas was essential. It was possible too many resources were being used in planning. What was important was the implementation of energy programmes that ensured the participation of beneficiaries. In this context, documenting the factors of success and failure of energy technology adaption could provide valuable insights. He quoted the case of the Barpak Micro-hydropower Project, in which a single entrepreneur proved instrumental in uplifting the economy of one area, and described the case as one in which the energy system played a key role as an entry point for the betterment of the community as a whole. The development of this scheme was based primarily on generating income rather than on consumptive use.

Professor Bansal suggested that different fuels, whether renewable or conventional, needed to be evaluated on the basis of their economic costs, also incorporating environmental costs, but that these evaluations had to be based on a systems' perspective. To this end, planning was required. He pointed out that energy planning should not be viewed as a static concept but taken from a holistic approach. With rapid changes in the availability of the types of energy resources and technologies and the increasing purchasing capacity of the mountain population, a different set of energy choices was appropriate. In this respect, local-level energy planning with dynamic sectoral links would be more suitable in mountain areas.

Dr. Rijal suggested that, while there was undoubtedly a need to create and establish an energy database, there was also a need to examine the appropriate institutions for this task and to identify the type of information required to help energy planners in the HKH Region. What was most important was to understand the dynamics of change in energy mix and energy demand. At the same time, it was necessary to understand the relationship between the types of behavioural change and of energy mix, along with the implications of these changes on the surrounding environment.

Energy Development and Sectoral Linkages

Professor Bansal observed that energy was primarily consumed in the household sector and fuelwood was the primary source in the mountains. There was a need to look at the possibility of increasing the use of energy in the productive sector so that the income of the mountain communities could be increased, thereby supplementing the energy demand of the consumptive sector. At the same time, it would help the commercialisation of fuelwood, and the resource cost of plantation would be realised gradually in rural mountain areas. Without linking energy to the productive sector, there was little scope for the judicious exploitation of mountain energy resources nor for the sustained promotion of renewable energy technologies.

Energy Resources and Technologies

Mr. S. L. Shrestha pointed out that the sustainability of biomass fuels should receive high priority in planning for the energy sector of mountain areas. Professor Nurul Islam suggested that there was a need for a national programme insofar as the suitability of renewable energy resources and technologies for mountain conditions was concerned. Professor Bansal noted that the rate of deforestation in the Indian Himalayas was aggravated by the need for forest products for construction rather than by the fuelwood needs of mountain communities. Dr. Junejo said there was a need to examine: a) what level of energy consumption was sustainable from the environmental point of view? b) what the appropriate sources of energy for mountain communities were? c) how the energy demand and supply could be made to match? d) how feasible and desirable the decentralisation of the energy sector was? and e) what type of inputs would be necessary to develop institutions at the local level?

Dr. Rijal observed that the present trend of energy use was unsustainable in both supply and demand. For example, though the HKH Region was rich in hydropower, the overexploitation of forest resources was causing rapid deforestation, not only resulting in soil erosion but in greater health hazards for the household, as well as increasing the burden on women and children who were the main parties responsible for collecting fuelwood. On the other hand, as a result of increasing population and poverty, more and more households were using 'other' biomass which was detrimental to their health as well as to soil fertility. On the demand side, no significant change had occurred in the share of energy requirements for consumption compared to those of the productive sector. Therefore, the pertinent issue would be to ensure the increasing use of energy for productive purposes so as to facilitate greater affordability for mountain people of the type of energy forms for consumptive use preferred.

Professor Nurul Islam cited the case of the Bangladesh *Gramin* Bank which made small groups aware of technologies and provided them with credit for their installation. Mr. S. L. Shrestha noted the need for local-level institutions to promote decentralised energy systems. Professor Bansal raised the issue of unreliability and the lack of after-sales' services for alternative energy technologies prevailing in the Indian mountains. Dr. Papola suggested that sole reliance on the private sector to develop the energy sector in mountain areas might not be the solution, as the methods of energy production might not always be environmentally benign nor affordable for local communities. The private sector's interest was to maximise profit, not social benefits.

According to Dr. Junejo, biogas development might not be environmentally friendly as it contained methane and carbon dioxide, which were the main ingredients of greenhouse gas. Dr. P. V. Ramana said the issue needs to be carefully examined from the systems' perspective; i.e., from energy resource extraction to end-use application, considering the energy transformation process and the associated environmental emissions at each node of energy transformation (for example, in burning dung or biogas as a fuel). In terms of gross efficiency parameters, biogas was more efficient and released less carbon.

Dr. Rijal expressed the need for persistent efforts with regard to the development of decentralised renewable energy systems in mountain areas. He cited an example from Nepal in which the establishment of a unit to coordinate the activities of the alternative energy sector was identified in 1984 and subsequently mentioned in two plan documents but took almost 12 years to materialise, and then too only because of persistent pressure from donor agencies. Also, there is a lack of commitment to developing renewable energy resources on the part of the government. For example, most of the energy investments made in the past were often initiated by donors with no long-term commitments from recipient countries. In some cases, these were not priority areas for recipient countries. Donors were not interested in recipients' priorities.

<u>Subsidies and Incentives</u>

Professor Bansal said subsidy schemes in relation to the promotion of RETs had failed and would fail as long as development of the energy sector was looked at in isolation. In disagreement, Mr. Zhang Mi said subsidies were required for the development of RETs not only for equity reasons in mountain communities but also to help develop a market for these new technologies. Mr. Shrestha suggested that subsidies should be considered for the RETs only as a short-term option to promote new and renewable technologies. Dr. Papola pointed out that the subsidy issue needed to be examined not only from the perspective of immediate and direct economic and financial aspects but also from the perspective of long-term social costs and benefits. The type of subsidy scheme would also have a bearing on the development of the energy technology or the promotion of a market for new energy technologies.

Chairperson's Remarks

Dr. Venkata Ramana, chairman of the morning session, summed up the discussions, giving his own views. He suggested that while building a reference energy system is a good exercise, the HKH Region would face numerous problems as a result of data not being available and the unreliability of the database. ICIMOD, as a regional institution, should direct its efforts towards creating and updating an energy database. The situation in the mountains was more complex because of the unpredictable dynamics, and area-specific treatment was required as the blanket approach to programme development tended to fail. Also, the sociocultural dimension needed much more careful examination in the mountains then in the plains.

Mr. Zhang Mi, chairman of the afternoon session, said aggressive promotional activities were desirable to promote the use of renewable energy technologies. At the same time, since it would be difficult to find suitable technological options to replace biomass fuels, especially in rural mountain areas, efforts needed to be directed towards planting more trees and the introduction of energy-efficient biomass technologies. In this context, the solution should be based on a consistent long-term approach rather than on unsustainable short-term solutions.

Energy Policies and Programmes in Mountain Areas

Technical Session 2 on 'Energy Policies and Programmes in Mountain Areas' was chaired by Professor M. Nurul Islam and **Ms. J. Gurung** acted as a resource person. Papers were presented by Dr. P. V. Ramana from India, Mr. V. B. Amatya from Nepal, Mr. Zhang Mi from China, and Dr. A. Junejo from ICIMOD. The essential points of each presentation follow.

Indian Mountains

Dr. Ramana began his presentation by describing the features of energy use in the context of the Indian mountains. Mountain areas had dispersed settlements and poor infrastructure, as a result of which cooking and heating demands were primarily met by biomass fuel. Biomass fuel was considered to be 'free' by the communities, though monetisation was being observed in and around urban areas. The overuse of biomass fuel had caused natural resource degradation, created health hazards, and increased the burden on women. Inadequate electrification, poor quality, and erratic supply, due to the unviable grid extension approach, as well as the inaccessibility and unaffordability of 'other' commercial fuels had hampered the fulfillment of the lighting and motive power requirements of mountain communities. Realising this, intervention programmes with a primary focus on new and renewable energy systems such as improved cooking stoves, biogas, solar cookers and heaters, small hydropower and afforestation were initiated. The impact of these interventions remained marginal, with a minuscule effect on substitution, because of a lack of systematic planning of supply and demand, the immaturity of some technologies, and an improper institutional framework. In addition, there was no operation and maintenance infrastructure available, no mechanism for local involvement, and no match was made between electricity generation and load.

With this background, Dr. Ramana presented the key parameter for policy planning at the operational and institutional levels. At the operational level, the issues that needed to be examined with regard to dissemination were: technology choices – including research and development, establishment of micro infrastructure, and capacity-building. On the institutional front, database creation and management, sectoral integration, the suitability of financial mechanisms, and the required policy support must be carefully examined.

The options available for the dissemination of energy technologies in the context of mountain areas were centralised, decentralised, and commercial. Each of these options had certain characteristics. For example, the centralised approach tended to be target-oriented but took into account the macro issues with a low penetration rate. The decentralised approach tended to be need-oriented and took into account the area-specific dynamics with a medium penetration rate. The commercial approach tended to be market-oriented and optimise product choice based on financial costs, and this might result in high social costs due to market imperfections but might have a high penetration rate.

Currently, technological choices were limited in the mountains. This was because little attention was given to research and development: less than 0.5 per cent of the total energy budget was made available for renewable energy technology. Also, matching of energy technologies to need and end-use requirements was not considered seriously. Some of the technological options that required further evaluation but showed strong application potential in the mountains were: i) improved watermills for motive power; ii) gasifiers for water lifting; iii) PV for refrigeration; iv) biogas for tough terrain; v) biogas for low temperatures; vi) small hydropower for small-scale industries; vii) forestry for fuelwood; viii) mini-/sub-grids and distribution utilities; and ix) hybrid systems of any combination such as water, solar, and wind.

The establishment of micro infrastructure and local-level capacity building might be instrumental in promoting suitable energy technologies in mountain areas;

for example, the establishment of operation and maintenance workshops in remote locations, the facilitation of access to spare parts, the development of local skills, and the promotion of user education and awareness campaigns. The suggested target group for capacity-building could be government functionaries, non-government organisations, and unemployed and semi-employed youths.

Database management was vital for proper planning within the energy sector and for integration with other sectors. There was a need to compile, update, process, and coordinate data and to make them available to different stakeholders at the regional level. There was a need to develop authentic and rigorous methods of estimation to aid practical planning and implementation of energy programmes. At the same time, there was a need to document the successes and failures of energy programme interventions, with the identification of causal factors, and a need for disseminating them widely. Also, it was necessary to develop methods of estimating the social and environmental costs and benefits of technology alternatives.

Energy planning should not be considered as an isolated activity but as an integral part of overall economic development. Among the examples of possible sectoral linkages were: a) developing biomass energy technologies for agricultural development; b) promoting small hydropower as part of a load development package with a focus on small-scale industries; and c) encouraging biogas development with a health and sanitation programme.

The suitability of financial mechanisms in mountain areas must be examined carefully with respect to the various options available. To do that, the form of subsidy (cash, interest, infrastructure) and its proportions needed to be designed appropriately. These varied substantially and were found to be effective in one place but not in another. Similarly, there were various forms of fiscal incentives (accelerated depreciation, tax reductions, duty exemptions) and soft credit mechanisms directed at users, manufacturers, and entrepreneurs. At the same time, the provision of risk or venture capital might be instrumental in promoting new and renewable energy technologies.

Special policy support was critical for development of the energy sector in mountain areas. These included: legislative support, inter-departmental coordination for sectoral integration, and effective monitoring of energy programme implementations. The recent policy initiatives taken in the Indian mountains included: a) acceptance of the promotion of renewable energy technologies (RETs) as part of a rural electrification programme in the North-East; b) the UNDP-sponsored five-year country programme on rural energy; c) an energy plan in preparation for Ladakh; d) plans to amend the Indian Electricity (1940) Act; and e) plans to introduce comprehensive legislation on renewable energy.

The role of ICIMOD in the region should be to act as a facilitator to promote the implementation of replicable models. ICIMOD could also take a leading role in carrying out detailed case studies to understand and capture the diversity within the region, database management, strengthening capabilities at different levels, through micro organisations, and pilot projects covering various approaches in relation to the energy sector.

Nepal

Mr. V. B. Amatya briefly described the energy sector and gave a review of energy policy in the context of Nepal. He observed that weak institutional arrangements, conflicting rules and regulations, and meagre budgetary allocations still afflicted the renewable energy sector despite the strong policy statement made in the plan document. Vagueness and generality were often encountered in policy statements, sometimes intentionally for political reasons, while, in other circumstances, it was due to a lack of relevant information. He reviewed the objectives and strategies of the energy sector as depicted in the Eighth Five-Year Plan (1992-97) and remarked that the various policies and programmes placed little emphasis on the issue of rural energy or on those issues related to forms of energy other than hydropower.

Mr. Amatya summarised various issues related to energy policies and programmes and discussed possible options. He observed that: a) fuelwood would remain the dominant source of energy for rural residential cooking and heating needs; b) fossil fuel demands would continue to rise at an accelerated rate; c) hydropower would also play an important role in the energy mix; and d) the growing energy requirements of the rural population would have to be met by renewable energy development. Given this situation, appropriate pricing policies, market arrangements, and energy quality regulations became prerequisites for ensuring sustainable energy management in line with the economic liberalisation policy adopted by Nepal. Appropriate policies on research and development and institutional strengthening to improve the very low technical and economic efficiencies of the energy sector were needed. Along with these efforts, concerns about social equity became more relevant in the Nepalese context. There was low affordability for the purchase of energy as a large section of the population lived below poverty line and market forces did not ensure that they benefited from development, and that included development of energy. But care must be taken that policy interventions encouraged rather than inhibited private sector efforts.

There was a shift in rural energy management in Nepal from a centrally-planned to people-based decentralised approach. This needed further strengthening at local level with planning and implementing energy programmes that gave adequate institutional support and incentive packages. In the interests of programme sustainability, it was necessary for energy development, especially rural energy, to be guided by a development focus. The following framework

Micro-hydro-power operated sawmill along Ghandruk trek route, Nepal

should provide broad guidelines for rural energy management.

- Development focus of rural energy systems - i.e., their ultimate impact on economic growth, human well-being, and environmental sustainability - should be the driving motivation behind all planning and programmes in rural energy through the principle of least-cost energy services.

- A long-term vision of the rural energy transition, comprising the phased technological evolution of rural energy systems, from a traditional energy base (fuelwood and other biomass) to a combination of available natural resources and technologies, including centralised and decentralised energy systems.

- Managing technology dissemination through a planning process not only focussing on commercialisation of technology but also on reducing technology dependency.

- Strategies should be pursued through the government-assisted market economy and people's participation should be supported by the government's indicative planning.

In conclusion, Mr. Amatya observed that emphasis on the market economy, without appropriate institutional mechanism, might not lead to a desirable solution on the energy front. This could be realised only with broader participation, with stakeholders (government, market, NGOs) doing what they could do best and supporting each other. The immediate efforts to promote the development of renewable energy technologies should focus on removing barriers to the operation of market forces; to give the role of financial intermediary to the NGOs, and to monitor, evaluate, and facilitate the renewable programme through AEPC.

The HKH Region of China

Mr. Zhang Mi briefly presented the factors for promoting energy policies and programmes with particular reference to the HKH Region of China. He highlighted the institutional arrangements that existed in Sichuan Province, China. There were five organisations responsible for the energy programme at the provincial level: namely, the i) Planning Committee; ii) Construction Committee; iii) Committee of Science & Technology; iv) Hydropower Bureau; and v) Village and Township Enterprises. Under the Planning Committee, there were three divisions, namely, energy, natural resources, and the monitoring division. There was an Energy Conservation Office under the Energy Division; and a Rural Energy and Environment Office at the county level, under the Construction Committee, was responsible primarily for the extension of biogas, efficient stoves, and solar technologies. The Committee on Science and Technology carried out relevant renewable energy studies at the provincial level. The mini-hydropower development unit of the Hydropower Bureau was responsible for construction activities. Small Coal Mining Enterprises, which fell under Village and Township Enterprises, were responsible for the development of coal mining activities.

Mr. Zhang said the Autonomous Region of Tibet was suitable for developing hydropower, solar, and geothermal energies, in general, while parts of Sichuan and Yunnan had good prospects for biogas development and small-scale coal mining activities, including hydropower, solar, and geothermal energy. He said the success of an energy programme was primarily reflected in the economic progress of an area and in itself reflected the soundness of goverment energy policies. The economic development of the HKH Region of China was comparatively lower than that of other parts of China and energy development within the region was in its infancy.

The presentation provided specific examples of energy development that had occurred in some parts of the HKH Region and explained the factors that contributed towards their development. He cited examples of hydropower, small-scale coal mining, biogas, and solar. Each of these energy resources had different characteristics and would require specific policies. For example, Aba Zang Minority Prefecture in Sichuan had made great progress in hydropower development because of the following policies of the government with regard to rural electrification.

- The provincial government, autonomous prefectures, and cities should make a development plan for rural electrification and integrate it with the local power development plan as well as the national economic policy and social development plan.

- The state must give priority to rural electrification. Key support should be given to the minority regions, remote mountain areas, and poor regions.

- The state strongly supported the construction of small- and micro-hydropower stations to promote rural electrification.

Solar water heater installed on the roof-top of an apartment building, Kunming, China

- The state encouraged and supported rural areas to carry out rural electrification using solar, wind, geothermal, biomass, and other energy resources to increase the rural power supply.

- The electricity price for agriculture should be set on a non-profit or micro-profit basis.

Another example cited was biogas development in Nanjiang County of Sichuan Province. The following measures had made biogas development successful in meeting the energy needs of the communities.

- Preparation of a biogas development plan at the district level, based on local conditions. For example, a) in the south lowland areas of Sichuan where farming and animal husbandry were in a relatively developed stage, biogas was being promoted to fulfill energy and fertilizer needs; b) in the northern mountain areas where tourist activities were being promoted, the stress was on environmental protection and energy recovery with biogas technology; and c) in the middle part, which was primarily an industrial area with a large residential section, community biogas plants and biogas septic tanks were being promoted to meet energy needs and to maintain hygienic conditions.

- More attention was paid to implementing policies that strengthened biogas organisations. For example, a biogas programme was specifically mentioned in the national economic and social development plans and also featured as the main agenda of the government at all levels of the county in 1994. The number of biogas plants was also included as a criterion in selecting local leaders at the district and village levels.

- The quality of biogas construction and biogas personnel was stressed. For example, training received by personnel became a criterion for heading the biogas team at the village and district levels.

- Regular after-sales' service was ensured through a contract system. In case of poor quality, the contractor became liable for carrying out repairs or for compensating the user for his total costs.

- Incentives were provided to users. For example, biogas users got land free of cost from the government and some cash incentives were provided as labour charges for the construction of a biogas digester.

- Setting up of a demonstration unit was key for propaganda and extensions.

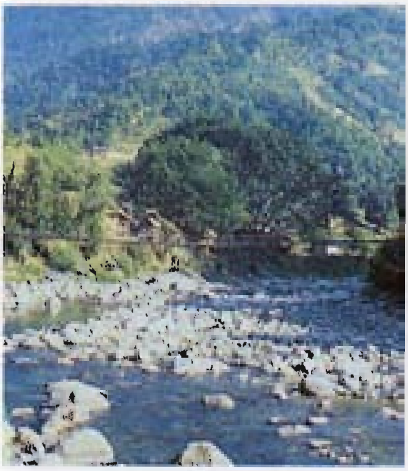
These examples suggested the following factors were instrumental in the development of small-scale energy technologies in the context of the HKH Region.

- The government's strong commitment to promoting new and renewable energy was crucial.
- Energy policies and programmes based on locally available energy resources.
- Combination of scientific knowledge with local economic, cultural, and environmental conditions to ensure technology adoption.
- Adequate attention to human resource development in terms of technical and managerial skills' formation in the field of small-scale renewable energy technologies.
- Financial viability of the programme, at the same time ensuring environmental and social benefits.
- Favourable financing, taxation, and pricing policies.

Energy Policy and Institutional Aspects: A Case Example of Private MMHP

Making a brief presentation on the policy and institutional aspects of mini-/micro-hydropower development, Dr. A. Junejo said that mini-/micro-hydropower (MMHP) was a very appropriate resource for remote and inaccessible mountain areas. It used the renewable resources available in most mountain areas; it was environmentally friendly; indigenous manufacturing facilities for the required equipment were usually available; and it could be a least-cost option in many areas. He said MMHP could become a viable option for mountain communities if the plants were: a) owned and managed in all respects by local community personnel or individuals; b) promoted and implemented by NGOs or autonomous GOs; c) indigenous equipment of reasonable quality was available; d) special funding arrangements were assured; e) appropriate policies and regulations were in place; and f) power was adequately used for productive end uses.

Dr. Junejo reviewed the status of private/decentralised MMHP in China, Nepal, and Pakistan. It was observed that costs of indigenous equipment varied from about US$ 400 to US$ 3,000 per kW; the quality and level of automation of equipment varied, but the quality was usually poor; plant factors were usually low; some progress was made in end-use development but not up to a desirable level; loans and/or subsidies were available but inadequate; and loan non-repayment was a serious issue, particularly in Nepal. He summarised the various issues related to private micro-hydropower development as high costs compared to diesel engines; design and manufacturing standards were not available or not followed; testing facilities were not available; insufficient management and operational capabilities as managers and operators were not educated or



Water stream and suspension bridge over the stream, Nepal

Mini-hydro-power plant in Leh, Ladakh, India

technically exposed and the training provided inadequate; back-stopping, monitoring, and advice were not available; funding was not adequate and also non-uniform, with inconsistent policies and procedures over subsidies, loans, and disbursement; inadequate repair facilities; and inadequate participation of beneficiaries.

He emphasised the positive aspects of some specific policies and legislation that existed in Nepal and highlighted prevalent deficiencies in the policies in other HKH areas. With the identification of these deficiencies, he suggested the following measures to promote the development of MMHP.

- Focussed attention required
- Identify suitable areas for prioritised promotion
- Increase funding level and improve fund disbursement and approval mechanism
- Determine optimum levels of subsidies
- Develop/improve technical standards/manuals and enforce them
- Strong support required to promote productive end uses
- Appropriate policies needed to overcome conflicts regarding water-use rights.

Giving an account of the current institutional arrangements that existed in Nepal with regard to micro-hydropower, Dr Junejo emphasised the need for the following.

- A central agency for policy, promotion, funding, coordination, database, technology improvement, training, repairs, end uses, and monitoring as well

- A funding approval and disbursement agency and a research and development institution
- Sufficient numbers of manufacturers, consultants, and implementers as they are key market players
- Local agencies to generate awareness and to provide information, training, and monitoring, as well as to provide repair and back-stopping facilities

The main conclusions of the presentation were as follow.

- Recipient/beneficiary participation in planning, implementation, and management is crucial.
- Local people/communities should own and manage the plants.
- Recipients must be appraised of benefits, limitations, their responsibilities and consequences of non-compliance.
- Indigenous equipment should be favoured but must be of improved quality.
- Training of various groups is necessary.
- Consistent and long-term policies and support are required.
- Repair and back-stopping facilities are needed.
- Adequate power utilisation for productive uses should be promoted.

Identification and Discussion of Issues

Dr. Papola began the discussions by saying policies could be classified into two categories: those related to the energy sector and general policies that have implications for the energy sector. At the same time, energy policies can be looked upon from the perspective of the end use of energy, productive or consumptive, and different processes and activities. The contribution that policies could make to promote a suitable energy mix (in terms of energy forms, price, affordability, quality, and quantity) to meet various energy services needed to be examined. In this context, the question was who makes these policies and to what extent do they reflect regional and local conditions and concerns – particularly those of mountain areas?

<u>Interest Groups in Decision-making</u>

Professor Nurul Islam said political stability was a precondition to putting forth and even to implementing new ideas such as the promotion of renewable energy resources and technologies in the face of conventional thinking on energy development in the region. Dr. Papola argued that political changes were not so important if long-term energy issues were identified and policy elements were appropriately intertwined with the development of the renewable energy sector. Professor Bansal said political instability affected the continuity of energy policies and programmes as most decision-makers in developing countries had a tendency to scrap initiatives taken by their predecessors, not based on their merit but for political advantage. Dr. Rijal expressed the view that although policies were influenced by the political decision-making process, they were supported by a certain section of professionals within the government and non-governmental sectors who were not always fully convinced by new ideas or who might be motivated by petty personal interests. Therefore, there was a need for good wholesome interaction among professionals within the government or outside, in order to resolve the policy issues. A consensus among professionals and experts could facilitate the continuance of accepted policies even in a situation of political change.

Need for Technology & Institutional Policy

Dr. K. Banskota pointed out that technology was available, but there was lack of a suitable mechanism to ensure the dissemination of available technologies, and, even when such a mechanism existed, there was a lack of coordination among GOs, NGOs, and the private sector. Dr. Junejo noted that the dissemination of renewable technologies required the identification of entry-points, whether technologies or institutions. In the varied experience of the region, sometimes it was good technology that helped the process of technology diffusion. In other cases, it was private entrepreneurs and manufacturers, or financial institutions, voluntary organisations, government or research institutions. What was required was a combined effort by all sides as the problem was growing more complex day by day.

Role of the Government

Mr. Wang emphasised the role of the central government in providing policy directives to the provincial level based on the long-term vision of the energy sector. It was quite obvious that new and renewable energy resources and technologies would have to take a leading role in the mountain areas or else little would be left for the future generation in terms of the availability of conventional fuels that were non-renewable by nature. Such a long-term perspective was appropriately taken into account in policy making at the national rather than local levels.

Sectoral Linkages at Policy Level

Dr. K. Banskota suggested that energy development needed to be linked with the issue of poverty alleviation. How the energy sector could help to generate more income for the mountain population was an important question that needed to be answered in energy development policies and programmes. Also, what type of energy resource development could generate more employment opportunities for them? In this context, it was important to capture the synergy of energy systems in relation to the various sectors of the economy.

Technology Choice: A Policy Issue

Mr. Zhang Mi said the basic premise for energy development should be to use natural resources in a sustainable manner. In this respect, attention should be focussed on promoting the application of solar energy in dry mountain areas like Tibet or similar areas in the region. At the same time, if there was a potential to tap hydropower on a large-scale, this should receive priority. He also emphasised the importance of local-level planning as decentralised energy systems were more suitable in mountain areas, and site-specific analysis was required prior to the commissioning of energy technology projects.

The Need for a Research and Development Policy

Mr. Shrestha called for new possibilities to be explored in the mountains. To this end, research and development were essential, for example, to promote the end use of energy as well as to capture the potential of oil seeds as a source of energy ('green energy'). The objective of the energy policy should not only consider fulfilling the existing energy demands but should also be instrumental in creating new energy demands. Dr. Ramana noted the need for assessing the application potentials of new technologies such as biogas production for decentralised electricity and fertilizer production, biogas production from agricultural residue, energy plantation for biomass gasification, and so on, in the mountains.

The Need for Knowledge Generation

Professor Bansal suggested that ICIMOD should document energy-use patterns in other sectors of the mountain economy besides households, as very little was known about the non-household sector. Dr. K. Banskota said documentation of successful cases of technology adoption in the mountains should receive priority, as these case studies would provide insight into factors that influence the adoption of a particular technology in the given socioeconomic conditions of an area. Mr. Myint proposed that biomass technologies should receive priority as biomass would dominate the energy scene of the HKH Region in the foreseeable future. Mr. Zhang Mi suggested that ICIMOD should document emerging technologies, for example, the efficient brick-making technology that had been popularised in China. This would help to promote the idea of technology transfer from one country to another.

Chairperson's Remarks

In his concluding remarks from the chair, Professor Islam said that development of renewable energy technologies should be considered within the framework of the technology dissemination process for which the four basic components were technologies, information, human resource development, and organisations. He added that modifications in the acts and legislations concerning the conventional energy sector might be required to promote renewable energy technologies. For example, there could be modifications in the Electricity Act to allow for multiple entry for power generation, introduction of a wheeling concept, financial and banking facilities, and entry of the private sector in the management of power distribution with regard to electrification in the CHT Region. He said the introduction of rational pricing policies might be an effective instrument in promoting the growth of the renewable energy sector.