ICIMOD

Implications of National Policies on Renewable Energy Technologies

Report of the Regional Experts' Consultation

Editor

Kamal Rijal

International Centre for Integrated Mountain Development

and

Canadian Cooperation Office

Kathmandu, Nepal

Implications of National Policies on Renewable Energy Technologies

Report of the Regional Experts' Consultation

3-4 July, 1997
Nagarkot, Kathmandu
Nepal

Editor
Kamal Rijal

Organized by
International Centre for Integrated Mountain Development

with Support from

Canadian Cooperation Office
Kathmandu, Nepal

Photo Credits : *K. Rijal*
Cover Photoes :
1) A Series of Wind Turbines(50-250 Watt) Installed at the Energy Demonstration Site, Badling, China - *K. Rijal*
2) Solar Photovoltaic Home System Installed in Kabhre District, Nepal - *CRT*
3) Dome Type Biogas Plant Installed in Panchkhal Valley, Nepal - *K. Rijal*
4) Five Hundred Litre Solar Water Heater Employed to Preheat Boiler Feed Water on a Dairy Farm, Near Solan, H.P., India - *K. Rijal*

Published by
International Centre for Integrated Mountain Development
G.P.O. Box 3226,
Kathmandu, Nepal

ISBN 92 - 9115 - 807 - 0

Typesetting at
ICIMOD Publications' Unit

Foreword

Renewable energy technologies (RETs) have considerable potential to contribute to environmental conservation and reduction of drudgery in the household tasks of mountain women. They can also act as engines of growth for mountain enterprises and off-farm employment. This has been widely demonstrated by individual actions and programmes promoting RETs such as improved cooking stoves, mini- and micro-hydropower, biogas, and solar photovoltaic equipment. Given the specific constraints to and opportunities for development that mountain regions are faced with, several of these technologies have comparative advantages for use in the mountains rather than the non-renewable fossil fuel-based technologies widely adopted in the plains.

Unfortunately, the wider adoption of RETs in the Hindu Kush-Himalayas has been hampered by the lack of or inadequate policies at the national level to promote RETs in a holistic manner or to give due recognition of mountain specificities with respect to both the choice of technologies and institutional mechanisms for their promotion. As a result the energy resources and technologies were not always appropriately matched with the needs of mountain households and mountain enterprises. Failure of some of the programmes has also been attributed to the lack of technical, financial, and organizational backstopping as well as the lack of proper understanding of the spatial characteristics of the mountains and the socioeconomic and cultural diversity of the region – which calls for a sensitive choice of energy mix and institutions.

In view of this, as part of its energy programme, ICIMOD initiated a study on 'Implications of National Policies on the Use of Different Renewable Energy Technologies in Nepal and Selected Other Countries of the Hindu Kush-Himalayas' with financial support from the Canadian Cooperation Office, Kathmandu. The study had three components: a) National Policy Studies in China, Nepal, India, and Pakistan; b) Case Studies on Four RETs in Nepal; and c) a Regional Experts' Consultation. The Regional Experts' Consultation was organized with a view to: a) assessing the implications of national policies on RETs in the context of the Hindu Kush-Himalayas; b) identifying factors that influence the adoption of RETs with particular reference to socioeconomic conditions and the biophysical setting; and c) recommending policies for the development of RETs in the mountains of Nepal. The meeting greatly benefitted from the contents of the commissioned studies and the additional inputs of the authors and other participants.

This report of the meeting, besides being a concise compilation of pertinent issues that various types of energy technology encounter, also provides useful insights to desirable policy shifts to promote use of renewable energy resources and the technologies that are available and suitable for mountain areas in a sustainable way.

I would like to extend my sincere appreciation to the study team from the Centre for Rural Technology, Kathmandu: Mr. V.B. Amatya, Mr. G.R. Shrestha, Mr. R.N. Gongal, Mr. S. Shrestha, and Ms. K. Bajracharya — who presented the findings of the study entrusted to them. I would also like to express my appreciation to Mr. Zhang Mi of China, Ms. Soma Dutta of India, and Mr. Tajjamul Hussain of Pakistan for the review studies carried out by them in their respective countries. My sincere thanks go to all the experts who presented

their opinions on various issues relating to RETs and provided suggestions that helped us arrive at conclusions and recommendations.

I would like to express my sincere appreciation to the Canadian International Development Agency (CIDA) for their generous funding of the consultation. Special thanks to Mr. Jaipal Shrestha, Environment Advisor and SPEF Coordinator, and Mr. Andrew Spezouuka, Environment Advisor, Canadian Cooperation Office, Kathmandu, for their active participation in the meeting.

Thanks are also due to Dr. Kamal Rijal who, as the coordinator of the programme, was responsible for organizing the meeting and preparing this report and to other ICIMOD staff, both professional and administrative, for their contribution and support.

Egbert Pelinck
Director General

Abstract

This report summarises the discussions held and recommendations made at the Regional Experts' Consultation on Implications of National Policies on Renewable Energy Technologies organized by ICIMOD from 2 - 3 July 1997 with support from the Canadian Cooperation Office in Kathmandu. The objectives of the consultation were to assess the implications of national policies on Renewable Energy Technologies (RETs) in the context of the HKH Region, to identify factors that influence the adoption of RETs in relation to particular socioeconomic and biophysical settings, and to recommend policy packages for the development of RETs for the mountain areas of Nepal.

The meeting reviewed and discussed various policies that had hampered the sustainable growth of RETs in the mountain communities of the HKH region with particular reference to China, India, Nepal, and Pakistan. The meeting helped to clarify the role energy can play in reducing drudgery, in reducing environmental degradation, and in providing linkages between energy and income generation. Also identified during the meeting was the necessity of compatibility of technology design to suit local conditions, private sector participation in the development of RETs, and the affordability of RET devices by mountain communities. All of these factors are critical for improving the financial viability of RETs. The meeting was instrumental in proposing a framework for policy recommendations to promote the development of renewable energy resources and technologies in the Hindu Kush-Himalayan Region.

During the meeting, four case studies carried out in Nepal were discussed:

a) Mini- and Micro-hydropower;
b) Solar Photovoltaic Technology;
c) Biogas Plants; and
d) Improved Cooking Stoves.

The meeting also charted out policy and institutional measures suitable for Nepal.

Contents

1
Background

A key characteristic of energy systems in mountain areas is that they remain heavily dependent on wood fuels, the supply of which is becoming critical due to the increasing rate of deforestation. These energy forms are not only used inefficiently, but they also involve significant tradeoffs in agricultural productivity due to the diversion of crop and animal wastes into cooking and heating devices. This results in environmental consequences such as loss of forests and woodlands, negative effects on health associated with indoor air pollution, as well as a range of social and economic impacts arising from fuel collection and use, many of which are experienced disproportionately by women and children.

There are, however, renewable energy technologies (RETs) available, within the HKH Region and beyond, which have enormous potential and linkages with synergy potentials to reduce the existing imbalance in energy supply and demand while decreasing socioeconomic and environmental stresses in the mountains. Programmes for adoption of these technologies have been initiated in the mountains but, unfortunately, only with limited success, insofar as they have not resulted in any significant increase in the use of renewable energy in spite of the existence of a great deal of potential.

Various studies have substantiated the comparative advantage of different RETs, particularly in mountain areas. They have also shown that experiences with these technologies have varied widely in terms of their adoption and success. Promotion of RETs was hampered by inadequate policies and appropriate matching of energy resources and technologies with the needs, to provide technical, organizational, and financial backstopping and lack of information and awareness could not be accomplished. In addition, the spatial characteristics of the mountains as well as socioeconomic and cultural factors have not been understood, leading to failures in RET intervention. It is also true that, in several instances, RET interventions have not only significantly improved energy supplies at household level but have also helped to support the economic productivity of the area.

It is now well recognized that this is not primarily due to the fact that saving energy with little negative impact on environment and health diminishes adverse environmental impacts and reduces life-cycle costs, but due to the lack of comprehensive national policies to promote the transfer and diffusion of efficient renewable energy technologies in mountain areas. These technologies may not become popular unless mechanisms for their transfer are available —

Rice Cooked in Solar Box Cooker at Women's Training Centre, Damauli, Tanahun District - Ms. Barbara Ross, Peace Corps Volunteer

whether organizational and institutional or financial — are improved, impediments to their adoption removed, and pricing issues properly addressed.

Given the abundant renewable energy resources in the mountains and the various constraints faced by RETs, national policies promoting their development are needed. This will be instrumental in ensuring a minimum supply of energy to meet the basic needs and sufficient energy to support productive activities.

The Canadian Cooperation Office (CCO) in Kathmandu funded a study entitled 'Assessment of Implications of National Policies on the Use of Different Renewable Energy Technologies in Nepal and Selected Countries in the Hindu Kush–Himalayas'. The study had three components: a) National Policy Studies in China, Nepal, India, and Pakistan; b) Case Studies on Four RETs in Nepal; and c) a Regional Experts' Consultation. As part of the study, ICIMOD organized a 'Regional Experts' Consultation on Implications of National Policies'. The Consultation was held in Nagarkot from 3-4 July, 1997.

The objectives of the meeting were to assess the implications of national policies on RETs in the HKH Region, to identify factors that influence the adoption of RETs, and to recommend policies for the development of RETs in the mountains of Nepal.

Brief presentations were made by study coordinators from India, Nepal, and Pakistan based on the findings on the 'Implications of National Policies on RETs' in Technical Session 1. **Dr. Kamal Rijal** made a brief presentation on behalf of the Chinese delegate who was unable to attend the meeting. Findings of the detailed case studies carried out in Nepal on micro-hydropower, biogas technology, improved cooking stoves, and solar technologies were presented in Technical Session 2. Following these presentations, detailed discussions were held to formulate recommendations on policies for the development of RETs in the Mountains of Nepal. Based on these discussions, a framework for policy recommendations was prepared. Finally, in the Closing Session, a presentation of findings and policy recommendations was made by the coordinator, followed by the concluding remarks and a vote of thanks. A detailed programme of the meeting is presented in Annex 1.

Altogether 33 participants took part in the consultation. Among them, five were from India, one from Pakistan, and 18 from Nepal – representing manufacturers, planners, promoters and experts, two from the Canadian Cooperation Office, and seven professional staff members from ICIMOD. Among the participants invited, the Chinese delegates could not attend. Annex 2 provides a detailed list of participants. The list of studies commissioned by ICIMOD and papers presented are reproduced in Annex 3.

2

Opening Session

Dr. T. S. Papola chaired the Opening Session. He welcomed all the participants to the consultation and expressed his regrets about the absence of the Chinese delegate. Dr. Papola stated that the energy development programme was one of the most important programmes of the Mountain Enterprise and Infrastructure (MEI) division of which he was the head. The mandate of the division, was poverty reduction through diversification of mountain economies and the promotion of eco-friendly activities. He briefly described the programmes of the division in mountain areas and emphasized two special features. Firstly, energy systems in mountain areas had to be eco-friendly, using renewable resources, and decentralized. Secondly, energy is an essential input in terms of meeting the basic needs of mountain people and in terms of poverty reduction. Finally, Dr. Papola expressed the hope that interaction with the participants on energy-related issues would be forthcoming during the workshop.

Mr. Egbert Pelinck, Director General of ICIMOD, delivered the opening address. He welcomed the participants and remarked that opportunities for greater cooperation would surely increase through interaction amongst various experts, planners, developers, promoters, and manufacturers. He thanked the representatives of the Canadian International Development Agency (CIDA) for their generous support to the consultation.

Mr. Pelinck stressed that mountain people had relied upon renewable energy resources, but due to the growing aspirations and increasing population, the prevailing technologies were unsustainable. He added that, although renewable energy resources and technologies had received attention in the 1970s, the era of cheap fossil fuels during the 1980s prompted many to shy away from renewable energy development, and this was unfortunate for mountain regions. He cited an example from the HKH Region in the context of overcoming the gross disparity between the potential and current contributions of renewable energy as a major challenge. He pointed out that energy use in the mountains had received scant attention, because the government and donor agencies, as well as the private sector, were more interested in large-scale energy development and their focus had mainly been on providing energy from the mountains to meet the growing needs of urban areas and the plains. He stated that attention is rarely given to the sustainability of use and the potential of energy for generating incomes for mountain communities, and that mountain-specific conditions were inadequately reflected in national energy strategies, policies, plans, and programmes.

Mr. Pelinck said that this was the reason why ICIMOD had embarked on a programme for renewable energy technologies suitable for mountain areas. He cited two important questions in relation to the energy sector. Firstly, how can energy use and development in mountain areas be adopted in such a way as to overcome the main constraints to development such as inaccessibility and fragility ? Secondly, how can one make use of the comparative advantages that mountains provide for sustainable development, based on the biological, ecological, and cultural diversity of the region?

Mr. Pelinck outlined the policies and technologies that could be discussed during the consultation. The issue raised regarding policies was which national policies favour the use of renewable energy systems and which the use of non-renewable energy? Another issue was the national energy-related policies that favoured mountain people and those that had a negative impact on them. Regarding technologies, he emphasized the types of renewable energy technologies suitable for mountain communities, taking sufficient account of the mountain specificities; what are the quantities and qualities of energy services required for different purposes? and how can social and economic benefits be maximised in both the short and the long term? and what are the potentially harmful and potentially positive effects on the environment of the use of different energy sources, taking into account the global imperative to reduce CO_2 emissions and local imperatives for maintaining adequate vegetation cover to prevent soil erosion and landslides? Regarding economics, he discussed whether the market prices of various sources of energy included the environmental and social costs to the nation as a whole; and whether we had enough knowledge about the costs of investing in the production, commercialization, and use of various types of energy. The last issue was the need to identify appropriate institutional mechanisms to ensure the development and sustainable management of the right type or mix of renewable energy resources and technologies at the household, village, and district levels. Such identification should be carried out with full participation from the ultimate beneficiaries and other stakeholders in the energy programmes.

Participants in Regional Experts' Consultation on Implications of National Policies on RETs

Mr. Pelinck expressed the hope that the meeting would be able to produce policy recommendations suitable for mountain areas, in general, but specifically for Nepal. Finally, he expressed his hopes for a successful outcome and that the participants would have a pleasant stay in Nagarkot.

Mr. Jaipal Shrestha, Environment Advisor and SPEF Coordinator, Canadian Cooperation Office, welcomed all the participants to the consultation on behalf of CIDA and the Canadian Cooperation Office. He explained the importance of RETs within the HKH Region. He described the HKH Region as being a most beautiful area in terms of scenic beauty, cultural heritage, and natural endowments. He added that the people of this area were facing severe hardships in terms of energy needs, therefore they had to depend on the ever- diminishing forest resources to meet this demand, and this resulted in deterioration of the ecosystem in the area. He mentioned the promotion of environmentally sound water and natural resource management as being one of the key Overseas' Development Assistance (ODA) priorities of CIDA in Nepal. He emphasized the contributions of ICIMOD to the field of mountain development and expressed his pleasure to be supporting the consultation initiated by ICIMOD. He hoped that the policy recommendations from the consultation would help the government and affiliated stakeholders in the adoption of RETs in the mountains of Nepal. He added that the knowledge and expertise shared in the consultation would increase the understanding of this important sector. Finally, he thanked ICIMOD for providing him with an opportunity to express his point of view.

Dr. Kamal Rijal, Coordinator, welcomed the participants and reviewed the past activities and the present focus on the energy sector by ICIMOD. ICIMOD had been concentrating on the key issues of energy in the mountains since 1984. From 1987 to 1989, a decentralized energy planning and management programme to develop methods of rural energy planning and management in mountain regions; to disseminate them among district-level officials; and to train trainers from selected institutions was undertaken. From 1990 to 1993 ICIMOD shifted its focus to generating more knowledge about renewable energy technologies (RETs) and their suitability in the context of mountain areas. For the development of a sustainable energy system in the HKH Region, ICIMOD formulated the energy programme with the objective of identifying appropriate policies and investment strategies. With this objective in mind, ICIMOD introduced a programme on Sustainable

Improved Cooking Stove Installed in a Remote Mountain Household of Nepal

Energy Development in Mountain Areas through the Four-year Regional Collaborative Programme, 1995-1998. Regarding mini- and micro-hydropower, from 1994-1995, ICIMOD prepared five country reports, organized national seminars and training programmes, and held a Consultative Meeting of International Experts. As part of its energy programme, ICIMOD commissioned a series of studies on the 'Analysis of Present Energy Use Patterns in Urban and Rural Areas of the HKH Region' in 1996. As a follow-up activity, a 'Regional Meeting on Energy Use in Mountain Areas' was organized in April 1997. A programme on 'Solar Energy Networking' commenced in mid-1996.

Dr. Rijal explained that the study funded by CCO had three important components: a) national policy studies in four countries of the HKH Region, namely, China, India, Nepal, and Pakistan; b) four case studies on renewable energy technologies (RETs) in Nepal, namely, micro-hydropower, biogas technology, improved cooking stoves, and solar technologies; and c) a Regional Expert's Consultation. The main components of the national policy studies were to review and examine the implications of national/provincial policies, to review and assess the implication of sectoral policies, to review institutional arrangements, and to recommend a comprehensive policy package. Detailed case studies on biogas, micro-hydropower, improved stoves, and solar photovoltaics were carried out by the Centre for Rural Technology, Nepal. The terms of reference for case studies included a review of technology, financing mechanisms, dissemination, promotional approaches and R&D with regard to each technology, a review of policy initiatives, a review of institutional arrangements, analysis of environmental implications, and review and analysis of existing information. Field surveys were carried out based on structured discussions and interviews and on a participatory rural approach. The main issues examined during the field survey were factors that influence the success and failure of RET promotion and dissemination, gender, institutional and management and financial aspects, the role of each stakeholder in the project or programme, and strengths and weaknesses of various forms of ownership and management practices.

Solar Water Heaters Installed on the Rooftop of an Apartment Building in Kunming, China

He highlighted the objectives of the consultation, which were to assess the implications of national policies, to identify factors that influence the adoption of RETs, and to recommend policies specific to Nepal. The expected outcomes of the consultation are increased understanding of the implications of national policies, improved knowledge of their status, identification of key factors, and policy recommendations.

Dr. Rijal added that Mr. Pelinck had raised a number of pertinent issues with regard to the development of renewable energy. These issues in themselves gave rise to a number of questions related to methodologies, implementation, and planning. He spoke about how to estimate the environmental cost of energy production and use and to internalise social costs while evaluating various energy options. He emphasized the minimisation of interference in energy-investment choices without disrupting the economy and allocative efficiency and how to influence the existing decision-making procedure of utilities so that RETs are also considered as appropriate supply options. He raised questions about how to change energy users' investment incentives to promote RETs and how to accelerate investment in renewable energy commercialisation without compromising concerns for social equity ? Finally, he raised questions about how to overcome the existing institutional barriers, in view of the fact that the provision of energy has always been the responsibility of centralized supply-side institutions where implementation of decentralized RETs demands decentralized energy institutions. Finally, Dr. Rijal expressed the belief that these questions and issues would be dealt with in depth during the consultation.

3

Implications of National Policies on RETs

The morning session was chaired by **Dr. M. Banskota**, Deputy Director General, ICIMOD. During this session, the first presentation was made by **Mr. V.B. Amatya**, Consultant, Centre for Rural Technology, Kathmandu. The presentation was based on a study commissioned by ICIMOD on 'Implications of National Policies on Renewable Energy and Energy Efficient Devices in Nepal'. This was followed by a presentation by **Ms. Soma Dutta** on a study on the same topic commissioned in India.

The afternoon session was chaired by **Dr. G.R. Bhatta**, Special Secretary and Advisor, National Planning Commission, Nepal. **Mr. Tajammul Hussain** presented a paper based on a study commissioned in Pakistan on 'Assessment of Implications of National Policies on Renewable Energy Technologies'. This was followed by the presentation of a study commissioned in China on the same topic. Dr. Kamal Rijal made the presentation on behalf of the Chinese expert. **Dr. S.S. Chandel**, Principal Scientific Officer, State Council for Science, Technology and Environment, Himachal Pradesh, India, made a presentation on 'Efforts and Expectations of Passive Solar Housing in the Mountains'. Discussions were held after the presentations.

Biogas Lamp Installed Inside the Kitchen of a Restaurant Owned by a Gurung Family along the Ghandruk Trekking Route, Nepal

3.1 Country Presentations: Nepal

The Nepal presentation briefly highlighted the current energy use pattern and supply potentials. Fuelwood represented 80 per cent of the energy consumption, mainly consumed in rural Nepal. Electricity supplies were limited to about 13 per cent of the total population. The rural population, which comprised about 90 per cent of the total population, had very limited access to elec-

Box 1: Status of Alternative Energy Development in Nepal

Alternative Energy/End Uses	Installed Units/	Institutions Involved Capacity	Comments
Biogas Digester/ Cooking and Lighting	> 32,000	ADB/N - Financing Biogas Co – Construction, R&D Other Co – Construction – Donors' Promotion	Mostly of 6 and 10 cum. fixed dome type
Micro-hydro (<100kW) Mechanical and Electricity	10,000kW	Private Sec. - Manf., R&D ADB/N - Financing I/NGOs – Promotion	Including non-electricity uses
Small-hydro (100-1000kW) Electricity	9,913kW	NEA – Implementation	Includes 100kW sizes
SPV Heat and Electricity	700kW	Private Sec. - Manf., user I/NGOs - Promoter, user NTC/Aviation – user	Power and communication
Wind Mechanical and Electricity	20kW	NEA	Experimental and Promotion stage
Improved Cooking Stoves Heat for cooking	90,000	I/NGOs, Private sector, Government	Residential Cooking stoves
Briquettes Indus. and Comm. appl.	12 industries	Private sector - Manf.	

tricity (4%). Petroleum fuels and coal were imported from other countries. Rural energy consumption comprised about 87 per cent of the total consumption and was an important sector. It was also evident from the rural energy consumption characteristics that most of the people relied heavily upon animate and biomass energy to meet their energy requirements.

Alternative energy technologies in Nepal primarily included biogas plants, micro- and mini-hydro power plants, solar technologies, and improved cooking stoves (Box 1). Nepal had made significant progress in developing and using its water resources for producing power in the micro range (up to 100kW) over the past three decades. A good micro-hydro technology manufacturing base had already been developed in the country. Currently, there were over 900 micro-hydro installations in the private sector scattered throughout 59 of the 75 districts of the country. The total installed capacity was about 5MW.

The success of biogas development programmes in Nepal could be attributed to the availability of government subsidies as well as the interest and involvement of a number of INGOs and donor agencies. Currently, the number of biogas plants of different sizes exceeded 32,000. The biogas support programme (BSP) had been set up as a joint venture between ADB/N, recognised biogas companies, and the Netherlands' Development Organization (SNV-Nepal) to support the biogas programme through subsidy, quality control, training, and research. A third phase of the programme has been proposed for the period from 1996/97 to 1999/2000 with the target of installing 100,000 biogas plants.

Traditionally, in Nepal, solar energy had been and still was used for drying purposes, mainly for drying agricultural products. A significant modern use of solar energy was for heating. Another important use of solar energy was electricity generation from Solar Photovoltaic (SPV) systems. According to one estimate, more than 6,000 units of 50W module SPV systems were being used by the Nepal Telecommunications' Corporation. Similarly, the technical and economic viabilities of solar PV systems for pumping water for irrigation and drinking was also being tried out in Nepal. Private entrepreneurs and NGOs had shown an interest in the promotion and dissemination of SPV home-lighting systems. The government was providing 50 per cent subsidies through ADB/N for the installation of household SPV units. The estimated total installed capacity of solar energy was 700kW.

Wind power development in Nepal was still in the experimental stages and, so far, no contribution had been made by wind energy to meet energy requirements. Absence of reliable data for proper assessment of wind energy and lack of adaptive R&D efforts were the main setbacks to the proper assessment of wind energy.

The only large-scale ICS programme carried out in Nepal was through the Community Forestry Development Division (CFDD), which was suspended in 1991. So far about 88,000 to 90,000 ICS of various types had been promoted and distributed by the government, NGOs, and private sector agencies.

Rice husks were used to make briquettes for space heating and cooking in the domestic and commercial sectors. There were 12 briquette industries in operation. But, due to various technical and marketing problems, in spite of some initial success, the industry was on the verge of total failure.

The presentation primarily focussed on the various policies on RETs. Nepal had been following planned economic development models through five-year development plans. The specific policy in energy development started from the Fifth Plan (1975-80). Energy policy covered only hydropower and forestry sectors until the Sixth Plan (1980-85). The highlights of various policies related to the energy sector (economic policies, industrial policy, foreign investment and technology transfer policy, trade policy, credit policy, interest rate policy, and energy pricing policy), and policies that would have implications on the energy sector (natural resources' policy, energy policy, alternative energy subsidy policy, hydropower development policy, water resources' policy, and forestry policy) were presented.

The presentation also highlighted the role of financial intermediaries in promoting RETs. The Agricultural Development Bank, Nepal (ADB/N), was the main development finance institute with an active role in the rural energy programme. It also provided loans to local entrepreneurs and channellised a renewable energy subsidy programme of the government. Commercial banks (primarily, Nepal Bank Limited and Rastriya Banijya Bank) had also started to act as financing intermediaries for the development of alternative energy technologies, as commercial banks had to provide 12 per cent of their total loan portfolios to the agricultural and rural energy sector under the priority sectors' lending programme launched by Nepal Rastra Bank (NRB). Among the 3,500 registered NGOs, the Centre for Self-help Development (CSD) and *Nirdhan* are the only noteworthy NGOs involved in the promotion of the alternative energy programme.

The role of technical intermediaries was highlighted in the presentation. This was related to providing the necessary information, research and development, technical services, and training. Various reports pointed out the urgent need to produce a cadre of lower, middle, and higher level technicians and motivators for promotion and research and development in the field of RETs. Manufacturers were playing a key role in training end users and promoters. There was a lack of institutions to provide technical backstopping, but it was expected that the recently formed Alternative Energy Promotion Centre (AEPC) under the Ministry of Science and Technology would play a significant role in this respect. Donor agencies, such as the Swiss Association for Technical Assistance (SATA), which had helped to establish BYS; United Mission to Nepal (UMN), which had helped to establish DCS; and SNV, which had funded the Biogas Support Programme, had all played a vital role in promoting renewable energy technologies in Nepal, in addition to ITDG, USAID, ICIMOD, and other similar organizations.

The presentation also reviewed subsidy programmes and policies and concluded that these had failed to address concerns regarding social equity in terms of class, gender, and ethnic groups. This had been because of the inadequate planning and poor analysis; i.e., inadequate in terms of resource and development objectives. Subsidies were provided on an *ad hoc* basis and were not based upon proper design that addressed the necessary minimum concerns (e.g., financial, technical, resource, and market externalities).

On gender issues, the presentation pointed out that, although women accounted for more than 50 per cent of the population, they found it difficult to become active participants in development activities because of poverty; illiteracy; poor health; traditionally conservative attitudes towards women; and lack of access and control over productive resources, information, and technology. Women played key roles in the management and use of energy resources, but they faced several problems related to using fuelwood and other biomass residues in poorly ventilated kitchens, grinding grains during the late evening or early morning, increase in time needed to collect fuelwood and fodder, increasing responsibilities in household management because of out-migration of the male members of the family, besides carrying out all other household errands. Though participation of women was being encouraged in planning and implementation of rural infrastructure this seemed unfeasible because of the work burdens with which they were associated. Review of various energy-related policies with gender implications indicated that they were gender blind. Even those policies that referred to gender issues failed to assess and address the practical and strategic needs and constraints that women faced.

The presentation also summarised the main barriers to dissemination and promotion of RETs. These were: high front-end capital costs, inadequate rural credit systems, non-continuous nature of energy supplies, an insufficient institutional base, and sporadic availability of low-cost information and services.

Following the presentation of the main findings from the field case studies carried out, the conclusions and recommendations of the study were highlighted.

The study concluded that Nepal had made remarkable progress in the development and dissemination of RETs such as biogas, whereas this was not the case with micro-hydropower and some other technologies that were in the initial phases of dissemination, for example, SPV home systems and Peltric sets. The progress in the biogas sector was phenomenal and, thus, had been specifically due to the establishment of an institutional set-up to supervise the programme in an integrated manner so as to facilitate the proper delivery of subsidies, quality control and standardisation, warranty charges for operation and maintenance, and development of training packages to promote private sector activities. This was a not the case with other RETs. For example, micro-hydropower development was beset with problems such as low load factors, frequent needs for repair and maintenance of water channels, high upfront capital costs even after subsidies, poor quality control, poor back-up services in most areas, and unresolved water rights. The success achieved in disseminating SPV home systems was being questioned as the subsidies reached affluent members of the community and there were no or limited linkages to income-generating and development activities. The improved cooking stove programme had failed miserably because of failure to set proper targets and because it catered to cooking needs alone, forgetting space heating and drying. There was hardly any programme for wind energy. The presentation made recommendations (See Box 2 above) with regard to legislative and regulatory arrangements, financial and

Box 2: Recommendations on RETs in the Context of Nepal

Legislative and Regulatory Arrangements

- Protection of for the lower stream users' rights
- Private sector R&D and intellectual property rights
- Standardisation of equipment and safety guidelines for construction and operation
- RET and ESD product warranty
- Registration should be scrutinised for mills and turbines

Financial and Economic Aspects

- Framework for subsidies based on a level playing field concept for all RETs
- Simplified and uniform banking procedures
- Promotion of productive end use
- Development of entrepreneurship
- Special programme to enable the poor to have access to RETs

Direct Public Investments

- Social equity concerns must over-ride technical efficiency
- Incorporate social equity concerns in all government programmes
- Design location-specific target-driven programmes for marginalised communities

Institutional Arrangements

- Greater commitments for technology promotion and dissemination
- Coordination, monitoring, and evaluation need to be established
- Provision of follow-up and technical backstopping
- Need for a training and awareness programme
- Use of Traditional Skills
- Encourage practice of traditional management
- Promote traditional technical skills
- Integrate traditional technical and management skills with new technology interventions

economic aspects, public investments, institutional arrangements, and utilisation of traditional technical and management skills to promote the development of RETs in Nepal.

Himalayan Region of India

The presentation provided general information on the Himalayan region of India. The region occupies an area of roughly 500,000 sq.km., spanning 11 states in the northern and north-eastern parts of the country. The Himalayan region contained more than two-thirds of the total hydropower potential (84,000MW). Currently most electricity generated was through thermal power, followed by hydro-electricity and diesel based products. A recent macro-level estimation of the total energy consumption indicated that about 20,977 million GJ were consumed within the region in 1992. Of this, 53.2 per cent was met through biomass resources, 31.8 per cent by coal , 11.4 per cent by petroleum products, and the balance by natural gas, electricity, and renewables. All the different studies clearly demonstrated a heavy dependence on biomass and fuelwood in the domestic sector. The penetration of commercial fuels, such as electricity, coal, and cooking gas, had been insignificant. Data on the number of LPG users showed that the HKH states had less than five per cent of the LPG consumers in the country. The Himalayan region provided an ideal niche for the deployment of renewable energy technologies due to the availability of a renewable natural resource base (solar, wind, hydropower, and biomass) associated with features such as difficult terrain, inaccessibility, poor infrastructure, and low levels of income.

The presentation reviewed the status of renewable energy technologies in the context of the Indian Himalayas (Box 3). Improved cooking stoves and family-sized biogas plants were the most widely distributed technologies within the HKH Region of India. Various reports evaluating biogas plants and improved cooking stoves indicated that the percentage of functional apparatus varied between 65 to 90 per cent and 50 to 65 per cent, respectively, throughout the various states. Currently, 376kWe solar PV systems, primarily for lighting, were being used in the mountain areas of India, though it was not clear how many of them were fully functional. This technology seemed to be feasible in areas in which houses were scattered and where it was not economically feasible to extend the grid. The Western mountains showed significant potential for solar energy technologies, and several private and public institutions were promoting them. For example, Solar photovoltaic home systems and street lighting facilities were popular in Ladakh. The use of solar greenhouses was also on the rise in Ladakh.

The Indian mountains provided good sites for the installation of mini- and micro-hydropower, as a potential of almost 2000MW existed in these areas. Only about 52MW were exploited, however. Almost all mechanical factories had the capability of constructing mini- and micro hydropower plants, if appropriate designs were provided.

Manufacturing of various renewable energy systems had advanced in India as a result of the promotional efforts of the Government. There were 74 manufacturers of solar photovoltaic and wind power systems, and they were capable of providing services within the HKH Region as well but were located outside the region. Household biogas systems had been installed throughout India, primarily by the Khadi Village Industries. The local craftsmen produced improved cooking stoves. A number of gasifier designs were available and several mechanical factories were capable of producing these units.

Box 3: Status of RETs in the Indian Himalayas

Technology	Status
Biogas Plant	High subsidy; problems of dung availability, water shortages, ambient temperature etc.; has not performed well; lack of maintenance due to remoteness; need of R&D and appropriate technology
Improved Cooking stove	50 per cent subsidy; inability to design stoves that suits local con ditions; improper construction and short life of the device; metal portables better accepted in the north-eastern states
Micro- and Mini-Hydropower	Up to 3MW capacity; installed capacity is 93.21MW; potential of 10,000MW in the HKH region; MNES provides subsidy; MNES has been encouraging state governments to develop and announce incentive packages to attract private sector participation; IREDA provides soft loans; operating at sub-optimal capacity due to load factor problems, technical constraints, organizational set-up, lack of private sector participation and manufacturing base, peoples involvement, etc
SPV Technology -	Applications are for minor irrigation and drinking water supplies, street and domestic lights, solar lanterns, lighting for schools, hostels, etc.; heavily subsidised; SPV pumps installed on a demonstration basis; the only functional device is the solar lantern; problems of climatic constraints, lack of technicians for distribution of many technologies, lack of users training for discharging batteries, high rates of dysfunctionality, and difficult terrain and poor infrastructure.
Solar Thermal-	Subsidy withdrawn by MNES, but some of the states have continued – a 90 per cent device cost subsidy in Arunanchal Pradesh, mainly for community use such as hospitals, health centres, etc.; mixed performance; the functionality level, except in Arunanchal Pradesh, is less than 50 per cent; new management system introduced in Assam; problem of damage by rains, hailstorms, and floods in hilly regions.
Biomass Gasifier-	Not successful in the hilly regions; costly; unviable options for small industries; Thermal applications have worked well; detailed and scientific study has not been carried out.

The Ministry of Non-conventional Energy Sources (MNES) was mainly responsible for developing renewable energy plans and programmes. State nodal agencies, such as the Himachal Pradesh Energy Development Agency, Arunachal Pradesh Energy Development Agency, State Rural Works' Departments, and so on, were implementing renewable energy programmes at the state level. Besides these, other government and non-government agencies were implementing these programmes. The national programmes for biogas development and improved cooking stoves were looked after by the agricultural department or state Agro-industries' Corporation and by the Rural Development Departments, respectively. Solar thermal and PV programmes were looked after by the State Energy Development Agency and small hydropower by the Power Department or the State Electricity Board. The improved cooking stove programme was implemented through several academic and social institutions to design more efficient cooking stoves and to undertake training programmes. Renewable policies had contributed to the deployment of a large number of devices in the hilly regions, but they had not been entirely successful in terms of ensuring satisfactory performance. The experience with RETs in the hill states showed that there were several shortcomings in policy and planning, implementation procedures, and institutional frameworks. There were technology-specific barriers as well as those common to all programmes and technologies. Barriers to large-scale distribution of different technologies are summarised in Box 4.

Regarding policy and planning, there were various barriers such as mismatch between technologies and local needs and preferences; approaches to distribution; supply-side planning; failure to incorporate linkages between components of livelihood systems; absence of reliable databases; high cost of renewables; and pricing of commercial fuels. It was pointed out that institutional constraints arose from the multiplicity of agencies and duplication of efforts, lack of monitoring mechanisms, and low level of participation on the part of NGOs and local bodies. The technological barriers were identified as lack of local manufacturing capabilities and low R&D invest-

Box 4: Barriers to Dissemination of RETs

Technology	Barrier to large-scale dissemination in present form
Micro- and Mini-hydropower	Inadequate work on load developing strategy Basic field data not available Technical and operational problems not yet solved
Improved Cooking Stove	Existing models incompatible with region-specific traditional lifestyle Inadequate attention to R&D
Biogas Plant	Issues of low temperature and scarcity of dung not resolved
Solar Photovoltaic	High initial investment required
Solar Thermal System	Technology not yet suitable for the mountains
Biomass Gasifier	Uneconomical, because of subsidised electricity and diesel
Wind Energy	Wind monitoring and mapping data not available for many places

ments. The presentation highlighted the important issues (Box 5) and made various suggestions (Box 6). The presentation suggested the following measures at the National Policy Level.

operated by government agencies. Mainly, two organizations, the Pakistan Council of Appropriate Technology (PCAT) and the Aga Khan Rural Support Development Programmes (AKRSDP) are engaged in the promotion of micro-hydropower plants up to 100kW in capacity. There were 200 micro- and mini-hydropower (MMHP) plants installed with a total capacity of three MW, out of these 160 plants were working with an 80 per cent success rate. The presentation identified the issues regarding the micro- and mini-hydropower plant as a mismatch between plant capacity and energy demand, inappropriate equipment, lack of trained personnel, tendering by the government, failure to identify local energy markets, and limited private sector involvement. PCAT had so far installed 750 biogas units throughout Pakistan. The government had recently given approval for the installation of 20,000 biogas plants. Solar thermal technology had been developed successfully in Pakistan for water heating and space heating and was being commercialised. About seven solar stations with a total capacity of 257 kW had been installed in various parts of the northern areas.

Box 5: RET Issues

Technology	Issues
Improved Cooking stove	Stove design and cooking practice, inconvenience, alternative uses of cooking stoves; R&D in ICS; performance of portable ICS better; dissemination strategy
Micro- & Mini-Hydro	Low load factor; technical and operational; Institutional set-up; private sector participation and mode manufacturing base; people's involvement
Solar Thermal System	Flat plate collectors - unsuitable for hills; damages caused by rain, hailstorm, breakage of glass panel, etc.; high investment cost
Solar Photovoltaic	High cost of technology; accountability towards installed systems; lack of users' training in system maintenance
Biogas Programme	Dung availability; water shortages; ambient temperature; high costs Swastik models for the hills; unsatisfactory field program; none of the existing models suitable

The HKH Region of Pakistan

The presentation highlighted the overall energy situation within the HKH Region of Pakistan. Biomass fuel (firewood, dung, crop residue, etc) accounts for about 80 per cent of the total energy. Natural gas is not in use, although Balochistan produces most of the natural gas for the country. LPG is used in the mountain areas of the Punjab and the NWFP. Kerosene is used in most of the mountain region, because it is affordable. Charcoal is also used in some parts of Pakistan. Firewood is used in all the regions of the HKH. The second fuel used is dung cake.

The presentation primarily dwelt on the status of renewable technology. In Pakistan, the recoverable potential of hydroelectric power has been estimated to be nearly 35,000MW out of which only 3,330MW, has so far been exploited. There are altogether 64 MMHP plants with a total capacity of seven MW

Box 6: The Main Technology Specific Suggestions were as follows

- Hilly areas needed specially designed cooking stoves to increase efficiency and the market should be selected suitably according to biomass scarce and peri-urban areas.
- Cheaper systems, such as the batch type Solar Water Heater, should be developed.
- To enhance solar PV technologies, only specific applications, such as electrification in remote areas, should be promoted.
- In the case of biogas, R&D are needed to focus on removing climatic bottlenecks.
- For the development of hydropower, basic data collection is needed for
  - policies on incentives, credit arrangements, etc,
  - baseline information on institution/manufacturers, etc,
  - region specific data, and
  - ready to use updated information for
    - load development strategies,
    - institutional requirements such as dedicated agencies, involvement of NGOs, and
    - regional manufacturing.

- To improve wind energy technologies, wind mapping and surveys in more locations, as well as extra emphasis on basic resource assessment, were required.
  - There should be a technology-specific requirement.
  - The approach to dissemination should be geographically focussed, prioritised in terms of available technologies, and NGOs and local institutions should be involved.
  - Interlinkages between sectors were very important. Two key areas that needed attention were: increasing biomass availability through local management of forests and the promotion of efficient and environmentally friendly, traditional water-harvesting methods.

Use of the improved design for traditional *chullah* had increased from 43 per cent to 50 per cent. This design saved about 50 per cent of fuelwood. So far, 6,800 stoves had been distributed in rural areas of the NWFP and Balochistan.

The Pakistan National Conservation Strategy document (1993) had outlined seven priority programme areas of activities for developing and deploying renewables in Pakistan (See Boxes 7 and 8). However, none of the projects identified in the NCS had been implemented except PCAT's MHP project and wood plantation initiatives taken by the Forest Department of the NWFP. The PCAT's MHP project had also not been

Box 7: National High Priority Renewable Energy Projects in Pakistan

- Installation of a 1MW solar thermal power plant in the desert area of Pakistan
- Energy self-sufficient model houses
- PV telecommunication system for rural areas
- Biomass plants using agricultural and municipal wastes
- Solar desalination pilot project
- Community solar dryers for drying grain, fruits, vegetables, etc
- Biogas plants for meeting the domestic fuel needs of rural areas

Box 8: RETs in Pakistan: Issues and Options

The following issues were identified at the national and provincial level with regard to RET policies.

- The nation lacked a clear cut and comprehensive national policy for the development of renewable technologies.
- The high initial cost of most renewables put them beyond the reach of most individual consumers or private enterprises.
- Market distortions and imperfections made energy from renewables appear more expensive than energy from conventional technologies.
- Suitable financial mechanisms and incentives were not devised to encourage adaptation of pre-competitive but highly promising renewable technologies.
- The country lacked the institutional capacity for indigenous planning and development of more challenging renewable technologies.
- Old planning tools and decision-making practices were not conducive to fair competition for renewables against conventional options.
- Development of human resources in RETs and training had not been effective.

The following measures were suggested for the development of RETs.

- The government should develop and integrate programmes for the development of RETs in the mountain region and set a target for each year in the five-year Development Plan.
- The Ministry of Planning (Energy Wing), and the Ministry of Science and Technology should assign specific projects to be implemented by each organization.
- Growing trees and development of forests by the private sector should be encouraged by supplying planting stock.
- Energy saving cooking stoves should be widely introduced. Local women should be trained and stove building should be undertaken by the local community.
- Local entrepreneurs should be given soft loans for manufacturing stoves.
- The government should formulate support programmes for the development of MMHP projects. Soft loan and financial incentives should be provided in order to attract the private sector. SHYDO, NAPWD, and PCAT could play a vital role in organizing the activity.
- Extension of the National Power Grid in the Northern areas could attract private investment. This would help to connect mini-hydel power plants to the grid line. Private entrepreneurs could sign agreements with WAPDA for the sale of power in accordance with the Private Board Power Policy.
- Import duties should be waived from all RET equipment to lessen the cost of application/production. (Currently this facility was available for solar energy technology equipment.)
- Tax holidays should be given to industry-based RETs in the region.
- Financing institutions/agencies should be issued instructions to facilitate soft loans to manufacturers of renewable energy application plants/products. Special allocations should be made in this respect.
- Solar water and space heaters should be installed in all the community and government buildings. Soft loans or subsidies should be provided by the government to make these appliances cost effective for low-income groups.

funded by NCS but initially by the Public Sector Development Programme and then from the Technology Development Action Plan (TDAP). These projects were also facing financial constraints, there being no fund allocations.

The presentation suggested measures such as explicit R&D planning, financial evaluation, survey and demonstration of RETs, identification of private sector participation, monitoring of performance, and training of local manpower in RETs for institutional development.

The Director General's Office for New and Renewable Energy Resources (DGNRER) had become non-functional and no policy on renewable energy existed in Pakistan. A proposal had been submitted by the Ministry of Science and Technology (MOST) recently to create a new Council for Renewable Energy Technologies (CRET) by merging PCAT, the National Institute for Silicon Technology (NIST), and the Solar Energy Centre of PCSIR.

The HKH Region of China

The presentation began with a review of the general situation of the HKH Region in China. The HKH region covers all of Tibet, 30 per cent of Yunnan Province, and 66 per cent of Sichuan Province. Traditional modes of energy consumption in the region were largely dependant on firewood, and this had caused a lot of problems, i.e., increasing rate of deforestation, soil erosion, flooding, environmental pollution, and landslides, which in turn had resulted in a decrease in agricultural production as a result of poor soil structure and quality. However, the region was rich in natural and energy resources. The presentation mainly provided information on Yunnan and Sichuan Provinces as examples.

The presentation reviewed the status of RETs within the region. The development of new and renewable energy technologies in the HKH Region was quite impressive in terms of the number of installations, though it was not clear what percentage of these were functional. For example, there were about 82,624 family-sized biogas plants, 1.5 million improved cooking stoves, 111,288 sq. m. of solar water heaters, 60,000 solar cookers, and 3,900 sq. m. of solar greenhouses (Table 3.1). Besides these, large-scale biogas plants to treat waste material products from townships, hospitals, and alcohol processing units were also operational. There were several small-scale coal-mine enterprises within the HKH Region of China, primarily in the Sichuan and Yunnan provinces.

The region was suitable for solar energy applications as solar radiation ranged between 335 - 921 kJ per cm^2 (equivalent to 2,800-

Table 3.1: Installation of Renewable Energy Technologies in China

Descriptions	Unit	HKH Region of China	Total in China
Family-size Biogas Plants	'000 Nos.	83	5,400
Improved Cooking Stoves	'000 Nos.	1,541	158,000
Solar Thermal Systems	Sq.m.	111	N.A.
Solar Cookers	'000 Nos.	60	N.A.
Solar Greenhouse	'000 sq.m.	15	N.A.
Solar Houses	'000 sq.m.	120	N.A.
Solar Lamp (7-9 Watts)	kW	800	N.A.
PV Systems	kWp	105	N.A.
Wind Turbine (100-200 Watts)	kWp	N.A.	234
Micro-hydropower	MW	< 2	600
Small Hydropower	MW	N.A.	15,760

3,000 hours of sunshine). It was a common feature in Tibet that most of the public sector residential houses had been retrofitted with sun spaces and trombe-walls. Solar water heaters of the flat-plate type were in operation, but, recently, vacuum tube solar water heaters had been developed and were being produced commercially. These systems were suitable for mountain areas as they did not suffer from extreme climatic conditions. There were seven factories to produce photovoltaic cells in China with a total production capacity of 4.5MW annually.

The pace of dissemination of new and renewable energy technologies in the HKH Region of China was slower than in the rest of the country. Manufacturing capabilities for these technologies were strong in China, but lack of institutions to promote them, the low rate of acceptability, and socioeconomic conditions in the HKH Region of China hampered large-scale diffusion of these technologies.

New and renewable energy technologies needed to be appraised and permission granted by assigned institutions. These institutions were identified in each province by the government body. A good manufacturing base existed within China. For example, 78 manufacturers were involved in the construction of small, mini-, and micro-hydropower in China, 17 of which were located in the Yunnan and Sichuan provinces — part of which fell within the HKH Region. The annual production of micro-hydro units in the capacity range of 0.1 - 15kW amounted to 26,000. Similarly, there were 9,867 institutions and 30,895 technicians involved in household-type biogas appliance distribution. There were eight technology service institutions that were capable of designing large-scale biogas plants for waste treatment and seven institutions with the capability to design solar buildings. There were about 300 manufacturers of solar water heaters, five service institutions for solar cookers, and four service institutions and eight manufacturers of solar photovoltaic systems.

The presentation highlighted that strong political commitment at the highest level and the establishment of decentralized institutions at village level were excellent examples with regard to the development of RETs (Box 9).

It was further pointed out that, in China, the national policy for developing rural energy is "making policies according to local conditions, compensating with various forms of energy comprehensive use, and seeking practical benefits". The different policies implemented by the government through the years were also elaborated.

The presentation highlighted the salient feature of existing policies with regard to RETs in China. These were as follow.

- Make policies according to local conditions
- Provinces, autonomous prefectures, and cities should design a development plan for rural electrification with the provision of financial support to minority regions, remote mountain areas, and poor regions
- Construction of medium and micro-hydropower stations should be given priority
- Encourage and support rural electrification activities using solar, wind, geothermal, and biomass energy resources to increase the rural power supply
- Electricity tariffs for the agricultural sector should be set on a non-profit basis
- Tax relaxation for producing new and efficient type building materials
- Strict rules to discourage conventional building materials

The main issues covered by the presentation with regards to RETs were lack of a re-

Box 9: Chronological Events of Biogas Development: An Example of Strong Political Commitment

Year	Policy statement made	Leader/Institutions
1958	Popularisation of biogas	Mao Tzedong
1959	Extension of the biogas programmme	Mao Tzedong
1970	Set up biogas offices at province, city, and county levels	Ministry of Agriculture
1980	Developed biogas as an example to the world Introduction of subsidies (IR - 0.21% loan) Provision of free land, subsidies for construction, free biogas appliances	Deng Xioaping
1981	Provision of 40 million *yuan* each year in soft loans	State Commission for Planning/China Agriculture Bank
1984	Tax exemption for biogas companies	Ministry of Finance
1986	Provision of 5 million *yuan* per year for soft loans for construction	Ministry of Finance
1989	Developed biogas in rural areas	Jiang Zeming
1991	Developed biogas to protect the ecological balance	Jiang Zeming
1993	Promulgation of the Law of Agriculture (promoting integrated approach)	

gional focus, of technical personnel, of local-level institutions and funds in mountain areas, of attention from the local government, and lack of public awareness.

Suggestions given were improvement in the existing policies, strengthening leadership and improving understanding, promoting various modes of ownership, providing technical knowledge to users, and strengthening scientific research, training, and propaganda.

3.2 Clarifications, Issues Raised and Suggestions Made

During the presentation, a question about the size of peltric sets was raised. It was stated that peltric sets usually come in one size with a capacity of 1-5kW. Clarification about the life of the battery used for SPV home systems was sought. The representative from Lotus Energy, Nepal, said that the battery they provided had a 10-year guarantee with 50 per cent discharge, and the price of the battery was Nepalese Rs 6,000.

Answering the queries about the Chinese presentation, Dr. K. Rijal, stated that the tariff rate for the agricultural sector was fixed on a no profit and loss basis. The tax rate applied to new and energy efficient types of building materials was lower than that for traditional building materials.

One of the participants was interested in the status of renewable energy technologies, particularly in Tibet. Dr. Rijal clarified the fact that the presentation on China covered the HKH Region within Yunnan and Sichuan provinces. He added that distribution of RETs was taking place, but almost all RETs manufactured in other parts of China were being distributed and marketed in Tibet. Manufacturers had appointed dealers in Tibet. It was pointed out that geothermal and SPVs were used for power generation, and distribution of solar cookers (mainly for boiling water), solar lanterns and passive solar building technologies was actively taking place in Tibet.

Mr. Kedia supplemented the presentation made by **Ms. Soma Dutta**. He pointed out that, in India, projects up to 100kW were categorised as micro-hydro, Up to 1,000kW, projects were categorized as mini-hydro and a capacity of 1MW to 15MW was categorized as small hydro (SHP). Earlier, the MNES had a mandate of up to 3MW, which they were trying to increase up to 15MW. The UNDP Project had planned to install 20 demonstration sites with a total capacity of 15MW and to install 100 water mills. In the seven eastern states of India,there were 29 installations with 26MW hydro-electricity generation capacity.

Profesor S.R. Chalise suggested that there should be a more integrated approach to the promotion of RETs in mountain areas. Opportunities in mountain areas were not isolated. In many cases, they were interrelated. The ability to use a particular resource might differ from area to area, and sometimes a mix, hybrids, or integrated implementation might be better. So, in terms of emphasis on policy, it might be better to emphasize renewable energy as a whole because that was the crux of the matter. No matter which technology was used, it had to be used appropriately.

Role of Energy in Reducing Drudgery

During the discussions, it was realised that energy technologies, such as improved stoves, biogas, and micro-hydro, might play a critical role in terms of reducing the drudgery of women in particular. There were issues of equity in total not settled by drudgery reduction alone. It was also acknowledged that, without reduction in drudgery, and as a result of the out-migration of men from the village, increasing the burden of mountain women in managing household and farm simultaneously, it would be difficult to bring about greater participation of women in decision-making to the extent needed in energy-related and other programmes. Some of the participants raised the issue of increased burdens on women in other activities, once they were relieved of one specific activity. For example, the availability of electricity in mountain communities had facilitated agro-processing activities, but the extension of working hours during the evening had substantially increased women's work in new productive activities. In this respect, however, most of the participants felt that, although the working hours of women had increased, households received more cash income from their extra work. As male householders make the financial decisions, women do not get the full benefit of their own income.

Linkage between Energy and Income Generation

Most of the participants recognized that the energy programme needed to be linked to income-generating activities so that increased income would provide people with the ability to pay for services. This in turn would attract private sector investment in energy infrastructure in mountain areas. There was a consensus among participants that an integrated and holistic approach was required for the promotion of RETs. For example, Chinese experts had tried to integrate biogas development while constructing buildings and infrastructure (roads, water supply), therefore biogas was a component of building. This was a good example of an integrated approach to energy development in China.

Compatibility of Technical Design: Technology for Whom?

Mr. K.C. Dhimole pointed out that, in the case of India, some models of cooking stove were designed according to the requirements of the people. He noted that some biogas models were working well in the midhills of the HKH region, but models with faulty designs needed to be improved. **Dr. S.S. Chandel** argued that *chulha* designs should be improved to suit local requirements. Though *chulha*(s) used at higher altitudes had taken roots in the mountains of India, in the lower hills the model really needed a more suitable design. Only about 20-30 per cent of the target was being met. An example was given of a solar thermal device, stating that this technology was not suitable for higher altitudes due to low temperatures.

Mr. Hussain emphasized the need for compatibility of technology, as cooking stoves failed in the context of adaptation. If a stove had been properly designed, it could have been one of the suitable technologies in the rural hills. He added further that properly designed ICS could save 50 per cent on fuel. Therefore, there was a need to look at the strategies and what had gone wrong in terms of adoption.

Participants agreed that renewable energy technologies should be developed to suit local needs and conditions. Most of the participants agreed that the concept of distribution was wrong, adoption and adaptation of RETs were required.

Dr. Chandel suggested that ICIMOD could play a key role in promoting adaptive research and development. One of the participants requested ICIMOD to introduce activities in cooking stove technology and to assess the problems related to its adoption.

Private Sector Participation versus Affordability

A question was raised regarding the performance and survival of the private sector in Pakistan Mr. Tajammul Hussain replied that the private sector was working on its own at present. He gave the example of solar water heaters that did not receive subsidies but which were still selling to communities and organizations such as hospitals, hotels, and offices.

Dr.G.R. Bhatta pointed out that, in Pakistan, there was a practice of tendering out the management aspect of maintenance for micro- and small plants. Unless there was some benefit to the private sector, it would not come forward. Therefore, the profits of the private sector increased the per unit energy cost. RETs were supplying energy to rural people where there were no grid connections and, moreover, where people's ability to pay was poor. How was the problem of affordability solved in such areas ?

Mr. Hussain replied that, up to the current time, about 80 per cent of the projects were working. Actually, the main contribution came from the government, and electricity was even distributed free of cost in some cases. There were also local management groups. The people were given training in maintenance and even to collect money from the households. He stressed that, judging by the different experiences from different countries, there might be a possibility of generating a joint venture among the private companies of the region which could increase the market size and even lower the per unit cost. There would be a tradeoff as one country might be good in a particular technology and another in another technology.

One of the participants cited the example of a tea plantation in West Bengal to emphasize the role of the private sector in increasing competitive behaviour which could reduce economic inefficiencies. In a tea project completed in West Bengal, the tea corporation owned the land and the people managed it. As the management was the most difficult part, giving it to the private sector reduced the cost and increased the financial sustainability of the programme. The state government was not capable of managing such activities and, even if the government had prepared the plan, it might have turned out to be expensive.

Some of the participants argued for a participatory approach for the sustainability of the energy programme. In this respect, most of the participants realised that there was a need to recognise the interests and objectives of each stakeholder (such as manufacturers, promoters, financiers, users, and government) in order to share the benefits of the programme based on the costs incurred by each of them on an equitable basis.

Creation of a Management Fund

Mr. Kiran M. Singh pointed out that a management fund needed to be created for pre-feasibility and feasibility studies for micro- and mini-hydropower in Nepal. However, participants queried the manner of managing of this fund. It was mentioned that studies carried out by the private sector did not help much to increase the number of installations, because the studies were conducted without realising the potential demand. There was also a discussion about manufacturers bearing the costs for such studies, which they might then add to the cost of the installation. Mr. Hussain cited an example from Pakistan in which a private investment fund had been created to promote the development of hydropower, but it had been very poorly managed and use of the fund was nominal. There could be different reasons for this, and nothing was known about it. There was a general consensus about establishing such a fund for the promotion of micro-hydropower development, but the issue of how to manage this fund needed further analysis.

3.3 *Chairperson's Remarks*

Dr. Mahesh Banskota, Chairperson for the Morning Session, commented on the widespread smoke-related problems, which were a hazard, especially in the kitchen. The problem of illiteracy could not be resolved because of time constraints during the day, therefore, illumination was justified as it could give the rural people a chance to study in the evening.

There were many problems related to subsidies, and many other factors should be incorporated into the calculations so that benefits would increase. There were a lot of discrepancies in the mainstream Cost Benefit Analyses for power projects presented by the organized sector. Projects could be feasible or unfeasible depending upon the person doing the analysis. Therefore, innovation was essential. He also pointed out that there should be a way of linking RETs as a systematic integrated system when issues of co-generation and coupling technology arose. He highlighted the Chinese experience in terms of energy villages, although, allowing that some of the experiences with energy villages had not been encouraging. Therefore, linkages between various components of different systems in specific mountain areas needed to be thought of in the development and promotion of RETs.

A lot of emphasis was given to intermediaries, especially in the presentation given by Nepal. Probably these intermediaries could be the problem. Every time an intermediary was added, the cost might go up, for example, by 10 per cent. So, this had to be looked at seriously. He stressed the subsidy issue as the main problem and identified the need to find real beneficiaries. The real beneficiaries, the poor, needed to benefit from the programmes. On the one hand, supply constraints and rationing, load shedding, etc continued, and, on the other hand, there were subsidies. This was bad economics and did not make any sense at all. Economics that did not benefit the poor and the worst sectors of the society must be discarded. If there were health and literacy benefits for poorer groups, then there might be a way of justifying subsidies. But, if they were only benefitting the well-off, then they really needed to be re-examined.

In the context of subsidies, the chairperson remarked that the actual beneficiaries needed to be identified in order to make them justifiable. He added that energy was not needed for its own sake but as an input into other sectoral economic activities and as a derived demand from other economic activities. A stagnant economic structure could not be changed overnight, therefore subsidies could be justified in such cases. However, real progress could only be judged if it was accrued without subsidies.

He stressed the need to investigate why and in what form energy was needed and how it should be linked to economic changes. Lastly, he stated that technical skills needed improving, for which basic literacy was absolutely necessary.

The Chairperson for the Afternoon Session, Dr. G.R. Bhatta, pointed out the increasing importance of rural energy that directly affected the rate of increase in the Gross Domestic Product (GDP). He added that large hydels and thermal or nuclear energy were required to provide energy for industrialisation and economic growth. But, due to environmental and health concerns, such large projects were discouraged because they caused displacement of people, submergence of cultural heritage, and danger from blasting, which affected the life and property of the people. This was also the case with thermal energy plants that created pollution. Therefore, new and renewable energy had great significance in the context of the hills and mountains, as it was the only alternative energy available.

Dr. Bhatta pointed out that not only the common people but also those who were involved in energy planning (planners, decision-makers, politicians) consumed energy but lacked the general awareness about what type of energy they were consuming and how sustainable these sources of energy were. The biggest hurdle in the way of promoting new and renewable energy resources and technologies while designing energy programmes was the lack of understanding about the nature and type of energy and its implications among planners, decision-makers, and politicians. Therefore, publicity at all levels could play a key role in promoting renewable energy technologies. ICIMOD could initiate this at the regional level. The development of renewable energy would not be possible until and unless the politicians were convinced of its importance. Dr. Bhatta added that there seemed to be a great potential for developing a hybrid energy system in the HKH Region (e.g., solar + micro hydro + wind). Such a development would not only mean increase in reliability but also improvement in the system load factor, thereby reducing the per unit cost of energy. He highlighted that the common issues brought out in all presentations were lack of national funds, lack of understanding at the highest level, lack of publicity, lack of human resources, and lack of incentives for the rural people.

4

Case Studies on Renewable Energy Technology

4.1 Nepal Case Study Presentations

This session was chaired by Dr. T.S. Papola, Division Head of MEI, ICIMOD. During the morning session, the first presentation was made by **Mr. Shrimat Shrestha.** Mr. Shrestha reviewed the 'Case Study on Micro-hydropower' carried out in Nepal. This was followed by the presentation of a 'Case Study on Biogas Technology' by **Mr. Ramesh Gongal** and a presentation on the 'Case Study on Improved Cooking Stoves' by **Ms. Karuna Bajracharya**. Finally, **Mr.V.B. Amatya** presented a 'Case Study on Solar Technology'. All of the speakers represented the Centre for Rural Technology, Kathmandu.

Micro-hydropower

This presentation reviewed the status of micro-hydro plants in Nepal where projects of less than 100kW were considered to be micro-hydro projects. Micro-hydro was not a new concept in Nepal. Traditional *ghatta*(s) (water mills) had been part of the rural setting in the hilly areas of Nepal for centuries and it was estimated that about 25,000 traditional *ghatta*(s) were currently in operation. There were more than 1,100 micro-hydro plants installed in Nepal, out of which the mechanical drive type numbered about 800 and turbines with electricity generators about 300 units. There were about 350 improved *ghatta*(s), MPPU, which were costly and had multipurpose uses, and there were about 250 peltric sets.

A good manufacturing base had already been developed and was primarily managed by 11 private sector manufacturers which were capable of producing turbine equipment of up to 300kW in capacity with a total production capacity of about 2MW per annum. Most of the factories manufactured turbines on demand, and they accounted for less than 25 per cent of their sales' volume. They had formed an association with the objectives of lobbying as a unified force to influence policy, providing support to its members, and becoming a focal point. These factories were located in Kathmandu and Butwal and, interestingly, most of the micro-hydro installations had been established in nearby districts. The presentation identified the key factors that had contributed to the growth of micro-hydropower. These were: low capital investment; short construction period; great potential; capabilities in indigenous technology manufacturing; simple to operate; attractive government incentives; and promotional activities had been carried out by many international agencies. At the same time, de-licensing of plants, initially those of up to 100kW and then up to 1,000kW in 1992, had further encouraged its development. Prior to 1993, the government subsidy was *ad hoc*, but now it provided subsidies through ADB/N of from 50-75 per cent on electrical components of both add-on or stand-alone electrification schemes. The main comment on the existing subsidy policy was that it did not take into account the transportation costs but provided a flat subsidy on a district basis, which according to the manufacturers was unfair.

The development of micro-hydropower was always cited as an example of technological innovation to suit the local needs and conditions of hilly areas, but the presentation identified various issues related to micro-hydropower (Box 10) which required earnest consideration by stakeholders involved in promoting this technology.

The presentation also highlighted the importance of micro-hydropower in terms of reducing drudgery for women, as it reduced the time taken in agro-processing activities and also provided opportunities for women to engage in income-generating activities and literacy classes in the evening.

Regarding legislative and regulatory issues, the presentation highlighted the following points.

- The Water Resources' Act 1996 did not specify the right of prior use of water resources for micro-hydropower projects.

Box 10: Various Issues Pertaining to Micro-hydropower Development in Nepal

- **Technological Issues**
  - Low load factor - lack of end-use diversification
  - Lack of technical back-up and monitoring
  - Long earthen canals
  - Lack of use of traditional skills: technical and management
  - Lack of emphasis on quality of civil works
- **Issues on Policies**
  - Water rights' issues
  - Lack of dissemination of smaller units
  - Increased competition with diesel mills
  - Lack of promotion of multiple-use of water resources
  - Quality control and standardisation issues
  - Gender issues
- **Institutional Issues**
  - Poor accounting system
  - Inadequate technology promotion institution and entrepreneurial development programme
- **Organizational Issues**
  - Lack of norms for project feasibility studies
  - Lack of training for operators
  - Lack of a management system
- **Financial Issues**
  - Lack of insurance
  - Warranty issue
  - Consumptive rather than productive use

- The private sector shied away from research activities because of the inadequacy of laws on patent and intellectual property rights.
- Lack of formal standardisation of procedures and guidelines had resulted in errors in flow measurements and demand estimation at the feasibility study stage of projects, as well as negligence regarding safety features in micro-hydropower plants.
- Prevailing laws and acts did not force manufacturers to provide long-term warranties or insurance.
- Entrepreneurs had to register micro-hydro plants as an industry (cottage) in order to receive industrial tax and duty exemptions.
- Entrepreneurs often found it difficult to get financial assistance from ADB/N for micro-hydro if a diesel mill or other water turbine existed within three kilometres of the vicinity. This had not only affected hydropower development but also created situation of monopolies.

The study team made presentations based on field case studies carried out on micro-hydropower. Box 11 provides the highlights of various issues that were faced at field level.

Clarifications and Discussions

During the discussions, a question was raised about the method of fixing electricity tariffs and the capacity of micro-hydropower installations. It was stated that the owner assumed that the total electricity produced would be consumed and the tariff rate was normally set as one rupee per watt per month. The rate also depended upon a particular village and its economy. The plant capacity was determined based on the number of houses willing to receive electricity for lighting, assuming three to four bulbs per household.

Regarding the case study on micro-hydro, the chairperson remarked that there was a long list of issues and preconditions for the successful operation of a five kW plant. He added that there were all kinds of internal as well as external factors that seemed to be influencing the performance or feasibility of a particular micro-hydro plant. If there were so many problems prevalent in micro-hydro, then who would really be interested in its implementation ? The chairperson requested the gathering to look at each of these technologies and also the kinds of recommendation made for policies relating to those technologies in a somewhat rational manner.

Mr. Kedia pointed out that there were 10 manufacturers working in the Eastern States of India, and they had the capability of producing turbines of different sizes up to 150MW per annum. He stated that he was very impressed by the kind of work carried out in Nepal in the capacity ranges below 20 or 40kW. In India, manufacturers would never be interested in producing turbines below 100kW, or maybe even 500kW, in capacity. It was also confirmed by another participant that India had had manufacturers for 35 years, but they were not interested in manufacturing small-sized machines. The average size of hydropower plant being installed at present was three MW.

Mr. Kedia observed that most of the work was being done by manufacturers in Nepal, whereas in India manufacturers would not bother. And there was something to learn from Nepal's experience and consultancy services could take up this responsibility. He added that they had been trying to replicate financial institutions like ADB/N in India, but up to now they had not been able to convince the government. He pointed out that there was a high subsidy rate in India, whereas in Nepal it was too low. He suggested that a methodology needed to be developed so that subsidies were limited to

Box 11: Status and Issues Identified from Micro-hydropower Field Case Studies

Description	Ownership	Status	Issues
1. 85 KVA Ghandruk Micro-hydro Electrification Plan	Community	Successful community	Low load factor
2. 68kW Barpak Micro-hydro Plant	Individual/Managed like company	Achievement of local young entrepreneur sound organizational capability	Poorly designed; Risk of flood and landslide; Remote location
3. 400kW Salleri Chialsa Mini-hydropower Plant	Salleri Chialsa Electric Company/Public Limited Company	Successfully managed	Poor transportation and communication
4. 100kW Sickles Hydropower Plant	Community/Sickles Village Electrification Committee	Successfully managed community scheme	Bulb fusing; lack of motivation of women
5. Improved *ghatta* in Urthu	Community	Success due to increase in grinding capacity	Need for orientation, training and improvement in the system
6. 9kW MHP at Urthu	Community		Lack of end use; Lack of managerial and technical capabilities
7. MHP owner became a diesel mill owner	Individual	Access to information a major need in the rural areas	High maintenance cost; Long earthen canal
8. 32kW MHP at Charaundi	Individual	Failure	Water rights' problem
9. 28kW Micro-hydropower mill at Kalidaha	Individual	Failure	Flood damage
10. 1kW peltric set at Ghode Sim Community	Successful	Small peltric electrification scheme	

whatever was the requirement and a performance linked subsidy could be worked out.

Mr. Surendra Shrestha stated that the government of Nepal was trying to solve the problems of micro-hydro development. Many participants believed that most of these problems would be taken care of with the establishment of AEPC. Some of the participants commented that the resources that the government had allocated as subsidies for the micro-hydropower sector were not used effectively.

The feasibility study of the project site itself was the most vital point. The main reason for the failure of micro-hydro was location, which was mostly remote and in hilly areas. The other reason might be that all the people who wanted to implement the project did it forcefully just for the sake of the government subsidies from which they benefitted. There was also a problem associated with the availability of subsidies and, at times, ADB/N was not able to cope with the demand. But, at a later stage, with an increase in the capital cost of turbines, the subsidy allocated for the micro-hydropower sector remained unused.

One of the participants pointed out that women had done all the agro-processing (grinding, de-husking) activities at home. But, with the introduction of micro-hydro, the burden on women had been reduced though, in fact, they now had to tend to other chores, thereby not freeing them as much as had been expected. One advantage was that now they could use the time saved as they chose. In some instances, the location of the micro-hydropower mill was such that they had to spend quite some time to reach the mill.

The manufacturers played a big role in the implementation of micro-hydropower projects; especially in Nepal. The promotion of this sector seemed to be very bleak unless the capabilities of manufacturers increased.

One of the delegates pointed out that MPPU in Gauhati had been developed after seeing the progress made in Ladakh, and he added that Nepalese manufacturers had not been really outgoing enough to promote their products outside of the country. There was a good market in the hilly regions of India. **Mr. Surendra Mathema**, representative of the Association of Micro-hydro Manufacturers described the problems faced by manufacturers in promotion of micro-hydro. Manufacturers had to do all the work themselves: identification of the site, design, cost estimates, installation, and so on; this had limited their capacity for growth. Mr. Mathema also pointed out that there was a scarcity of trained operators. The association had carried out training for about 60 people, and it planned to do more in future; and thus this might solve some of the problems.

The manufacturers were not very keen on site surveys because, if the site was not feasible, the manufacturers had to bear all the costs. Therefore, if there was a subsidy for site surveys, it would help. In Nepal, a subsidy of only 50 per cent on electrical parts was provided, and this was not sufficient.

Micro-hydro projects in Nepal were in decline because the banks did not accept the project itself as collateral and the interest rate was very high. A good end use had to be perceived before installation of the plant.

Mr. Bhola Shrestha, of the Intermediate Technology Development Group (ITDG), provided a good example of how the load factor had been successfully increased. In Ghandruk, the load factor had been increased up to 60 per cent with the use of various low-wattage end-use devices to heat water, cook rice, etc; primarily thermal applications. Tourists could get hot showers in both Ghandruk and Muktinath. Paper dryers and grinding of herbs were also being explored as ways of diversifying end use. A ropeway had been installed in Barpha. The most important aspect was identified as transferring and building local capacities. Mr. B. Shrestha described the training needs. Over the last three years, regular training had been conducted and the training facilities needed to be institutionalised. Mr. Bhola Shrestha emphasized project appraisal as it was very important. The first criteria would be socioeconomic and management practice. An appraisal format should be developed for socioeconomical, technical, institutional, and managerial practices.

The chairperson remarked that he wished that there were more cases of more than 60 per cent load factors. The whole question of quality depended upon the government and other institutions also. He thanked Mr. Shrestha for his positive presentation and stressed that this kind of interaction was needed to convince policy- makers.

Dr. Junejo remarked that, at this stage, private micro-hydro in Nepal was at a critical stage. Initially, plants had been more or less distributed or given a push by government agencies and people had accepted them enthusiastically. Then came discrepancies and problems with micro-hydro plants. On a positive note, the situation had improved. The number of plants was increasing.

Issues Identified and Suggestions Made

The study team made a detailed presentation of the main findings and came up with various suggestions. These suggestions were commented upon and supplemented by the participants during discussions. Most of the issues raised and suggestions made are as presented in the following passages.

Management Aspects: Most of the community-owned and managed micro-hydro plants had been more successful than individually-owned and managed plants because of frequent debates over water rights and non-participation by the community in repair and maintainance of canal damage caused by floods and landslides in the latter case, as indicated in Box 9. A strong community organization, cohesiveness of the community, democratic leadership, good technical and managerial capabilities, and strong technical back-up were indispensable for making a micro-hydro scheme successful.

Administrative and Financial Procedures: Many plant owners complained about the cumbersome procedures of banks and other administrative units involved in loan sanctioning. This demotivated many from installing micro-hydropower plants. Simple and transparent procedures should be developed and institutionalised for loan sanctioning.

Technical and Financial Feasibility: Optimistic assumptions of various factors, such as high electricity consumption, low costs of maintenance of long earthen canals, and inaccurate head and discharge measurements, had caused many entrepreneurs heavy financial losses. This would mean that proper evaluation of the socioeconomic setting, technical and managerial capabilities, and the adequacy of surveys and designs were essential while carrying out feasibility studies. Accountability on the part of the surveyor and manufacturer was also essential.

Choice of Smaller Units: The promotion of smaller units, such as improved *ghatta*(s) to replace traditional ones, would not only bring economic gains to marginalised *ghattera*(s) but also reduce drudgery at household level by introducing rice hullers. In many instances, micro-hydropower plants had replaced a number of traditional *ghatta*(s) from a particular locality.

Maintenance of Earthen Canals: High seepage, damage by frequent landslides and floods, and blockage of the canal were the main problems. These resulted in high maintenance costs and unreliability of micro-hydro plants. Availability of construction manuals and a code and enforcement of standards while constructing canals would result in reduced maintenance costs.
Technical Back-up Service and Moni-

toring: Technical back-up service and monitoring were nobody's responsibility, as the bank was only concerned with the financial viability of the project. There should be an institution responsible for monitoring and backstopping to improve the technical and managerial capabilities of micro-hydropower entrepreneurs.

Training: Most of the micro-hydropower operators had not received training. They had become operators by learning and doing. Most of the owners did not know how to keep business records and lacked appropriate business skills.

Warranty and Insurance: There were a number of instances of damage to micro-hydropower installations caused by landslides and floods. In order to safeguard entrepreneurs from such calamities, insurance should be mandatory. Similarly, long-term warranties from manufacturers might be instrumental in cutting down on losses that might accrue to the plant owner due to manufacturing defects.

Quality Control and Standardisation: The quality of raw materials used, safety codes to be followed during installation, and rated power of turbines and generators needed standardising received from plant owners.

End Use Diversification: It was observed in almost all micro-hydro plants that the generation of electricity primarily for illumination resulted in financial losses. There was a strong need to diversify end uses into productive purposes such as agro-processing, cold storage, ice factories, power looms, carpet weaving, wood carving, and food processing.

Gender Implications: The field study revealed that the installation of micro-hydropower resulted in saving women's time because less time was required for agro-processing, in some instances, increasing their productivity in activities such as weaving and increasing their quality of life through educational programmes in other instances. Women did not participate in planning, implementation, operation, and management of micro-hydro plants, although they were instrumental in convincing the men to support the installation of micro-hydro plants.

Water Rights' Issue: The issue of water rights was critical and prevailing laws did not ensure the right of prior use for agro-processing and electricity production. Instead, water could be diverted as and when deemed necessary for irrigation. There was a need to provide appropriate compensation to the owners if such a situation arose.

Existing Policies Favour Diesel Mills: The existing subsidy on diesel fuel, low capital investment, and flexibility of diesel engines, along with the various constraints faced by micro-hydropower (as discussed), had prompted entrepreneurs to switch over to diesel mills.

Changing Cropping Patterns: The shift from cereal crop production to cash-crop farming systems had not only reduced the volume of agro-processing activities but also increased the cash income for the purchase of grain products grown in the *Terai*. This was a visible phenomenon in places like Dhading. This had decreased the economic feasibility of micro-hydropower plants.

Integrated Approach to Promoting Micro-Hydropower Plants: Case studies revealed that the repair and maintenance of canals were problematical. The benefits provided by installation of micro-hydro turbines were not sufficient to meet the cost of repairing the canal and also frequent water rights' disputes made these systems unattractive. The appropriate approach in this context would be to integrate irrigation water requirements of a particular community with the installation of a microhydropower plant. By doing so, the cost of maintaining the canal would be borne by the profits that accrued from increased productivity, and the cost of installing the turbine would be recovered through the sale of electricity and agro-processing activities.

It was also suggested that the technical and managerial aspects should be strengthened for effective implementation. In order to reduce the cost of the project, the design should not require a long earthen canal in order to reduce the cost of the project. There should be more emphasis on quality civil work. Policies that promote microhydropower, especially in the case of water rights, should be implemented. Technology promotion and entrepreneurial development programmes should be organized. Project feasibility studies should be carried out efficiently and training and orientation must be given to operators. Warranties and insurance must be granted to the projects, and projects should have more of a productive than consumptive use.

Biogas Technology

The presentation indicated that biogas in Nepal had been quite successful as a result of government subsidies and the interest and involvement of INGOs and donor agencies. Private biogas companies were introduced after 1990. The Biogas Support Programme (BSP) was set up as a joint venture between ADB/N, recognized biogas companies, and the Netherlands' Development organization (SNV). The history of biogas development dates back to 1975/76 (i.e., Agriculture Year) with the installation of 199 plants. There were 32,000 biogas plants and the target was to install 100,000 biogas plants in the third phase of the programme during the period from 1996/97-1999/2000.

Prior to 1991, the subsidy policy of the government was not consistent. With the Dutch-funded BSP programme, there was a subsidy on the total cost of Rs 7,000 in the *Terai* and Rs 10,000 in the hills, and recently an additional subsidy of Rs 2,000 was introduced for remote hill districts where the headquarters were not connected by road. The programme also provided indirect financing through training and observation tours to staff of biogas companies and other relevant agencies.

The subsidy scheme was channelled to manufacturers, primarily through ADB/N. The participation of other banks (NBL, RBB) was limited to two per cent in 1995/96. The percentage of subsidy in the *Terai* varied from 17-40 per cent and in the hills from 24-58 per cent depending on the size of the plants, as the subsidy decreased with increase in plant capacity. This policy resulted in reduced under-feeding of biogas plants as they were installed in smaller units. At the same time, the higher subsidy rates provided in the hills resulted in increased installation in hilly regions (i.e., 55 per cent of the total installations). Landless farmers were not able to take advantage of this subsidy scheme, as they did not possess physical assets for the bank collateral. The real price of biogas plants had decreased by about 20 per cent in the past five years if inflation can be assumed to be 10 per cent. This could be due partly to an increase in the numbers of private biogas companies (from one [up to 1991] to 36 companies) and also because of economy of scale as more plants were installed during these periods.

The presentation highlighted the various socioeconomic benefits of biogas plants, particularly for women and children. The most prominent was for saving women's labour from collecting fuelwood and managing kitchens (and children for fuelwood collection), as time for cooking and cleaning decreased substantially. This has improved the quality of indoor air and thus the health of the household as this fuel was less polluting than fuelwood. Sanitary conditions improved not only in and around the kitchen but also around the village, since the construction of toilets along with biogas plants eliminated breeding grounds for houseflies and mosquitoes.

In spite of the relatively successful implementation of biogas promotion and development programmes, there were still several technical, financial, and institutional problems in the effective promotion of this technology. These were as follow.

- Reduction in gas production during winter
- High initial cost
- Poor performance of the biogas lamp
- Sub-optimal use of biogas slurry
- No linkage between livestock development programmes and biogas promotion activities
- Lengthy procedures for obtaining information, loans, and subsidies
- Lack of follow-up action due to shortage of trained technicians for maintenance and repair of plants

The study team made a detailed presentation of findings based on the field surveys carried out. Box 12 summarizes the status and presents the main findings. The presentation highlighted various issues identified during the field survey (Box 13) which corroborated some of the issues identified in the sectoral review.

The presentation pointed out the positive aspects of biogas plant installation based on field survey results. These were: saving time spent on collection of fuelwood, reduced pressure on forests for fuel, less consumption of kerosene for lighting, improvement in health conditions, and improved health and sanitation due to construction of toilets and feeding of animal dung into biogas digesters.

Clarifications and Discussions

Dr. Papola, chairperson of the session, raised a question about ways of assessing the performance of biogas plants. The study team pointed out that the evaluation of plants was being carried out through quality control measures introduced by the BSP programme.

Box 12: Main Findings of the Biogas Case Study

Type/ Plant Location	Cost	Status	Findings
Fixed dome Mahadevsthan Kabhre (Hill)	Total cost Rs 29,000 Subsidy Rs 10,000 BSP/ABDN	Almost all plants constructed during the early eighties were abandoned and all others established after the late eighties are in use	Link biogas with livestock; Health and sanitation improvement; High cost
Deenbandhu Chitwan (*Terai*)	Total cost Rs 14,000 Subsidy Rs 10,000 KMTNC/IRVDC	All plants in use. Successful distribution of low cost biogas plant with maximum use of local resources.	Cheaper cost; sense of belonging; effective slurry use

Box 13: Various Issues Identified During Field Survey

- No linkage between livestock development and the biogas programme
- Lacks participatory/innovative biogas promotion approach
- Lacks proper use of biogas slurry
- Most of the biogas plants are owned by villagers with high incomes
- Biogas plants are costly for low income villagers
- Lack of trained (skilled) masons
- Lack of awareness campaign about slurry use and toilet-attached biogas plants
- Unwillingness of hired labours to handle slurry coming out of toilet-attached biogas plants

Mr. Baral refuted the statement that people were not using slurry because of the attachment of toilets to the biogas plant. He cited the example of Pokhara. There were 456 biogas plants and all of them used slurry and had toilets attached to the plants. The application of slurry was very beneficial for vegetable crops. He suggested that awareness among the people about the benefits of applying slurry to the fields was more important. The study team replied that the same might not apply in all places because of the varying sociocultural contexts.

A question was raised regarding the comparative productivity of a typical gas plant with respect to the use of raw materials. It was pointed out that production depended upon the total volume of raw material fed to the plant and plant capacity.
Dr. Papola stated that subsidies, up to a certain extent, would be essential for a programme like this, and they should decrease over the years. So, basically, the question was how to reduce the cost of the plant and what could the government and institutions do to bring this about.

The study team stated that the subsidy on biogas plants in the *Terai* was NRs 7,000, even though there was more potential there, whereas the subsidy for the hills amounted to NRs 10,000. This was primarily because living conditions in the hills were more vulnerable because of physical hardship and the fewer energy options available to them. It was found that biogas plants were not financially viable without subsidies, though they provided greater social profits than other forms of energy. Therefore, there should be subsidies for biogas plants, and the present rates were satisfactory. The study team also mentioned that the rates of subsidy had gone down in the last five years if inflation was taken into consideration. Also, the government was planning to gradually reduce the subsidy rates in the third phase of the biogas programme.

Mr. Baral highlighted the positive impact of biogas installation on women and children, as it saved three hours a day of women's time. Usually, small girls were sent to collect firewood instead of them going to school. Therefore, with the introduction of biogas, children now had time to go to school and fuelwood was also saved. He observed that the low cost biogas plant (i.e., Deenbandhu Model) was very efficient for use in the *Terai*. Experiments were needed with other types of low-cost model.

Issues Identified and Suggestions Made

The study team made various suggestions and these were supplemented by the participants during discussions. Most of the issues raised and suggestions made, both by the experts and the study team, were as follow.

Biogas programme for low income groups: Most plant owners surveyed were from high income groups, as they had provided land as collateral for loans. Biogas plants should be made available to low-income villagers. For this to happen, low cost biogas plants had to be promoted along with easy access to credit facilities for low income households through community loan schemes for landless and women's groups instead of the usual collateral.

Demonstration promotes adoption: Almost all plant owners interviewed had installed biogas after they had seen it working in the neighborhood. They did not believe hear-say about the advantages of biogas. A biogas promoter or developer had to find a progressive farmer willing to install the biogas plant properly to bring about a demonstration effect, as a target-driven approach had not worked in the past. Resilience was necessary.

Promote use of biogas slurry: Almost all biogas owners were unaware of how to use slurry efficiently and also had a problem of getting labour to apply it to their fields once it had been attached to a toilet. Demonstrations on the applicaton of slurry in development of appropriate tools/equipment (such as a trolley) for slurry handling were needed.

Structure and level of subsidy: The flat rate subsidy for biogas plant sizes had prompted farmers to install the smaller plants. This had reduced the tendency to over-size the plant capacity and later plants were subject to low gas production due to under-feeding of the plant - a common phenomenon during the 80s. This also encouraged farmers with fewer cattle to install biogas plants and integrate toilet facilities. The presentation suggested that the policies pertaining to biogas programmes should be consistent.

Quality control and standardisation: Strict enforcement of quality and standardisation by BSP helped to reduce operational failures of biogas plants. On the other hand, manufacturers claimed that it had stopped innovations to reduce costs as only one type of design was approved for construction by the BSP.

Promote low-cost biogas plants: The distribution strategy adopted and performance of the Deenbandhu biogas model were encouraging. Similar action research programmes should be carried out in other areas to cater to the needs of low income farmers. The initial costs for biogas programmes were very high, therefore, R&D should be carried out to reduce the cost.

Need for an Integrated Approach: The BSP programme should be integrated with the livestock development programme along with rural development initiatives.

Improved Cooking Stoves

The main objectives of the improved cooking stove (ICS) programme were to reduce the consumption of fuelwood and to improve hygiene in the kitchen. The ICS is convenient for women and safer for children. It reduces the time spent collecting wood, cooking, and cleaning pots/pans after cooking. It improves the general health conditions of women, as they will not be exposed to smoke.

Up to now, about 88,000 to 90,000 ICS of various types have been distributed by the government, NGOs, and private sector agencies. During the mid-80s, the community forestry programme and other programmes distributed 44,000 insert type stoves, of which 35 per cent were believed to be still in operation. ICS programmes in the past had used a target driven approach which had not worked. Users had no part in designing and planning. So most of the stoves installed were unused. Currently, this type of stove had been abandoned in favour of stoves built on site using locally available materials and skills. A number of NGOs and INGOs had included ICS programmes in their rural development efforts. Installation by trained women promoters had created employment opportunities and generated income.

Problems of ICS dissemination included their lack of diversity in use, people's social and religious beliefs absence of strong government promotional programmes, lack of proper user education and training, availability of and accessibility to free fuelwood, low rate of involvement of women in ICS programmes, and lack of financial and institutional support for local NGOs and research institutions. However, active users' participation and mobilisation of NGOs and the private sector have proven to be an effective approach to ICS distribution in recent years.

Cast iron stoves in Jumla (suitable for cold regions), the most expensive model so far distributed, received about Rs 2,000 per stove as a subsidy, whereas other clay models, costing around Rs 200 including labour, generally received a subsidy for the cost of installation through NGOs and other organizations. Considering the overall ICS programme, except for the expensive cast iron heater stoves, the cost of installations constituted a small portion of the overall cost. Most of the cost was on research and development, promotion and distribution, and training. So far, these activities had been covered by donor and HMG grant assistance. However, there was no clear-cut, integrated comprehensive programme.

The presentation highlighted the salient features of ICS distributed to some rural areas based on the field surveys and case studies available (Box 14), various issues

Box 14: Salient Feature of the ICS Programme in Villages

Place	End Use	Cost/Subsidy	Status
Pokhari Danda, Bhumkot VDC Gorkha (1 and 2 pot holes)	Cooking Animal feed	Rs 120 50% subsidy	Almost all are in use; Total of 270 ICS distributed
Mangalpur VDC Chitwan (Two pot holes)	Cooking	Rs 100 per ICS 60% subsidy	75 ICS installed of which only 60% are in use
Urthu village, Patmara VDC Jumla (Cast iron sove)	Space heating Cooking	Rs 4,500 75% subsidy	The number of installations is 60, of which all are in use; but it consumes more fuelwood than traditional stoves
Bayarban VDC Morang (Two pot holes)	Cooking	Rs 60 100% subsidy	The number of installations is 58 of which only 25% are in use; lack of technical backstopping.
Rajahar VDC Nawalparasi (Two pot holes)	Cooking	Rs 65 100% subsidy	Data on the performance are not available; use of locally available materials.
Jyamire Makawanpur (Two pot holes)	Cooking	Rs 60 100% subsidy	Tribal group; successful programme; training to ICS women motivators and installation by women technicians

were identified (Box 15), and appropriate measures suggested for the promotion of ICS in Nepal.

Clarifications and Discussions

Profesor Chalise suggested that the importance of fuelwood must not be minimised, irrespective of all the progress in the RET manufacturing sector. He said that most people in Nepal will be using fuelwood for the next 50 years. Therefore, fuelwood was and would remain a very important factor, especially for mountain people. He wondered why there was no priority for research into fuelwood and why it was not discussed. He added that talk of alternative fuels was only lip service because 80 per cent of the people were using fuelwood, but it was not reflected in government programmes and policies. People in the villages, especially housewives, had no time to go and voice their opinions. Women were busy collecting fuelwood and cooking for the family. He said that he had been involved with discussions on RETs since the early 70s and, even today, the data on energy were inadequate. Therefore, he emphasized the fact that collection of data was very expensive and difficult, and this should also be given priority during the consultation.

Dr. Papola, chairperson of the session, stressed the importance of fuelwood. Deforestation and environmental degradation in mountain areas were primarily caused because it was difficult for poor mountain households to meet their daily needs. This factor should be examined very critically. There were other causes for deforestation

Box 15: Issues Identified from Case Studies on ICS

Technological Issues

- Lack of alternative, various appropriate designs matching the needs of users
- Suitable for multi-fuel use
- Stoves capable of fulfilling cooking and heating requirements as desired by users
- Stove should match with housing structure and climatic conditions
- Stoves to cater for space heating needs
- Lack of technical backstopping
- Repair and maintenance problems

Financial and Economical Issues

- Free access to fuelwood

Institutional Aspects

- Sporadic promotional programme
- Intermittent promotion and lack of continual effort
- Lack of monitoring agency
- Lack of research agency for continual efforts to improve designs

Social Issues

- Lack of local-level women technicians
- Incompatibility of stoves with social and religious practices
- Weak participation of women in ICS programme
- No housing and kitchen improvement programme to link up with the ICS programme

and environmental degradation also, so mountain people alone could not be blamed. He pointed out that, while looking for alternative sources of energy for mountain areas, somehow the focus always seemed to be on saving fuelwood. Much more importance had to be given to saving fuelwood by providing a higher grade, more efficient, and more versatile form of energy, because fuelwood, even when available, was not a versatile source of energy. **Mrs. D.D. Shakya** stated that RECAST was still involved in the *chulha* programme by promoting household cooking stoves and institutional cooking stoves. RECAST was also looking at how to minimise fuelwood use by looking for fuelwood alternatives.

Dr. Rijal said that open fire type traditional stoves were more efficient than improved cooking stoves if space heating requirements were also taken into consideration. Therefore, the important issue was to identify household needs and comparison of technologies should be based on the types of tasks performed. It was wrong to say that improved cooking stoves were more efficient than traditional ones without properly understanding the role that traditional *chulha* had played in mountain households. This statement might be true for the plains where space heating requirements were minimal. The improved cooking stove programme in the past had clearly had a bias towards the plains. Although the smokelessness of improved cooking stoves must be recognised fully, as they reduced health and environmental problems, most of the ICS programmes were designed to reduce the increasing rate of deforestation rather than to minimise negative health impacts. It was, therefore, suggested that the ICS programme should be considered a component of the kitchen improvement programme in the hills and mountains of Nepal; and this would mean better health and hygiene, eventually reducing pressure on the forests as well as the burden on women and children who collected the fuelwood. To add to this, it was pointed out that, in India, less than five per cent was saved in fuel from cooking stoves and biogas, and it was suggested that there was a need to re-orient the ICS programme to make it suitable for the hills and mountains.

Issues Identified and Suggestions Made

Various suggestions were made concerning policies, institutions, technical and financial aspects, research and development, and gender issues based on the observations made by the study team. These were commented on during deliberations. Most of the issues raised and suggestions were as follow.

Develop long-term vision: Long-term vision was essential for a healthy kitchen environment and reduction in fuelwood consumption. The programme needed to be conceived from the kitchen improvement perspective.

Technical back-up and monitoring: An institution with the responsibility for providing technical back-up and monitoring the programme should be created so that technical problems encountered by users could be resolved without them abandoning improved cooking stoves.

Matching technology with user needs: The type of stove required varied from place to place because of the fact that different needs were being met by traditional stoves. At the same time, cooking habits and needs differed among various ethnic groups. Different models were needed for different locations and ethnic groups. It was found that promotion of a fixed/one-type design of ICS had not been successful.

Use of local materials and indigenous skills: It was found that by using local materials and training local women to construct ICS, successful promotion of ICS was realised. This aspect must be considered in designing ICS programmes.

Need for intensive research and development: Development of various types of stoves suitable for different rural communities was essential. This would require continuous R&D activities with good financial support. The type of research activities that could be considered were: low-cost ICS for space heating with smoke removal devices; versatile ICS that could be operated with different types of biomass fuel; easy to install and clean chimneys; ICS for big families, hostels, and police/army barracks, *rakshi* (alcohol) preparation, animal feed preparation, and ICS that reduce cooking time. Efforts must be made to commercialise these developments.

Building Capabilities at Village Level: It was found that ICS technicians played a vital role in successful ICS programmes. The criteria for selection of the trainee should be that he/she be unemployed, local, innovative, with good motivational skill, and preferably a woman. Users should also be oriented, so that they understood the importance of each component of the ICS and were involved during the placement and construction of the same. Users should have a say in choosing the location for installation.

Subsidy needed for promotional activities: The sum of money involved was not great, except for stoves to be distributed in cold regions. The cost incurred during the distribution of ICS (for cooking) was primarily for training ICS technicians and promotional materials. It was suggested that the promotional activities related to ICS distribution should be subsidised.

Solar Photovoltaic Technology

The presentation reviewed the status of solar energy technologies, in general, but primarily focussed on the development of solar photovoltaics (SPVs). The development and promotion of SPV home lighting systems (roughly, 400 households with 30-35Wp for lighting) were recent in Nepal. This was being promoted by private entrepreneurs and NGOs. There were three companies who assembled and supplied these systems. Accordingly, SPV for small-scale irrigation and drinking water supplies was only in the experimental and demonstrative stages. Nepal Electricity Authority had pioneered the installation of a 30-50kW SPV for rural electrification in remote areas such as Simikot in Humla, Gamgadi in Mugu, and Tatopani in Sindhupalchowk, but frequent breakdowns had occurred. There were more than 6,000 units of 50W module SPV systems installed in different parts of the country for communication purposes; these were mostly installed by the Nepal Telecommunication Corporation and the Civil Aviation Department and military barracks in remote locations.

The presentation highlighted the government subsidy scheme. In FY 1996/97, the government provided 50 per cent and 75 per cent capital subsidies on the total cost for SPV home systems and irrigation, respectively, and ADB/N was still doing so. SPV companies enjoyed tax and duty exemptions for importing solar cells and other accessories. There was no subsidy on solar dryers and cookers. The interest rate for entrepreneurs was 16 per cent, and this was being channelled through ADB/N.

The presentation highlighted the salient features of SPV systems distributed in parts of the country based on the field survey and case studies (Box 16) and various issues were identified (Box 17).

Clarifications and Discussions

Prof. J.N. Shrestha stated that one insurance company had begun to insure the PV

Box 16: Salient Features of SPV Technology in Nepal

Place	Cost/Subsidy	Status
Timilsina Gaun Kabhre (35W stand alone)	Rs 30,000 50 per cent subsidy	Installed in 13 houses. All are in use
Pullimerang Tanahu (35 stand alone)	Rs 23,000 50 per cent subsidy	Installed in 80 houses – almost all are in use – installed by higher economic class villagers Villagers attempting to link it with the socioeconomic development of their village
Simikot, Humla (50kW central SPV)	Monthly average charge of Rs 76	Irregular supply due to frequent breakdown of inverter; high installation costs
Sundarighat Water pumping Bode, Kathmandu (I phase - 4kW and II phase - 40kW)	US$ 482,000 (I Phase) US$1538,000 (II Phase)	Operating well; high cost research project
Rural/Remote Communication	Not available	Operating well and replaces 1.2kW generator set; successful application of SPV for remote/ rural communications

Model System and 75 systems were established in Dhading at the cost of just Rs five per month. He outlined the revolving fund system of Pullimarang that had facilitated the installation of SPV home systems and said that it had been very beneficial to the community. He added that some of the data presented by the study team were misleading, therefore real data had to be worked out. He stressed the need for subsidies for the PV system.

Dr. Junejo was of the opinion that the cost of PV was higher than the cost of micro-hydro. He added that there should be demarcation of areas for SPV promotion, so that energy would be available to communities at the cheapest possible rates.

It was pointed out by Ms. Soma Dutta that, in India, the PV system was used for back-up in some areas. PV was used to operate pumps and for various other uses in India. The only problem with PV was that it needed a lot of space.

Mr. K.C. Dhimole stressed the importance of creating a database on radiation, sunshine hours, topography, hydrology, and so on. He requested ICIMOD to create a database in consultation with various other agencies working within the HKH region. He suggested that the cost of solar photovoltaic modules should be reduced in order to reduce the cost of the whole system. Systems should be designed taking into consideration the climatic conditions of the location. A research centre could be established in one of the countries of the HKH region in order to study different climatic conditions. He stated that the policies that had been discussed would help create awareness and foster development. They would also help to assimilate the commercialisation of RETs in trying to create an effective institutional infrastructure.

Mr. Navin Dhungel suggested that a better mechanism should be adopted and he stressed the urgent need for R&D for the promotion of private enterprises. He added

Box 17: Issues Identified from Case Studies Pertaining to SPV Technology

Policy Issues

- No policy-level emphasis on equity issues
- Need for demarcation for SPV electrification

Financial and Economic Aspects

- Poor people cannot afford it
- No linkages with income-generating activities, but has potential
- High up-front costs
- More suitable for low load applications such as communication
- Low maintenance costs

Technical Aspects

- Frequent fusing of bulbs
- Centralized system suffers from frequent invertor break-down
- No over charge controller
- No research activities

Social Issues

- SPV home system is a household status symbol and creates tension in rural areas
- Increased communications by installation of TV in remote locations, but only rich people can afford it
- Increased social interaction among villagers
- Technical skill improvements at village level

that subsidies should be given to PV Solar Systems, even though it distorted the market.

Issues Identified and Suggestions Made

The study team made various suggestions with regard to SPV development in Nepal. These were commented upon by the participants. Most of the issues raised and suggestions made were as follow.

Area identification for SPV home systems: SPV systems were found to be appropriate for low power applications and where no other options were available because of their high cost perkWp. For example, it was found that, if the demand was very low, less than 300 W, SPV systems were cheaper than diesel generators. Also, the SPV system was cheaper than grid electricity when demand centres were located further than 40km from the grid. It was, therefore, important that areas where such possibilities did not exist were places to be considered for SPV home system promotion. Contrary to this, it was observed in Kabhre that these systems were promoted in places where it was planned to extend the national grid.

Subsidy - mechanism for demonstration: It was observed that, as a result of the 50 per cent subsidy on the capital cost of the SPV system, it was becoming popular among high-income families. The question of social equity had become crucial, as in most cases subsidies were received by the rich, and the prime motive for such an installation was to demonstrate their status, contrary to the objective behind providing a subsidy. However, in the initial phase, it could be justified in terms of creating a demonstration effect in remote areas to popularise the technology.

Minimise technical constraints: The system faced various technical constraints such as: low power conversion efficiency, storage problems, and climatic uncertainties. These constraints needed to be resolved for smooth functioning of SPV systems.

Stand-alone versus centralized systems: The comparison between centralized systems in Mugu and Humla and stand-alone systems in Kabhre and Pullimarang in Nepal showed that the latter were more appropriate in remote areas due to conversion, transmission, and managerial problems. Stand-alone SPV systems should be promoted rather than centralized systems.

Promote institutional linkages and coordination: There was a lack of coordination and monitoring of the various institutions involved in the development and promotion of SPV. A newly established organization, AEPC, should play the lead role in facilitating the efforts of various organizations to promote SPV technology.

Need to design an innovation funding mechanism: At present, rich families had enjoyed the benefits of subsidies as bank loans were available for those who could provide land as collateral. It was important to create access to capital resources for poor and marginal farmers to purchase technologies for labour saving and to improve the living conditions of poor families through income-generating activities. In this respect, formation of village-level cooperatives could be an important beginning, for which the government might have to provide seed money. This approach needed to be tested prior to its replication.

Integration with income-generating activities: The subsidy that was being provided could only be justified if it was linked properly to income-generating and social development activities. An attempt to promote a bag-making enterprise in Pullimarang was a remarkable example of productive end-use of an SPV system. Similarly, conduction of literacy classes in the evening, educational programmes through TV, and provision of light to the Health Post were a few positive development activities initiated in Pullimarang.

Increase Opportunities for Women's Participation: The impact of SPV systems was positive on women and children, as they provided opportunities for women to perform their activities in a more relaxed manner, whether tending their babies or spending time in income-generating activities or participating in development activities such as literacy classes and awareness programmes, forestry users' groups, and so on.

4.2 Technology Dissemination and Adoption Approach: A Case Example of Passive Solar Housing in Himachal Pradesh

Dr. S.S. Chandel highlighted the importance of the Passive Solar Housing Programme in Himachal Pradesh. The majority of buildings constructed in recent years ignored energy-saving opportunities such as orientation towards the sun during winter, proper ventilation during summer, landscaping, breezes and other natural elements of the site, and opportunities in the structure and materials of the house itself which, with thoughtful design, could be used to collect and use free energy. A climatically responsive building reduces adverse impacts on the natural environment while improving the quality of life. It was possible to reduce energy consumption by 50-70 per cent by using well-tested concepts of passive solar and climatically adapted building designs.

The presentation described site, shape, and orientation of building; reflectivity of ground and building surfaces; vegetative cover around the building; size and orientation of window and door openings; and planning of interior space to play a significant role in terms of increasing the effectiveness of building for energy saving.

The presentation highlighted the main features of the Solar House Action Plan for Himachal Pradesh, India (Box 18). The State Council for Science, Technology, and Environment (SCSTE), HP, is the nodal agency for coordinating this activity. Under the programme, designs incorporating the solar concept were prepared for 20 buildings to be constructed by the State, of which three buildings had already been constructed. At the same time, the Ministry of Non-Conventional Energy Sources (MNES) had formulated a passive solar programme with the following objectives: a) to create awareness of passive solar technology through training and education of the masses for large-scale application and b) to provide comfortable conditions in the living and working spaces of buildings by optimum use of available solar energy in buildings, energy management to reduce the consumption of commercial energy in buildings through preparation of a detailed project report (DPR), and construction with the same. In order to meet these objectives, MNES had provided various incentives. For example, MNES had provided 50 per cent of the costs of the DPR of a building using passive solar architecture up to a maximum of ICRs 50,000 or 2.5 per cent of the estimated cost of the building for each project. These facilities were available to state nodal agencies also.

Dr. Chandel's presentation also highlighted various projects being undertaken by the SCSTE. These were: a) establishing a network of institution/experts within the HKH region of India - funded by ICIMOD; b) reviving traditional hill architecture; initiatives in the cold desert of Spiti Valley; c) tra-

Box 18: Main Features of the Solar House Action Plan for Himachal Pradesh

- Design and construction of buildings as per the norms of solar passive concepts
- Organization of specialised training courses in passive solar housing techniques
- Constitution of an expert group from the State/National/International R&D institutes to coordinate and catalyse the Solar Housing Programme in the state
- Establishing a Technical Project Management Cell in the SCSTE to create in-house facilities for technology dissemination
- Retrofitting old government and private buildings with passive solar systems
- Modification in building bye-laws to make passive solar features compulsory in buildings
- Incentives to the public for solar construction in urban and rural areas
- Construction of demonstration houses in four major climatic zones
- Research and development/evaluation studies related to solar houses for cold climates, encouraging R&D activities in State Universities/Institutions
- Conduct energy audit of government buildings to suggest measures for reducing energy consumption
- Compilation of data on solar radiation, weather pattern, and climate
- Identification of passive solar features of traditional hill architecture
- Establishment of a Solar Energy Research Centre for Mountain Regions

ditional architecture of HP; d) compilation of meteorological data of HP; d) passive solar design of houses to be constructed under the *Gandhi Kuteer Yojna*; and e) organization of specialised training programmes.

The presentation recommended guidelines for passive solar technology adoption (Box 19) based on experiences gained in implementing these programmes in HP as well as guidelines prepared for other hilly states of India.

Clarifications

Answering a query on Passive Solar Heating, Dr. Chandel replied that there should be a proper mix of various options. Designs were made suitable to lower costs. He stated that, while designing the building, a panel of experts (architects) worked along with the solar scientist.

4.3 Chairperson's Remarks

Dr. T.S. Papola, Chairperson of the session, remarked that some proportion of the initial or intermediary costs should be given. A lot of work had been done, but the most crucial and most important issues needed to be identified so that they could be tackled first. All the issues related to mini- and micro-hydel plants were not going to be resolved in this session of the meeting.

Dr. Papola added that, as far as the meeting was concerned, the recommendations for the promotion of these appropriate technologies which had come forth had been eagerly awaited. He said that certain points had to be kept in mind. What was the government doing that was discouraging a particular sector ? What should the government do in order to encourage it ? The fact that this sector needed more subsidies meant that it could not be run profitably, why should the private sector be interested in it ? Some basic issues needed to be tackled. Micro-hydro technology was considered the most appropriate form of energy supply in mountain areas in spite of all the issues raised.

The chairperson pointed out that, from the perspective of economics, subsidies could not be justified if they could not meet the basic objectives of development and poverty alleviation in the long run. He added that

Box 19: Guidelines for Passive Solar Technology Adoption

- Government housing agencies in the hilly regions need to incorporate provision for passive solar technology in building estimates
- Housing agencies should make systematic efforts to orient/train their architectural and engineering wings to adopt this technology
- Housing agencies should also study the feasibility of suitable changes in the existing buildings for incorporating passive solar technology
- Suitable modifications in building bye-laws need to be carried out
- Suitable incentives should be identified for its adoption
- The buildings requiring central heating systems should install systems that work in conjunction with solar passive heating systems to reduce the cost
- The use of natural daylight features in buildings should be incorporated so as to reduce electrical consumption in daytime lighting
- The features of traditional hill architecture need to be retained to promote eco-friendly housing technologies

he was not totally against subsidies as long as they were justified. The issue of private sector participation on the one hand and subsidies on the other needed to be discussed in more detail and resolved.

Regarding private and public sector issues, he thought that plants could not be run successfully by either the public sector or the private sector. They could best be run by the community. Big industries would not be interested in installing small plants in the remote parts of Nepal because they would not get anything out of them. In most cases in which these plants had been run successfully, viably, and had benefitted people, they had been successful because of local community participation. Subsidy and assistance were provided not for the profit of an individual but for the upliftment of a community.

Dr. Papola stated that ICIMOD was not in the business of promoting manufacturers or a particular group. It was in the business of trying to exchange information and, if possible, facilitate or transfer appropriate technology for the alleviation of poverty of mountain people. He added that he believed that the development of micro-hydropower was very crucial for the alleviation of poverty in the mountains. This was the reason why ICIMOD was interested in the promotion of micro-hydropower.

Low-cost Solar - Timber Kiln Installed at Energy Park, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, H.P., India

Paddy De-husker Operated by Micro-hydropower Plant Multipurpose Power Unit at Gajuri, Dhading District, Nepal

Policy Recommendations

This session was chaired by Dr. T. S. Papola. Dr. Kamal Rijal presented a framework for the development of renewable energy technologies. He suggested that this framework would be helpful for integrating the issues raised and suggestions made during the previous two days, and that he would appreciate further comments on them. Detailed discussions were held on the framework proposed. Following this presentation, Nepal-specific recommendations were made for the development of RETs.

The proposed framework for policy recommendations to promote renewable energy resources and technologies had six components. These were as follow.

Recognising the Benefits of Renewable Energy: It was crucial to recognise the long-term economic and social benefits of renewable energy resources and technologies in order to make the mountain energy system sustainable. The exploitation of RETs would result in reducing the level of emissions caused by fossil fuels; ensuring economic sustainability, which most often was reflected adequately in energy markets; increasing energy supply security, as the availability of renewable energies were more equitable in terms of their geographical distribution; and reducing the impending drudgery on women and children in particular. In addition, there was an increased opportunity of equitable distribution of social and economic benefits through exploiting renewable energy resources and technologies, as access to these resources were more equitable in terms of both geographical distribution and income levels. Also, the nature of these resources demands a decentralized institutional structure because they were available in scattered locations and because of the suitability of small-scale technologies.

Reforming Energy-price Signals: The growth of renewable energy technologies would be feasible only if the prices of various forms of energy reflect their long-term social and economic benefits. The prevailing price structure of various forms of energy resources favours the overexploitation of fossil fuels and biomass fuels beyond their regenerative capabilities. This situation is further aggravated due to the low purchasing power of the mountain population. There is an urgent need to reform energy prices so as to reflect the true economic cost of resources, taking into consideration the environmental mitigation costs. This can be achieved by internalising the social costs of exploiting various sources of energy and thereby subsequently influencing energy supply choice. There are packages available in terms of energy taxes. The subsidies that various energy technologies receive are not properly understood and, in most cases, they result in distortion as there are no energy markets in most mountain communities. Given this situation, two policy options are available: either to create countervailing subsidies for renewable energy technology or to minimise subsidies for fossil fuels. At the same time, energy subsidies should be targetted at poor populations to increase their access to renewable energy resources and technologies.

Revamping the Energy Decision-making Process: The existing mechanism of the centralized decision-making process tends to favour large-scale energy investments. The equity concerns of poor mountain populations, or social obligations, are assumed to be taken care of by providing electricity to villages from the grid without assessing the physical limitations of such extensions, understanding the local needs for energy services, investigating possibilities of developing suitable small-scale renewable energy technologies, and understanding the long-term economic and institutional implications of such development. Currently there are various renewable energy technologies to meet the needs of mountain populations within the HKH Region and beyond. In this context, the involvement of beneficiaries and entrepreneurs engaged in developing RETs, while selecting forms of energy to fulfill demands should be mandatory. This would not only ensure the economic sustainability of the programme but also institutional sustainability.

Changing Energy Users' Investment Incentives: Entrepreneurs need to be encouraged to manufacture and market renewable energy technologies to reduce the cost of production and generate awareness among energy users about the benefits of RETs. For this to happen, energy price signals should favour renewables and improve investment incentives for RETs, e. g., loans below the normal rates of interest, grants, rebates, tax incentives and tax credits, exemptions, and deduction. Substantial improvement in policy implementation by integrating policy approaches, developing marketing strategies, providing technical support services and information, conducting training programmes, evaluating cost effectiveness, and systematic monitoring and evaluation of RET performances are needed. In this context, appropriate institutional arrangements need to be established to promote RETs. Care must be taken not to duplicate institutions at local level but to involve existing indigenous institutions or NGOs or entrepreneurs as a vehicle for technology transfer by maximising the participation of beneficiaries. In addition to these, what is more important for decision-makers and planners is the promotion of private entrepreneurs in development of RETs by reducing financial risks and costs, realising the benefits of modularity of RETs, reducing unforeseen risks, and relaxing resource rights.

Accelerating Investment in Renewable Energy Commercialisation: There was no concerted effort to commercialise RETs in the past, but most of the time they were subsidy-driven and, in addition, considered as poor people's energy options. This situation needs to be avoided if meaningful development of RETs is envisaged. Investments made in promoting RETs are comparatively meagre. To derive the full advantages of RETs, investment in commercialisation of renewable energy needs to be increased. This could be achieved by providing enough support for research and development and establishing demonstration units (RD & D). Public investment in RD & D can be improved by allocating public funding, integrating RD & D into a broader context of economic gains for mountain communities, and improving the effectiveness of RD & D institutions. Investments in RETs can be increased by attracting private investment, and for this targetted incentive packages need to be devised. These incentives should be a part of the commercialisation plan in order to reduce investment risks.

Developing a Coordinated Commercialisation Plan: A commercialisation plan for each of the renewable energy technologies needs to be developed. The efforts required might differ according to the level of development that each technology has reached in a specific country. Appropriate participation of each stakeholder in the development of RETs and consensus among them are crucial for the successful implementation of the commercialisation plan. In this context, the role of the government should be to create the right kind of policy atmosphere, as mentioned above, whereby reluctant entrepreneurs are attracted to invest in renewable energy technologies. Further, broad guidelines should be given to various donor agencies to avoid duplication of efforts. Some donors may be interested in capacity building, some in marketing technologies, and others in research and development. Yet others may be interested in promoting these technologies in specific areas or to specific ethnic groups. Each of them should be allowed to function with clear mandates and objectives. The lessons and successful strategies learned in promoting RETs must be taken into consideration in designing programmes related to RET promotion. The role of donor agencies has been effective in terms of capacity building and research activities. The implementation of various renewable programmes should not be directly handled by donors as it builds up local capabilities. The implementation of the programme should be carried out in partnership with local institutions, whether they be government or non-government organizations or local traditional institutions.

Discussions and Suggestions Made

During the discussions, **Dr. R. D. Joshi** suggested that policies should be classified at two levels, namely, planning and operational. He added that recommendations should be as few as possible because only then would the recommendations actually be considered for implementation.

Dr. Joshi stressed that RETs should not be implemented without properly assessing their viability in the given circumstances. In the case of Nepal, some of the RETs were pushed at rural communities without properly understanding the sociocultural needs of the society and, therefore, had failed miserably. He pointed out that RETs were feasible only in certain settings and there was scope for all. They are supplementary in nature, especially in the case of Nepal. Therefore, all RETs should be evaluated within a common framework. RETs should not be promoted on an *ad hoc* basis as if they were religion but on a very solid footing, and adaptation of technology should have a solid base.

Dr. Joshi stressed the need for dissemination of information and knowledge with regard to various RETs so that thereby users could have a fair choice. The aim of promoting RETs should be to promote rural development through rural industrialisation rather than just providing electrical power to villages and to increase the coverage and add to statistics.

Mr. S.L. Shrestha pointed out that the institutional gaps should be dealt with and institutions made more efficient. There should be recognition of the value of inputs. In the context of RETs, he said subsidies were the main issue and could bring about a breakthrough. He added that solar PVs might not be within the reach of the very poor but, through these technologies, other income-generating activities might benefit the poor. He stressed that literacy programmes and creating awareness were essential in this context.

Dr. Junejo said an authentic database and its exchange between HKH countries were needed. He also suggested that a framework to evaluate awareness raising and training for different groups should be developed. Mr. Hussain requested ICIMOD to play a vital role in creating a database for HKH countries.

Mr. G. R. Shakya pointed out that a lot of funding was provided to discover the problems, but no funding was available for finding the solutions. He added that solar water heaters had been successful in Nepal without a single incentive from the government. He stressed the fact that projects can be successful even without policies if the initiative and working spirit are present.

Mr. J.N. Shrestha brought up the issue of solar rights, which had already been discussed in some western countries. A good institution must be established for the standardisation of the sub-system.

Ms. Dutta stressed that performance should be linked to subsidies and that the conditions in which projects would work should be identified.

During the discussions, emphasis was given to monitoring, supervision, quality control, strengthening of existing institutions, and government impetus for the promotion of RETs.

General Recommendations

The framework presented by Dr. Rijal was agreed upon, as it provided broad policy guidelines for the development and promotion of RETs in the context of the HKH region. These were as follow.

a) Recognise and measure the benefits of renewable energy technologies (RETs) with an emphasis on drudgery reduction
b) Reform energy-price signals to provide a level playing field for each energy source
c) Revamp the energy decision-making process to promote decentralized renewable energy technologies and involvement of local-level institutions
d) Change energy users' investment incentives by attracting the participation of the private sector and NGOs in manufacturing and promoting RETs
e) Accelerate investments in commercialisation of RETs by supporting RD & D, capacity building, and information and awareness generation through public sector or donor funding and by providing attractive incentives to manufacturers
f) Develop a coordinated commercialisation plan for each RET to suit country-specific needs.

Nepal-Specific Recommendations

Besides these recommendations, the following specific recommendations were given for Nepal, based on the presentations and discussions.

Policy and Institutional Recommendations

a) Legislation is needed to clearly define ownership rights on various natural resources such as forests, water, wind, and sun.
b) Need for legislation to protect intellectual property rights to promote private sector R&D.
c) Need for high-level commitment to the promotion of RETs.
d) Develop standards incorporating safety guidelines for manufacturing and construction of RETs.
e) Product warranty should be made mandatory for manufacturers and service providers.

f) Encourage private entrepreneurs to develop RETs by reducing financial risks and costs, reducing unforeseen risks through insurance, and improving investment incentives, e.g., loans below market rates, grants, rebates, tax incentives and tax credits, exemptions, and deductions.
g) Develop a framework for subsidies with respect to each RET based on the service they provide.
h) Develop simplified banking procedures and interest rates and standardise other loan conditions for all RETs.
i) The Alternate Energy Promotion Centre (AEPC), a recently established institution, should function as a task manager to promote RETs. Care must be taken not to duplicate institutions at local level but to involve existing indigenous institutions or NGOs or entrepreneurs as a vehicle for technology transfer by maximising the participation of the beneficiaries. Coordination, monitoring, evaluation, and technical backstopping functions are crucial for the commercialisation of RETs. The AEPC should take on this responsibility.

Technology-Specific Recommendations

Micro-hydro Power

a) Water rights were a critical issues. Prevailing laws do not ensure the right of prior use for agro-processing and electricity production. There is a need to provide appropriate compensation to owners if water is diverted from micro-hydro plants for irrigation purposes.
b) An integrated approach to promoting micro-hydropower development needs to be adopted.
c) The participation of women in planning and implementation of micro-hydro plants needs to be ensured.
d) Simple and transparent procedures for loan sanctioning should be developed and institutionalised.
e) Proper evaluation of the socioeconomic setting, technical and managerial capabilities, and adequate survey and design must be ensured while carrying out feasibility studies. Accountability on the part of surveyors and manufacturers is essential.
f) Community-owned and managed micro-hydropower plants should be promoted. Care must be taken to build up or establish strong community organization, cohesiveness of the community, democratic leadership, good technical and managerial capabilities, and strong technical back-up.
g) Diversification of end uses for productive purposes such as agro-processing, cold storage, ice factories, power looms, carpet weaving, wood carving, and food processing should be promoted.
h) The quality of raw materials used, safety codes to be followed during installation, and rated power of turbines and generators should be standardised.
i) Promotion of smaller units, such as improved *ghatta,* to replace traditional ones should be given priority.
j) Preparation of construction manuals and codes and enforcement of standards are essential.
k) Preparation of training manuals on operation and maintenance as well as on book-keeping and provision of training to micro-hydropower operators and owners are essential.

Biogas Technology

a) Low cost biogas plants should be promoted through easy access to credit facilities for low-income households through community loan schemes for landless and women's groups.
b) Demonstration biogas units must be established by identifying progressive farmers willing to install them.

c) The subsidy policy for biogas plants should be made consistent.
d) Strict enforcement of quality control and standardisation is needed. But care must be taken not to overdo it as it prevents innovation.
e) R&D should emphasize reducing the cost of the plant.
f) Plant owners should be made aware of how to apply slurry on their fields and to develop appropriate tools/equipment (such as trolley) for slurry handling.
g) BSP programmes should be integrated with livestock development programmes along with rural development initiatives.

Improved Cooking Stoves

a) A long-term vision for a healthy kitchen environment should be developed along with the reduction of fuelwood consumption. The programme needs to be conceived from the perspective of kitchen improvement.
b) An institution with the responsibility for providing technical back-up and monitoring of the programme should be created.
c) Various types of models needed for different locations and ethnic groups should be developed and demonstrated.
d) The use of local materials and indigenous skills should be promoted and training imparted to women for the construction of ICS.
e) Strong research and development with adequate financial support are needed.
f) Capabilities should be built up at village level. Selection of persons to be trained as ICS technicians should follow the criteria that these people should be unemployed, local, innovative, have good motivation skills, and preferably be women. Users should also be oriented so that they understand the importance of each component of the ICS and should be involved during the placement and construction of the same.
g) Promotional activities related to ICS dissemination should be subsidised.

Solar PV Technology

a) Areas suitable for the promotion of SPV technology should be identified.
b) Subsidies for SPV technology are justified in terms of creating demonstration effects in remote areas to popularise initial phases.
c) Various technical constraints (low power conversion efficiency, storage problems, and climatic uncertainty) need to be resolved for the smooth functioning of SPV systems.
d) Stand-alone SPV systems should be promoted rather than centralized systems.
e) Institutional linkages and coordination must be promoted among the various institutions involved in the development and promotion of SPVs. A newly established organization, AEPC, should play the lead role in facilitating the efforts of various organizations to promote SPV technology.
f) Innovative funding mechanisms are needed. In this respect, formation of village-level cooperatives could be an important beginning, and for this the government might have to provide seed money. This approach needs to be tested prior to its replication.
g) There is a need to integrate SPV technology promotion with income generation and social development activities in order to justify the subsidy scheme.
h) There is a need to seek active women's participation as SPV systems provide opportunities for women to participate in various income-generating and social development activities.

6
Closing Session

In the closing session, Dr. K. Rijal made a presentation of findings and policy recommendations (as presented in the earlier section). This was followed by concluding remarks by Dr. T.S. Papola and a vote of thanks by Mr. Jaipal Shrestha.

Dr. T.S. Papola, in his concluding remarks, said that he was satisfied with the lively deliberations that had taken place during the previous two days. He hoped that the findings and recommendations arrived at would be useful not only in the context of Nepal but also in other countries of the Region. He genuinely hoped that these recommendations would be taken care of by the respective organizations in Nepal, as these were not only based on discussions but were an outcome of the studies carried out in the four countries of the HKH Region and, in the case of Nepal, detailed field surveys were also carried out. He also assured the participants that ICIMOD would produce a report of the experts' consultation in due course of time. Finally, he thanked all the participants who contributed towards the success of the meeting.

Mr. Jaipal Shrestha, in his vote of thanks, remarked that the previous two days had brought about reorganisation of the different challenges to promoting energy technologies in the HKH region, with specific emphasis on Nepal. He added that realistic and feasible policy interventions had also been identified. He outlined the perspective of CIDA's priorities in Nepal and identified issues such as the proper analysis of incentives for community and commercial participation, government subsidies per optimal technology mix, and the strengthening of Nepal's policy environment; answers to none of these issues were easy.

Mr. Shrestha mentioned that, in most cases, the value of RETs is clear. There is still a need to broaden the legitimacy of and argument for RETs within a development context. That is, in terms of poverty alleviation, health and sanitation, environmental conservation, literacy and education, and, most importantly, community economic development. He stressed the need for establishing a policy environment which is supportive of RETs, together with appropriate institutions, that go beyond conventional cost benefit analyses. He emphasized adopting practices that integrate the full benefits of RETs into market prices. Although the unit cost is important, it must be valued against the contributions to development within the HKH region which can be derived for improving access to reliable and environmentally sustainable sources of energy. He added that, once the perspective was enlarged, the need to strengthen opinions supportive of RETs would be clear.

Annex 1

Programme

July 2, 1997 Arrival of Participants

July 3, 1997

10:00 – 11:00	**Operning Session** • Welcome by Head, MEI Division • Opening Address by Mr. Egbert Pelinck, Director General, ICIMOD • Welcome Address by Mr. Jaipal Shrestha, Environment Advisor and SPEF Coordinator, Canadian Cooperation Office • Introduction by the Experts • Introduction to Regional Experts' Consultation by the Coordinator
11:00 – 11:15	**Tea/Coffee Break**
11:15 – 13:15	***Technical Session 1***: Implication of National Policies on RET's Chairperson: Dr. Mahesh Banskota Country Presentation and Discussions 1. Nepal 2. India
13:15-14:00	**Lunch Break**
14:00-16:30	***Technical Session 1***: Continued Chairperson: Dr. G. R. Bhatta Country Presentation and Discussions 1. Pakistan 2. China
15:00-15:30	**Tea and Coffee Break**

4 July 1997

09:00-13:15	***Technical Session 2***: Presentation of Nepal Case Studies Chairperson: Dr. T. S. Papola Micro-hydropower: Main Findings Discussions
10:30-10:45	**Tea and Coffee Break** Biogas Technology: Main Findings Discussions Improved Cooking stove: Main Findings Discussions
13:15-14:00	**Lunch Break**
14:00-15:00	Solar Technology: Main Findings Discussions
15:00-15:15	**Tea and Coffee Break**
15:15-16:30	Policy Recommendations Chairperson: Dr. T.S. Papola Presentation by Coordinator Discussions
16:30-17:30	**Closing Session** • Presentation of Findings and Policy Recommendations by Coordinator • Concluding Remarks by Chairperson • Vote of Thanks by Mr. Jaipal Shrestha

Annex 2
List of Participants

India

1. Mr. D. Kedia, Director
   Industrial Consultants
   GS Road Bhanga Garh
   Guwahati - 781005, Assam, India
   Tel: (0361) 56-3860 (O); 52-0876 (R)
   Fax: (0361) 56-5139

2. Ms. Soma Dutta
   C/o Lt. Abhijeet Majumdar
   13 A, CHITRA, NOFRA, Navynagar
   Colaba, Mumbai - 400 005
   Tel: 022-2152935

3. Mr. K. C. Dhimole, Director
   Arunachal Pradesh Energy
   Development Agency,
   P. O. Box 141, Itanagar - 791111,
   Arunachal Pradesh, India
   Tel: 0360-22701
   Fax: 0361-22446

4. Mr. Ram Subhag Singh,
   Chief Executive, HIMURJA,
   SDA Complex, Block No. 8-A,
   Kasumpti, Shimla - 171009
   Himachal Pradesh, India
   Tel: 0177-222471
   Fax: 0177-221783

5. Dr. S. S. Chandel
   Principal Scientific Officer
   State Council for Science, Technology
   and Environment,
   34, SDA Complex, Kasumpti,
   Shimla - 171009, H. P., India
   Tel: 0177-222489/90
   Fax: 0177-220998

Pakistan

1. Mr. Tajammul Hussain, Director
   COMSATS Secretariat
   30, Ataturk Avenue,
   Sector G-6/4, Islamabad, Pakistan
   Tel: 92-51-9204892 (O); 263916 (R)
   Fax:92-519216539
   E-mail: husseint@isb.comsats.net.pk

Nepal

1. Dr. Dilli Devi Shakya, Director
   RECAST/TU, Kirtipur,
   Kathmandu, Nepal
   Tel: 330348

2. Mr. Gyani Ratna Shakya
   Energy Expert, RONAST
   New Baneshwor
   Kathmandu, Nepal
   Tel: 241387 (O); 247672 (H)

3. Mr. Surendra L. Shrestha
   Deputy Secretary
   Energy and Infrastructure Division
   National Planning Commission
   Singha Durbar, Kathmandu, Nepal
   Tel: 222690 (H); 230047 (O)

4. Dr. Rajendra Dhoj Joshi
   Dean, Institute of Engineering
   Pulchowk, Lalitpur
   Tel: 521251/521531

5. Mr. Navin Bhujel
   LOTUS Energy
   Bhatbhateni Dhunge Dhara
   P. O. Box 9219

Kathmandu, Nepal
Tel: 418203; Fax: 412924

6. Mr. Yug R. Tamrakar
Managing Director
Solar Electricity Co. Pvt. Ltd.
Solar Complex, Bagbazar
P. O. Box 12515, Kathmandu, Nepal
Tel: 227876

7. Mr. Surendra B. Mathema
Member Secretary
Association of Micro-hydro Manufacturers ADB Building
Kathmandu, Nepal
Tel: 214487

8. Mr. Prem Narayan Baral
Chairman
Nepal Biogas Promotion Group
Min Bhawan, Kathmandu, Nepal
Tel: 474115

9. Mr. Kiran Man Singh
Programme Manager
Rural Energy Development Project
Pulchowk (Damkal)
Lalitpur, Nepal
Tel: 520048

10. Mr. Bhola Shrestha
Programme Manager
Intermediate Technology Development Group
P. O. Box 2325, Kamaladi
Kathmandu, Nepal
Tel: 220572

11. Prof. J. N. Shrestha, President
International Solar Energy Society
Nepal Section, G.P.O. Box 12515,
Baghbazar, Kathmandu, Nepal
Tel: 227876/225253
Fax: 414653

12. Mrs. Indira Shakya
Head, Technology Unit
RONAST, New Baneshwor
Kathmandu, Nepal
Tel: 241387 (O); 247672 (H)

13. Dr. G. R. Bhatta
Special Secretary and Advisor
National Planning Commission
Singha Durbar, Kathmandu
Tel: 227439

Nepal Study Team

1. Mr. G. R. Shrestha
2. Mr. V.B. Amatya
3. Mr. Srimat Shrestha
4. Mr. Ramesh Gongal
5. Ms. Karuna Bajracharya

Canadian Cooperation Office

1. Mr. Andrew Spezouuka
Environment Advisor

2. Mr. Jaipal Shrestha
Environment Advisor
Lajimpat, Kathmandu
Tel: 415193/415389
Fax: 410422

ICIMOD

1. Mr. Egbert Pelinck, DG
2. Dr. M. Banskota, DDG
3. Dr. T. S. Papola, Head, MEI
4. Dr. A. A. Junejo, Project Coordinator, MMHP Project
5. Ms. J. Gurung, Gender and Development Specialist
6. Prof. S. R. Chalise, Water Resources' Specialist
7. Dr. K. Rijal, Energy Specialist

Rapporteurs

1. Mr. Navin Singh
2. Mr. Saurav Bikram Rana

List of Studies Commissioned by ICIMOD and Papers Presented at the Meeting

Studies Commissioned by ICIMOD

1. Implications of National Policies on Renewable Energy Technologies and Energy Efficient Devices with Detailed Case Studies in Nepal. Centre for Rural Technology, Kathmandu

2. Assessment of Implications of National Policies on Renewable Energy Technologies and Energy Efficient Devices in the HKH Region of India. Ms. Soma Dutta, Mumbai, India

3. Assessment of Implications of National Policies on Renewable Energy Technology and Energy Efficient Devices in the Context of the HKH Region of Pakistan. Mr. Tajammul Hussain, Commission on Science and Technology for Sustainable Development in the South (COMSATS), Islamabad, Pakistan

4. Implications of National Policies on Renewable Energy Technologies and Energy Efficient Devices in the HKH Region of China. Mr. Zhang Mi, Energy Consultant, Sichuan Shineday Development Co. Ltd (SSDC), Chengdu, China

Papers Presented

1. Assessment of Implications of National Policies on Renewable Energy Technologies and Energy Efficient Devices in Nepal: Country Presentation by Mr. V. B. Amatya, Centre for Rural Technology, Kathmandu

2. Assessment of Implications of National Policies on Renewable Energy Technologies and Energy Efficient Devices in the HKH Region of India: Country Presentation by Ms. Soma Dutta

3. Assessment of Implications of National Policies on Renewable Energy Technology and Energy Efficient Devices in the HKH Region of Pakistan: Country Presentation by Mr.Tajammul Hussain
4. Implications of National Policies on Renewable Energy Technologies and Energy Efficiency Devices in the HKH Region of China : Country Presentation by Dr. Kamal Rijal on behalf of Mr. Zhang Mi

5. Passive Solar Housing in Mountains : Efforts and Expectations: Presentation by Mr. S. S. Chandel, Principal Scientific Officer, State Council for Science, Technology, and Environment, Himachal Pradesh, India

6. Case Study on Micro-hydro in Nepal: Presented by Mr. Srimat Shrestha, Centre for Rural Technology, Tripureshwor, Kathmandu

7. Case Study on Biogas Plants in Nepal: Presented by Mr. Ramesh Gongal, Centre for Rural Technology, Tripureshwor, Kathmandu

8. Case Study on Improved Cooking Stoves in Nepal: Presented by Ms. Karuna Bajracharya, Centre for Rural Technology, Tripureshwor, Kathmandu

9. Case Study on Solar PV Technology in Nepal: Presented by Mr. V. B. Amatya

ICIMOD

Founded out of widespread recognition of degradation of mountain environments and the increasing poverty of mountain communities, ICIMOD is concerned with the search for more effective development responses to promote the sustained well being of mountain people.

The Centre was established in 1983 and commenced professional activities in 1984. Though international in its concerns, ICIMOD focusses on the specific, complex, and practical problems of the Hindu Kush-Himalayan Region which covers all or part of eight Sovereign States.

ICIMOD serves as a multidisciplinary documentation centre on integrated mountain development; a focal point for the mobilisation, conduct, and coordination of applied and problem-solving research activities; a focal point for training on integrated mountain development, with special emphasis on the assessment of training needs and the development of relevant training materials based directly on field case studies; and a consultative centre providing expert services on mountain development and resource management.

ICIMOD Workshops

ICIMOD Workshops are attended by experts from the countries of the Region, in addition to concerned professionals and representatives of international agencies. Professional papers and research studies are presented and discussed in detail.

Workshop Reports are intended to represent the discussions and conclusions reached at the Workshop and do not necessarily reflect the views of ICIMOD or other participating institutions. Copies of the reports, as well as a Catalogue of all of ICIMOD's Publications, are available upon request from:

Documentation, Information, and Training Service (DITS)
International Centre for Integrated Mountain Development (ICIMOD)
G.P.O. Box 3226
Kathmandu, Nepal

Participating Countries of the Hindu Kush-Himalayan Region

- Afghanistan
- Bangladesh
- Bhutan
- China
- India
- Myanmar
- Nepal
- Pakistan

International Centre for Integrated Mountain Development
4/80 Jawalakhel, G.P.O. Box 3226, Kathmandu, Nepal

Telephone : (977-1) 525313
e-mail : distri@icimod.org.np
Facsimile : (977-1) 524509, 536747
Cable : ICIMOD NEPAL