ANNEXES

SEMINAR ON RURAL ENERGY AND RELATED TECHNOLOGIES

26-28 March, 1991
Kathmandu

TIME	DAY ONE SESSION - 26 MARCH	TIME	DAY TWO SESSION-27 MARCH
3:30-4:00 PM	o Registration	9:00-10:30 AM	o Presentation - "An Assessment of the Energy Sector in Nepal" Speakers: Mr. Mohan Shakya Mr. Suresh Sharma - Commentator's Observation - Floor Discussion - Speaker's Response
4:00-4:45 PM	o Inaugural Session o Arrival of the Chief Guest, Rt. Honorable Prime Minister Mr. K. P. Bhattarai o Welcome Address - Dr. Tilak Rawal General Manager, ADB/N o About the Seminar - Dr. E. F. Tacke Director, ICIMOD o Inaugural Address by the Chief Guest - The Honourable Prime Minister, Mr. K. P. Bhattarai o Chairman's Note - The Honourable Minister for Water Resources & Local Development, Mr. M. N.Nidhi o Vote of Thanks - Dr. C. K. Sharma Executive Secretary, WECS	10:30-10:45 AM	T E A
		10:45-11:45 AM	o Presentation - "Development of Micro-hydro Systems in Nepal: Problems and Prospects". Speaker: Dr. Deepak Bajracharya - Commentator's Observation - Floor Discussion - Speakers' Response
4:45-5:15 PM	Tea and Alternative Technology Exhibition	11:45 AM-1:PM	o Presentation - "Application of Biogas Technology in Nepal: Problems and Prospects" Speaker: Mr. R. K. Pokhrel - Commentator's Observation - Floor Discussion - Speaker's Response - Chairman's Conclusion of the Morning Session: Dr. C. K. Sharma

DATE	DAY TWO CONTD.
2:00 PM- 3:15 PM	o Presentation - "Biomass Production and Conservation of Energy through Improved Cookingstoves in Nepal: Problems and Prospects" **Speaker:** Mr. K. M. Sulpya Commentator's Observation: Mr. B.P. Kayastha - Floor Discussion - Speakers' Response
3:15 PM-3:30 PM	T E A
3:30 PM-4:30 PM	o Presentation - "Role of Solar and Wind Energy in Nepal: Problems and Prospects" **Speaker:** Mr. L. Tsering - Commentators' Observation Dr. M. L. Shrestha - Floor Discussion - Speaker's Response - Chairman's Conclusion of the Afternoon Session: - Mr. R. P. Sharma
4:30 PM-5:00 PM	o Formation of Discussion Groups Group 1: Rational Approach to Rural Energy Planning Group 2: Planning and Implementation of Micro-hydro Technology Group 3: Planning and Implementation of Biogas Technology Group 4: Planning and Implementation of Energy Conservation Measures

TIME	DAY THREE-28 MARCH
9:00 AM-9:30 AM	o Video on Alternative Energy Technologies, 'Looking for Alternatives' - Group Discussions
10:30 AM-10:45 AM	T E A
10:45 AM-1:00 PM	o Group Discussion and Preparation of Group Reports
1:00-2:00 PM	L U N C H
2:00-3:45 PM	o Plenary Session: Presentation of group reports, discussion and adoption of reports by the seminar; seminar chairman: Dr. Mahesh Banskota
3:45-4:00 PM	T E A
4:00-5:00 PM	o More video films on rural energy technology and exhibition of appropriate technology

ANNEX: 2

LIST OF PARTICIPANTS

AGRICULTURAL DEVELOPMENT BANK, NEPAL

1. Mrs. G. Sijapati
2. Mr. H. G. Gorkhali
3. Mr. M. B. Bista
4. Mr. P. N. Regmi
5. Mr. S. B. Pradhan
6. Dr. T. Rawal
7. Mr. U. P. Banskota

BALAJU YANTRA SALA, KATHMANDU

8. Mr. S. L. Baidhya

CENTRAL ELECTRONICS LTD., INDIA

9. Mr. R. K. Raidan

CENTRE FOR RURAL TECHNOLOGY, KATHMANDU

10. Mr. G. R. Shrestha

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11. Mr. N. Gurung

GERMAN AGENCY FOR TECHNICAL COOPERATION, KATHMANDU

12. Mr. M. Bach

GOBAR GAS COMPANY

13. Mr. R. K. Pokhrel

HILL FORESTRY DEVELOPMENT PROJECT, KATHMANDU

14. Mr. P. B. Khatri

INTERNATIONAL CENTRE FOR INTEGRATED MOUNTAIN DEVELOPMENT, KATHMANDU

15. Mr. B. Bhatta
16. Dr. E. F. Tacke
17. Dr. M. Banskota
18. Dr. R. P. Yadav

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19. Mr. Peter Schultz

INTERMEDIATE TECHNOLOGY DEVELOPMENT GROUP

20. Mr. A. Brown U.K.
21. Mr. L. Perera Sri Lanka
22. Mr. Mark Walthan Kathmandu

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23. Dr. G. Thapa

MINISTRY OF FINANCE

24. Mr. K. R. Pandey

MINISTRY OF FOREST AND SOIL CONSERVATION

25. Mr. R. Bista

MINISTRY OF WATER RESOURCES

26. Mr. V. S. Shrestha

NATIONAL PLANNING COMMISSION, KATHMANDU

27. Mr. C. B. Khadka

28. Mr. R. P. Sharma

NEPAL COAL LIMITED, KATHMANDU

29. Mr. D. Bhattarai

NEPAL ELECTRICITY AUTHORITY, KATHMANDU

30. Mr. H. O. Shrestha

31. Mr. R. B. Shrestha

NEPAL FORUM FOR ENVIRONMENTAL JOURNALISTS, KATHMANDU

32. Mr. K. P. Sigdyal

NEPAL OIL CORPORATION

33. One representative

PRIVATE ENTREPRENEUR, BIRATNAGAR

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35. Mr. V. M. Shrestha

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36. Mr. G. Shakya

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37. Mr. P. B. Adiga
38. Mr. U. N. Sigdyal

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39. Ms. Y. Sherpa

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40. Mr. N. Prasad

THE RISING NEPAL

41. Mr. B. Bhattarai

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43. Ms. Shanta Khadgi

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44. Mr. A. P. Pradhan

45. Dr. C. K. Sharman

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Commentators

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ANNEX: 3

Group 1: Rational Approach to Rural Energy Planning

1.	Sigdya,l K. P.	NEFEJ	Group Chairman
2.	Acharya, Suresh	UNDP	
3.	Banskota, Mahesh	ICIMOD	
4.	Bhattarai, Deepak	NCL	
5.	Gurung, Narendra	East Consultant	
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7.	Shakya, Mohan	WECS	
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Group 2: Planning and Implementation of Micro-hydro Technology

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2.	Baidhya, Shanker Lal	Balaju Yantra Shala	
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9.	Rimal, Sunil	WECS	
10.	Shrestha, V. S.	Ministry of Water Resources	
11.	Sijapati, G.	ADB/N	
12.	Walthman, M.	ITDG	

Group 3: Planning and Implementation of Biogas Technology

1.	Joshi, Dhurba	NARSC	Group Chairman
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3.	Bach Manfred	GTZ	
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7.	Pokhrel R. K.	Gobar Gas Company	

8.	Regmi P.N.	ADB/N	
9.	Singh Kiran Man	ADB/N	
10.	Shakya G.	RONAST	
11.	Yadav R. P.	ICIMOD	

Group 4: Planning and Implementation of Energy Conservation Measures through Improved End Use Devices (ICS+ Solar and Wind Energy)

1.	Haas, L.	WECS	**Group Chairman**
2.	Adiga, P. B.	Solarex	
3.	Bhattarai, B.	TRN	
4.	Bhattarai, Lila	WECS	
5.	Khadgi, Shanta	UNICEF	
6.	Khatri, P. B.	HFDP	
7.	Raidan, R. K.	Central Electronics Ltd. India	
8.	Sharma, P.	ICIMOD	
9.	Shrestha, Madan Lal	Department of Hydrology & Meteorology	
10.	Sulpya, K. M.	RECAST	
11.	Tshering, Lakpa	ICIMOD	

Summaries of Papers Presented at the Seminar

AN ASSESSMENT OF THE ENERGY SECTOR IN NEPAL: IMPLICATIONS FOR THE PLANNING AND MANAGEMENT OF RURAL ENERGY

Suresh Sharma, Mohan Shakya, Lila Bhattarai, Sunil Rimal

This paper deals with energy demand patterns, end uses of different energy sources, and Nepal's energy resource base and its use; the strategy, policies, and programmes in the energy sector; and the major issues and options pertaining to the rural energy scene. The paper also highlights the components of an integrated approach to rural energy development in Nepal.

Most of the Nepalese live in rural areas and will continue to do so for some time in the foreseeable future. Currently, the population distribution between rural and urban Nepal is 90:10 and by the end of the next 20 years the distribution is expected to be 78:22. In numerical terms, this means that approximately 24.4 million Nepalese will live in rural areas by 2010 A.D. The number is almost one and a half times the current population. The current population distribution between the mountains (including the hills) and the *Terai* is 53:47 and this is expected to be 47:53 by 2010 A.D. When discussing rural energy, it is the energy needs of this population that demand attention.

The current level of energy consumption is low in Nepal; less than 500 kg of oil equivalent per capita. Traditional energy sources, meaning fuelwood, agricultural residue, and animal dung, provide 95 per cent of the total energy and the balance is met through use of commercial energy in which petroleum, oil and lubricants (POL) are most important. Although the share of traditional sources remained stable at around 95 per cent during the 1980s, there has been an increased use of agricultural residue and animal dung to compensate for a decreased use of fuelwood in the domestic sector. The share of electricity has been less than one per cent in the total energy budget of the country, even though growth in the demand for electricity was fairly high during this period. Demand for hydrocarbons too showed a high growth rate. Transport and industry were the main users of hydrocarbons. Petroleum, all of which is imported, places a strain on the State exchequer and POL imports accounted for about 30 per cent of the receipts from exports during the 1980s, even though for some years the figure has been as high as 50 per cent.

Energy demand projections by source of energy and the consuming sector were made by the Water and Energy Commission Secretariat (WECS). The projections were made for the year 2000/01 with 1985/86 as the base year. The total energy demand was expected to grow at a rate of 1.9 per cent per annum with an expected domestic sector demand at 1.7 per cent per annum. The industrial, commercial, agricultural, and transport sector demand growths were estimated to be 5.1, 4.5, 8.5, and 5.2 per cent per annum respectively. Demand projections by energy sources showed a negative growth rate for fuelwood. Demand for other energy sources ranged between 3.3 per cent to 8 per cent per annum. The projections thus showed that the share of fuelwood in the total energy would decrease over the years to about 55 per cent in 2000/01. This decrease would be partially caused by an increased use of agricultural residue and animal dung and partially by an increased use of commercial energy in which POL and, to some extent, electricity, are expected to play important roles. The decrease in fuelwood supply will be acute in the *Terai* where the energy deficit will be met by an increased use of agricultural residues and other biomass. Alternative energy technologies and their possibilities therefore should be examined in terms of geographical dimensions.

There is a gross mismatch between Nepal's energy resource endowment and its actual use. In terms of the theoretical potential, hydropower, with 1461×10^6 GJ raw energy available, is the most abundant energy resource accounting for about 79 per cent of all available energy. Forests with 293×10^6 GJ raw energy available is the second-most important source. Other sources such as agricultural residue, animal waste, solar power, and fossil fuel exhibit relatively low theoretical potential. The location of major hydro-electric plants and transmission and distribution lines; location of small hydropower units; and the location of alternative energy plants in the country indicate that major hydro-plants are concentrated in and around the capital region and that the transmission lines are mostly confined to the *Terai*. Rural energy resources in Nepal exhibit a trend of unsustainability arising out of a combination of the factors discussed so far and it is necessary to address this issue with demand and supply management measures.

Regarding the strategies, policies, and programmes in the energy sector, there is lack of a clear and articulated strategy as a result of which energy planning has tended to move away from the overall goals of socioeconomic development planning in Nepal. Planning for hydropower development has been taken to be synonymous with energy development, but the direct benefits of large hydropower projects do not reach the rural masses as they have no access to electricity or other associated benefits. Indirect benefits certainly do not reach them and this can be attested by the poor standard of living of the majority of the rural people. While planning documents discuss the exploitation of alternative energy sources in the rural areas, in actual practice this has never been translated into concrete action. Investment allocations during the 7th Five Year Plan show that water resource development programmes, which were basically for exploiting large hydropower projects, received an allocation of Rs 4,757 million. In the same plan period, alternative energy programmes received an allocation of Rs 50 million or only about 1 per cent of the allocation for the water resource sector. The figures clearly indicated where the government priority lay in the energy sector. The implications for the rural energy sector were that, in addition to the low priority accorded, there was no attempt to integrate various sub-sectors within the energy sector itself.

Pricing policy has been one of the main tools used in managing the energy sector in Nepal. But the goals of various pricing policies have often been in conflict with one another, especially as the Government appeared to promote different socioeconomic goals, such as equity, efficiency and, revenue considerations, through the pricing policies. It is observed that the relative prices of various energy forms (e.g, fuelwood, electricity, and POL) do not reflect their true scarcity value resulting in implicit encouragement of the use of scarce resources. The divergence between the private and social cost of resource use has led to this situation. This policy has resulted in distortions in resource allocation resulting in insufficient generation of investable funds. There have been organizational deficiencies that have resulted in the different organizations dealing with particular energy forms using pricing policies to meet their own sub-sectoral objectives. Thus, the effect of the pricing policy was the reduction of fuelwood supplies in rural areas. The policy even encouraged fuelwood exports from deficit regions. The policy did not systematically bring about changes in rural energy consumption. There has been no appropriate organization to implement policies in rural areas.

Another major policy, the energy conservation policy, lacks a consolidated approach even though biomass conservation is likely to have the greatest impact on rural energy supplies. Regarding the promotion of improved cooking stoves (ICS), instead of following a target-oriented approach, where the number of ICS distributed are the sole criterion of success, it would be preferable to concentrate programme efforts in areas where backup services could also be provided.

An important component of the government policy has been that of providing subsidies in the energy sector. Although in different forms, the Government has subsidized electricity, fuelwood, biogas, micro-hydro, ICS, and many other energy technologies. Since subsidy had to come from government revenue, a rethinking on the rational, mechanism, and extent of subsidy was urgently required. Government support to the energy sector should not necessarily mean the provision of subsidies.

Biogas and solar and wind energy programmes have potential but have yet to be exploited in Nepal.

It is apparent that rural energy sector should be treated in an integrated manner. The elements of an integrated approach to rural energy planning are:

- o integration of economic and energy planning,
- o ensuring that energy contributes to the economic well-being of the rural populace by linking energy, agriculture, and agro-processing activities,
- o trade-offs on conflicting objectives, and
- o exploitation of local resource potential.

The approach used by the Chinese Academy of Science, Chengdu, in implementing energy villages could be a guide in this respect.

Major options available to policy planners are the use of energy to transform the economy, promotion of water resources for rural energy by using a decentralized approach for water resource development, and the reduction of dependence on the forests by pursuing a combination of policy tools such as pricing, conservation, management, and resource ownership. Additionally, enhanced reforestation, higher investment in the improvement of end use devises, and conservation education should also be emphasized in this context. Finally, the location-specific potentials of biogas, micro-hydro, solar and wind energy have to be exploited by following a decentralized planning and management approach.

Nepal requires foreign assistance to exploit its potential energy resources. The country could derive maximum benefits from this assistance if it supported components of a national strategy on energy development that are a part of a well-thought out overall development strategy. Otherwise, each donor is likely to promote and invest in projects that they think Nepal needs. This may or may not be relevant to the majority of Nepalese people.

DEVELOPMENT OF MICRO-HYDRO SYSTEMS IN NEPAL: PROBLEMS AND PROSPECTS

D. Bajracharya, A. M. Nakarmi, & K. M. Singh

The micro-hydro systems discussed in the paper include improved ghattas, multipurpose power units (MPPU), and turbines, all below 100 kW capacity. The principal parties involved in the development and dissemination of these units are village entrepreneurs and local community groups, equipment manufacturers, and the Agricultural Development Bank of Nepal (ADB/N) as the main promoter and resource mobiliser on behalf of the Government and donor agencies. The paper argues that the pattern of development has been encouraging, particularly over the last fifteen years, but additional efforts, in a much more intensive and consolidated manner, are necessary, if the potentials are to be tapped effectively. The existence of some 25,000 traditional ghattas in the country is a rough indicator of the required level of dissemination. Considering there are currently about 600 micro-hydro units (other than the traditional ghattas), the rate of expansion has to increase by several orders of magnitude. For this purpose, specific attention has to be directed to (a) formulating clear government policies, (b) establishing a practical institutional framework, (c) assessing energy demand and supply possibilities based on available resources, and (d) demonstrating the Government's political will through increased budgetary allocations and emphasis on manpower training.

Analysis of available information shows that technical innovations and the manufacturing of equipment locally have played critical roles in the dissemination of micro-hydro units since the mid 1970s. Also, the Government's policies, since 1984, of delicensing installations below 100 kW and, since 1985, of providing a subsidy on the electro-mechanical costs of power generation have proved to be effective incentives. However, dissemination appears to be concentrated mainly in the vicinity of Butwal and Kathmandu. The more remote and inaccessible districts are to a large extent ignored. There are indications that from 1986 onwards, some form of saturation had been reached in the relatively accessible areas and the rate of installation of micro-hydro units is on the decline. ADB/N's loan amount on an annual basis has been decreasing but prices have been increasing. There is a long list of customers who have applied for adding-on induction generators for electrification but the limited amount of money made available by the Government for subsidies has made it difficult to respond to these requests.

Six samples cases were cited for elements of success and failure. On the whole, the modest success achieved in micro-hydro systems can be attributed to the following factors:

- meeting of locally felt needs (e. g., agroprocessing, lighting, lift irrigation, etc.) at affordable costs;
- reliance on technologies (equipment as well as civil works) that are easily understood and provision of training for operation and maintenance;
- gradual build-up of entrepreneurship with support services provided by ADB/N and manufacturers; and

- o reasonable integration of organisational and management functions at different levels (e.g., the Government's policy of delicensing and subsidy, promotional efforts by ADB/N, provision of reliable technology, services by manufacturers, and strengthening of organisations at the local level).

The options for the future may be seen in two ways: (a) continuation of the present strategy as the minimum, but preferably with greater concentration on dissemination in remote areas; and (b) emphasis on diversified end uses of electricity and mechanical power to increase the load factor and promote productive activities. To this end, the role of the different parties concerned must be seen in an integrated fashion. The role of the Government and the involvement of the banks have to extend beyond the current practices of loans and subsidies. Particular emphasis is needed with respect to the national coordination of micro-hydro activities, systematic planning in conjunction with the principles of decentralisation, mobilisation of greater amounts of funds, and provision of better incentives to all parties concerned. The manufacturer is currently too heavily involved in every step from site survey to installation of equipment to provision of repair and maintenance services. On top of that, the eight or nine manufacturers are based in Butwal and Kathmandu and the servicing of remote installations is a controversial point. Emphasis is needed on improving the spread of manufacturing and servicing seminar in order to encourage more rapid dissemination in remote areas. Technical support to manufacturers is also crucial (e.g., establishment of steel foundries with casting facilities; organisation of training and study tours; and provision of importing facilities with respect to bearings, electronic load controllers, and generators above 20 kW; etc.).

Research and development (R & D) is the weakest factor in micro-hydro development. This is happening mostly in an *ad hoc*, uncoordinated fashion. A more integrated approach to R & D is advocated with particular focus on the following:

- o assessment of micro-hydro potentials and development of systematic location-specific plans;
- o cost-effective equipment design and civil works with specific emphasis on governor technology;
- o consolidation of hydrological, geological, and socioeconomic information; and
- o a quality control centre for performance testing and standardisation.

Action research projects and training programmes need to be promoted in conjunction with these.

The key to success lies ultimately with the local people who are the users and the beneficiaries of micro-hydro systems. Their organisational strength and entrepreneurial pursuits need to be boosted if the micro-hydro system is to be used for purposes other than just milling and lighting as has been the case until now. Complementary support services and a favourable policy environment are critical inputs if these attempts are to take off.

APPLICATION OF BIOGAS TECHNOLOGY IN NEPAL: PROBLEMS AND PROSPECTS

R. K. Pokharel, R. P. Yadav

The shortage of energy is a serious constraint to the achievement of sustainable development. Predominant dependence (95%) upon traditional energy sources, such as fuelwood, agricultural residues, and animal wastes, characterises the energy situation in Nepal. Among traditional energy sources, fuelwood alone constitutes 75 per cent. Poorly-managed forests have to shoulder this immense burden to meet the increasing demand for energy. Therefore, the search for and promotion of alternative options to meet energy needs is of paramount importance.

One of the alternative sources of energy for cooking in the rural areas is biogas. It has been estimated that the potential number of biogas digesters could be about one million in Nepal.

Although initiatives to promote biogas began in 1975 during the International Agricultural Year; more systematic efforts began only in 1977 with the establishment of the Biogas and Agricultural Equipment Development (Pvt) Ltd. as a specialised company through joint investments from the Agricultural Development Bank, the Nepal Fuel Corporation, and the United Mission to Nepal. The company aims to construct and provide services for operation and maintenance, to train local manpower, and to conduct problem-oriented research and development.

The Biogas Company initially promoted the Floating Steel Drum type of biogas digester, a technology imported from India, but during the last six years emphasis has almost exclusively shifted to the promotion of the Fixed Concrete Dome type, a technology imported from China.

A total of 5,739 biogas plants was installed in Nepal between 1974/75 and 1989/90 in a proportion of 3:1 between the *Terai* and Hills. In the fixed dome design, the size of the biogas plant in common demand is 10 cubic metres, whereas in the case of the floating drum design the popular size is 200 cubic feet. The attachment of latrines to the biogas plant is also being promoted. This has increased the production of biogas as well as manure and is a good method of using night soil which otherwise would have been wasted. It has also improved the sanitation of the villages.

It has been estimated that the construction of 25,000 plants over a period of five years would require a government subsidy of about 288 million rupees if 50 per cent of the capital cost of biogas installation is subsidised. On the other hand, the estimated total value from replaced fuelwood and additional plant nutrients would be about 1,085 million rupees. This would bring the net benefit of biogas plants to about 800 million rupees after deducting the government subsidy. The total benefit comes to three times the total government subsidy. Assuming the lifespan of a biogas plant to be about 25 years, with an annual net benefit of 800 million rupees a year, the total projected benefits over 25 years would be about 20 billion rupees.

It is also estimated that through the installation of 25,000 biogas plants, about 1.44 million mandays of unskilled and semi-skilled labour would be used, the value of which is approximately 50 million rupees.

Similarly, the other intangible benefits are the stall-feeding of livestock, relieving rural women from the task of burning hazardous fuelwood and from the physical hardships caused by several hours of travel each day in search of fuelwood, and improved sanitation in the villages.

The Biogas Company is planning to decentralise and to promote the privatisation of its activities, gradually limiting its role to research and development and to supervising and monitoring biogas plants installed by private firms and individuals.

The main issues discussed in the paper and the recommendations made have been outlined below.

1. The Government does not have a consistent policy for the promotion of biogas to meet energy needs. This is reflected in the *ad hoc* nature of its subsidy policy. Therefore, it is now high time for the Government to make a firm policy commitment in this area, in particular, and towards the development of renewable energy resources in general.

2. There is no specific department or ministry responsible for promoting the development of renewable energy resources. At present, several departments and ministries are engaged in promoting different energy technologies but their efforts are not coordinated, rendering it hard to identify one institution to plan and implement renewable energy policies. Since activities are uncoordinated and isolated, there are no systematic future plans or perspectives. It is important to make a specific department in the Government responsible for the development of renewable energy resources.

3. The initial installation cost of existing biogas designs is high and beyond the reach of the majority of rural families in Nepal. Research into more cost-effective designs is essential if biogas is to be accessible for poor households as well.

4. Low gas production during the winter months, particularly in the colder hilly regions, has been a constraint to the promotion of biogas in the hills and mountains. Research is needed for identification of methods of maintaining higher temperatures in the digester pit so that optimum gas production can be ensured throughout the year.

5. There is very little publicity, particularly of the audio-visual kind. A better extension and dissemination programme is essential.

6. There is an insufficiency of trained manpower to build, supervise, and repair biogas digesters. Training at different levels is essential.

7. Construction materials such as cement, G.I. pipes, biogas lamps, and other appliances are unavailable in some parts of the country. They are also difficult to transport in the remote hilly areas. Transportation subsidies will be necessary if biogas plant installation in inaccessible areas is to be promoted. Here again, a definite government policy is needed to assess the amount of subsidy required.

8. Community biogas plant construction has not been successful in many places. This is largely because of institutional failures rather than the shortcomings of technology. There is a need to search for improved institutional mechanisms to promote community biogas to enable poor households, who cannot afford and maintain a small plant on their own, to derive benefits from jointly owned biogas plants.

9. The Agricultural Development Bank has already taken a lead in the promotion of biogas. Other commercial banks should be encouraged to participate in the promotion of renewable energy resources.

BIOMASS PRODUCTION AND THE CONSERVATION OF ENERGY THROUGH IMPROVED COOKING - STOVES IN NEPAL: PROBLEMS AND PROSPECTS.

K. M. Sulpya

Biomass fuel is the main form of energy in rural areas; both for domestic as well as industrial use. This has led to a heavy use of forest resources to meet fuelwood needs. Additionally, forests have been used for agricultural and commercial purposes as well. This has affected forest density and has led to reduced crown cover, resulting in fuelwood scarcity. Also, agricultural residue and animal dung are being increasingly used as energy sources. Therefore, there is a need to reduce the pressure on biomass resources by using them more efficiently and effectively. This could be achieved by using technologies such as densification, biogas production, thermochemical gasification, and bio-energy plantation. But, at present, these technologies are not being exploited in Nepal and it will be some time before such capabilities are developed. In the meantime, a more efficient and effective use of biomass can be made by using improved cooking stoves (ICS)

ICS have been promoted in Nepal for some time already, but it has only been since the early 1980s that laboratory work and research and development activities have been conducted in the country. Different types of ICS, such as ceramic, mud and brick/stone, mud, and metallic stoves have been designed and developed. These ICS have a higher range of efficiencies (from 21.5 to 26.7 per cent) in field conditions. An associated benefit of ICS with chimneys is reduction in the level of carbon monoxide in the kitchen.

The Community Forestry Development Project carried out large-scale distribution of ICS. A few other agencies were also involved in ICS distribution with donor support. There has been no uniformity in the type of ICS distributed nor has there been uniformity in the approach used in distribution. In the past, types of distribution have ranged from free distribution to sales. Monitoring the programme involves assessment according to geographical region and back-up technical services are virtually non-existent.

An evaluation of the ICS programmes shows that when access to fuelwood is poor people tend to use ICS. There were instances of stoves remaining unused when received free alongside examples of people paying up to Rs 150 per stove. It was also observed that in some areas the ICS produced and distributed had structural deficiencies. Three of the principal factors involved are:

- o that the priorities of rural women vary a great deal - saving energy is not a top priority;
- o that mass adoption of unifocal ICS needs to be replaced by broader-based development projects in which ICS are integrated as a component, e.g., improved kitchen conditions and sanitation; extra-income generation; and biogas for lighting cooking, kitchen gardens, and agro-forestry; and
- o that the distribution of ICS through commercial channels is likely to succeed more rapidly in the monetized urban and semi-urban areas where firewood is purchased rather than collected.

In future, the ICS programme should be launched in a more systematic manner. This would help in realising the potential benefits of ICS. The main elements that should be considered relate to design and certification, training and extension, monitoring, and inter-agency coordination.

Testing and certification should be done prior to the distribution of ICS. RECAST can act as a technical back-up unit and can test the efficiency of the stoves and certify them. Training should be given for research, production, promotion, marketing, and management at various levels and should include programme implementors, artisans, local village people, and the ultimate users (women). A regular monitoring and review system is necessary, respective roles of lead and supporting agencies should be defined and support provided accordingly. Inter-agency cooperation and coordination are vital in this respect. The involvement of women should be augmented and improved, and they should be trained in production, distribution, and extension methods.

The ICS programme on its own with a focus on energy conservation only is shown to be ineffective. For improved impact, the ICS programme, along with other rural development activities, should be promoted as a package.

ROLE OF SOLAR AND WIND ENERGY IN NEPAL: PROBLEMS AND PROSPECTS

Lakpa Tsering

The overall energy situation of Nepal indicates that it is predominantly dependent upon traditional sources of energy. In fact, traditional energy resources account for 95 per cent of the total energy consumed out of which about 75 per cent is fuelwood. Nepal has abundant hydropower potential but no appreciable, known deposit of oil, coal, or natural gas. Exploiting indigenous energy sources is vital as a sizeable proportion (about 30 per cent overall but as high as 50 per cent in some years) of export earnings are used for imports of petroleum products. Exploiting solar and wind energy becomes important in order to ease the energy situation.

The average solar energy potential of Nepal is 6 kW hour per day from 8 hours of sunshine. This is more favourable in Western Nepal. Because of the lack of a research and development infrastructure and of manufacturing capability, the country depends mainly on the import of solar devices from other countries.

Solar energy is used on a limited scale in the country. Nepal has a fairly long experience in the use of solar water heaters. There are 20 to 25 manufacturers of this device in the country, and it is used for both domestic and industrial purposes. One limitation of its usage in certain industries is that the outlet water temperature is not hot enough. Solar energy has been traditionally used for drying agricultural and other products. Several models of solar driers are available. Although potential for its use is quite considerable, a major constraint is the high cost. Nepal's experience in the use of the solar cooker as an alternative to fuelwood for cooking is almost non-existent. Some of the constraining factors in this context are its high cost, the uncertainty of weather conditions, breakage of glass, and the need for adjustments to the sun's direction from time to time.

Although a number of solar pumps have been installed by ADB/N for lifting water for domestic and irrigation purposes, one constraining factor for its mass adoption is its high cost. In remote areas, where there is no power infrastructure, solar panels have a comparative advantage over other energy systems. This advantage has been used in Nepal, where 64 out of 75 remote area wireless stations have photovoltaic back-up. Use of solar generators for rural electrification by Nepal Electricity Authority (NEA) with French assistance has been done in some areas. The relative costing of four units-at Kodari, Tatopani, Simikot, and Gamgadhi-shows that the bigger the solar plant capacity, the less the generating cost per kW power generation. However, as compared to hydropower, it is many times more expensive for equivalent power generation.

In view of the extreme heterogeneity of the topography, it is difficult to generalize on wind potential as it is a site-specific technology. No wind potential on a national scale is currently available. Studies indicate that wind potential for power generation is favourable for the Palpa, Tansen, Lo Manthang, Mustang, and Khumbu regions of Nepal. Presently, a three year wind assessment study for Jomsom Mustang is being carried out by RONAST. There have been many attempts to introduce wind generators into the country . Among the more recent ones is the 20 kW wind generator erected by NEA at Kagbeni, in Mustang. This unit is facing some problems.

RECAST has experiences in field testing the Indian prototype, Apoly 12 PU500, on the RECAST premises at Kirtipur and at the Kalwalguri Training Centre, Jhapa. The performance of both units has been disappointing. Soon after installation, failures involving distortion of rotor blades during strong winds, pump foundation failures, and the uprooting of the rotor blade assembly system have been experienced.

The general recommendations made in the paper included the formulation of a suitable national policy that will make solar and wind devices competitive in the open market, the promotion of a free-flow of information on these two technologies, the training of the nationals as an important component of solar and wind energy development strategy, development of national research and development capacity (especially applied research to begin with), and mobilisation of international assistance (both in terms of finances and technology transfer) to promote environmentally sound solar and wind technologies.