ENERGY FOR MOUNTAIN DISTRICTS

Report of the

International Workshop on District Energy Planning and Management for Integrated Mountain Development

Organised by the International Centre for Integrated Mountain Development

ICIMOD

Kathmandu

3-5 May 1986

ICIMOD PHASE I Workshop Series

The International Centre for Integrated Mountain Development began professional activities in September 1984, with the first objective of reviewing development and environmental management experience in the Hindu Kush - Himalaya Region. An International Workshop was planned for each of four major fields to review the state of knowledge and practical experience, and also to provide an opportunity for the exchange of professional expertise with regard to integrated mountain development.

ICIMOD completed Phase I activities in June 1986, having held :

- the International Workshop on Watershed Management in the Kush - Himalaya -- Chengdu, China, 14 to 19 October 1985
- the International Workshop on Planned Urbanisation and Rural Urban Linkages in the Hindu Kush - Himalaya Region -- Kathmandu, Nepal, 25 to 29 March 1986
- the International Workshop on District Energy Planning and Management for Integrated Mountain Development -- Kathmandu, Nepal, 3 to 5 May 1986
- International Workshop on Off - Farm Employment Generation in the Hindu Kush - Himalaya -- Dehra Dun, India, 17 to 19 May 1986

These Workshops were attended by over two hundred experts from the countries of the Region, in addition to concerned professionals and representatives of international agencies. A large number of professional papers and research studies were presented and discussed in detail. With the permission of the authors, copies of papers in full will be supplied on request, with a charge to cover reproduction and postage costs.

In September 1986, ICIMOD published four summary Workshop Reports. Each is intended to represent the conclusions reached at the Workshop and does not necessarily reflect the views of ICIMOD or other participating institutions.

Copies of the reports are available upon request from :

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Cover photograph : Fuelwood collection in the Peshawar Valley
Dr. Kk. Panday

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Foreword

After substantial preparatory work by an ICIMOD staff team during 1985, in close cooperation with collaborating institutions in India, China, Pakistan, Nepal, Bhutan, and Bangladesh, an International Workshop on District Energy Planning and Management was organised to review experience in this field throughout the Hindu Kush-Himalaya Region, and to design an international collaborative programme of integrated research, training, and information exchange. One of the first results of this Workshop is this summary Workshop Report, to be followed by an Occasional Paper, prepared by Dr. Deepak Bajracharya, based directly on the Workshop discussions, and the publication, jointly with the Tata Energy Research Institute in Delhi, of collected papers on rural energy planning in the Indian Himalaya. The major long-term consequence of the Workshop will be the implementation, under ICIMOD coordination and with significant financial support from the Commission on Development Aid of the European Communities, of a programme of regional collaboration on District Energy Planning and Management in mountain districts with emphasis on the development of effective training on rural energy programmes for district level professional and technical staff.

Our thanks are due to those professionals throughout the countries of the Region -- and from the international agencies and academic institutions much further afield -- who prepared papers for this important Workshop and participated so enthusiastically in its deliberations. Our particular thanks are due to the Royal Government of Bhutan for its generous offer of hospitality for this International Workshop, and directly to the Workshop Organising Committee chaired by Ugyen Tsering of the Planning Commission of the Royal Government of Bhutan, with Lakpa Tsering, Director of the Science and Technology Division and Member of the ICIMOD Board of Governors, as its member-secretary.

It was a special pleasure to all of us that Dr. Ratna S. J. B. Rana, Vice-Chancellor of the Royal Nepal Academy of Science and Technology and Chairman of the Board of Governors of ICIMOD, inaugurated the Workshop with a characteristically stimulating Opening Address.

Finally, a special acknowledgement is due to all the organising staff of the Workshop for their exceptional efforts, and most particularly to Dr. Deepak Bajracharya, Dr. Binayak Bhadra and Vinod Kumar for the preparation of this Workshop Report.

Colin Rosser
Director

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Introduction

In the Hindu Kush - Himalaya Region, a fuelwood crisis has evolved, due primarily to excessive dependence on forest biomass energy. Inadequacy and inflexibility of traditional technologies, lack of new arable land, and the subsistence level of the rural economy are contributing factors. While total forest resources are abundant in areas of Bhutan, the northeastern Indian Himalaya, and Sichuan and Yunnan, China, where exploitation is limited due to inaccessibility and high transportation costs, deforestation near human settlements is widespread. It is ironic that the Region, endowed with one of the largest hydropower potentials in the world, should face an energy shortage. Rural energy is accorded high priority by all countries of the Region, as well as by bilateral and multilateral agencies. Yet many important energy issues relevant to research, training, implementation, coordination, and monitoring and evaluation, remain unresolved.

The question of how energy is related to the rural development framework is particularly complex. The challenge is to achieve a balance in a situation of continuing deforestation and pressing need for improved standards of living in rural areas. Throughout the Region, the importance of decentralisation as a means to achieve rural development is being reiterated. Although the district is often considered an appropriate planning unit, the diversity of the Region allows for little generalisation as to the most effective means. Nevertheless, scope exists for evolving a general approach in decentralised energy planning.

A systematic data base, upon which to wrestle with this issue, is largely non-existent, which makes analysis of alternative solutions to energy problems a difficult task. Yet, understanding of the traditional economies, population trends, and ecological balance is essential to permit interventions and promote innovations, while preventing detrimental environmental impacts.

Ongoing national efforts can be made more effective by information exchange and the sharing of experience in rural energy development. While location - specific approaches and responses are essential, lessons learned in one area will have implications for other areas. Mutually reinforcing and successful approaches can be systematised for the benefit of the Region as a whole.

With this target in view, ICIMOD initiated an intensive eighteen - month review of energy development in the Hindu Kush - Himalaya. Reports at national, regional, and subregional levels, in addition to issue and theme papers, were prepared by national energy institutions and professionals actively involved in mountain development. Several in - depth working papers were also prepared by ICIMOD energy specialists. Country review activities encompassed Bhutan; Nepal ; Sichuan, Yunnan, and Tibet in China ; the western, central, and northeastern Indian Himalaya; and Pakistan.

The principal national collaborating institutions which conducted review activities were: the Energy Research Institute, Academia Sinica, Beijing ; the Tata Energy Research Institute, New Delhi ; the Water and Energy Commission, Kathmandu ; the Appropriate Technology Development Organisation, Islamabad ; the Science and Technology Division, Planning Commission, Thimphu ; and the Bangladesh University of Engineering and Technology, Dhaka. (Refer to Annex 3. Background papers.)

The International Workshop on District Energy Planning and Management for Integrated Mountain Development, held in Kathmandu, 3 to 5 May 1986, represents the culmination of ICIMOD's Phase I review activities on rural energy planning. The fundamental objective has been to review work completed and in progress in the energy sector, to share experiences, and to look ahead to a future of collaborative effort and activity. This Workshop Report has three principal sections. The first encompasses the findings of state - of - the - art reviews from Bhutan, China, India, Nepal, and Pakistan, undertaken prior to the Workshop, and provides brief thematic descriptions. Themes developed in the reviews provide the basic framework for the Workshop papers and discussions, which elaborate the complexities involved in the task of decentralised energy planning and management. The concluding section looks ahead to the proposed collaborative work initiated by ICIMOD in the sphere of rural energy planning.

The themes were subsequently elaborated to encourage and assist the discussions of the Workshop, in identifying research, training, and policy concerns. Five major themes were identified:

The first theme of **District Energy Planning Framework** provided the setting for energy development, in terms of the existing institutional and organisational structures. The second, third, and fourth themes focused respectively on **fuelwood problems, non-wood energy options** and the **interrelations between energy and other sectors.** The final theme was the **planning and policy implications** that could be drawn from the previous discussions.

The specific objectives of the Workshop based on the review findings were:

- To review experiences concerning energy planning and implementation in the participating countries of the Hindu Kush-Himalaya Region

- To understand how the evolution of policies, as well as the planning and implementation framework of government and related agencies, could effectively meet energy needs and priorities of local communities

- To assess potentials and constraints of candidate energy technologies, financing arrangements and research and extension mechanisms by focusing particularly on the motivation and participation of local communities and organisations

- To analyse the relations of energy with the mountain economy, environment, and production systems

Participants at the Workshop included energy planners, policy makers, practitioners, and researchers from five of the countries of the Region (Bangladesh, China, India, Nepal, and Pakistan) and the representatives of selected international agencies (Refer to Annex 5).

Background :

Rural Energy Country Review Findings

The agro - climatic and geophysical heterogeneity of the Hindu Kush - Himalaya Region implies great diversity in energy situations. Complexities in energy endowments and energy use patterns do not lend themselves to generalisations. Yet, it is possible to categorise energy issues within three broad themes, which emerged unambiguously from the country reviews :

Fuelwood Crisis and the Afforestation Imperative. A fuelwood crisis, to which cooking energy needs have largely contributed, is ongoing. The increasing environmental damage makes afforestation crucial.

Energy Options for Integrated Mountain Development. The role of small hydro, farm biomass, biogas, and fossil fuel options, together with the related technologies, their diffusion, and extension, are important considerations in integrated mountain development.

Institutional and Organisational Constraints. In order for decentralised energy planning and management to succeed in overcoming the absence of microfocus in present energy development approaches, institutional and organisational constraints to integrated energy development need to be examined.

A brief summary of each issue follows, although it may be noted that these general issues are not uniformly applicable and that they by no means exhaust all the area-specific problems of the Region.

Dominance of Fuelwood Energy and the Afforestation Imperative

Rural energy consumption is generally dominated by non-commercial fuelwood energy used for cooking and heating. The resulting deforestation near settlements has contributed to landslides and erosion. Open access to difficult terrain and high wood collection rates give rise to pressures and destruction at forest boundaries. The large biomass growth potentially available in the forests does not supplement the fuelwood supply. Non-commercial fuelwood cannot be substituted by most commercial energy (e.g. kerosene, coal, and electricity) without substantially improving the buying power of the mountain communities. Furthermore, forest fuelwood has no immediate substitute other than farm biomass energy (including biogas). In addition, agricultural productivity can decline further if a loss of nitrogen from farming systems is permitted through the burning of farm biomass.

The need for integrated approaches in afforestation, combining fuelwood, fodder trees, and improved cooking stoves, has been realised on account of environmental concerns. These approaches have gradually overtaken the more traditional timber - oriented afforestation schemes. However, inadequate focus on indigenous institutions, forest acts, and legislation make present community and social afforestation programmes largely ineffective for resolving the fuelwood crisis. Thus, institutional and organisational innovations are necessary for extended and successful replication of community afforestation schemes (through effective participation of the people) and the resolution of the fuelwood crisis. The provision of technology which reduces time and effort needed for wood collection and transportation will greatly facilitate acceptance of afforestation schemes by the people.

Energy Options for Integrated Mountain Development

Modernisation of agriculture and promotion of cottage and small-scale industry form the core elements of a strategy for the transformation of the mountain economies, off - farm employment generation, and enhanced incomes. Therefore, rural energy development in the mountains should be viewed from the context of energy constraints in agriculture, cottage industries, transportation, and communication, particularly in the context of emerging energy requirements due to ongoing development.

Rural fossil fuel consumption, dominated by kerosene demand for lighting, is being gradually diversified as more diesel and petrol are utilised for grain mills, irrigation pumps, tractors, and power tillers. Similarly, consumption of diesel for trucks, buses, and aviation fuel has been growing, with increasingly adverse impact on the balance of payments. In this context, the substitution for fossil fuels of renewable energy options such as small hydro, farm biomass, biogas (and, to a limited extent, wind, solar, and geothermal energy) resources needs to be promoted. The adjustment of priorities towards small hydro, biogas, and similar renewable energy resources is a prerequisite to move from singular reliance on forest energy resources, which has caused deforestation and ecological damage.

Inaccessibility and scattered settlements make small-scale, decentralised energy development more attractive than centralised energy supplies, such as grid electricity, large-scale biogas plants, and similar large - scale modern energy units. Significant progress has been achieved in small hydropower development in India, Nepal, Pakistan, and Sichuan and Yunnan in China. Small hydropower has been found cost - effective when adapted to allow use of local construction techniques and resources. Also, hydraulic rams have proven to be the cheapest means of lifting water for irrigation and drinking. It has been found that costs can be further reduced by promoting indigenous designs, local fabrication of equipment, and utilising local civil work designs. Considerable improvements in load factors can be achieved in small hydel units, by the integration of energy demands from food processing (mills), lift irrigation, cottage and small - scale industries, with lighting load. The improved profitability of integrated small hydel development schemes

provides an opportunity to draw private sector investments into small hydel development and to launch such schemes in a self - sustaining manner. The provision of low - interest loans, through various credit institutions to farmers' groups, individual entrepreneurs, and equipment manufacturers, has played a significant role in the promotion and dissemination of small hydro units in the Region (e.g. Nepal, China, and to a certain extent, India and Pakistan). The potential contribution of small hydel development towards agro - processing, cottage and small - scale industry development, and off - farm employment generation can be significantly increased through integration with other sectors.

Fuelwood - scarce mountain communities utilise crop residues, animal dung, and agricultural wastes for cooking and heating. The conversion of farm biomass and dung into biogas provides an improved alternative to direct burning, as biogas manure retains most of the valuable nitrogen nutrients. But the scope of biogas development in the mountains is limited to the lower valleys which have a warm climate. Limited experiences with biogas plants in the mountains to date indicate that water and dung scarcity is a major problem apart from low digester efficiency. Hydrams and turbine pumps can provide the needed water at low cost if resource potential exists nearby. However, the most binding constraint to biogas development arises from fodder and grazing limitations, and low levels of dung collection due to the migratory pattern of livestock rearing. Stall feeding and/or improved organisational methods for dung collection and biogas distribution are necessary for the development of large community biogas plants, which may exploit converted internal combustion engines to provide motive powers for grain mills, irrigation pumps, and electricity generation, for example.

The potential for wind, solar, and geothermal energies are location - specific. This and their generally high costs imply that applicability is limited to special use in particular geographic areas. Considerable scope, however, exists in utilising solar energy, for uses such as water heating and grain drying, and photovoltaics for communication equipment. Wind energy has been used for lifting water and electricity generation on a limited basis in the mountains. Geothermal energy resources have been exploited to some extent on the Tibetan plateau.

Energy development efforts do not satisfactorily deal with existing energy interrelations. Studies of shifting cultivation in the eastern Himalaya, and mountain agriculture in general, indicate that energy flows in traditional subsistence activities are highly complex, requiring carefully designed energy development strategies which are economically and environmentally sound. In attaining an energy (supply and demand) balance, it is necessary to incorporate the spatial dimension in energy planning. The concept of regionalisation becomes a necessary construct in dealing with the topographical, ecological, and environmental diversity in the mountains. Multilevel energy planning based on regionalisation, and energy extension based on micro-experiments, are needed for rapid dissemination of rural energy innovations.

Institutional and Organisational Constraints in Integrated Energy Development

Lack of implementation of well - conceived energy policies is typical of energy development in most of the Region. No specific executing institutions in Bhutan, Nepal, or Tibet may be considered entirely responsible for energy planning and development. Energy - related activities of government departments, research and credit institutions, private and public enterprises, and external donor agencies are often coordinated by a national level planning agency, which is not an executing institution. Thus, energy plans and policies are often formulated from a macro - perspective and suffer from lack of microlevel specificity during implementation. In a majority of countries in the Region, a clear gap exists between microlevel energy programme implementation and the macrolevel plan and policy formulation. The energy planning process does not extend to the lower levels where specific energy projects and programmes have to be identified and examined for implementation and management.

In the context of new decentralisation policies that have been gathering momentum, decentralised energy planning can provide a means to overcome energy development constraints arising out of the weak functional linkages between national institutions engaged in planning, and implementation of energy programmes. This need for a decentralised energy planning and management approach was crystallised during a meeting of Indian energy professionals held at ICIMOD, in January 1986.

There is a need to strengthen the decentralised energy planning process, to build planning and implementation capabilities, particularly to promote energy sector investments, and to develop materials based on field experience which could enhance the effectiveness of training in the energy sector. Although the exact mechanism for implementing the proposed collaborative work has yet to be determined, the present report is oriented towards a discussion of problems and issues and a proposed action programme.

Workshop Discussions

The International Workshop on District Energy Planning and Management for Integrated Mountain Development explored the concept of energy - centred integrated mountain development. As shown in the Workshop Programme (Annex I), presentations and discussions were divided into five sessions : (1) District Energy Planning Framework : Problems and Issues, (2) Fuelwood Crisis and Solutions, (3) Non - Wood Energy Options, (4) Energy Intersectoral Relationships, and (5) Planning and Policy Issues (Refer Annex 5 : Summaries of Papers).

District Energy Planning Framework

The first paper in this session, presented by T. M. Vinod Kumar, argues that district energy planning provides a bridge in overcoming limitations posed by micro and macrolevel planning. Systematic and decentralised planning and management are necessary and must be supplemented by flexible procedures for release and transfer of funds, coordination with state and sectoral plans, and monitoring, review and evaluation. The methodology is aimed at changes in resource flows by application of additional sources of energy to improve access to basic needs, increase employment opportunities and promote equitable distribution of income. A multilevel spatial planning approach is advocated to take into account the hierarchies of market service centres and dependent villages, while emphasising supply - receipt relations of various components.

Supplementing the above framework, Dr. Deepak Bajracharya advocated in his presentation the need to incorporate users' perspectives in district energy planning. He highlighted, through field experience, how villagers' perceptions are influenced by subsistence living conditions, existence of inequality, agro - ecological variation, and sociocultural diversity, and how energy may not be perceived as the highest priority when compared with other problems. Participatory action research is suggested as an approach for implementing innovative alternatives in harmony with indigenous knowledge systems and local organisational strengths. The role of the catalytic agent is emphasised in the process of transformation to foster interactions between external resource agents and village residents and to promote active negotiations among them. He concluded that this type of approach presents opportunities for overcoming politico - administrative constraints as manifested by existing top - down biases, technological determinism and inflexible and uncoordinated bureaucratic structures.

In the discussions following the presentations, the issue of whether energy is the top priority in rural development emerged. Though energy is not perceived as a pressing problem in some areas, rapid environmental deterioration throughout the Region calls for raising awareness and taking immediate actions. The existing dichotomy between energy and other problems is not beneficial to meeting the overall challenge of rural development. A holistic, integrated approach is essential, and must be implemented systematically.

Questions were raised regarding how broad the topic of energy should be. The argument was made that while it should include food, human energy, and draught power, the risk of becoming so comprehensive as to lose focus for implementation must be avoided.

The availability of energy technologies generally poses no problem. The challenge is to determine the right mix of technologies to fit location - specific conditions and disseminate them in accordance with villagers' aspirations and priorities. Fixed packages resembling those of the "green revolution" are not suitable.

It was agreed that people's participation should not be pushed so far as to suggest that every action ought to be decided by an opinion poll. Implementation with regard to village - specific problems can be participatory, but planning might have to be done at the district level to meet administrative requirements. The important challenge is to provide a bridge between micro - and macro - approaches so that interaction can take place.

Fuelwood Crisis and Solutions

Dr. S. P. Singh presented the first paper, which emphasised the need to take an ecosystems approach. The author argues that the Central Himalaya has become ecologically unsustainable. A protective system is advocated to encourage additional forest cover and discourage pastoral systems and crop cultivation. In terms of productivity in energy units, the model advocated above is demonstrated to be much more efficient. The major prerequisite is to develop mutualistic relations between the populations in the mountains and the plains. The latter would, in this model, provide food energy in exchange for the revival of forest cover in the mountains, thereby providing protection from hazards of peak floods and siltation of water bodies. Alternative energy schemes such as solar cookers and pumps, improved cooking stoves, microhydel installations, and geothermal energy are also deemed necessary in this endeavor.

Wang Shizhong, in the second presentation, showed how relevant energy techniques are developed in China through fundamental research in laboratories with inputs from scientists and engineers from different institutes. Selected techniques are subsequently tested in "energy villages" to see whether they can be incorporated for comprehensive use in the villages

and how they fit local conditions. If they should prove successful under field conditions, commercialisation of the product is promoted on a large scale. Local manufacturers and entrepreneurs are provided with technical information including drawings and design specifications through special training programmes. Rural household members are at the same time educated and encouraged to adopt new products.

In Dr. Kk. Panday's paper, he emphasises the need to reconsider the fodder problem, stating that there is a tendency to overlook this aspect while considering deforestation. The paper highlights the important role of rural people in planting forest and fodder trees. Examples are cited from Nepal, to show how farmers have successfully organised locally to protect natural systems. The need to bring community forestry from the village panchayat level to individual communities is stressed. Considering the projected increase in ruminant animal population by the year 2000, emphasis is placed on the need for active and effective government response to people's programmes. Case studies concerning the manufacture of dairy products are described to show how fuelwood requirements led to deforestation. This has not, however, impressed planners sufficiently to encourage appropriate measures.

The last paper of the session was presented by Dr. T. B. S. Mahat. The paper highlights the role of hill farmers in preserving and improving the fragile environment of the Himalaya, emphasises that forest biomass is the main source of energy, and argues that it will remain so for several decades to come. Alternatives suggested so far are too expensive to be taken seriously as viable substitutes. The confusion caused by widely varying data on forest and forest biomass was also mentioned. The need for a reliable data base is stressed, and the need to extend community forestry programmes to government - owned land from common land is emphasised. The speaker also advocated promotion of better management of existing forests. Considering the gross inadequacy of the resource base for meeting rural needs, the paper highlights the role of agroforestry in solving rural energy problems.

A lively debate took place concerning the proposal that the exchange of wood from the mountains with food from the plains must be promoted. Objections were raised that this ignores sound practices regarding agroforestry and agricultural systems practised in the mountains. It was argued that greater dependency of the mountain people on the plains people would be created. Mountains are not homogenous. There are areas where specific types of cropping are suitable. Valleys and sound terraces do exist where efficient agricultural systems have been practised for ages. Selective choice of areas where the proposal would be implemented is clearly necessary. Given the vulnerability of the mountain ecology, however, radical alternatives might have to be considered. Suggestions were made that pilot projects utilising action research methods be tried out, particularly with respect to marginal agricultural areas.

The point was raised during the discussions that exotic fast - growing species, such as *Leucaena Leucocephala*, have not done well in the mountain

region. Greater emphasis should be given to systematic scientific studies on indigenous fast - growing species under various climatic and soil conditions. The use of these trees for producing hydrocarbon is debatable. A systematic study on indigenous fast - growing species was reported from Tata Energy Research Institute in India. Exchange of information and sharing of experiences between countries would be valuable in this regard.

An important issue was raised concerning reluctance of donor agencies to invest in agricultural development in the mountain / hill areas. Their perception is that much of the agricultural land is of marginal nature and hence the return is less promising. This is most unfortunate, given the increasing problems caused by the inability to produce enough food crops to cope with mounting population pressure.

Questions were asked about the importance given to fuelwood production in China. In general, greater emphasis is placed on the use of animal waste for fuel production and the forests are preserved for maintaining ecological balance. The situation in mountain regions such as Tibet may be different. The Seventh Five - Year Plan includes the extension of energy testing villages to Tibet.

People's participation was again discussed. It was felt that village - level activities should be increased and that governments be more responsive to people's programmes. This will help change top-down planning approaches in efforts to improve rural quality of life, including satisfaction of energy needs. Local people's knowledge of local resources, particularly of indigenous fast - growing species, must be utilised and greater efforts should be made to identify suitable local species for fodder and forest plantations.

Non - wood Energy Options

Two papers on micro and minihydro were presented in this session, along with one on geothermal energy. Dr. D. P. Sen Gupta pointed out that despite great potential and obvious benefits, micro and minihydro projects have received low priority. Big hydel projects continue to get attention, as evidenced by the increase in capacity from 2300 MW in the late 1940's to 46,000 MW today. The proportionate increase of small projects is much lower, (e.g. from 40 MW to 168 MW). The apparent reasons are that decentralised small hydel projects are expensive because of problems of access and absence of infrastructure in mountain areas. In addition, the load factors tend to be low. Most importantly, however, the Central Electricity Board gets much less return from small projects than from big schemes. This points to the need for a separate small hydel board whose primary task should be to promote small projects. An important factor to be considered in their promotion are the social benefits derived.

Dr. M. Abdullah focused on the proven benefits of small hydropower. He stressed the need to adopt a nonconventional approach to such development, whereby maximum efficiency and high costs are compensated by moderate efficiency and much lower costs. The nonconventional approach emphasises community involvement, greater innovations and use of local materials. A case in point is the efforts of the Appropriate Technology Development Organisation of Pakistan to develop and disseminate hydropower technology in the villages of the Northern and North West Frontier Provinces. By relying on people's participation and local resources, benefits such as increased awareness of the development process, employment generation ; and low costs accrue. Experience suggests that small microhydro schemes, if implemented along nonconventional lines, offer the best solution for remote areas.

Zhang Mingtao reported that approximately half of the national hydrothermal zones lie in the Himalaya - Hengduan Region. Geothermal resources have been exploited in Yangbaijan field, northwest of Lhasa, since 1975. This provides 60 - 70 per cent of Lhasa's energy needs during winter. Potential is high for geothermal development for Xigaze, Shiquanhe, Naggu and twenty other residential areas. Power for processing livestock products at Ganzi, wool products at Kangding Wool Mill, and tea and rubber processing in southern and western Yunnan are examples of how geothermal energy has been used.

During the discussions it became clear that a common characteristic in rural areas of the Hindu Kush - Himalaya is very low load factors, which indicates the tremendous subsidy required for rural electrification. Furthermore, grid extension is not always possible and is often cost - prohibitive for mountain villagers. Along with open subsidies are hidden subsidies and this is true for urban electrification as well. However, for harried government officials, electrification is an easier option than development of alternative energy sources. For national planners, small isolated projects attract little attention. For these reasons alone, other options are often ignored.

To overcome low load factors, an approach is to start with end use planning. Microhydel installation then should include concurrent development of other schemes for increased agricultural activities and horticulture, and promotion of small - scale industries. Such an approach would require credit arrangements and other incentives for comprehensive schemes.

Energy Intersectoral Relationships

Dr. Pachauri began by presenting an approach for examining energy-employment interrelations. He suggested a time allocation approach would be suitable, as it permits examination of changes in household labour time allocation on account of changes in other variables like travel time, wages, prices of raw materials, and resource availability. As far as time allocation to energy is concerned, it was pointed out that the growing fuelwood crisis would

result in shifts from other activities, with consequences for household income and output. More work is required to understand these relations.

Other issues raised were the possibility of increasing agricultural employment based upon expanding the coverage of the "green revolution" and the significance of off - farm activities in general, and particularly for women, whose nutritional status is relatively low compared to that of men. The need for greater understanding of the consequences of growing energy scarcities in hill economies, the role of forests in sustaining employment generation in the hills, the need for investments in development of technology and skills, and the search for measures to improve the socioeconomic status of women were emphasised as issues deserving greater attention in the future.

Dr. Sharma and Dr. Bhadra argue that changes in energy - based inputs per unit of land and outputs for some hill areas indicate substantial increases in energy consumption with little change in output. The increasing energy intensity of agriculture has significant implications for deforestation, substitution among energy inputs, distortion in choice of technology, and financial liability for the government. It is argued that measures to remove market distortions, promotion of research on intercropping, and enhancing efficiency of energy use are critical. The appropriateness of the extension system must also be evaluated.

The second part of the presentation emphasised the need to examine the potentials for multiple use of any energy technology. Given the problems of access in the hills and the consequent transport costs, it is necessary to explore the potential for production of fertiliser using electric power. Although initial experiments in Nepal have not been encouraging, further work is needed in this critical area.

Dr. Huang Zhijie explained that biomass is the major source of energy for rural areas and will continue to play a critical role in the future. It is therefore necessary to identify ways by which available biomass can be used as efficiently as possible. Direct use of biomass as energy or as fertiliser is not as efficient as when it is used to diversify rural production through integration with livestock, fisheries, and even useful insects. Examples of such diversification using the biogas system currently in practice in China were highlighted. It was pointed out that all available energy inputs should be used efficiently so they are mutually complimentary.

A detailed analysis of *jhum* (slash and burn) agriculture as practised in northeastern India was provided by Dr. Ramakrishnan. A 10 - year cycle was argued to be the most desirable in terms of sustainability. Population increase and dispersion have, however, been instrumental in reducing the *jhum* cycle to four or five years. The ecological balance is consequently distorted. Serious and urgent attempts are needed to bring about an appropriate transformation. Economic activities need to be diversified through the promotion of horticulture and plantation crops, intensification of animal husbandry practices and improvement of agroforestry systems. The challenge lies in

public intervention for development programmes in which government agencies act as catalysts and the local people take part in design and implementation. The importance of using the village as the focal point and involving the people as much as possible in any decision making affecting the development of the area was emphasised.

Questions were raised during the discussions about the sustainability of the slash and burn system to support a growing population. It was argued that despite its efficiency in using natural processes to restore soil fertility, it is fundamentally a low - density system, increasingly unable to cope with growing demands.

The point was made that it is insufficient to concentrate on shortages of water and nitrogen in hill agriculture ; shortages of other non - nitrogen nutrients exist. The availability of organic manure is critical for providing these nutrients.

The fact that China has started energy schools where children are being exposed to energy problems, options, and potentials is an innovative approach which aroused much interest among the participants.

Planning and Policy Issues

The first presentation, by Wang Hai, illustrated the fact that the traditional fuels of animal dung, fuelwood, and grass account for three - quarters of the energy consumption in Tibet. Eighty per cent of the energy is used in the domestic sector. This pattern poses a continuing threat to ecological balance. Absence of coal, oil, and gas contributes to a 70 per cent dependency on external energy resources. The plan is to orient energy development to parallel economic development. Policy guidelines include : creation of a prosperous economy, reliance on private and collective enterprises according to market trends, open door policies, and maintenance of autonomous status. Emphasis is on development of agriculture and animal husbandry, as well as mining, tourism, and service industries. Low education levels and difficulties in disseminating scientific and technical advances need to be overcome.

Priorities are accorded to establishment of electricity supply facilities for use in the domestic sector and light industry. The region has the highest hydropower potential in the country, and geothermal and solar potentials. These resources, plus wind energy, should be exploited. Emphasis is on small - scale construction to suit local conditions. Together with efforts to improve technologies, the government will continue to provide assistance for energy development. The application and popularisation of fuelwood forests, improved stoves, and biogas generation should be promoted.

Ganesh Ram Shrestha emphasised the urgent need to develop cheap and reliable sources of alternate energy including microhydro plants, biogas plants, and improved cooking stoves. Water and biomass constitute the major sources of renewable energy in Nepal. Decentralised energy planning can be adopted as the means of involving local people's participation, mobilising local skills and resources, and strengthening private sector enterprises, which are all important for successful alternative energy development. The experience of the Agricultural Development Bank of Nepal in relation to the Small Farmers Development Programme and Appropriate Technology Unit was explained in this context.

One fundamental question which emerged repeatedly during the discussions is, " Energy for what? " Energy development is not synonymous with development ; it is a part of the process. This process must be strengthened and made flexible for decentralised planning and management. Major public sector resources are required for energy development. Currently, national and local levels of administration are emphasised ; a middle level must now be sought. It may be most appropriate to call this "decentralised level planning" rather than "district level planning" given the variation existing in the Region.

Many considerations complicate the relatively straightforward goal of supplying energy in an economically and ecologically sound manner to promote rural development. The lack of planning capability at the district level, restrictive sociopolitical structures, power and resources in central line agencies, absence of sectorial interlinkages at all levels, and limited private sector investment capacity are a few examples. Regarding district level energy planning and management, it is idealistic to have energy specialists in each district. Concurrently, planners in central energy development institutions are unable to accurately assess the needs for appropriate development. Integrated extension workers, who can judge needs at the village level, obtain technical assistance from a variety of sectoral agencies, bypass mid - level bureaucratic procedures, and identify ongoing trends and local efforts deserving of government support, provide a possible solution to some of these constraints. Another fundamental question is, " How can political will be influenced?" It is not enough to stress the importance of energy development, or to raise awareness. Demonstration - cum - production centres such as China's energy villages, in areas with high potential, can effectively prove the importance of energy within the socioeconomic system. Although conflicts of interest may exist between national, district, and local level planners, planning needs to be carried out at all levels. Conflicts should be anticipated and diffused.

Existing programmes are highly fragmented within relevant agencies. Lack of integration within and between agencies confuses villagers and has led to fiascoes such as increased and improved goat herds eating all the increased and improved fodder. Rural development planners need integrated extension training ; involvement of non - governmental organisations is recommended. Research and planning for animals and fodder production are often ignored in national planning, and should be included.

People's participation at the local level is essential. Means to mobilise local level involvement include credit allocation, profitable employment opportunities, and discussion with local leaders. Provision of credit on a package basis (e.g. livestock and biogas plants) has proved effective in Nepal. This credit is extended to farmers through Appropriate Technology Units made possible by Nepal's Decentralisation Act. Also, the Small Farmers Development Programme has proved that small farmers can effectively organise themselves for credit extension and programme implementation.

Training is an important part of successful decentralisation. As people in rural areas often regard government planners with suspicion, it must be ensured they perceive that their well - being is of major concern. Education of young people is effective. Monitoring and evaluation are critical for feedback to improve technology and management systems; existing village studies need to be analysed and district level planning experiments carried out.

In order for rural energy planning to benefit a majority of the population, local incomes need to be raised to allow investment in energy. Provision of indirect subsidies (e.g. at the manufacturing level) can be effective. While localised successes such as energy villages cannot be expected to have a spread effect without central level planning toward this end, it is important for specific actions to be taken for particular areas. Waiting for the best approach or searching for the right preconditions may stand in the way of development of extension programmes necessary for integrated rural development.

Looking Ahead

The concerns expressed during the Workshop about the present gap in knowledge and understanding of different aspects of energy problems, causes, and solutions, imply a definite need for further applied research and training. Similarly, general consensus and recommendations about a framework and approach towards decentralised energy planning and management have evolved; however, specific methodological and operational details are to be further elaborated.

In looking towards the future, the two broad areas of planning methodology and applied research represent potential contributions by ICIMOD and other institutions, which are committed to energy - centered rural development in the mountains. Research and training priorities for rural energy development in the mountains are broadly indicated below, and are followed by the prospects for an action - oriented, district level energy planning and management approach in the Region.

Research and Training Priorities

The Workshop identified the following broad areas for research and training :

- Policy Analysis and Planning
- Energy Linkages with Other Sectors
- Monitoring and Evaluation

Policy Analysis and Planning. A more effective planning and policy framework requires a multilevel spatial planning approach through participatory methods. Applied research is needed to understand the role of catalytic agents in promoting participation and determine the needed training of such catalysts. Another important research area relates to the integrated approaches of technology development and dissemination, as exemplified by the Chinese energy village approach. How can these approaches be transferred elsewhere so they are consistent and complimentary to local types of multilevel energy planning ? What are the institutional and organisational innovations necessary for large - scale commercialisation of appropriate energy technologies ? An appropriate applied research programme can help answer these questions. Similarly, impacts of energy pricing and subsidy policies constitute another priority area for policy research.

Energy Linkages with Other Sectors. At present, discernible data and information gaps exist regarding the relations between energy and other sectors. Research is needed to analyse the continuing changes in energy-employment, energy-agriculture, and energy-industry linkages, so that it becomes possible to assess the consequences of energy scarcity on the growth of non-energy sector incomes and employment. Research can also help explain the energy implications of developmental changes in agriculture, industry and other sectors. Furthermore, it is necessary to look into approaches for concurrent and complimentary development of small and cottage industries, agriculture and energy sectors, to evolve methodologies for end-use energy planning, and to examine the potentials for multiple use of energy technologies. There is a need to assess methods of designing appropriate packages of energy technologies and their scale of operation, for specific local energy needs and energy resource endowments.

Monitoring and Evaluation. Monitoring and evaluation of various energy projects, such as biogas, community forestry, and improved stoves are presently ineffective or entirely lacking. Applied research in these areas can help towards the design of more effective methodology to carry out such monitoring and evaluation activities. Appropriate and timely feedback on technological and institutional problems is presently not available to research and developmental institutions and implementing agencies.

District Energy Planning Prospects

The district development planning approach has been accepted and is being practised in the Hindu Kush - Himalaya Region. The challenge now is to integrate energy with district development incorporating rural energy planning with the emerging and ongoing district level planning process. Undoubtedly, China's energy villages and India's rural energy centres are noteworthy pioneering efforts. However, effective political, administrative, and implementing structures generally exist at the district level, not at the village level. There is scope for promoting additional investment in energy, developing guidelines for district (or equivalent level) energy planning and management, and strengthening district energy planning and implementing capabilities.

Although planners and engineers work with well - tested technologies, they are often not in a position to adopt the latest scientific advances. Applied research is required to incorporate these in their designs.

During the first phase of ICIMOD's rural energy planning programme, consultations in China, India, Nepal, and other countries in the Region were held, and cooperative action was initiated. The objective of the programme has been specified as : **assisting the countries in the Hindu Kush - Himalaya to strengthen their capacity to plan rural energy at the district level within the framework of integrated mountain development and improved management of mountain resources.**

The main emphasis of such a programme would be energy for integrated development, giving due importance to conventional, non - conventional, renewable, non - renewable, commercial, non - commercial, internal, and external sources of energy within the context of decentralised development.

District energy planning and management is visualised in conjunction with integrated area development. Energy technologies would be designed for accelerated socioeconomic development. Such energy planning would demand a high degree of autonomy in decision making at the district level and strengthened participation by politicians, administrators, financing organisations, and beneficiaries.

Areas of further work discussed in the Kathmandu Workshop include food and energy, energy in agriculture and irrigation, energy for production systems, energy planning for human settlements, sharing of knowledge on indigenous fast - growing energy plantations in the Hindu Kush - Himalaya Region, links between forestry management and energy planning, and implementation of energy villages.

Programme Objectives

Programme objectives designed in consultation with the participating countries include :

- Strengthening the district planning process by integrating rural energy planning
- Building capability for decentralised energy planning, for better utilisation of investment in energy at the district level
- Developing practical guidelines for district energy planning and management which could be used as training materials for district planners and implementors

Regional Cooperation

Such a programme can best be executed jointly by energy research institutions and development planning institutions. Further regional cooperation is highly desirable ; many combinations are possible in the Hindu Kush - Himalaya. Since October, 1985, ICIMOD has had several consultations with :

- Division of Science and Technology, Planning Commission, Royal Government of **Bhutan**
- Appropriate Technology Development Organisation, and Pakistan Institute of Development Economics, **Pakistan**
- Water and Energy Commission, Agricultural Development Bank, and Agricultural Projects Services Centre, **Nepal**

- Tata Energy Research Institute, and School of Planning and Architecture, New Delhi, India

- Energy Research Institute, Institute of Rural Development, and Commission for Integrated Survey of Natural Resources, China

Selection of Study Districts

Preliminary surveys and district selection have been attempted, though these are in no way considered final. The following criteria were utilised for tentatively identifying study districts :

- Agro - ecological and altitudinal variations (may include predominant activities such as animal husbandry, grazing, shifting cultivation, sedentary agriculture, urbanising regions and/or plantation economy)

- Levels of socioeconomic development as indicated by selected demographic and socioeconomic indicators

- Accessibility to markets, technologies, and services

- Varying energy constraints and potentials

- Presence of rural development programmes and projects

Indication of the selected districts for all countries at this formative stage of the programme is premature. This is ultimately the responsibility of the concerned governments. As an example, China has indicated the following counties: Neimo or Dingri County in Xi Jian Province, Ningnan County in Yunnan Province, and Teng Chong County in Sichuan Province.

Programme Funding

The Commission of the European Communities and other funding agencies have shown considerable interest in the energy programme of ICIMOD.

A six - month participatory trainers' training programme is to be conducted in China, India, Pakistan, Nepal, and Bhutan. Intensive field - oriented training is to be designed for ten professionals from those countries drawn mainly from potential training institutions. They would utilise the available training materials with the help of subject matter specialists to formulate a broad approach to district energy planning and management. This would help the participants to delineate district energy problems and issues, evolve strategies and policies, and use analytical procedures.

This would be followed by four months of fieldwork, analysis, and report writing based on studies conducted in the selected districts. ICIMOD staff, in addition to organising this programme, would assist in giving field supervision, guidance, and adopting methodologies for the mountain regions.

An international trainers' workshop would be held in Kathmandu to be attended by national and state level decision makers, in addition to the participants. This meeting would be utilised to present the prepared plan, utilising the methodology. Hence this meeting would promote the importance, rationale, and methodology of district energy planning and management.

A project of this duration can only be a preliminary attempt at pretesting methodologies already available. However, it is important to develop a specific methodology for mountain regions. This may involve collection and analysis of primary data from sample clusters of villages and development in district energy planning and management. This may be considered ICIMOD's Phase II effort on District Energy Planning and Management. A clear idea is expected to emerge from the case studies developed during the scope of Phase II activities.

Phase II Programme on District Energy Planning and Management

A two - year programme is envisaged for the second phase activities of the District Energy Planning and Management Project. This would have a substantial field research component in which primary data would be collected and analysed. As a regional project, about ten representative districts would be covered from the Hindu Kush - Himalaya Region. The approach would be to make the available survey research methodology more efficient and less time - consuming and to develop newer appropriate analytical methods. Experience gained from the project would be utilised to prepare the case studies and guidelines for district energy planning and management. The project would be designed based on reviews of the Phase I project.

The major output expected from this project would be :

- Regional cooperation to train trainers in district energy planning and management
- Standardisation in resource inventory, survey research, and analytical tools for planning
- Ten district energy plans as case studies
- Guidelines for district energy planning and management

Annex 1.

Workshop Programme

DAY ONE

Opening Session

Welcome Dr. Colin Rosser
Director
ICIMOD

Opening Dr. Ratna S. J. B. Rana
Chairman, ICIMOD
Board of Governors

Introduction to the Workshop

T. M. Vinod Kumar

Session I

District Energy Planning Framework : Problems and Issues

Chairman Wang Hai

District Energy Planning and Management for the Indian Himalaya
T. M. Vinod Kumar

Users' Perspectives for District Energy Planning
Dr. Deepak Bajracharya

Session 2

Fuelwood Crisis and Solutions

Chairman Dr. K. L. Shrestha

Energy Use Pattern and Environmental Conservation : The Central Himalaya Case
Dr. D. D. Pant and Dr. S. P. Singh

Survey of Rural Energy Studies in the Academia Sinica
Wang Shizhong

Fuelwood and Fodder in Nepal : Problems and Prospects
Dr. Kk. Panday

Rural Energy from Forest Biomass in Nepal
Dr. Tej B. Mahat

DAY TWO	DAY THREE
Session 3	**Session 5**
Non - Wood Energy Options Chairman Dr. M. A. Hossain *Potentials for Mini and Microhydel Projects in the Himalaya* Prof. D. P. Sen Gupta *Small Decentralised Hydropower for Rural Development* Dr. M. Abdullah *Geothermal Energy Resources in the Himalaya - Hengduan Region* Zhang Mingtao and Tong Wei	**Planning and Policy Issues** Chairman Prabhir Sengupta *Role of Private Sector in Decentralised Energy Planning :* *Alternate Energy Technology Options* G. R. Shrestha *Plans and Policies for Energy Development in the Autonomous Region of Tibet* Wang Hai
Session 4	**Concluding Session**
Energy Intersectoral Relations Chairman Dr. M. Abdullah *Energy, Employment and Rural Development in the Mountain Areas of India* Dr. R. K. Pachauri *Food - Energy Relations in Nepal* Dr. S. Sharma and Dr. B. Bhadra *Energy and Rural Production System* Dr. Huang Zhijie *Energy Flows and Shifting Cultivation* Dr. P. S. Ramakrishnan	Chairman Dr. Colin Rosser Panelists Wang Hai Dr. K. L. Shrestha Dr. M. A. Hossain Dr. M. Abdullah Prabhir Sengupta

Annex 2.

ICIMOD Rural Energy Planning Programme

Working Papers

Samuel P. Mauch	Destruction of the Margin Process : Dynamics of Interaction between Rural Production, Energy Related Resource, and Rural Development
Ji Xiao Yun	Issues of Mountain Development in China
Binayak Bhadra	Food and Energy Interrelations in Nepal : Policy Issues and Research Objectives
T. M. Vinod Kumar	Micro-Experiments and Macro-Applications for Rural Energy Planning and Implementation in the Mountains
T. M. Vinod Kumar	Methodological Notes on Multilevel Rural Energy Planning for Mountainous Regions
D. Bajracharya	District Energy Planning Policy Issues and Planning Framework

Annex 3.

Background Papers :

Country State - of - the Art Reviews

CHINA

Energy Institute of the State Economic Commission and the Chinese Academy of Sciences

- The Status and Future Prospects on Rural Energy in the Southwestern Region of China
- Report on the Tibetan Autonomous Region in China
- The Survey Report of Rural Energy Resources in Yunnan Province, China

Feng Yao-Zong	An Effective Way to Resolve Energy Resource Problem in Mountain Regions
Huang Jhijie and Han Yinghua	Survey of Rural Energy in Sichuan Province
Ji Xiao Yun	Application of Chinese Biogas Technology in Nepal: An Evaluation
Li Zhou Sesheng Dong Jianguo and Yang Guang	Research on Matching Mixture Patterns of Grasses/Shrubs/Trees of Fire Wood on the Loess Plateau of China
Liu Ke-Xin	Exploitation and Application of Biogas in the Transverse Mountain Region of Sichuan Province
Zhangm Song-Yun	The Study of Fast-Growing and Disease - Resisting Genetic Breeding of Larch

INDIA

Sushil C. Agrawal	Energy Technology for Himalayan Development: Prospects for Community Biogas Plants
S. Manzoor Alam and Mazid Hussain	Energy Scenario in the State of Jammu and Kashmir

L. S. Bhat	Sub - Regionalisation of the Himalaya
Ashok Gadgil	Energy Technologies for Mountain Development
Ramachandra Guha	The Himalayan Eco-Crisis : A Historical and Socio-Political Analysis
P. N. Gupta	Interpretation and Use of Landsat Imagery for Resource Planning in the Himalaya
Vinod Gupta and Ranjit Singh	Energy Conservation in Traditional Buildings in the Mountains
T. M. Vinod Kumar	Micro Experiments and Macro Applications for Rural Energy Planning and Implementation in the Indian Himalaya
T. Mathew	Status Paper: North - Eastern Region
J. P. Painuly	Energy Demand and Supply in the Indian Himalaya
Dharam Singh	Hydraulic - Ram and Its Uses in Hill Areas
Padma Vasudevan and Santosh	Role of Women in Energy Related Activities in the Mountains
Varun Vidyarthi	Local Participation in Rural Energy Development Programmes

NEPAL

Devendra B. Amatya	Forest Fuels
D. P. Joshi	Crop Residues (Agroforestry and Farm Biomass)
Khilendra N. Rana	Fossils Fuels
Hari Man Shrestha	Hydro Energy Sector
Ganesh Ram Shrestha	Rural Energy Development Institutions and Organisations in Nepal
Sidhartha Tuladhar	Biogas Energy

PAKISTAN

M. Jamil Mahara	Application of Biomass for Mountain Development
I.H. Shah	Solar Energy Applications for Mountain Communities

Annex 4.

Summaries of Papers Prepared for the Workshop*

SMALL DECENTRALISED HYDROPOWER FOR RURAL DEVELOPMENT

M. Abdullah

For socioeconomic development of rural areas, electrical energy must be made available. The conventional method of rural electrification by extending national grids has not benefited rural people due to limited funding and low prioritisation. Relative simplicity, absence of fuel purchase and low maintenance costs make hydropower attractive for mountain communities.

Development of small hydropower plants has two main purposes : improved quality of life and improved productivity. The supporting institutional arrangements vary from country to country, but two general approaches are centralised and decentralised. The main issue in the selection of development approaches is the trade - off between cost and performance. Planning and implementation of small hydropower projects as scaled - down models of large hydro projects may lead to excessive costs. Small decentralised hydropower matches the needs, resources, and capabilities of local communities, and thus is geared toward comprehensive rural development.

Small hydropower has the advantages of being a well - developed technology where mechanical power can operate all machinery, being based on renewable energy resources with no adverse effect on the environment, and being amenable to local implementation and management. While the capital investment for a conventional hydropower installation is high, small capacity power is sufficient for rural communities' needs. For example, with 20 kw capacity, agro - processing units can be operated by staggering loads, and lift irrigation can be undertaken by operating lift pumps at night.

Although social cost/benefit analysis must be considered in association with economic analysis, one of the main constraints is investment. Cost reduction can be achieved through civil engineering approaches (e. g. indigenous fabrication, use of pumps as turbines and electronic load controllers). As hydrological study is the basis for determining economic feasibility, methods need to be developed for obtaining reliable estimates of flow at ungauged sites. A simplified analysis is recommended in which estimation of the physical characteristics of the potential plant, including stream flow and available head, is the main focus.

The Appropriate Technology Development Organisation, started in 1975 by the Government of Pakistan, has a programme to develop and disseminate hydropower technology, relying on local resources. Benefits such as increased awareness of the need for development, and employment generation, have accrued from this approach, along with cost reduction. Experience suggests that small microhydro schemes, if implemented along unconventional lines, may offer the best solution for remote rural areas.

* Not all authors have had the opportunity to comment on the summaries presented here ; ICIMOD has tried to reflect as accurately as possible the major points raised by the authors.

USERS' PERSPECTIVE FOR DISTRICT ENERGY PLANNING

Deepak Bajracharya

The recognition that perspectives of beneficiaries and users must be considered in district energy planning represents a leading edge in "third generation" activities concerning rural energy research and development. Villagers' perceptions and priorities are influenced by their subsistence living conditions, existence of inequality, agro - ecological variations, and socio - cultural diversity.

The participatory action research approach is advocated for implementing innovative alternatives in harmony with indigenous knowledge systems and local organisational strength. This approach also presents opportunities for overcoming politico - administrative constraints as manifested by the existing top - down bias, technological determinism, and inflexible and uncoordinated bureaucratic structures. The role of the catalytic agent can effectively foster interactions between external resource people and village residents, and promote active negotiations for achieving transformation.

ENERGY AND RURAL PRODUCTION SYSTEMS IN CHINA

Huang Zhijie

Energy use in rural China is predominantly direct burning of biomass, which threatens ecological systems. Significant progress has been achieved through improved stoves, but biomass burning is incapable of satisfying the diversified demands of rural development and transformation.

Theoretically, biogas presents the most satisfactory energy utilisation for an efficient agricultural ecosystem. To improve the economic impacts of biogas, comprehensive systems of material - feed - fuel - fertiliser linkages are being developed. Further studies are needed.

Small hydropower resources are important for rural electrification programmes and have contributed to an increase of 11 per cent from 1979 to 1984 in rural household electricity. In areas with coal resources, cheap loans, appropriate services, marketing, favourable prices and tax privileges should be provided. On the Quingzhang Plateau in northwest China and Inner Mongolia, livestock manure is usually used for fuel, but abundant solar and wind energy resources await exploitation.

Rural energy policies have played a role in improving energy utilisation and reducing deforestation. However, longer term efforts are required. Different methods to reduce energy deficits will be required to suit local conditions.

APPROACH TO PLANNING AND IMPLEMENTATION OF ENERGY DEVELOPMENT IN MOUNTAIN COMMUNITIES

M. Nurul Islam

The main objective for mountain area development is to provide basic needs and essential services for mountain communities. Rational development of mountain area resources should contribute to national development, as well as meet local energy needs. In many areas today, however, overexploitation of forests, development of large hydro projects, and increasing agricultural production through energy intensive processes are resulting in social unrest.

Energy development should be considered an integral component of mountain development, which is in turn part of national development. Equity between mountain areas, and upland - lowland equity, are important considerations. An evaluation of past development strategies indicates that a decentralised approach best meets these criteria. Furthermore, energy technologies such as biomass fuel, biogas, minihydro and solar, have high potential for decentralised development.

Energy planning and management at the district level (meaning the bottom level development unit having local government and administrative line ministries) would encourage appropriate diversification of energy plans, localised budget allocation and integration of development efforts and institutions. Integrated energy planning means analysis of all energy issues within a unified policy framework for long - term national goals. Three areas of integration must be

considered : economic and energy plans, energy subsector plans, and various energy sources and technologies.

Integrated National Energy Planning has a series of steps: first and most importantly, establishing an energy data base with reference to districts ; building economic growth scenarios ; making energy demand projections ; assessing energy sources and supply technologies ; supply demand balancing ; financial planning ; and framing supply and demand management strategies. District Energy and Management project design should use a flexible, adaptive learning approach. Other factors necessary for effectiveness include : political commitment, human resource development, people's participation, participatory action research, compilation of innovative experiences, flexibility in project implementation, coordination of implementing institutions, and monitoring and evaluation.

DISTRICT ENERGY PLANNING AND MANAGEMENT FOR THE INDIAN HIMALAYA

T. M. Vinod Kumar

Past planning experience in the Indian Himalaya shows that programmes prepared at the national and state levels are not effective in bringing about integrated development in the mountains. Since June 1982, the National Planning Commission has promoted the establishment of district level planning bodies, which now exist in most states of the Himalaya. Systemic, decentralised management is necessary, with procedures for release and transfer of funds, coordination with state and sectorial plans, and monitoring, review, and evaluation.

District energy planning methodology is aimed at change in resource flows by the application of additional sources of energy, to improve access to basic needs and increase employment opportunities and equitable distribution of income. A spatial planning approach, with hierarchies of market service centres and dependent villages, is useful. The starting point is analysis of existing conditions based on supply - receipt relations of various components, such as market, land by type, household by type, and livestock.

Among the challenges to a district energy planning approach are the substantial investments and risks associated with renewable energy technologies. Success can only be achieved by developing field - tested methodologies including a rapid appraisal of natural and energy resources, by preparing case materials for training programmes and guidelines for district energy planning and management, and by establishing rural energy service and extension centres for the gradual institutionalisation of decentralisation.

RURAL ENERGY FROM FOREST BIOMASS IN NEPAL : PROBLEMS AND PROSPECTS

T. B. S. Mahat

A direct link exists between the welfare of local communities and the use of forest land for fuelwood, fodder, leaf litter, poles and small timber, and other materials mostly obtained as free goods. These linkages have only recently started to be appreciated by professionals. While fuelwood is usually assumed to be the principal contribution of forest to the rural population and hence, the cause of deforestation in the underdeveloped world, evidence from Nepal and India clearly indicates the overwhelming importance of forest - fodder for livestock. The rural household energy question in less developed countries, however, is very important and plant biomass from forest plays a significant role, though only scattered and isolated efforts have been made to assess the quantities and patterns of fuel biomass consumption by rural populations.

In predominantly rural Nepal, with a low per capita fuel consumption of about 200 kg of oil equivalent, by far the most important source of energy is plant biomass. The situation is unlikely to change in the foreseeable future. Traditional fuel from biomass supplies 93 per cent of the total utilised energy in the country and even in urban areas the share of biomass fuel is 83 per cent. In the Middle Hill Region, biomass from forest including shrubland supplies two - thirds of the total annual fuel supplies. However, great variability occurs

between estimates of fuel biomass use and hence, in conclusions regarding adequacy of forest to meet either fuelwood demand or consumption. Therefore, currently accepted per capita fuel consumption for Nepal is overestimated at 1 cu.m. (640 kg) per annum. Estimates show that for the current mixed farming system in Nepal, not less than 3 ha of forested land are required to support 1 ha of cultivated land, and a requirement of at least 0.3 ha is estimated for fuelwood alone.

On these criteria, most hill areas in Nepal are deficient in forest area, including shrubland. Similarly, with the assumed forest growth of not more than 2 cu.m / ha / annum, the net annual increment is estimated at about 12.5 million cu.m. / year growing in an estimated total forest area of 6.3 million ha. This cannot meet the fuelwood demand of an ever - increasing population which at present stands at 16 million. The problems in general, therefore, are related to a dwindling resource base and the deteriorating local environment.

This calls for special emphasis on forest development activities, such as protection and improved management of existing forest, and afforestation of large denuded areas in the hills. In the short run, these programmes have high potential for creating employment and income opportunities, particularly for the economically weaker section of the local population. In the long run, they provide effective cover for the conservation of soil and water. The need for local people's participation in such resource management activities cannot be over emphasised and should be encouraged through Community Forestry Programmes. These seem to be the only practical solution to the increasing rural energy problem in Nepal. Popularising improved energy efficient stoves capable of reducing fuelwood consumption could help conservation of energy in the rural areas.

Alternative sources of energy such as hydropower, solar radiation, and natural gas will involve much greater cost, prohibiting their widespread use in rural areas. Their development for domestic and other uses in urban areas, however, will also relieve the pressure on the forests, thus reducing competition for scarce forest resources between rural subsistence farming communities and urban societies.

ENERGY, EMPLOYMENT AND RURAL DEVELOPMENT IN THE MOUNTAIN AREAS OF INDIA

R. K. Pachauri

Energy scarcity is on the increase in several parts of the Third World. Nowhere is this problem more acute than in the Hindu Kush - Himalaya. Time needed for productive activities is being sapped by the incessant search for energy resources. Forests needed for raw materials and capital inputs for non - farm activities are being depleted.

Although modernisation of mountain agriculture may initially have a positive effect on labour demand, employment generation has to extend beyond agricultural activities. Looking at non-farm activities in the total perspective on rural households, it becomes evident that the allocation of women's time is central to the entire analysis. With more time spent collecting fuel, women's productive output declines in quantity and quality.

Development planning in mountain regions should bring about investment in new technologies to harness local energy resources, not only to ease the problem of fuel scarcity but to provide employment, and ultimately improve the economic and social well - being of mountain societies.

FODDER-FUELWOOD ENERGY PROBLEMS OF RUMINANT ANIMAL HUSBANDRY IN NEPAL

Kk. Panday

The issues of energy input / output of the ruminant animal population and their impact on the economy and environment have received scant consideration in the development planning of Nepal. Both in terms of land use planning and information acquisition, the field is almost neglected, while ironically the production of tobacco gets attention. Statistics on the ruminant population and milk and meat output are under - and overestimated.

The negative impact of the ruminant population on Nepal's fragile environment is overemphasised. At the same time, the contribution

of the ruminant population to the economy, from food to draught energy, is undervalued by economists and land use planners. Consequently, one of the basic points missing in the planning of ruminant animal economies is the mention of supply of fodder and fuelwood input/draught power output of this sector.

A review of statistical documents (population and products) and dairy strategies (supply and pricing mechanisms) of Nepal reflects the current opinion of experts that fodder collection is having serious impact on land erosion, in the widest sense, and soil erosion, in the narrowest sense.

The consequences of fuelwood use for, especially, commercial processing and supply schemes of milk and milk products do not receive mention. The approach and attitude towards supply and pricing mechanisms of milk and milk products are rudimentary as reflected in fuelwood collection and consumption in dairy factories.

Although localised, the dairy industries, especially cheese and butter factories located in the mountains, have become stress factors in already stressed ecological conditions. These cases will form the basis of arguments for ecologically sound planning for dairy development. Responses are needed from forestry on a long - term basis.

ENERGY USE PATTERNS AND ENVIRONMENTAL CONSERVATION : THE CENTRAL HIMALAYA CASE

D. D. Pant and S. P. Singh

In the context of a larger regional ecosystem, we assign mainly a protective role to mountain ecosystems and a productive role to adjacent plains ecosystems. In view of this, only low - energy sources are discussed. The principal problem in the Central Himalaya is how to develop an energy use pattern which also facilitates the revival of forest cover, which is far less than generally thought. Of the total area, about 15 per cent is in agro - ecosystem, less than 2 per cent in urban - industrialised system, leaving about 83 per cent in natural system, most of which is being converted into ecologically non - sustainable ecosystems.

Productivity in terms of energy is greater for forest (relatively undisturbed) ecosystems than for either grasslands or croplands. A comparison of agronomic yield with commercial yield indicates that forests are more productive. The cropland productivity is inadequate ; consequently about half of the total food energy requirement is imported from the plains. However, each unit of agronomic (plus milk) energy produced consumes about 12 units of forest energy, mainly in terms of fodder and fuelwood exploitation. Since the forest area required to support the agricultural activity is inadequate, onslaughts on the remaining forests are great and abandonment of agriculture is not ruled out in some localities.

This situation calls for alternative models of development. Our model involves the replacement of the crop system with the tree farm system. The major prerequisite is to develop a mutualistic relationship between mountain and plains populations in which the latter would provide food energy and the former, by reviving forest cover, will protect the latter from hazards of peak floods and siltation of water bodies. Socio - political factors seem to be favourable for adopting this model.

In order to achieve the above goal, alternative energy sources need to be developed. The per capita energy consumption is so low it cannot be reduced further. Solar energy has not been technologically harnessed. Use of solar cookers or solar pumps is still non - existent. There is scope for extensive use of Chullahs (stoves) of improved efficiency and other energy saving devices, such as pressure cookers.

Potential for geothermal energy as an alternative source is low, however, it can be made available in remote areas where fuelwood and hydroelectricity are difficult to obtain. Though available in plenty, technological breakthrough is still awaited in the use of wind energy. Thus the situation is similar to that of solar energy. The ecotechnological implications of pine needles as a source of biomass fuel need to be determined. The use of gobar gas is limited to areas below 1000 m. Instances of setting up microhydel systems by village communities exist, however, their use has been mostly for lighting purposes.

ENERGY FLOWS AND SHIFTING CULTIVATION

P. S. Ramakrishnan

In the interests of ecologically and economically efficient development, the traditional practice of jhum (shifting agriculture) deserves consideration. With five to fifty units of food energy harvested for every unit put into the system, it is a model of productive efficiency. However, population increase and dispersion have shortened the traditional jhum cycles. The distorted ecological balance in the northeastern hill region of India reflects these changes.

A characteristic feature of the jhum system is the high accumulation of biomass in relation to actual economic yield, which ensures the stability of the system. In studies carried out in Meghalaya, low and high elevation jhum system varieties were found to exist. The studies revealed : (1) a longer jhum cycle gives better yield than a short cycle, (2) a 10 - year jhum cycle is economically viable, (3) though terrace cultivation gives as much return as jhum under a 10 - year cycle, a major fraction of input for the former is through organic fertiliser, while labour is the chief input into jhum.

The main advantage of the jhum system is that it meets the diverse needs of the tribal farmer, such as cereals, vegetables and tubers, and even fibre. Mixed cropping is an insurance policy against crop failure.

Considering that the 4 to 5 year cycle, now prevalent in the northeastern hill region is inefficient, and that terracing is not a viable alternative, the only alternatives seem to be the 10 year cycle (restricted by population pressure on land) and confinement of cereal cultivation to valleys.

One way of taking pressure off the land to allow longer jhum cycles is to diversify economic activities. Encouraging horticulture and plantation crops, intensifying animal husbandry and improving agroforestry systems with better crop varieties, sound management techniques, and fast - growing native tree species are recommended.

Nowhere is the interlinkage between energy and environment so evident as in the tribal societies of the northeast. Public intervention for development should be given first priority, with people's participation in design and implementation of programmes. Apart from providing acceptable appropriate technology, government agencies can act as catalysts for providing the organisational base both for production and marketing.

POTENTIAL FOR MINI AND MICROHYDEL PROJECTS IN THE INDIAN HIMALAYA

D. P. Sen Gupta

The development of small, mini and microhydel power in India has been extremely inadequate. There are 84 units generating 168 MW, of which over 40 MW were installed by the British.

It is essential that this renewable source of energy be developed further, especially in hill regions. The states of the Indian Himalaya are Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim, Arunachal Pradesh, Nagaland; Manipur, Mizoram, Meghalaya and Tripura are also included.

The technology for SHP, particularly for high heads, is well established. However, it is necessary that technology suitable for the terrain, utilising local skill and manpower, is developed. This will bring down cost per kw and reduce costs of operation and maintenance. If standard CPWD norms are to be followed everywhere, the cost / kw can be as high as Rs. 40,000 / kw. On the other hand, a number of minihydel units were set up in Arunachal Pradesh at less than Rs. 8,000 / kw by deviating from rigid norms. Similarly, operation and maintenance costs may be prohibitively high if the standard rules of Electricity Boards are always adopted. It is, therefore, essential that standardisation of SHP technology should have built - in elements of adaptation to local needs and environment. Training of manpower for survey, implementation, and maintenance is essential.

The major objectives of electrification in the Himalaya region are to :

1. Provide lighting and save kerosene

2. Provide lift irrigation

3. Help the development of cottage industries
4. Help the setting up of industries such as poultry farming, fruit canning, tea and other agro - based and forest industries
5. Save diesel where diesel generation is being resorted to for strategic purposes

Recommendations include :

1. Setting up a Central Public Sector Corporation to deal with Small Hydel Projects
2. Carrying out extensive surveys at the sites Already identified for SHP
3. Training engineers for design and construction
4. Providing domestic connections free of charge for low income groups

FOOD - ENERGY INTERRELATIONS IN NEPAL

Shankar Sharma and Binayak Bhadra

The pattern of resource use in Nepalese agriculture reveals that inputs are increasing because of declining land per capita. More labour, energy, and fertiliser per unit of land than before is being used to raise productivity. Chemical fertilisers and commercial energy are heavily subsidised. However, forests, the major source of fuel and fodder, are also being destroyed for additional land for cultivation and rising fuelwood needs. Animal dung is increasingly used for fuel and a lower proportion of it is available for crop production. The present food - energy sector policies have high social, economic and environmental costs. The farming system is geared towards highly energy intensive technology.

Food - fuel - fodder - fertiliser linkages are vital to the sustenance of agricultural productivity. The solution to food and energy problems requires both direct and indirect methods of intervention and innovation in technology and institutions. Research, development and extension of local and new varieties suitable for rainfed and irrigated conditions, intercropping systems suitable for microclimatic zones, and nitrogen fixing legumes deserve high priority. In the present conditions, a low - energy, high - production food system should be the main strategy of agricultural policy. The investments in newer technologies should be concentrated so village communities generate a self-sustaining process of economic growth. In planning any food - energy programme, due consideration should be given to the rural institutions, rural resource endowments, and their interactions in light of the growing interest in decentralised, participatory planning concepts.

ROLE OF THE PRIVATE SECTOR IN DECENTRALISED ENERGY PLANNING IN NEPAL (ALTERNATIVE ENERGY TECHNOLOGY OPTIONS)

Ganesh Ram Shrestha

Energy is at present one of the major constraints to the economic development of Nepal. Lack of any commercially exploitable fossil fuels, increasing cost of imported fuels, and over - reliance on fuelwood supply are among the major problems the country faces today. In view of this situation, there is an urgent need to develop cheap and reliable sources of alternative energy that can substitute for the increasing fuelwood consumption and, at the same time, provide the additional energy required for meeting basic needs of the rural population. In the Nepalese context, water and biomass form major sources of renewable energy. Serious efforts, therefore, need to be taken towards careful planning and implementation of alternative energy development projects like installations of small - scale microhydro plants, biogas plants, improved stoves and other energy technologies which have good potential for widespread dissemination, particularly in rural areas.

The success of the energy development programme depends largely upon the effective mobilisation of users and local communities as partners in planning, as well as greater involvement of private sector organisations. For this, a decentralised energy planning approach

should be adopted to involve participation of the local population in energy development programmes and mobilise local skills and resources available in rural areas. On the other hand, greater emphasis should be given to the development and strengthening of private sector enterprises for developing alternate energy technologies.

ENERGY DEVELOPMENT IN BHUTAN

Lakpa Tsering

Bhutan's hydropower resources and vast forests, covering 70 per cent of the country, offer tremendous potential for energy development. Improvement of traditional stoves, development of methane digesters in Southern Bhutan, and installation of windmills in isolated areas are also important.

Non - commercial fuelwood energy accounts for 97.4 per cent of total energy consumed in Bhutan, most of which is domestic. Electricity supply is limited to major urban centres and, in Southern Bhutan, is supplied by Indian grids. Diesel consumption is primarily for trucks, buses,and electric generators ; demand for fossil fuels is expected to grow rapidly. Small turbine units and hydel development are promising, particularly in remote areas. Bhutan's coal resources will remain supplementary to hydropower.

The main institution dealing with the energy sector is the Department of Power. Major planning approaches have been: progressive augmentation of generation capacity through hydroelectric plants for use primarily in the country, but also for export ; building of a national grid of transmission and distribution lines from existing grid lines in Western Bhutan ; and installation of new systems using diesel generating sets for areas where energy is absolutely necessary.

Over 90 per cent of Bhutan's total demand is expected to be met by development of hydropower. Conflicts in interest between hydropower and irrigation schemes must be carefully avoided. Numerous hydroelectric projects are already underway with external assistance. Regional, international, bi - and multilateral cooperation will all be important for Bhutan's energy development.

TENTATIVE PLAN AND POLICIES FOR ENERGY DEVELOPMENT IN THE AUTONOMOUS REGION OF TIBET, CHINA

Wang Hai

The traditional fuels of animal dung, fuelwood and grass account for three - quarters of the energy consumption in Tibet, which poses a continuing threat to ecological balance. The stagnant economy retains 80 per cent of consumption in the domestic sector. Absence of coal, oil, and gas contributes to a 70 per cent dependence on energy from outside the region.

Energy development should parallel economic development. Policies for development of the region include : creation of a prosperous economy, reliance on private and collective enterprises according to market trends, open door policies and maintenance of autonomous status. Emphasis is on development of agriculture, animal husbandry, and animal products, as well as mining, tourism, and service industries. Low educational levels and difficulties in disseminating scientific and technical advances need to be overcome.

Priorities should be accorded to construction of electricity supplies, especially for domestic and light industry (handicrafts and tourism). The region has the highest hydropower potential in China -- which already supplies over 80 per cent of the electricity generated in Tibet -- along with abundant geothermal resources, and solar energy potential second only to the Sahara Desert. These resources along with wind energy should be exploited, however, energy construction should be small scale and suitable to local conditions. Along with improving technologies, the government should continue to provide financial assistance for energy development. The application and popularisation of fuelwood forests, improved stoves, and biogas generation should be stressed.

CHINA'S ENERGY VILLAGE EXPERIENCE

Wang Shizong

Rural energy shortages exist in much of China. Research and field testing of technical improvements for natural resource use are important. The guiding policy of the government is that rural energy problems should be solved with consideration of local conditions, using alternative energy supplies comprehensively, with great attention to practical results.

The Chinese Academy of Sciences has selected six villages for tests and demonstrations of single technical achievements (e.g. combination firewood - saving stoves and solar water heaters) and comprehensive studies of energy systems. Results are expected to be transferred to various products and equipment.

GEOTHERMAL ENERGY RESOURCES IN THE HIMALAYA - HENGDUAN REGION

Zhang Ming - Tao and Tong Wei

Approximately half of the national active hydrothermal zones, created by recent orogenic events, are in the Himalaya - Hengduan region in two geothermal belts : the Himalaya Geothermal Belt and the Hengduan Mountain Geothermal Belt. Surveys indicate a vast energy resource.

Apart from hydropower, which has made limited progress due to physical conditions and transportation difficulties, southern Tibet lacks conventional energy sources. The population presently cuts fuelwood and collects dung, straw, and turf for domestic use. The northern plateau of the Hengduan faces similar conditions. Shortage of conventional energy resources restricts progress towards diversified economies.

Geothermal resources have been exploited in Yangbajain field, northwest of Lhasa, since 1975, providing 60 - 70 per cent of Lhasa's energy needs during winter. Potential is high for geothermal development for Xigaze, Zetang, Shiquanhe, Naggu, and twenty other residential areas. Power for processing livestock products at Ganzi, wool products at Kangding Wool Mill, greenhouse heating in the Litang basin, and tea and rubber processing in south and west Yunnan, are further potential uses for geothermal energy in the region.

Annex 5.

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Founding of ICIMOD

The fundamental motivation for the founding of this first International Centre in the field of mountain area development was widespread recognition of the alarming environmental degradation of mountain habitats, and consequent increasing impoverishment of mountain communities. A coordinated and systematic effort on an international scale was deemed essential to design and implement more effective development responses to promote the sustained well-being of mountain communities.

The establishment of the Centre is based upon an agreement between His Majesty's Government of Nepal and the United Nations Educational, Scientific and Cultural Organisation (UNESCO) signed in 1981. The Centre was inaugurated by the Prime Minister of Nepal in December 1983, and began its professional activities in September 1984.

The Centre, located in Kathmandu, the capital of the Kingdom of Nepal, enjoys the status of an autonomous international organisation.

Director : Dr. K. C. Rosser Deputy Director : Dr. R. P. Yadav

Participating Countries of the Hindu Kush - Himalaya Region

- o Afghanistan
- o Bangladesh
- o Bhutan
- o Burma
- o China
- o India
- o Nepal
- o Pakistan

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