# WOOD ENERGY NEWS

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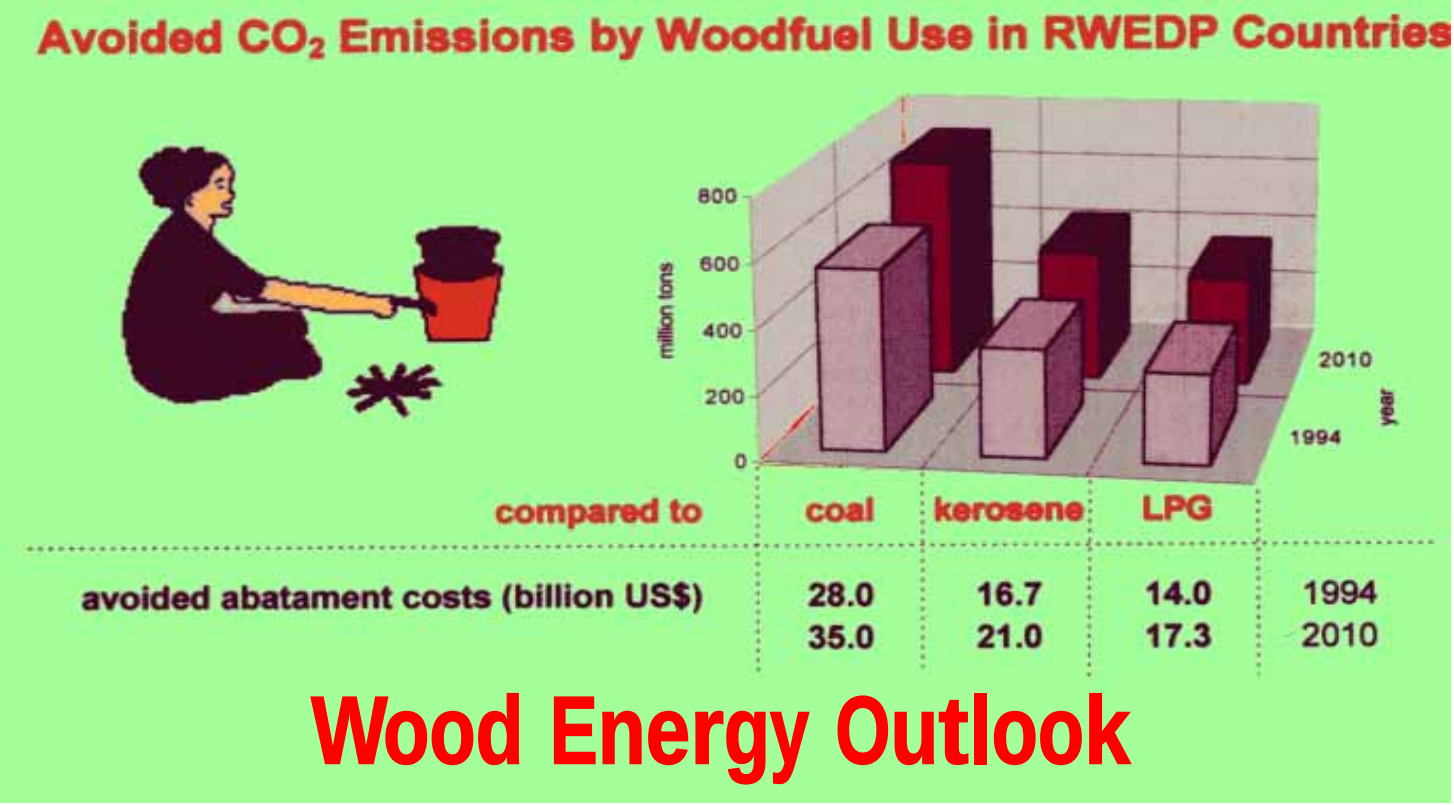


## Wood Energy Outlook

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## Colophon

**Project Information**

The Regional Wood Energy Development Programme in Asia (RWEDP) aims to assist 15 developing countries in establishing and strengthening their capabilities to assess wood energy situations, plan wood energy development strategies and implement wood energy supply and utilization programmes. The programme promotes the integration of wood energy in the planning and implementation of national energy and forestry programmes.

**Wood Energy News**

The programme's newsletter, *Wood Energy News*, which is published on a regular basis, addresses a wide variety of wood energy issues, such as woodfuel resources, woodfuel flows, wood energy planning and policies and wood energy technologies. Its purpose is to share information on wood energy with its subscribers. Suggestions, reactions or contributions are more than welcome, and don't forget to share your own experiences.

Those wishing to obtain *Wood Energy News* can write to the RWEDP secretariat at:

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**Publications**

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The opinions expressed in this publication are those of the authors alone and do not imply any opinion whatsoever on the part of the FAO.

# Editorial

In Asia the potential supply of woodfuels is more than adequate for meeting the ever increasing demand on a sustainable basis. RWEDP has estimated that this situation will remain at least until the year 2010. At the same time, lack of accessibility and fair distribution are major constraints to 'woodfuel security' for millions of people. Moreover, many of those who do have access to woodfuels, do not avail themselves of technologies to use them in a convenient and efficient way. Neither fossil fuels nor renewable energy options other than biomass provide alternatives for the bulk of Asia's domestic energy needs.

At the end of three years of operations of the present phase of RWEDP, delegates from the 16 member countries gathered in Bangkok to review the past achievements and discuss priorities for further activities in the programme. Main policy issues for wood energy resource development, conservation, and energy planning were discussed. It was most encouraging to observe that the participants in the meeting were determined to continue their efforts in wood energy development and spoke a common language. The importance of sustaining the ongoing efforts, especially for the period beyond termination of RWEDP was firmly stated.

Part of the discussions was directed to implications of woodfuel use for the global atmosphere. More than two billion woodfuel users live in Asia, which happens to be by far the largest number in any continent. Therefore, trends in Asia have major implications for the global environment in terms of greenhouse gas emissions. The current practice of using woodfuel saves enormous amounts of carbon which would otherwise be released into the atmosphere from alternative fossil fuel use.

The picture of the woman on the front cover of this issue of Wood Energy News symbolises how much the woodfuel users in Asia save in terms of $CO_2$ abatement costs for all those who have so far not come much further than talking about greenhouse hazards. It can safely be stated that her contribution is as yet hardly appreciated by the many people who are much more affluent than she is.

*Front page: Avoided $CO_2$ Emissions and Abatement Costs*

## Programme Focal Points

Bangladesh: Chief Conservator of Forests, Forest Dept, Min. of Environment and Forest; Industry and Energy Dev., Planning Commission, Min. of Planning.
Bhutan: Dir, Dept of Power, Min. of Trade; Joint Secretary, Forest Services Division, Min. of Agriculture.
Cambodia: Chief Community Forestry Division, Reforestation Office, Dept. of Forests and Wildlife
China: DG, Dept of International Cooperation, Min. of Forestry; Dp. Dir INFORTRACE.
India: Inspector General of Forests, Min. of Environment and Forests; Secr., Min. of Non-Conventional Energy Sources.
Indonesia: DG of Electricity and Energy Devt; Dir of Regreening and Social Forestry, Min. of Forestry.
Laos: DG, Dept of Forestry, Min. of Agriculture and Forestry.
Malaysia: DG, Forest Research Institute; DG, Economic Planning Unit, PM's Dept.
Maldives: Dep. Director, Agricultural Services, Min. of Fisheries and Agriculture
Myanmar: DG, Forest Dept; DG, Energy Planning Dept, Min. of Energy
Nepal: DG, Forest Dept; Executive Secretary, Water and Energy Commission Secretariat
Pakistan: Inspector General of Forests, Min. of Env., Local Govt and Rural Devt.; Chairman, Pakistan Council of Appropriate Tech.; Chief, Energy Wing, Planning and Devt. Divison
Philippines Secretary, Dept of Energy; Secretary, Dept of Environment and Natural Res.
Sri Lanka: Conservator of Forests, Forest Dept; Sec., Min. of Irrigation, Power & Energy.
Thailand: DG, Royal Forest Dept; DG, Dept of Energy Development and Promotion.
Vietnam: Director, Forest Sciences Institute; Dep. Dir., Institute of Energy, Min. of Energy

# Two Years More and Beyond

*Report from CTA to RAC*

The most tangible result of RWEDP in the past three years have been the implementation of 37 workshops (group activities for training or otherwise), in which 1,100 staff from member-countries participated; the publication of 13 wood energy reports, each one distributed to some 150 institutions in the region; and the publication of eight issues of *Wood Energy News,* distributed to more than 3,200 organizations. However, these facts hide a lot of qualitative information which may be more important than numbers.

Bringing together expertise from forestry and energy sectors, along with staff from both, is a stated aim which seems to work. The two professional groups would otherwise seldom interact, whereas both have a role to play in wood energy and can learn from each other. What also works is the trickling down from regional activities to national ones. At the regional level, concepts have been developed which provide a valuable basis for national activities. In all member countries (except, as yet, Bhutan, Laos and the Maldives), one or more regional or national workshops have been implemented. It is believed that the strategy of spreading group activities over member-countries adds to the momentum generated.

It is obvious that misconceptions about wood energy still need to be addressed in the region (and not only within the region!). The present phase of RWEDP has reformulated and widely communicated important findings. Some of these findings were already available in the 'Chiang Mai Papers' of 1993 (RWEDP Field Documents 57 a, b and c), but only a few insiders absorbed them. RWEDP has amplified and communicated the information and drawn stronger policy conclusions from the same. Conceptual issues are time and again communicated in publications and meetings. RWEDP has made special efforts to direct its periodical, *Wood Energy News,* towards of wood energy development themes, in addition to its in-house communications and reporting functions.

## Aims for the Remaining Project Period

The main aim for the remaining project period is to complete the planned activities, so as to consolidate current impacts. It is anticipated that this will strengthen the momentum being built up in relevant departments in member-countries. The skills being developed by country staff may then have sustainable impacts. Some planned group activities will be modified in order to maintain quality and impact.

Another prime objective is to strengthen wood energy data collection and provide updated overviews as far as possible. RWEDP's efforts will be put in the perspective of new and upcoming activities of other international organisations entering into biomass energy data. Consultations have started on how best to cooperate.

By now the directions and country-specific issues have become sufficiently clear to address top policy makers in energy and forestry, and this will be another priority. It is also RWEDP's intention to convey relevant messages to departments of agriculture and environment.

## Activities in the Remaining Project Period

The immediate Objectives, Outputs and Activities of RWEDP are specified in the Project Document for the total project period, 1994–99. RWEDP submits its workplan to the FAO and member-countries on an annual basis, and has done so for 1995, 1996 and 1997. For the remaining project period RWEDP, plans to complete the Activities formulated in the Project Document. However, some modifications are proposed based on experiences so far, and in the context of changing conditions and observed needs of member-countries. The following are the main modifications:

### *Group Activities*

Complete the remaining group activities with the following modifications:

- Reorientation of regional workshops on industries into expert consultations, with emphasis on documentation/manual production
- Reorientation of some national seminars on planning, policies and strategies to selected area-based case studies, and applications of LEAP for integrating wood into energy analyses;
- Add a regional expert consultation on wood energy in forestry education.

### *Data and Planning*

- Complete wood energy database system and enter available data;
- Collect, analyse and compile secondary national data;
- Carry on with selected case studies in area-based planning;
- Initiate case studies on wood fuel productivity of various land-use types;
- Develop broad guidelines to sustain capacity building in data collection and planning.

### *Resources*

- Complete survey on education in the forestry sector;
- Identify, analyse and document commercially viable cases of fuelwood production;
- Provide support to woodfuel flow studies, either with or without emphasis on gender aspects.

### *Conservation*

- Analyse and document wood energy in traditional industries;
- Direct efforts on training of trainers in household energy;
- Analyse and document further the role of residues for fuel.

*Gender*

- Complete training modules for third parties;
- Activate and brief local groups and NGOs on gender and wood energy;
- Initiate selected case studies on gender and wood energy.

*Policies*

- Address policy makers in relevant sectors through country-specific briefings;
- Further analyse and communicate environmental implications of wood energy use;
- Raise awareness amongst donors on same.

## Beyond RWEDP

All available information indicates that wood energy will remain in Asia for many decades to come. It is also quite likely that not all wood energy-related problems will be solved by the end of 1999, when RWEDP will terminate. Some problems may even become more pressing. So how can the momentum for wood energy development be maintained in the next century? This will very much depend on national efforts. By 1999 national policies will have developed further, many people will have been trained or at least briefed, and substantial information will have been disseminated. This all may help to sustain the efforts. However, most countries have a high turnover of leading and middle level government staff. Many staff committed to wood energy now may already be in different positions, or even sectors, in two years' time. This may not be favourable for the sake of continued national wood energy development.

RWEDP's 'heritage' of 15 years of wood energy development in the region must be transferred in an optimal way. The heritage includes its library, periodicals, training materials, expertise, references, networks and concepts. Some follow-up project outlines in wood energy are being prepared and efforts made to raise donor interest. Priority countries would be those which as yet have had limited opportunity to benefit from the regional programme.

After 15 years of regional wood energy development one should not expect more of the same. If wood energy development is to receive further donor support, it would be country-specific and/or within broader frameworks, like poverty alleviation at large, gender issues, food security, or the environment. Also, we must be realistic. Today's world is competitive, and donors are keen on efficiency and effectiveness of the projects they support. Donors have become less generous in supporting bureaucratic procedures, overheads or rituals.

The international concerns about global climate change provide a strong case to justify wood energy development. In Chapter 9 of RWEDP's recent study, *Wood Energy Today and Tomorrow in Asia,* calculations are given to show that all the money invested in the three phases of RWEDP together is paid back in less than 11 months of RWEDP's operation, in terms of avoided $CO_2$ emissions, if the programme produces 0.1% of wood energy conservation in the region. At this moment, nobody knows what the exact contribution of a programme like RWEDP is or has been, because any contribution is indirect and RWEDP has not been designed with such particular targets in mind. Perhaps RWEDP member-countries which are keen on donor support for further wood energy development could capitalise on the economic justification of woodfuel use in the framework of global environmental concerns. Several industrialised countries and international agencies have allocated substantial funds to offset carbon emissions. Reference is made to a recent study commissioned by FAO-RAP on 'Opportunities for Forestry Investment in Asia and the Pacific Through Carbon Offset Initiatives' (in draft).

Apart from the context of the global environment, as mentioned above, the broader frameworks of poverty alleviation and food security, as well as natural resource management, also provide opportunities for further support to wood energy development in Asia. RWEDP can assist interested parties.

*RWEDP*

*Woodfuel watchers*

# 2nd Regional Advisory Committee Meeting of RWEDP

The second meeting of RWEDP's Regional Advisory Committee took place in Bangkok, from 2-5 September 1997. Participants were delegates from the focal point agencies in the 16 member-countries as well as representatives from FAO Headquarters, FAO Regional Office in Asia and the Pacific, the Government of the Netherlands and its embassy in Bangkok, several specialized institutes in the region, FAO-RAP forestry officials, CTAs of several regional projects of the FAO and CTA and staff members of RWEDP. The regional meeting marked the end of three years of operation of the present phase of RWEDP, and as such was also attended by the team evaluating RWEDP. The meeting provided an excellent opportunity to discuss the experiences of the past three years and look ahead at the coming two years and beyond.

The general objective of the meeting was to contribute to the development and implementation of improved wood energy policies, plans and strategies in member-countries. The immediate objectives of the meeting were:

1. Overview current policies and programmes for wood energy development in RWEDP member-countries;

2. Provide strategic advice on priorities for RWEDP's workplans and implementation at the regional level;

3. Discuss priorities and options for further wood energy development programmes after termination of RWEDP as a project.

## Opening Addresses

Mr. Sathit Sawintara, Director General, Royal Forest Department Thailand, welcomed the delegates on behalf of the host government. He pointed out that Thailand is keen to collaborate with the countries in the region and share experience in wood energy development. The Director General mentioned as specific benefits from the collaboration with RWEDP that knowledge and skills in policy formulation, programme planning and implementation related to wood energy have been enhanced. An additional advantage is the co-ordination and linkages established not only between organizations within the forestry sector itself, but also between the forestry and energy sectors. Now the two sectoral agencies are fully aware of the problems and potentials of area-based integrated rural energy development. Thailand has a strong interest in participating further in the coming years.

The meeting was officially inaugurated by Dr. Soetatwo Hadiwigeno, Regional Representative for Asia and the Pacific and Assistant Director General of FAO. Dr. Hadiwigeno extended FAO-RAP's warm welcome to the delegates. He highlighted the development objective of RWEDP and stressed the importance of wood energy issues in the countries in the region. Woodfuels are often seen as a by-product of forest and other tree production systems rather than as a main product. Still, numerous people in the region depend on wood for their daily needs and their numbers will increase. It was stressed that there are still a lot of problems related to the use of wood energy, like the burden wood energy use places on women and children. All these problems underline the importance of the efforts of policy makers in the forestry and energy sectors to pay extra attention to wood energy development.

Uninformed outsiders still look at woodfuel use as a major threat to natural forests or even as a main cause of deforestation. From studies by RWEDP and others it is now clear that this concept is false. In fact most wood energy use is on a sustainable basis. Another environmental aspect of wood energy use is related to $CO_2$ emission. The sustainable use of wood energy implies that whatever $CO_2$ is emitted by using wood as a fuel is recaptured from the atmosphere by regrowth of trees and other vegetation. Therefore, such use of woodfuels has no net effect on greenhouse gases. At the end of his statement the ADG expressed his confidence that, with all the experience gathered at the RAC meeting, RWEDP will be in a good position to carry on with the same vigor as it has exhibited up until now.

On behalf of the Assistant Director of the FAO Forestry Department, Mr. Harcharik, a statement was presented by Mr. Miguel Trossero, Senior Forestry Officer. Mr. Trossero highlighted that energy remains a hot issue in the region, and the demand for fuels is growing continuously. Wood energy is and will remain the most important source of energy for traditional use, and increasingly also for modern applications. Mr. Trossero stated that we are entering a "Wood Energy Revival Phase". More and more policy makers and private organizations are becoming attracted to wood energy as an environmentally friendly, "green" source of energy, both in developed and developing countries. Several "Wood Energy for Today and Tomorrow" studies show that similar wood energy situations are found in both the developed and the developing countries. The biggest problem for implementation of projects in the field of wood energy is the lack of data. FAO-Headquarters is now focusing on this.

In his statement, the FAO Senior Forestry Officer highlighted several special issues and events which had occurred since the first RAC-Meeting in 1995, such as the incorporation of Cambodia as the 16th RWEDP member country, the huge efforts of RWEDP towards incorporating wood energy issues in national policies strategies and programmes in the forestry and energy sectors, and the attention paid to gender issues. According to Mr. Trossero, the project is gaining a new momentum, which will enable the successful implementation of new approaches and strategic lines of action over the next two years.

Mr. Rienk Wiersma, Head of the Development Cooperation Section, Royal Netherlands Embassy in Bangkok, expressed his appreciation for the efforts of FAO jointly with member-countries in

Asia for the development of wood energy. Mr. Wiersma underlined the importance of the subject in relationship to people's needs as well as for the healthy state of countries' natural resources. Wood energy supply and use remains a key issue for development on a long-term basis in this part of the world. Strengthening of capacities and skills enhancement are essential. The representative of the Dutch Embassy extended a special welcome to the delegates from Cambodia as a new member-country of RWEDP, and expressed his confidence that the regional project will assist the country to sustainably utilize its forest and tree resources.

A statement on behalf of the Dutch government was presented by Ms. Hanneke van Toorn. The starting point of the government's development policy is to stimulate sustainable development. With respect to energy, the Netherlands is of the opinion that new strategies are needed which are based on rational use of energy and development of renewable energy. For this goal, a transition to sustainable energy systems and services is needed. In Asian countries wood is one of the most important renewable energy sources, although its potential is often underestimated and misconceptions still hamper the development of biomass energy. The Dutch government is of the opinion that biomass should be part of energy development policies, and that substantial progress can be made in addressing and developing the instruments to efficiently produce, manage and utilize wood fuels for the benefit of households, industries and other enterprises. RWEDP is seen as an important program in the efforts to achieve these targets.

In 1999, RWEDP will terminate. Therefore, the RAC-meeting should, according to Ms Van Toorn, also discuss what steps should be taken to ensure that the participating countries can be self-sustaining in the development and implementation of wood energy policies and strategies.

## Presentation on RWEDP

Dr. Willem Hulscher, Chief Technical Adviser of RWEDP, expressed his deep gratitude to all organizations and individuals who made the organization of the second Regional Advisory Committee meeting possible, in particular, FAO-RAP and the FAO Headquarters Forestry Department. He extended his welcome to the delegates and expressed his hope for a successful meeting. Dr. Hulscher then presented a report on RWEDP and discussed the main achievements so far. These were in the three major expert fields of RWEDP: "Wood Energy Conservation", "Wood Energy Resources" and "Wood Energy Data and Planning", which were discussed in more detail. Dr. Hulscher presented the outline of the workplan for the remaining project period. The overall aim is to complete the planned activities, so as to consolidate current impacts. The activities in the remaining project period were also discussed. Finally, the question of what to do after RWEDP terminates was raised.

## Country Presentations

The first session of the meeting consisted of country presentations. The delegates discussed the following developments.

1. National policies for wood energy, in particular: main policies and legislation regarding wood energy production and use; current arrangements and institutional strengths and weaknesses in the country regarding wood energy production and use; the position of wood energy in energy planning; priorities of the Focal Points and/or National Advisory Committee for RWEDP; and activities of National Wood Energy Working Groups.

2. Experiences so far and problems encountered, in particular: advances made in wood energy development and how these have been achieved; current main wood energy problems in the country; major constraints to wood energy resource development, conservation and planning; and other constraints as relevant.

3. On advice to the RWEDP, in particular: priorities suggested for further RWEDP assistance and co-operation; observations on training in wood energy as relevant for further activities; how to further strengthen wood energy data collection and analysis; and priorities for follow-up after termination of RWEDP.

Finally, Dr. Hasan Ibrahim, Director of the ASEAN-EC Energy Management Training and Research Center, gave a short presentation on AEEMTRC and its activities related to wood energy.

## Presentations on Sustainable Strategies for Wood Energy Development

The second session of the meeting consisted of three presentations on Sustainable Strategies for Wood Energy Development. The papers presented by RWEDP's specialists were as follows:

Mr. Tara Bhattarai, Wood Energy Resources Specialist, gave a presentation on "Wood Energy Resources".

Mr. Conrado Heruela, Wood Energy Planning Specialist, gave a presentation on "Wood Energy Data and Planning".

Mr. Auke Koopmans, Wood Energy Conservation Specialist, gave a presentation on "Issues and Options for Wood Energy Conservation".

Summaries of all three presentations appear on page 9 - 10.

## Discussion Groups

The third and last session of the meeting consisted of group workshops. The participants split into three groups and were requested to make recommendations in the following areas:

1. Development of policies and institutions

2. Human resources development

3. Development of databases, information and networking.

These areas of discussion were proposed by RWEDP as they are considered to be amongst the most important and complicated issues in wood energy development at the moment. The group discussions culminated in a plenary session where all conclusions and recommendations were presented, discussed and adopted. At the close of the meeting, Dr. Hulscher thanked the groups and all delegates for their contributions and recommendations.

### Field Trip

On the last day of the RAC-meeting, the participants visited the Lad-Krating tree plantation of the Thai Plywood Company and nearby charcoal production sites in Chacheangsao Province. Waste wood of the plywood factory, branches and stems under a certain diameter and under a certain quality produced during timber harvest, are used as raw material for the charcoal factory. The visit was arranged by Mr. Pralong Dumrongthai of the Wood Energy Research Division of the Royal Forest Department.

*RWEDP*

# Main Conclusions and Recommendations from the RAC

The Regional Advisory Committee reiterated the need to continue and intensify efforts in wood energy resources development and utilization. The unanimous view was that problems of wood energy still persist, notwithstanding ongoing national and international initiatives for improvement of production and utilization systems. The Committee noted with satisfaction the catalytic role played by RWEDP and emphasized that RWEDP should continue to provide assistance to increase the momentum. After RWEDP terminates in 1999, the roles of the project can be handed over to the member-countries. It was, however, recognized that some countries would still need further assistance from outside agencies.

### On Wood Energy Resources

In the area of wood energy resource development, it was appreciated that operational concepts of incorporating woodfuels in multipurpose tree production and farming systems have been identified, developed and presented. The concepts are spreading amongst foresters, and the documents produced by RWEDP are most relevant. Also, understanding woodfuel trade and flows is gradually acknowledged as being essential for policy making in the forestry sector. The need to integrate policy plans of the forestry and agriculture sectors and to co-ordinate strategies for the implementation of wood energy development activities is clearly visible in the region.

It was observed that institutes for theeducation and training of foresters in the region as yet pay little attention to fuelwood issues. It is considered very important to update and complement existing curricula at this time. The assistance of RWEDP to implement such changes was requested by many country delegates.

### On Wood Energy Conservation

The Committee acknowledged with appreciation that new issues have been put on the wood energy conservation agenda: stoves for loose residues as a fuel; institutional stoves; stoves for space heating; modern applications of wood/biomass in general, and health aspects of stoves, particularly from a gender perspective. These issues are important and have as yet hardly been addressed, either within or outside RWEDP. In its remaining period, RWEDP should proceed with these issues, in addition to the continuing attention paid to develop the more traditional ones, like research and development on improved cookstoves, strategies to disseminate ICs, improving the efficiency of brick-kilns and other wood energy intensive industries and documentation of existing technologies of wood energy combustion in traditional industries/services and in the briqueting industry.

Several country delegates stressed the importance of continuing the process of technology transfer at the national and regional levels. RWEDP was asked to carry on with this.

### On Wood Energy Data and Planning

Most country delegates identified inadequate information as one of the main constraints of wood energy development and planning. Inadequacy of wood energy data has led to erroneous perceptions of wood energy situations and problems. RWEDP has intensified efforts to improve data and information on wood energy through continuing training in wood energy planning and data collection, and through providing better understanding of wood energy systems. Still, serious gaps in information were observed by the member-countries. They recommended that RWEDP should continue its efforts to assist in data collection, processing and evaluation for planning and policy making.

### On Development of Databases, Information and Networking

Constraints to the development of wood energy data bases relate to limited financial resources, facilities and tools, as well as lack of skilled manpower. A further problem related to data bases is inadequate networking amongst different agencies involved. Adding to the chaotic structures of wood energy data are conflicting inputs from consultants. RWEDP was requested to assist in solving these problems, e.g. by introducing standard formats, training of data collectors, use of standard units, and networking amongst agencies. Country capabilities need to be strengthened because of the need to continue data

collection and processing after RWEDP is terminated.

It was recommended to continue with publication of the various reports. Further, RWEDP should look into effective areas of information dissemination, both regional and in-country, in particular putting wood energy information on the Internet. It was strongly recommended to continue the distribution of 'Wood Energy News' after termination of the present RWEDP.

### On Wood Energy Policies and Institutions

The country delegates observed that institutional arrangements in the wood energy sector are still weak. The meeting underlined the importance of bringing together expertise from the forestry, energy and agriculture sectors. The delegates agreed with the problem analysis of RWEDP that a major constraint is the general lack of institutions which undertake training and research in wood energy and which are able to develop and implement adequate wood energy policies. RWEDP was asked to assist member countries in strengthening institutional structures in which all the relevant sectors can be represented, not only at national level but also at regional level.

Inadequate appreciation for wood energy amongst the centers of political power was recognized, notwithstanding the proven social, economic and environmental importance of the fuel. RWEDP's assistance was requested in developing guidelines, rationale, and frameworks for wood energy policies. The messages should reach the political decision makers and the top officials involved in policy formulation and implementation. The committment of the government in terms of implementing biomass-related activities and projects is essential. Seminars, training courses, and presentations during regional meetings were recommended as a means to enhance awareness amongst policy makers. RWEDP should also participate actively in regional forums on (wood) energy.

### On Human Resources Development

Enhancing awareness, knowledge and skills were considered keys to further develop wood energy for both subsistence needs and commercial endeavors. There is a need to consolidate what RWEDP has done in HRD to ensure the momentum beyond the program's life for the benefit of its member countries. Relevant training programmes are in: data, planning and policy on different levels; resource assessment and development; conversion technologies (both modern and traditional applications).

There will be a continued need for HRD, which eventually should be internalized in regular country programs. Using local languages is often necessary. Training of trainers is recommended as a means to sustain efforts in the future. Networking is a further relevant means for sharing of technology through linkages between institutions, both NGOs and GOs. RWEDP can assist in stimulating member countries to establish these linkages.

### On Follow-up Projects

The country delegates expressed their gratitude for the activities and achievements of RWEDP, and strongly recommended a follow-up project on wood energy development. The new project should concentrate on countries facing the gravest wood energy problems. It is hoped that the donor country is willing to provide the budget for such a project.

Special emphasis was laid on continuing the publication of 'Wood Energy News' as an important means of disseminating wood energy information. It was stated by the country delegates that after RWEDP terminates in 1999, Wood Energy News should still be published and distributedfor free of cost (charging fees would not be feasible). It is hoped that the donor will support this as a follow-up activity of RWEDP.

A full report on the meeting will be available from RWEDP.

*RWEDP*

## Internships at RWEDP

A unique and fruitful way of co-operation between RWEDP and member countries, is via "internships". Occasionally RWEDP invites professional staff from member countries to work as interns at its office premises. For example, during the preparation of a national workshop, RWEDP may invite two or three professional staff from the focal points as interns for two weeks. During this period they would develop the training programme and identify training materials advised by RWEDP staff. After the internship, the interns will take further responsibility for the organisation of the workshop and they will act as resource persons. Other interns may assist in the preparation of publications or training materials.

During their time at RWEDP's office, the interns can make full use of RWEDP's facilities and documentation centre, and interact with RWEDP staff. Both the national staff and RWEDP benefit from this process, with the national staff having the opportunity to enhance their experience and capabilities for wood energy development, while RWEDP can learn from national staff about wood energy and other issues in their country. RWEDP has already received interns from Cambodia, China, Indonesia, Laos, Sri Lanka, the Philippines and Vietnam, and hopes to invite other countries as well.

*J.S.*

# Summary of Specialist Papers Presented at the RAC Meeting

## Wood Energy Resources

In most cases, fuelwood is a by-product of forest and non-forest area based production systems. Some recent studies suggest that the share of wood waste and by-products in the total fuelwood consumption is as high as 90% (in Pakistan), and the estimated average for the 16 RWEDP member countries is as high as 66%. As woodfuel is mainly a by-product of other multiple objective production systems, programmes of woodfuel production should be pursued together with other major activities of rural development. Implementation of such integrated woodfuel production strategies call for effective co-ordination between the different actors and activities in related sectors.

### *Wood Energy Resources Activities*

- Two sub-regional training workshops on integrating fuelwood production in the implementation of agriculture, forestry and rural extension programmes were organized, which now could serve as references to programmes in these countries.
- As a national level follow-up to these sub-regional courses, RWEDP has sponsored a number of national level training courses in member countries. So far, seven countries, have successfully replicated this type of training exercise.
- The other regional/national level activities carried out during the past years are an expert consultation on woodfuel trade in Asia and two national follow-up training courses on woodfuel trade.
- The Institute of Forest Conservation, College of Forestry, UPLB, Philippines, has started integrating wood energy development related issues and topics into their on-going International Short Courses in Forestry.

### *Potential Area for Future Collaboration*

- During regional/national training courses and during expert consultations a number of new areas have been identified requiring further research.
- More national training courses on woodfuel production/trade will be conducted.
- The establishment of linkages between GO's , NGO's and PO's will continue.
- There exists a need for identification of training curricula on wood energy development
- RWEDP now realises the need to expand its linkages with the agriculture sector

### *Commonly Observed Issues and Constraints*

- In most areas, the major concern is not the availability or quality of woodfuel, but its distribution to the needy.
- The impact of woodfuel shortages will be felt more directly by rural women and children.
- The institutional responsibility for wood energy development is not clear in most countries.
- Most countries still face chronic problems of land and tree ownership/ tenure.
- Technical information flow and support with needed inputs to private tree growers is still weak.
- Support will be necessary to the private sector in their effort of integrating multipurpose tree species in the farming system.

*T.B.*

## Wood Energy Data and Planning

Inadequacies of wood energy data and information have led to erroneous perceptions of wood energy situations and problems which in turn has led to inappropriate policies and strategies.

### *Data Collection and Assessment Activities*

In the current phase, RWEDP has tasked itself to lead efforts in the region to intensify efforts to improve data and information on wood energy and to provide a better understanding of wood energy systems. Since the project has started it has accomplished the following:

- Developed a framework for a wood energy data base
- Reviewed and organized available secondary data
- Identified "best estimate" wood energy consumption data
- Organized more detailed wood energy supply data
- Initiated regional-level institutional linkages
- Conducted training activities

### *Issues in Data Collection and Management*

- Wood energy consumption data are limited to household consumption data.
- Data on wood energy resources are only available for a few countries.
- Limited wood energy data hinder proper and in-depth policy advisory work.
- There is a need to improve projection techniques to correct misconceptions about wood energy.
- The support for continuing improved data collection activities has declined.
- Regional-level wood energy data collection and management is insufficient.
- A universal wood energy data base format may be necessary.

### *Issues in Wood Energy Planning*

- Past wood energy interventions/activities have been mainly at the project level.
- Wood energy analyses have generally been excluded in macro-level sectoral planning exercises.

- Wood energy situations and problems are site-specific, requiring a decentralized approach to the design of interventions.

### *Issues in Wood Energy Planning Exercises*

- Inadequacy of wood energy data.
- Improper or lack of understanding of wood energy systems.
- Weak institutional capacity for wood energy planning at central and local levels.
- Weak or lack of linkages among relevant agencies.

### *National Follow-up Activities*

It is desirable that regional courses are followed-up at the national level. National level activities may include national training courses and case studies. Till now only five countries have conducted or have definite plans to conduct national follow-up training courses. RWEDP has received initial proposals from a few more countries. Many other countries have made verbal indications of their interest for follow-up activities.

In the next two years RWEDP will expand its initiatives in national capacity building. What RWEDP can do in this respect is initiate activities that lay down a framework and guidelines that define the basic tasks for national capacity building.

A regional body that will provide the lead role and expert advise in formulating activities for strengthening national institutions after the RWEDP terminates its work is desirable.

*C.H.*

## Options for Wood Energy Conservation

### *Background*

Biomass energy, including wood, has been and still is an important source of energy for all types of applications. This situation is expected to remain for the foreseeable future. The World Energy Council quotes a figure of approximately 12% as being the share of biomass in the total amount of primary energy used on a world-wide basis. However data for regions and individual countries show considerably higher amounts (e.g. the figure for South Asia is about 50%)

*Fuelwood comes from various sources*

### *Modern and Traditional Biomass Applications*

Biomass being versatile results in it being used for many varied applications. Such applications can be loosely divided into "traditional" and "modern". In comparison to traditional biomass applications, the share of modern biomass applications is still low (only about 11–12% of all officially recorded biomass energy use). Based on total primary energy consumption data from 1990, modern biomass energy applications still have a long way to go before they become as important as the traditional applications.

### *Support Required for Modern/ Traditional Applications*

Improvements in information exchange will require concerted efforts in the form of institutional support. For the larger scale modern biomass energy sector such institutional support may already exist. For the small scale industrial and the domestic sector institutional support is lacking.

With regard to infrastructure as well as financing, the larger scale modern applications again appear to be favoured over the traditional sector.

Based on the above it is clear that when comparing the modern and traditional sectors with regard to the need for assistance in the field of wood and biomass energy, it is in particularly the traditional energy using sector which requires a larger amount of varied forms of support.

### *RWEDP Wood Energy Conservation Activities in the Remaining Period*

Reflecting upon the wood energy conservation activities already undertaken it can be concluded that emphasis has been placed on "general" subjects during regional activities. During the remaining period wood energy conservation activities will be more country based and at the same time the way in which information is presented will be changed (e.g. there will be more intensive "hands-on" training as opposed to "general" approaches target groups i.e. participants in workshops, etc will be more carefully selected). Furthermore, greater efforts will be directed towards those activities which may help in addressing environmental issues.

Some initial steps in this new direction have already been taken:

- An extensive training manual on cookstove development has been developed and is available to trainees and other interested parties.
- For information gathering on industrial applications of wood fuel, small teams of experts from a few countries in the region are preparing information in written form.

*A.K.*

# Biomass Energy in ASEAN Countries

In June 1997 the Senior Energy Officials of the ASEAN member countries met in Manila. The delegates were briefed by RWEDP on wood and other biomass energy in ASEAN. An information brochure on the same was prepared in cooperation with AEEMTRC and COGEN (copies are available from RWEDP). The following is a summary.

Biomass is an important source of energy in ASEAN member countries. It includes wood, wood residues, charcoal, and agriculture residues used as fuel. In ASEAN, biomass energy represents about 40% of total energy consumption, which is more than 2.5 million Tera Joules per year. The bulk (74%) is from woodfuels with an estimated value of 7 billion US$ per year. The main applications are in the domestic sector and small-scale industries, but also increasingly in modern systems for combined heat and power generation.

Biomass energy can be sustainable, environmentally benign and economically sound. Moreover, biomass energy creates substantial local employment. The advantages are also being recognised in industrialised countries [see paper on Biomass energy in selected industrialised countries, on page 13], where several governments have successfully adopted articulate policies for promoting biomass energy.

Tropical countries enjoy favourable conditions for growing biomass. However, constraints on its optimal use as an energy source are still to be resolved. The main issues are legal and institutional barriers, as well as lack of information and technology transfer. Furthermore, common misconceptions about the role of biomass energy have to be redressed. For instance it should be emphasised that biomass energy will not phase out in the foreseeable future, and that biomass energy is more than a traditional commodity.

It is recommended that energy policy makers in ASEAN member countries acknowledge the important role of biomass energy and its future potential. This can help to integrate biomass energy in overall energy policy making and planning. In particular the potential of modern applications for power generation should be given serious consideration for optimal utilization. Currently, most agro-residues are still wasted, whereas they have the potential to meet some 30% of all energy needs in the ASEAN countries.

## The Increase of Biomass Energy Use in ASEAN

The use of conventional energy sources like oil, coal and electricity has increased enormously in the last 25 years in ASEAN economies. During the eighties, consumption more than doubled, with an average annual growth rate of 7%. Although less spectacular and somewhat overshadowed by the booming consumption of conventional energy, the consumption of biomass energy has also increased substantially. For the five ASEAN countries where biomass is an important energy source (Indonesia, Malaysia, Philippines, Thailand and Vietnam), consumption increased with an average annual growth rate of nearly 2% between 1985 and 1994. Consumption is highest in Indonesia, accounting for more than half of the total consumption, which is due to its large population, whereas the increase is highest in Malaysia and Vietnam.

The share of biomass in the total energy consumption has been decreasing for most countries, which often leads to the misconception that biomass energy is being substituted by modern energy and that it is phasing out. On the contrary, in absolute terms biomass energy consumption is still increasing, due to both population growth and increase of per capita consumption (See paper on "Fuel Complementation Rather than Substitution", on page 20). Conventional energy is mostly used for new applications such as new industries, transport and household electricity, whereas wood and other biomass continue to be applied for domestic activities such as cooking and various industries.

Recent and regular national statistics on wood and other biomass energy consumption are available only for Thailand. Comparing these with population data, it appears that there is a strong correlation between population and biomass energy consumption between 1985 and 1995 (0.99). Together with population forecasts, this can be used to forecast the consumption of biomass energy up to the year 2010. This shows an increase of nearly 15% in 2010 compared to 1995. Accurate data on supply sources, both from forest and non-forest areas, are lacking. Therefore, it is difficult to assess if enough woodfuel supply will be available to meet future demand.

For the other four countries, similar or even higher trends of increase in biomass energy consumption apply, considering their higher population growth and higher dependence on biomass energy (except Malaysia). Of course the above is only a simple modelling exercise, but it shows the need for more accurate, regular and detailed data on consumption and production of biomass energy and its sources, in order to asses trends, to develop forecasts and to introduce appropriate policies.

## AEEMTRC - COGEN - RWEDP

AEEMTRC, COGEN and RWEDP are all involved in biomass energy in the ASEAN region. The organizations have complementary strengths and are keen to assist ASEAN member countries to further benefit from biomass energy, including through regional projects and programmes. At present AEEMTRC, COGEN and RWEDP cooperate in order to integrate information on biomass into energy data bases and assist in the development of sustainable energy policies. The organizations have agreed upon a Memorandum of Understanding for cooperation with the following objectives:

1. To integrate wood/biomass energy information into energy data bases;

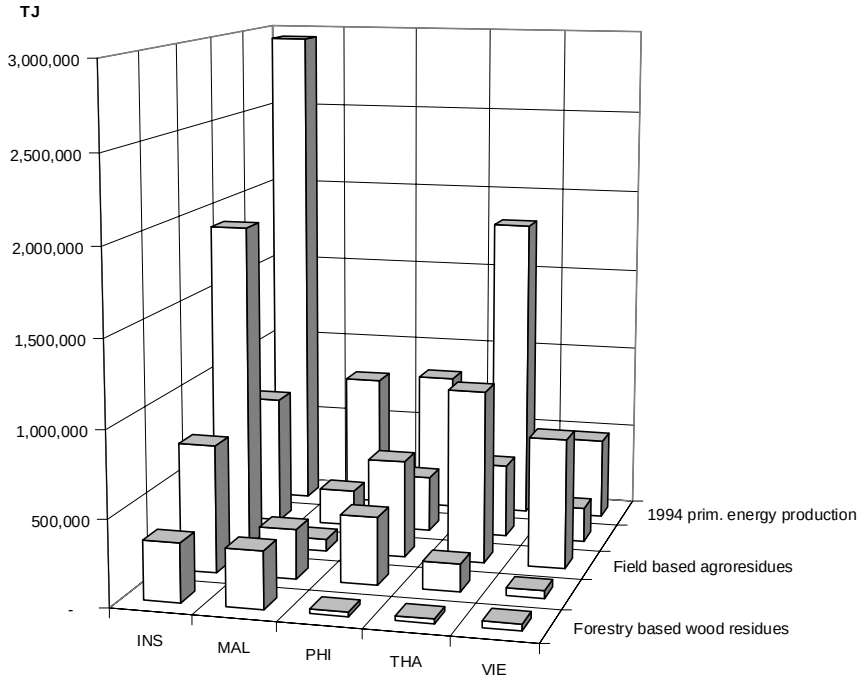
2. To identify data gaps which limit the integration of wood/biomass energy aspects into long-term development programmes;

3. To identify data collection activities which countries need to undertake to fill these data gaps;

4. To assist in the development of sustainable energy policies.

*RWEDP*

*Figure 1: The Energy Potential of Agroresidues and Wood Residues in ASEAN Countries*




## ASEAN-EC Energy Management Training and Research Centre

AEEMTRC is based in Jakarta. Its objectives are to further enhance the cooperation between the seven ASEAN countries, and to strengthen the political, economic and commercial links between the ASEAN and the European Union in the field of energy. AEEMTRC is guided by a Project Steering Committee composed of Senior Officials on Energy (SOE) from the respective governments and an EC representative. In 1996 the ASEAN Ministers on Energy Meeting (AMEM) decided that AEEMTRC should be transformed into an ASEAN energy centre, with effect from January 1999. The centre will be placed under the auspices of the AMEM and the SOE leaders. The mission is to accelerate the integration of energy strategies within ASEAN to ensure over the long-term the necessary energy development in harmony with economic growth and the environmental sustainability.

## EC-ASEAN COGEN Programme

The COGEN Programme is an economic cooperation programme between the European Commission (EC) and the Association of South-East Asian Nations (ASEAN) co-ordinated by the Asian Institute of Technology (AIT), Bangkok. Its aim is to accelerate the implementation of proven technologies for generating heat and/or power from wood and agro-industrial residues through partnerships between European and South-East Asian companies. In a short period of time, the COGEN Programme has established references of European and Euro-ASEAN equipment in selected wood and agro-industries in ASEAN. It is now involved in the promotion of reference projects, thus forging closer links between European suppliers and ASEAN customers and partners. The Programme is currently involved in the implementation of over US$ 100 million worth of Euro-ASEAN biomass energy equipment.

## FAO Regional Wood Energy Development Programme in Asia

RWEDP is a long-term project implemented by the Food and Agriculture Organization of the United Nations. The project is funded by the Government of the Netherlands and is based in Bangkok. RWEDP has 16 member-countries in Asia, including 5 ASEAN Member Countries (Indonesia, Malaysia, Philippines, Thailand and Vietnam), as well as 3 incoming ASEAN Member Countries (Cambodia, Laos and Myanmar). RWEDP focuses on wood/biomass energy and aims to (1) strengthen institutional capacities for databases, (2) assist in policies and planning, and (3) develop capabilities for implementing programmes. Main areas of expertise are wood energy resource development, wood energy conservation, and wood energy planning and policy development.

# Biomass Energy in Selected Industrialized Countries

Several industrialized countries promote biomass energy for both environmental and socio-economic reasons. These countries use locally available wood and biomass fuels as alternatives to oil or coal, taking advantage of recently developed technologies, and thus avoid $CO_2$ emissions and reduce their own dependency on oil.

## Finland

The situation in Finland is similar to that in Sweden, with as much as 30% of total energy supply coming from biofuels, hydroelectricity and peat. Again, of the total of around 330 PJ/a being supplied by biofuels, pulp waste liquors account for the largest share (45%), followed by peat (19%), woodwaste (18%) and firewood (18%), with municipal waste less than 1%. Over 140 biomass-fueled district heating systems exist, varying in size from less than one MW to over 50 MW. One of the largest cogeneration plants is peat-fired and produces around 80 MW of electricity and 120 MW of district heat.

Whether peat is renewable and counts as biomass, or is close to the initial stages of the formation of coal and other fossil fuel, is a matter of debate. Finland has over 10 million ha of commercial peat reserves which should last for at least 200 years at the present rate of use, though renewal of the exploited land takes several thousand years. However, it is generally included along with wastes and residues, partly because it can be utilized with similar burners or grates. Tree planting is another ongoing strategy to extend the energy potential of Finland.

## Sweden

In Sweden, biomass and peat contribute about 12% of the total energy supply of around 1,600 PJ/a. The main source is liquors from pulp mills, but woodfuels (logs, bark and sawdust), municipal solid waste and peat are all used for district heating, home heating and in the forest products industry itself. Biomass-based district heating has increased more than fivefold in less than 20 years, from 5 PJ in 1980 to 53 PJ today. Of this, 27 PJ comes from woodfuel, 15 PJ from refuse and 11 PJ from peat. In addition, some 7 PJ of biofuels were used for electricity generation last year. Seventy buses are currently running on ethanol to demonstrate the potentials of liquid biofuels.

## Austria

In Austria, renewable energy sources supply 27% of the country's primary total energy consumption (PTEC) of 1,143 PJ/a, with biomass providing 13%. Of the biomass used, almost 98% is fuelwood, bark, wood chips and other forest industry by-products. Most of this is used in over 530,000 small wood-burning installations and 400,000 tiled stoves, as well as in 63,000 larger furnaces and 200 district heating plants. The other 2% is made up from biogas plants, together with small-scale use (0.4% or 0.6 PJ) of rapeseed methylester (RME), produced in six installations as a substitute for diesel fuel. However, Austria is currently considering producing up to 150 million litres of RME per year from 150,000 ha of rapeseed plantations. This represents an annual yield in energy terms of about 500 PJ. Other ongoing developments include the use of straw and fast-growing trees for energy.

## European Union

In the European Union, large areas of land area have been set aside to grow rapeseed for fuel. This has expanded from 200,000 ha in 1992 to nearly one million ha in 1995. This expansion was stimulated by the revised Common Agricultural Policy which introduced more direct payments to farmers – in theory to compensate for lower prices. Bio-energy research in Europe focuses on the production of liquid fuels from lignocellulosic materials, thermochemical conversion as well as gasification linked to power generation.

## USA

The use of wood for energy in the USA is growing steadily at about 1.2% per year and is expected to reach around 3,000 PJ by the year 2000. Around 70% of the woodfuels is used within the forest products industries themselves, the rest for household heating and electricity generation. Wood-based electricity generation is expected to grow fast, consuming around 500 PJ in 2000, 1,000 PJ by 2010 and possibly reaching 3,000 PJ by 2030.

The production of electricity from wood has been highly successful in moderate-scale facilities, with some 700 MW electricity generating capacity provided by 30 or more cogeneration or free-standing plants built over the last decade. Many of these plants are located at pulp and paper or other forest-product mills that produce both steam and electricity. New technologies are being developed for co-firing biomass in coal-fired boilers.

Dry densified woodfuels, such as pellets and briquettes, can be burned efficiently in furnace/boiler units and wood stoves by commercial or residential users. For instance, wood or biomass is pelletized and fed into coal boilers in a mix of 15% pellets and 85% coal. This low-cost supplemental fuel helps dispose of wood wastes, produces lower emissions of sulphur dioxide and other undesirable gases, and reduces fossil-fuel consumption.

If short-rotation forestry is implemented over the next decade as expected, dedicated energy crops may overtake agricultural and forest residues as a source of fuel for electricity generation before 2020. In some regions, relatively large power stations in the 60–100 MWe range are possible, making the economics much better than those for smaller systems such as those found in Europe.

The other major biomass use is in the production of bio-ethanol for addition to petrol, as an oxygenate and octane enhancer. The corn-processing industry

now uses around 20 million tonnes of maize a year (some 10% of total corn use in the USA), with a recent annual growth rate of around 4%, mainly accounted for by increased production of fuel alcohol. The primary driving force for expanding ethanol sales is now the reformulated gasoline programme, which began on 1 January 1995, as mandated by the Clean Air Act Amendments of 1990. In the Chicago and Milwaukee markets, ethanol's market share was as high as 70%, while it captured almost 100% of the premium winter oxygenated fuel markets in Colorado. For regions where transportation and other distribution costs limit competitiveness, gasoline is blended with ethanol-derived ethyl tertiary butyl ether (ETBE) at the refinery, and shipped in common carrier pipelines. Tax exemption for biofuels is in place to support this.

The potential market for corn-based ethanol is limited once industrial use starts to compete with food use. A present priority issue for the US government's renewable energy activities is therefore research on producing new liquid biofuels and blending additives from other agricultural materials and wood.

*In Denmark, special equipment is used for collection and chipping of forest residues.*

An ambitious programme has been launched to produce up to 20% of liquid fuel requirements from short-rotation wood plantations and other biomass. A major goal of the programme is to reduce the cost of producing ethanol from energy crops from US$ 0.33 per litre in 1990 to less than US$ 0.25 by 2005 and under 20 cents by 2010. For ethanol from cellulosic waste materials, the goals are 13 cents per litre in 2005 and 9 cents in 2010. It is this setting of specific objectives and targets that distinguishes the US R&D strategy from that in the EU.

JK

# Energy and Environment Basics

Discussing energy problems without using the appropriate concepts and terminology, dimensions and units, makes as little sense as disregarding the universal laws of nature. It is virtually impossible to make a sensible contribution to energy development without, at some point, mentioning quantities – of power, of fuel, of emissions etc. This is well understood by scientists and engineers, but there are many more disciplines which make important inputs into energy – and particularly wood energy – development. We will all understand each other better if we are speaking the same language.

*Energy and Environment Basics* is a guide to the technical side of energy and the environment. It is aimed at those who work in the field of energy and related aspects of the environment, but have a limited background in science or engineering. It is not a compendium for specialists; rather it is intended as a basic training and reference resource.

Compiled by RWEDP in cooperation with the Technology and Development Group of the University of Twente in the Netherlands, the updated and expanded second edition of *Energy and Environment Basics* was published by RWEDP in July this year.

The new *Energy and Environment Basics* begins by laying out some of the basic concepts of energy in their simplest forms. The next section gives all the common units of weight, volume, power etc. used in discussing energy, and shows how to convert from one to the other, for example from tonnes to tons, calories to BTUs. Other sections cover energy accounting and the characteristics of different fuels, and the guide ends with a comprehensive glossary of energy and environment terms.

In due course, RWEDP aims to prepare another guide, on Wood Energy and Environment Basics, which may serve those involved in developing wood and other biomass energy even more specifically. Comments and suggestions from readers will be welcome. In the mean time, copies of *Energy and Environment Basics* are available from RWEDP.

# The Fuelwood Gap Theory Rejected - Quotes and Notes

*Arjan Kraijo*

Many institutions and researchers have published their findings, questioning the fuelwood gap theory. The quotes below are included in the RWEDP *Regional Study Wood Energy Today and Tomorrow in Asia*:

"In most countries, forests are disappearing not because people want the trees to burn, but because they want the land under the trees for agriculture." *Fuelwood: The Energy Crisis that Won't Go Away,* E Eckholm, G Foley, G Barnard and L Timberlake, 1984.

"Little attention is paid to changing land-use despite evidence that it is not the demand for fuelwood which creates deforestation but land clearance for agricultural production." *The Fuelwood Trap: a study of the SADCC Region,* B Munslow, Y Katerere, A Ferf, P O'Keefe, 1988.

"Indeed, in the view of many, population pressure does lead to deforestation, but not because of the direct cutting of wood for fuel. Instead, population growth leads to pressure for more farmland, and natural woodlands are cleared to grow food." *The Energy Dimension: A Practical Guide to Energy in Rural Development Programmes,* C Hurst & A Barnett, 1990.

In 1976, The Energy Research and Development Group in Nepal forecast that exploitation of the hill forests for fuelwood alone at 1976 rates would mean there would be no commercial forests left in the hills by the year 1985. As this has not occured even with the resources being exploited for multiple uses it is clear that exploition rates for fuelwood were seriously overestimated. *Nepal: the Energy Sector,* ERDG, Kathmandu, 1976

"To arrest deforestation, one needs to halt the depredations caused by agriculture rather than by fuelwood consumption. … Indeed, if all woodfuel use stopped tomorrow, deforestation rates would hardly be altered." B*eyond the Woodfuel Crisis People, Land & Trees in Africa,* G Leach, R Mearns, 1988.

"All the available evidence shows that the rural fuelwood requirement does not seem to lead to deforestation." *Biomass, Energy and Environment: A Developing Country Perspective from India,* N H Ravindranath and D O Hall, 1995.

The "fuelwood gap theory", formulated in the 1970s, implies that woodfuel consumption is unsustainable. The gap is between consumption of fuelwood and what could sustainably be harvested from forest land as whole trees. In some countries, consumption is considerably higher than the forests alone could supply, so it was concluded that deforstation and forest degradation were largely due to fuelwood harvesting. This, understandably, caused a great deal of concern among national and international agencies regarding the future of forests. However, that it continues to cause concern is less understandable, as there is now strong evidence that in most cases the "gap" does not exist.

When the gap theory was developed, it was assumed that all fuelwood originated from forests. Data and information gathered in the intervening years give an entirely different picture. Most importantly, a number of surveys have revealed that large amounts of fuelwood originate on non-forest land: in fact, about twice the amount than comes from forest land. This non-forest supply alone appears sufficient to "fill the gap".

The weight of evidence now points to the conclusion that fuelwood harvesting from forest land is not necessarily unsustainable, and that fuelwood use is not necessarily linked to deforestation. While it is still possible that in certain areas and under certain condidtions woodfuel use may contribute to deforestation and forest degradation, it can no longer be considered a major cause.

"Rural people rarely fell trees for fuel use, and most depend on trees close to their homes. This means that trees outside the forest, within the agricultural landscape, are the main source of fuel for rural people." *Fuelwood Policies for the 1990's,* J Soussan, D E Mercer and P O'Keefe, 1992.

"… in most cases, fuelwood collection is not a primary cause of deforestation. Furthermore, it is now clear that fuelwood production and harvesting systems can be, and often are, sustainable." S*tate of the World's Forests 1997*, FAO, 1997.

A recent study in Cebu Province of the Philippines found that patterns of woodfuel use and resource management have likely been misunderstood, have changed little over the years and may well be sustainable for the foreseeable future. *Patterns of Commercial Woodfuel Supply: distribution and Use in the City and Province of Cebu, Philippines* Bensel, T.G and Remedia, E.M., 1993.

"Commercial logging, clearance for large-scale ranching, in-migration following road construction or through government-sponsored transmigration schemes, flooding from giant hydroelectric project schemes and other development pressure are all widely cited as contributing to large-scale deforestation. The exploitation of forests for fuelwood use contributes little to this process." *Fuelwood: An Analysis of Problems and Solutions for Less Developen Countries*, D E Mercer and J Soussan, 1991.

The Pakistan Household Energy Strategy Study carried out by the World Bank/ ESMAP and the UNDP in 1993 concluded that "... it is unfair and simply untrue to claim that the continuing pressure to clear forest resources is largely attributable to fuelwood demand," in a country estimated to have a 9.7 million ton "fuelwood gap". The study further reports that during a period of one century (1880-1980) the population has quadrupled and approximately 80,000 $km^2$ of forest area was converted to other types of land; cultivated land increased by 90,000 $km^2$, and human settlements absorbed another 10,000 $km^2$. *Pakistan Household Energy Strategy Study: Household Energy demand Handbook for 1991,* World Bank/ESMAP and UNDP, 1993

*Mr. Arjan Kraijo of the University of Twente, is working with RWEDP as a research assistant.*

# Woodfuel Consumption and Supply in RWEDP Member Countries

The FAO Regional Wood Energy Development Programme in Asia has evaluated and projected the consumption and potential supply of wood and other biomass fuels in its member countries. The sources of potential supply and the consumption of wood and other biomass fuels for all 16 countries together are presented in Table 1. The overall trends in supply and consumption per country are presented in Table 2.

When reading these tables it should be noted that aggregation over a wide region in Asia leads to hypothetical supply availability. In reality, fuelwood markets are extremely localised and fragmented. Still, some general observations can be made.

From Table 1 it is observed that by 2010 the sustainable aggregated potential supply of woodfuels still outweighs aggregated demand. This positive balance does not depend on the accuracy of the estimates made, or on the assumptions incorporated into the estimates. A reasonable margin of error would still produce the same results. Moreover, the assumptions on supply potential are on the conservative side. Much more important than the potential supply as such is its geographical and social distribution, since consumers may not be able to use available resources due to physical, financial and social constraints.

Table 1 further illustrates that any deforestation process generates a large additional (potential) supply of woodfuels which, however, is not required for a positive balance of potential supply over consumption. If deforestation is due to conversion of forest land into agricultural land, the process would result in a sustainable increased supply of potential biomass fuels, because generally agricultural land has a higher biomass fuel productivity than forest land.

It is also observed that at present the sustainable potential supply of woodfuels from agricultural lands more or less can meet the consumption. The same applies for the aggregated sustainable potential supply from forest lands. However, the latter are more likely to be found in remote areas, whereas the former are generally closer to the rural consumers. This may explain the fact that most woodfuels originate from non-forest land, as shown by data for several countries. When looking at the total potential supply of biomass from agricultural lands, i.e. wood and crops residues together, it is observed that this can meet both the present and projected consumption.

From Table 1 it is further observed that, overall, the potential supply of biomass fuels in the form of crop-processing residues is substantial. It should be noted that the estimate builds on (only) half of the processing residues, leaving all field residues (which are about 4 times the processing residues) untouched. Indeed, local shifts from wood to other biomass fuels can be anticipated to increase. This implies an immediate and increasing need for further development of cost-effective technologies for upgrading and combusting traditional fuels from crop residues, and for disseminating such technologies, and corresponding managerial systems. In the longer term there may be scope for expanding modern bio-energy fuels based on advanced R&D.

*RWEDP*

*Table 1: Consumption & potential supply of biomass fuels aggregated for the 16 RWEDP member countries*

| | 1994 | | | 2010 | | |
|---|---|---|---|---|---|---|
| | Area Mha | Mass Mton | Energy EJ | Area Mha | Mass Mton | Energy EJ |
| **CONSUMPTION** | | | | | | |
| **total woodfuels** | | **646** | **9.7** | | **812** | **12.2** |
| **POTENTIAL SUPPLY** | | | | | | |
| sustainable woodfuel from forest land | 416 | 670 | 10 | 370 | 629 | 9.4 |
| sustainable woodfuel from agricultural areas | 877 | 601 | 9 | 971 | 692 | 10.4 |
| sustainable woodfuel from other wooded lands | 93 | 54 | 0.8 | 81 | 47 | 0.7 |
| waste woodfuels from deforestation | -4 | 606 | 9.1 | -3 | 438 | 6.6 |
| **total potentially available woodfuels** | **1,382** | **1,931** | **29** | **1,420** | **1,806** | **27.1** |
| 50% of crop processing residues | 877 | 219 | 3.5 | 971 | 322 | 5.1 |
| **total potentially available biomass fuels** | | **2,150** | **32.4** | | **2,128** | **32.2** |

*Table 2: Potential supply and estimated consumption of woodfuels in 1994 and 2010 in 16 RWEDP member countries*

| | 1994 | | 2010 | |
|---|---|---|---|---|
| | **Potential supply** *(kton)* | **Estimated consumption** *(kton)* | **Potential supply** *(kton)* | **Estimated consumption** *(kton)* |
| Bangladesh | 8,999 | 9,396 | 9,271 | 13,320 |
| Bhutan | 5,946 | 819 | 5,624 | 1,195 |
| Cambodia | 81,565 | 5,375 | 43,827 | 7,553 |
| China | 598,546 | 219,122 | 639,733 | 252,819 |
| India | 235,167 | 173,412 | 255,729 | 225,725 |
| Indonesia | 439,049 | 54,474 | 394,923 | 67,465 |
| Laos | 46,006 | 2,329 | 38,902 | 3,496 |
| Malaysia | 137,301 | 6,187 | 97,777 | 8,216 |
| Maldives | 34 | 80 | 41 | 123 |
| Myanmar | 129,935 | 23,058 | 106,930 | 31,183 |
| Nepal | 11,444 | 12,787 | 10,304 | 18,378 |
| Pakistan | 22,569 | 34,687 | 21,144 | 52,167 |
| Philippines | 89,267 | 23,051 | 71,171 | 30,329 |
| Sri Lanka | 8,963 | 5,681 | 9,044 | 6,769 |
| Thailand | 67,030 | 46,069 | 59,157 | 53,390 |
| Vietnam | 48,960 | 29,368 | 42,730 | 39,418 |
| **RWEDP** | **1,930,778** | **645,895** | **1,806,307** | **811,548** |

# Implications of Woodfuel Use for Greenhouse Gas Emissions

The implications of woodfuel use for the global environment can be evaluated by estimating the associated greenhouse gas emissions. Only the main greenhouse gas, $CO_2$ (carbon-dioxide) will be considered here, leaving aside gases like methane and other carbon-hydrogens. Any emissions caused by woodfuels can be compared with emissions from alternative fuels.

Although combusting wood, of course, emits $CO_2$ into the atmosphere, regrowth of wood captures $CO_2$ from the atmosphere. As a first approximation it can be stated that woodfuel use is carbon neutral, i.e. there is no net emission of carbon into the environment. The approximation is supported by the evidence of two dominant mechanisms. First, it is observed that by far the largest part of woodfuel use takes place on a sustainable basis. This applies to virtually all woodfuels originating from non-forest land (e.g. agriculture land, plantations and homegardens), and to most of the woodfuels from forest land. Sustainability implies carbon neutrality, because the same amount of $CO_2$ emitted by wood combustion is recaptured from the atmosphere by regrowth of wood. Second, with regard to woodfuels acquired as left-overs from non-sustainable logging and land conversion, it is noted that not-using the left-overs for fuel (or for other purposes) would imply that they will decompose by natural processes. Eventually, natural decomposition leads to the same amount of carbon emitted in the atmosphere as when the woody material would be combusted (though not necessarily distributed amongst $CO_2$, methane and other greenhouse gases in the same way).

Obviously, if woodfuels were not utilised, some alternative energy source would be required and used. For most applications and in most countries, the hypothetical alternative would be a fossil fuel, i.e. coal, gas, or oil products. For a few applications and in a few countries, hydro and wind power might be the hypothetical alternative. But it should be noted that within the next 15 years or so the option of other renewables like solar photo-voltaics will be negligible in terms of energy quantity.

The specific emissions of fossil fuels to the global atmosphere has been well documented. Furthermore, the other renewable energy sources are considered to be carbon neutral, like wood. The implications of woodfuel use in Asia for the global environment can, then, be evaluated by estimating how much net $CO_2$ emission is avoided by using woodfuel instead of the most likely mix of hypothetical alternatives. The precise composition of the most likely (or least unlikely) mix obviously varies from country to country. For the purpose of the present study, which seeks an overall picture, LPG can be considered a typical alternative. (It should be noted that the results derived will be conservative, as coal emits about 33% more and kerosene 7% more $CO_2$ than LPG[1] per unit of energy produced.) The results of this calculation are summarized in Table 1.[2]

Switching between wood and other biomass fuels like agri-residues is ignored, because these fuels are carbon neutral for the same reasons as for wood.

By these calculations, in 1994, woodfuel use aggregated for RWEDP member-countries resulted in avoided emissions of about 278 million tonnes of $CO_2$ over the year. This saving is equal to six per cent of the current aggregate total emissions of the same countries. By the year 2010, the saving will rise to 349 million tonnes, though by then this will equal three per cent.

The global economic benefits of current woodfuel use in Asia can be appreciated by estimating the cost which would otherwise be required for using technology to avoid or recapture the emitted $CO_2$. Cost estimates for the latter vary widely, depending on conditions and technological options (like removal, storage, recapturing, avoiding, etc., of the $CO_2$). Based on IPCC estimates, avoiding or recapturing one tonne of emitted $CO_2$ would typically cost US$ 50 within the present range of options. From this it can be estimated that in 1994 about US$ 14 billion were avoided in $CO_2$-related costs, rising to a likely US$ 17 billion in 2010, by woodfuel use in RWEDP region.

## Global Environmental Policy

Overall, global environmental policy has yet to take account of the clear evidence of the environmental benefits

*Table 1: Greenhouse Gas Implications of Woodfuel Use for 16 RWEDP Countries*

| Environmental effects (Million Tonnes) | 1994 | 2010 |
|---|---|---|
| $CO_2$ emission from fossil fuels* | 4,317 | 10,602 |
| $CO_2$ emissions avoided by woodfuel use, as compared to **LPG** | 278 | 349 |
| as compared to **kerosene** | 334 | 420 |
| as compared to **coal** | 560 | 703 |
| Avoided $CO_2$ clean-up costs (against LPG, in US$ million) | 14,000 | 17,500 |

**1994 data from ORNL, 1997; 2010 projections made using projected growth rates from ESCAP 1997.*

of wood energy. Policies regarding wood energy and environment are still based on what are now known to be the exceptional cases – the relatively few areas where woodfuel use is not sustainable. This even leads to donor policies for the promotion of fuel transition, away from woodfuel and towards fossil fuels or expensive forms of renewable energy, based on the misconception that woodfuel use leads directly to deforestation. In fact, from the available evidence, by far the larger part of woodfuel production and use takes place on a sustainable basis. It is, therefore, beneficial that people stick to the practice of woodfuel use for their daily needs.

The very fact that wood energy is used by the majority of people is even more important than efficient wood stoves being adopted by a limited number of users. This observation could redirect priorities within wood energy conservation programmes. Rather than targeting maximum efficiency of stoves – with an associated increase in their price – priorities could be shifted to convenience, health and overall attractiveness while maintaining affordability, so as to reach the maximum number of users. Of course, for those areas where woodfuel practices are not sustainable, priorities would be different and tailor-made programmes should be designed.

As far as carbon sequestration through reforestation, afforestation and/or forest rehabilitation is an objective of present global environmental policies, it is obvious that such forest-related activities will be economically more feasible when the new or upgraded forest resource base will be available for sustainable use of wood and non-wood products. Sustainable woodfuel use qualifies as one of the prime applications in this context.

The above policy considerations are not only relevant for international agencies, but also for forest policy makers in the Asia-Pacific region in preparing an outlook to the year 2010. Further programmes and projects targeting wood energy development could be prepared and justified with a view to substantial global environmental benefits, not only for the present RWEDP member countries, but also for other countries in Asia and the Pacific.

*RWEDP*

*Notes:*

[1] Based on the equivalence values of the fuels. If stove efficiencies are taken into account, the respective values will be about 122% and 24% higher using coal and kerosene as the alternatives.

[2] The full calculations are available on request.

*Domestic charcoal making in Thailand*

# Wood Energy in Forestry Training

Woodfuel is an important product of both forest and non-forest tree production systems in Asia and elsewhere. It makes many contributions to society and the environment if sustainably produced and rationally utilized, as well as providing short-term economic gains. However, we are still only starting to learn and understand woodfuel's role and contributions. None of the education programmes currently offered in the region on forestry, agroforestry or any other relevant field adequately covers this important topic. It is now time to address this shortfall and agree upon a common list of issues which should be incorporated into forestry/agroforestry training curricula.

The developing countries in Asia meet between 30 and 80% of their energy needs with wood fuels (firewood and charcoal). All 16 RWEDP member countries still rely on wood and other biofuels for energy to varying degrees, generally for domestic cooking, but also for space heating in cooler areas, and many food and agro-processing activities and small or medium-scale rural industries. Although the amount of woodfuel required for specific uses is as yet unknown for most areas, it is certainly very large.

The direct positive contributions woodfuel can make to local income and employment as well as national economies and environments and the global environment (in the prevention of climate change) are not yet fully understood in most member countries. Although studies under the Energy Sector Management Assistance Programme (ESMAP) of the UNDP/World Bank covered this topic and revealed invaluable information on the role of woodfuel, this type of information does not exist for most countries, nor is there an established programme to gather it. This is not least because the relevant government agencies do not have the necessary skills.

Both of these points need urgent attention, and this will only be possible by incorporating them into the educational curricula for relevant sectors, primarily forestry and agroforestry. Available information indicates that there are very few forestry training institutions that offer regular courses in wood energy-related topics, either in their formal or their informal education programmes. PFI, Pakistan and UPLB, Philippines may be the only exceptions.

## Need for Wood Energy Education

All developing countries of Asia are experiencing large increases in energy consumption. While this is most visible in the area of conventional fuels, wood energy consumption is also rising, both in absolute terms and per capita, particularly in rural areas and small towns. Both trends are expected to continue for the years to come.

Concerns over environmental damage caused by conventional fuels are largely responsible for a growing interest in long-term development and promotion of carbon-neutral, renewable fuels, particularly wood fuels. Use of modern cogeneration technologies using woodfuel has expanded rapidly in many environment-conscious, natural-resources-rich developed countries of Europe and North America in recent years. This is expected to promote the development of modern wood energy in Asia in the future.

In fact, cogeneration technologies based on industrial waste wood, woody by-products and agro-processing residues have already been introduced in some of the rapidly industrializing countries of Asia. But the initiative has in each case been taken by the developers of the new technologies themselves and relies heavily on outside skills and expertise. The knowledge and skills required to support this type of development are apparently lacking in the region. Technologies developed in one country may not work in another. The need for pre-testing and modification to match local conditions will also require knowledge and skill within the region. All these issues need to be addressed by integrating relevant topics and courses in forestry and/or agroforestry education programmes.

## Constraints

Despite the fact that informal education programmes may directly contribute to imparting basic skills and knowledge on specific aspects of wood energy development which deserve priority, they invariably look weak when it comes to embracing the whole range of issues associated with the wood energy sector. Hence, wood energy development would be better addressed through more formal training courses.

Most of the institutions offering forestry and agroforestry in the region are concentrated in a handful of countries: China has the highest number at 33 institutions (28 universities/colleges, four forestry schools and two horticulture faculties in agriculture universities). This is followed by India, with 20, the Philippines with 17, and Indonesia with 10. The other member countries all have five or less. Not all offer the same level of education. The number and the type of education offered largely reflect the country's requirement for trained foresters. Any attempts to integrate wood energy development into forestry or agroforestry curricula will necessarily be limited by the number of institutes in the country and by their priorities.

Consideration of these issues will be essential in planning a strategy to incorporate the additional subjects of wood energy development into existing forestry and agroforestry curricula in the region. This will be a challenging task, but one which is essential in the promotion of sustainable wood energy development in Asia.

## Immediate Priority

In order to integrate wood energy in current education programmes, it will be essential to know to what extent wood energy development is already covered in the forestry education programmes offered in the Asia region. This could prove a difficult task, when even a reliable list of all the existing forestry training institutions in RWEDP member countries is difficult to obtain.[1]

The immediate priority for now will be to ask the relevant national agencies to make a quick review of the situation regarding wood energy education in their respective countries and present a country status report. Once the reports are prepared, the authors may be invited to present their findings in an expert consultation, together with other selected specialists in the field, to review the regional situation.

The consultation should produce a recommended broad framework curriculum on wood energy for integration into forestry/agroforestry programmes in the future, along with possible follow-up strategies for this integration.

*T.B.*

[1] The FAO's earlier publication entitled Directory of Forestry Education and Training Institutions, 1994, attempts to list them, but seems to be incomplete. Further, the list includes different types of institutions ranging from universities/colleges, departmentally-run training centres, forestry schools etc. – formal training institutions which award degree or certificate-level qualifications in forestry – to many other non-academic training centres. The Directory lists 105 forestry training institutes in the RWEDP member countries, particularly universities/colleges and forest department-run institutions that give training in forestry. And not all of them offer courses in agroforestry-related subjects either.

# Fuel Complementation Rather than Substitution

It is widely assumed that increased penetration of modern fuels in developing countries implies a process of fuel transition (or fuel shift or fuel substitution), away from traditional fuels and towards modern fuels. A related assumption is that such a shift depends on per capita GNP, and further assumptions are that this fuel shift can and should be promoted by development efforts.

These assumptions derive support from the way changes in fuel mix are usually represented, i.e. as shares of traditional fuels in overall energy consumption, rather than in absolute quantities. For instance, the World Bank correlates the share of biomass energy per capita with GNP per capita for 80 countries, which clearly shows a declining trend (Figure 1). In these types of analyses, biomass energy is considered a traditional fuel which 'helps trap the user in poverty' (World Bank, 1996). It is then concluded that rising per capita GNP causes a shift away from traditional fuels towards modern fuels. The conclusion is usually supported by selected case studies from urban areas.

Taking a closer look, we find that these assumptions and this conclusion cannot be validated for the vast majority of the world's traditional energy users, who happen to live in South and South-east Asia (including China). There appears to be no inverse correlation whatsoever between consumption of biomass fuel per capita and per capita GNP for the 16 RWEDP member-countries countries (Figure 2).

Historical analyses by country also contradict the hypothesis of a fuel shift. For instance, in Thailand over the period 1980–96 when per capita GNP almost trebled, biomass energy consumption per capita increased by 68% (Fig. 3, Thailand Department of Energy Development and Promotion). In Indonesia, over the period 1986 to 1994, when GNP per capita increased by 46%, per capita biomass energy consumption increased by 7%. In Nepal, between 1981 and 1995, when per capita GNP increased by 28%, biomass energy consumption per capita fluctuated by about 2%.

Overall in Asia, biomass energy consumption per capita has been, and still is, increasing. On top of the increased per capita consumption comes, of course, an increase due to rising population.It is further noticed that in 1987, per capita GNP in North America was 40 times larger than in South and South-east Asia, but biomass consumption per capita was the same in both subcontinents (Hall, 1997). More recent data (1993) confirm this picture, and it is noted that more than one third of the biomass energy in the USA is consumed in the residential sector (IEA).

*Figure 1: The use of biomass in relation to GNP in 80 countries (WB96)*

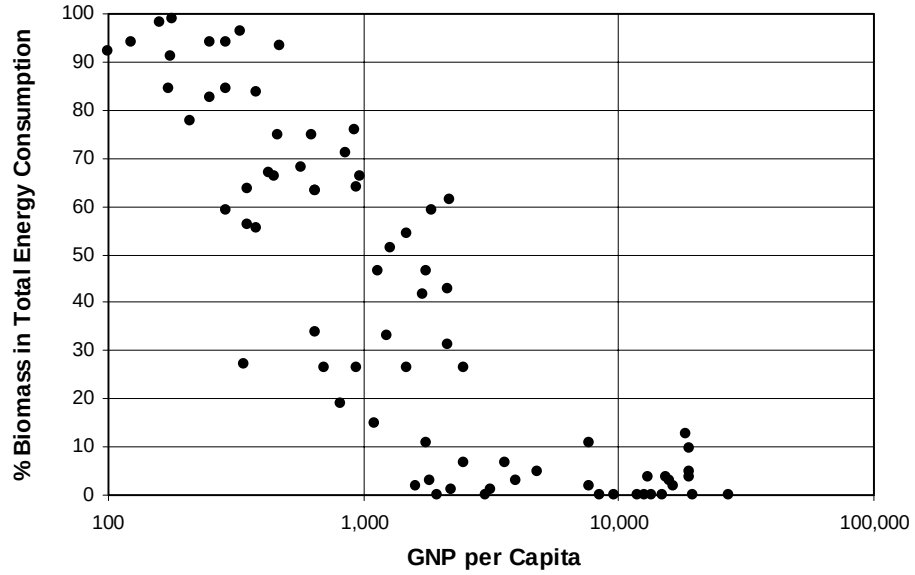
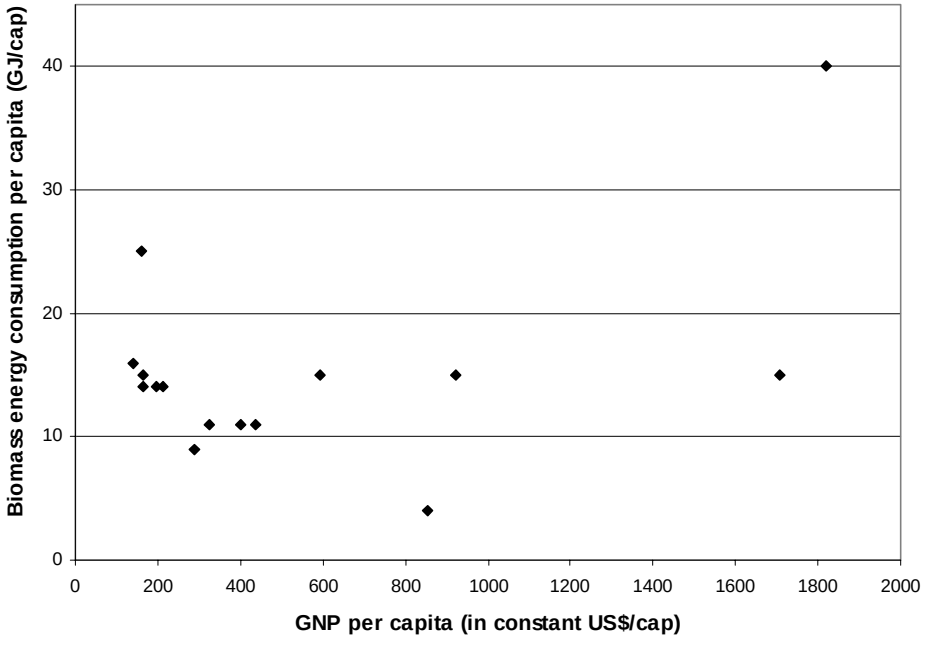



*Figure 2: Biomass energy consumption/cap vs per capita GNP in 1987 for 16 countries in Asia*



These important facts remain hidden when we look at the share of biomass fuels in total energy consumption. Also, it is not very helpful to classify biomass energy as traditional and correlate its consumption with per capita GNP. In fact, wood and other biomass can be used in a traditional way, a modern way, or any way in between. Their consumption may be governed by many factors, amongst which per capita GNP appears not to be a significant one.

Presently in Asia, fossil fuel use is increasing faster than use of 'traditional fuels' over time. The country data from Asia show that this increase does not imply an overall process of fuel substitution with rising per capita GNP. Fossil fuel use essentially comes on top of biomass fuel use. To the extent that per capita GNP is a relevant parameter at all, the dominant process seems to be one of fuel complementation rather than fuel substitution when incomes rise. Similarly, aeroplanes do not substitute bicycles, they complement the modes of transport in times of rising incomes.

The importance of clarifying these points is more than just semantic. They are highly relevant for effective policies with a view to both assisting people and the energy-environment nexus. A policy of 'helping people to make the shift' can only be futile when there happens to be no shift. Policies of 'helping people where they stay' seem to be more apt, i.e. focussing on people's real priorities. In developing countries in Asia, cooking is by far the largest energy end-use activity.

In fact, 40% of all national energy consumption is in the domestic sector, and 78% of this relies on biomass, which mainly consists of wood. For many decades to come, this situation is not likely to change and, therefore, introduction of better biomass technologies is a top priority. Much needed improvements are safer, cleaner, more reliable, more convenient and affordable wood energy technologies for the masses. Fortunately, the larger part of biomass energy in Asia is used on a sustainable basis, and this has major benefits for the global environment (RWEDP, 1997).

The importance of wood and other biomass energy is still undervalued in donor policies. For instance, in the period 1980–95, the World Bank's total lending for sustainable supply and use of woodfuels was less than half its lending for rural electrification alone. At the same time, relatively few people in developing countries can afford to use electricity or even gas for their basic energy needs. Biomass energy development should be recognized as the main priority for improving the quality and convenient use of fuels and their reliable supply for the large majority of the population. Such objectives simultaneously support people in their daily energy struggles and assist local and global environmental management.

*W.H.*

## *References*

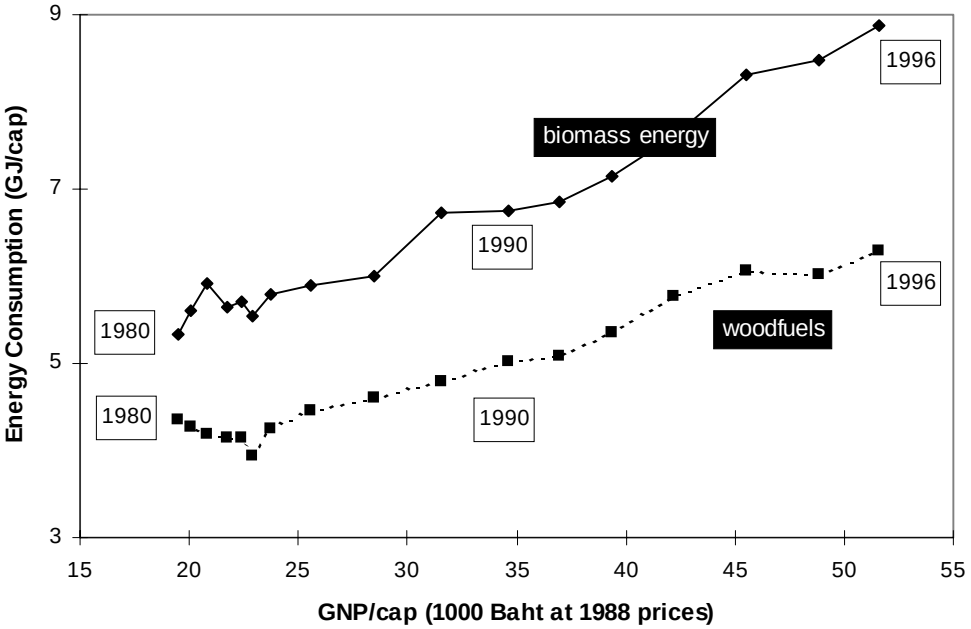

Hall, 1997: B*iomass Energy 'Forever" in Non-OECD Countries? – Why It is Important to Know What is Going on and How This Can be Determined*, David Hall, Biomass Energy: Key Issues and Priority Needs, Conference Proceedings, IEA, OECD, 1997

IEA:*Annual statistics*, OECD-IEA.

RWEDP, 1997: *Regional Study on Wood Energy Today and Tomorrow in Asia*, RWEDP, 1997

World Bank, 1996: *Rural Energy and Development - Improving Energy Supplies for Two Billion People*, World Bank, 1996


*Figure 3: Wood/biomass energy consumption/cap vs per capita GNP, 1980–96, in Thailand*



# Biogas for All?

*I. Natarajan*

Concerned about the ever increasing demand for biomass in rural India and the consequent widespread denudation of tree cover, the Government of India has launched several programmes to contain this growth and to induce people to move away from biomass to other, better, environmentally friendly fuels. The National Programme on Biogas Development was one of the major programmes initiated to this end. Biogas plants produce clean and smokeless fuel in addition to enriched manure and it was expected that with such a resource, the biogas plant owner would do away with smoky fuels like biomass. Apparently, this has not happened

In a recent survey carried out by the NCAER, it was found that biogas plant owners burn significant quantities of firewood and other biomass alongside the biogas in order to meet their cooking and/or heating energy requirement. The survey covered 27,000 Indian biogas plant owners. Of these, 22.5% did not operate their biogas plants for various reasons, mostly defects in their plants. The rest often used other fuels as well as their biogas. Some 69.5% used firewood, 28.9% used crop residues and 25.1% used dung cakes. (These numbers should not be added, as the same households may be using more than one fuel.) Only about 17% of all biogas plant owners/users depend entirely on biogas. The pattern of energy consumption for all those surveyed, including those who did not operate their plants (in effect they are non-users of biogas), is given in Table 1.

*Table 1: Pattern of fuel consumption for users and non-users of biogas*

| Fuel type | Fuel unit | Non-users of biogas | | | Users of biogas | | |
|---|---|---|---|---|---|---|---|
| | | Average qty used | Percent of users | Share in energy % | Average qty used | Percent of users | Share in energy % |
| Firewood | kg | 1618 | 93.9 | 55.5 | 400 | 69.5 | 12.9 |
| Dung cakes | kg | 839 | 59.5 | 14.9 | 225 | 25.1 | 3.1 |
| Crop waste | kg | 495 | 60.4 | 15.1 | 160 | 28.9 | 4.5 |
| Kerosene | l | 30 | 40.3 | 11.1 | 3 | 7.3 | 0.8 |
| Biogas | $m^3$ | - | - | - | 489 | 100.0 | 78.7 |
| Others | -- | - | 6.9 | 3.4 | - | neg. | neg. |

As is evident, some 21.3% of the energy requirements of biogas users was met through various types of biomass, with firewood being the most widely used fuel (nearly 70% of those using biogas used firewood as well). What also comes out very clearly in this survey is that the use of biomass by households is deliberate and is generally not caused by constraining factors like a shortage of biogas production capacity, shortage of dung to be fed into the biogas digester, etc. This is demonstrated by the fact that the average level of utilization of the digesters' full capacity leaves room for growth, as shown in Table 2.

At the same time most users did not feed all the dung available to them into the digester, irrespective of under-utilization of the digester's full capacity. This is shown in Table 3. Although 24.6% of the households indicated that they had a shortage of dung, some 65.5% indicated that they did not need more gas and therefore did not feed all the dung which was available to them. The other 9.9% cited other reasons for not using all the dung.

The survey results also showed that even with this under-utilization of capacity, most households did not use all the gas produced in the plant, and they reported that gas produced in excess of their needs was disposed of by letting it escape.

Biogas plant owners are relatively affluent. Installation of a biogas digester needs a relatively large initial investment as well as ownership of a certain number of cattle. Consequently, most of these households own land and have trees on their farms which are periodically pruned. The prunings, which are normally in the form of twigs although occasionally bigger branches are also available, are used as fuel. Some 76% of biogas unit owners quoted that the availability of wood as well as other biomass residues was one of the reasons why biogas was not used for all cooking/heating tasks. Some 15% indicated that their reason for not fully making use of biogas was that they did not consider the use of biogas suitable for certain tasks. These tasks included cooking/boiling in large vessels, for example cooking cattle feed, where the small size of the biogas burner meant heating was not uniform. In some cases, even making chapattis (a type of flatbread) on the biogas burners was found to be difficult.

The results of the study indicate that, as most of the users of biogas units are relatively affluent with easy access to wood and other biomass residues growing on their own land (basically free of charge), biomass energy will continue to play a significant role in the local energy scene. Only in those cases where alternative uses for the biomass residues are found, and along with them a market, will biogas become more important as a source of energy.

*Table 2: Rate of capacity utilization of biogas digesters*

| Digester size | $m^3$ | 1 | 2 | 3 | 4 | 6 | 8 |
|---|---|---|---|---|---|---|---|
| Distribution in | % | 0.3 | 11.9 | 31.2 | 24.6 | 23.7 | 5.5 |
| Average utilization of capacity | % | 88 | 60 | 44 | 36 | 25 | 20 |

*Table 3: Users not feeding all available dung*

| Capacity utilization | % | < 10 | 11-25 | 26-50 | 51-75 | > 75 | 100 |
|---|---|---|---|---|---|---|---|
| Users not feeding all available dung | % | 67.06 | 74.22 | 61.19 | 56.21 | 54.79 | 61.06 |

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# Publications

## Energy from Biomass and Waste

This publication, "Energy from Biomass and Waste" is a PhD thesis from the University of Utrecht, The Netherlands by André P.C. Faaij. It was published in 1997, under ISBN number 90-393-1592-2 Although the study is mainly concentrating on the Dutch situation, many problems related to energy cropping are relevant to the Asian situation. For example, the problem of available land for energy cropping may also be one of the main constraints in RWEDP member countries.

The thesis focuses on a number of aspects relating to the utilization of biomass and waste for energy purposes. The general objective of the thesis is "to analyse the possibilities for biomass (both crops and wastes) as a modern energy carrier in the Dutch energy system."

In chapter II, the characteristics and availability of biomass waste streams and residues for power production by means of integrated gasification/combined cycle technology (BIG/CC), are evaluated with respect to the situation in the Netherlands. Four main categories are investigated: streams from agriculture, organic waste, wood and sludge. An inventory is made of gross availability and net availability. Various properties (composition, beating value, supply patterns) are analyzed and the suitability of these streams for conversion in a BIG/CC unit is studied. The costs at which various streams are likely to be available are assessed.

Chapter III investigates in more detail the performance of BIG/CC technology for different biomass fuels. The technical feasibility and the economic and environmental performance of atmospheric gasification integrated with a combined cycle to convert the energy from biomass wastes and residues to electricity are investigated for Dutch conditions. Electricity production costs, including the costs of logistics and, in some cases, involving a negative fuel price, vary between minus 6.7 and plus 8.5 ECUct/kWh. Fuel costs are negative if the current costs for waste treatment can serve as income to the facility. Environmental performance is expected to meet the strict emission standards for waste incineration in the Netherlands. The system seems flexible enough to process a wide variety of fuels. The kWh costs are very sensitive to the system efficiency but only slightly sensitive to transport distance; this is an argument in favour of large scale power plants. As a waste treatment option the concept seems very promising. There seem to be no fundamental technical and economic barriers that can hamper the application of this technology.

In chapter IV the optimization potential in both economic and energetic terms of the final waste treatment system in the Netherlands for the year 2010 was studied. In this evaluation the performance of new technologies that may be available within a time-frame of about 15 years is taken into account. It is concluded that it should be possible to perform final waste treatment both at lower costs and with substantially increased energy recovery, than in the present situation.

In chapter V the author assessed the spatial and energy potential in the Netherlands for energy farming as well as for a number of biomass residues. Taken together, these potentials could satisfy 1–1.5% of the energy requirements of the Netherlands in 2000 and 1.5–2.5% in 2015, provided that energy farming is an economically feasible activity for farmers.

In the Dutch context biomass production by means of energy farming is at present clearly an expensive option compared to the use of fossil fuels. However, according to a number of studies the use of fossil fuels leads to social and environmental costs damage which are generally not reflected in the cost of these energy carriers. Furthermore, renewable energy carriers are often said to involve far lower social and environmental costs than fossil fuels. In this context, in chapter VI the external effects of bioenergy are evaluated for the Dutch context. The average private costs of biomass and coal based power generation are projected to be 68 and 38 mECU/kWh respectively in the year 2005. When the quantified external damages and benefits are included, the calculated cost range for bio-electricity amounts to 53–70 mECU/kWh and for coal 45–72 mECU/kWh.

According to this thesis the total energy potential of net available biomass wastes and residues in the Netherlands amounts to about 70 PJ (LHV). Waste streams add about 90 PJ. Around 2015, energy crops could supply 30–60 PJ, depending on developments in agriculture and possibilities of combining biomass production with nature development. A total contribution of 190–220 PJ (in 2010–2015) to the Dutch energy supply seems therefore in principle possible. This is equivalent to about 6–8% of the current primary energy demand of the Netherlands. The energy potential from energy crops is directly linked to the potentially available land. This thesis indicates that in the Netherlands a certain surplus of agricultural land may become available for energy farming.

In the Dutch context cultivated biomass is currently more expensive than fossil fuels. However, when the social and environmental costs and benefits are included in the costs of electricity from (cultivated) biomass and the figure is compared to the costs of coal based power generation, we find that the cost difference between the two becomes much smaller. Despite the uncertainties, this outcome could lead to increased support for electricity production from biomass.

Some more general conclusions and recommendations of particular relavance to RWEDP countries are presented below.

Biomass is currently regarded as a renewable energy source which can contribute substantially to the world's

energy supply in the future. Various scenarios for the development of energy supply and demand, indicate that biomass has the potential to make a large contribution to the world's energy supply.

If biomass is to make a substantial contribution to the world's energy supply it will have to include not only biomass residues—such as from commercial forestry and agriculture—and organic wastes, but also energy crops. Perennial crops seem to be a particularly promising energy source. The use of such crops in a Biomass Integrated Gasifier/Combined Cycle (BIG/CC) plant to produce electricity or combined heat and power, and the gasification of these crops to produce fuels like methanol and hydrogen appear to be promising routes for achieving high energy conversion efficiency at relatively low cost.

However, despite the promising outlook, various barriers are hampering the large scale development and implementation of commercial biomass energy systems. At the moment specially cultivated biomass is too expensive an option. Furthermore, biomass has a relatively low energy density. The production of biomass is bound up with seasons and makes high demands on organization and logistics. It involves many different actors involved in the production and utilization of energy crops. Difficulties concerning public acceptability and uncertainties concerning the ecological effects of the large scale production and use of biomass form another problem. Last but not least, the availability of land may be a major problem. If agriculture is not modernizing, there might be very little room left for alternative crops. Energy farming may then conflict with food production, a situation which is highly undesirable.

### Wood Residues in ASEAN: Market Opportunities, Trends, Industry Dynamics.

This EC-ASEAN Cogen Programme report has been produced with the overall objective of helping European decision-makers in the European biomass energy sector to be aware of, and to evaluate, the business opportunities for, heat and power generation using biomass residues from the wood sector in four Southeast Asian countries.

The report is supposed to be an objective addition to technical analysis, and economic and social aspects are also taken into account as factors influencing the viability of any project concerning wood energy conversion.

Southeast Asia, is characterized by a plentiful supply of homogenous wood resources. The fast industrialization of the wood based sector has, however, led to an increase in the price of tropical logs coming from native forests. Big producers of native logs like Malaysia and Indonesia have therefore decreased the availability of this raw materials locally and in the world market and are now encouraging their respective wood based industries to optimize the use of raw materials. Malaysia and Indonesia have good potential to generate electricity from the waste wood. In 1994/1995, taken together, Malaysia and Indonesia have a potential to generate about 765 MWe from power plants fueled by wood residues. Current situations could favour the governments' decisions to provide better conditions for private power using renewable energy technologies. These situations include the governments' desire to promote 'green' technologies, the ongoing threat to the security of the supply of conventional fuels, and the increasing lack of financial capability of the governments to provide added capacities for power generation. All these factors should give a cause for some optimism that biomass energy projects could take off within the next few years.

This publication in the series "Competing in the ASEAN Biomass Energy Markets" was written by Jean-François Menu

### Master Theses

The following Master Theses of the Asian Insitute of Technology, School of Environment, Resources and Development, were supported by RWEDP:

- *Woodfuel Use Survey and Benzo-Pyrene Determination from Woodfuel Burning in the Low-income Households of Cebu City, Philippines*, by Ramir L. Jarabis
- *Analysis and Assessment of Fuel Wood Use in Foothill Areas Towards a Sustainable Strategy: A Case Study of Xixia County, P.R. China*, by: Xia Zuzhang

*Arjan Kraijo*

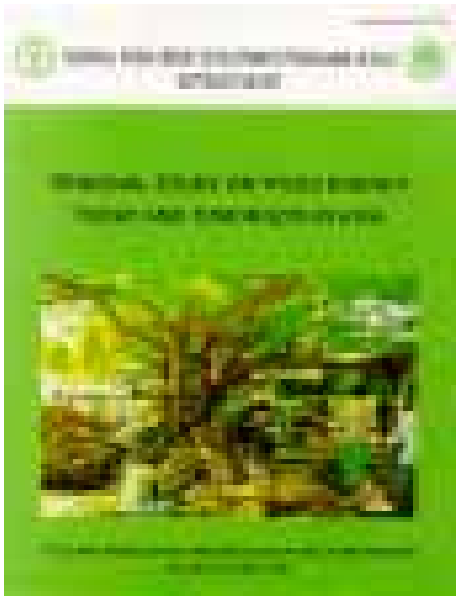
# News and Notes

### Wood Energy Today and Tomorrow

RWEDP has published an outlook on wood energy in Asia up to the year 2010. The title of the publication is "Regional Study on Wood Energy Today and Tomorrow in Asia". The study has been prepared by RWEDP staff at the request of the Asia-Pacific Forestry Commission, as a contribution to the upcoming Forestry Sector Outlook Study for the Region.

The document summarises characteristics of wood energy supply and use, and provides an outlook on wood energy to the year 2010. The document presents a critical review of available wood energy data, leading to best estimates of future consumption. It also tries to estimate the present and future potential supplies of fuels from wood and crop residues. The study shows that in most countries, the actual availability of woodfuels is not the major concern; rather it is their distribution to people in need.

This point leads to recommendations to policy makers on how best to integrate woodfuel supply with other objectives, particularly in the forestry sector. The integration of woodfuel development in other relevant sectors like agriculture and energy is also strongly recommended. The document further calls for efforts to upgrade fuels from



crop residues by using cost-effective technologies.

Greenhouse gas implications of wood energy use in RWEDP member-countries are discussed. It is estimated that in 1994 emission of some 560,000 kton of $CO_2$ was avoided by the use of woodfuels as compared to coal as a (hypothetical) alternative. This figure will increase to about 700,000 kton by the year 2010. When capitalised in terms of avoided costs for $CO_2$ abatement, this leads to an indicative figure of 28 billion US$ annually (respectively 35 billion US$).

The study reveals the weaknesses of available data and cautions about scenario development which lacks substantial basis. One of the striking messages is that the future of Asia's tropical forests and the problems of woodfuel users are not as closely linked as is often assumed.

Copies of the document are available from RWEDP (Field Document No.50, October 1997

## Training for Trainers Workshop, Indonesia

Most improved stove programmes have had limited success in terms of adoption of the new stove models they offer. The main reason is the highly centralized approach to cookstove design and selection taken by many, with little or no attention given to the users' actual needs, motivations and constraints. For this reason, the RWEDP and the Asia Regional Cookstove Program (ARECOP) decided to support the organization of national training courses on improved cookstove selection and dissemination.

As a preparation for these national courses, a training-of-trainers (TOT) workshop was held in Mataram, Lombok, Indonesia from 28 June to 8 July 1997.

The objectives set for the TOT workshop were: to familiarize the trainers with all components of the training materials; to show why and how stove selection should be done in practice and how this is reflected in the training materials; to show that participatory training is the most effective when training adults, and how to practice it; to bring country delegates closer together in order to make them a more unified and committed training team; and to enable trainers to translate the manuals into their own language.

While some sessions focused on the contents of the national trainings (stove selection and dissemination), others were related to group dynamics and essentials of participatory learning in general. All trainers were requested to practise participatory training methods during group training sessions conducted by themselves. These sessions were recorded on videotape, which were later used for evaluation purposes. Participants responded very positively to this kind of self-assessment. Follow-up national workshops, using the skills and knowledge gained during this TOT workshop, are being mooted for Cambodia, Bangladesh, Nepal, Vietnam and Myanmar.

## Integrated Rural Energy Planning, China

A National Training Workshop on Integrated Rural Energy Planning, with Special Emphasis on Wood Energy was conducted in Beijing, from 27 April to 4 May 1997

In spite of more than a decade of the Integrated Rural Energy Program (IREP) in China, wood and biomass have so far not been properly addressed in rural energy planning activities. This training therefore introduced a group of participants, mostly from local rural energy offices, to techniques for wood energy data collection and planning. Participants were also given wood energy data from countries in the region, which allowed them to compare them with their own local situations.

As a follow-up, case studies involving "supervised applications" of the concepts learnt in the workshop will be tried at national, provincial and local levels. Using secondary data, they will also be used to identify data gaps. Experiences from the case studies will be documented and published as a guidebook.

Participants said they particularly appreciated this training course because it highlighted both the major role of woodfuel in meeting rural China's energy needs and the importance of planning for wood energy.

## Regional Training on Wood Energy Planning

RWEDP and the Centre for Energy and Environment Research and Development (CEERD) of the Asian Institute of Technology (AIT) cooperated to organize a Regional Training on Wood Energy Planning, which took place at the AIT campus in Pathum Thanee, Thailand, from 4 to 16 August 1997. The training was the third of five regional trainings on Data Collection, Assessment and Analysis for Wood Energy Planning which are to be held in this phase of RWEDP, with the aim of capacity building at the national level.

Some 31 participants from 16 countries, split fairly evenly between forestry and energy sectors, attended. The training covered four modules: Data Base for Wood Energy Development, Wood Energy Project Planning and Evaluation, Integration of Wood Energy Analysis in Energy Planning and Wood Energy in Decentralized Area-based Planning. It consisted of lectures and discussions, group exercises in data collection, project planning and formulation, and use of LEAP (Long-

range Energy Alternatives Planning) software.

The workshop was generally considered a success, particularly from the point of view of deepening the understanding of senior planning staff concerning wood energy planning and so help them in organizing follow-up activities in their own countries. The participants said they found the training very useful, and would have liked it to be longer. In an unexpected gesture, they presented RWEDP and CEERD with plaques of appreciation.

## Wood Energy Planning, Vietnam

A National Training Course on Wood Energy Planning was held in Hanoi, Vietnam from 22 to 29 September 1997. The training course was organised by the Institute of Energy (IOE) in cooperation with the Forest Science Institute of Vietnam (FSIV), both RWEDP focal points. The training programme and training materials were prepared by nationals, who served as resource persons.

The training course was attended by 20 participants, of which three came from the energy sector, four from the forestry sector and the remainder from other agencies such as the government statistical office, rural development agencies and NGOs. Six participants came from provincial offices.

The course was conducted in a rather informal atmosphere, and this, together with the fact that the course was conducted in the Vietnamese language, allowed for interactive sessions and lively discussions. For many participants it was the first time to attend such a seminar, so it was a good opportunity for them to interact with people from other agencies. The presentations by RWEDP staff were alsointeractive and led to lively discussions because of the presence of a translator and attempts to involve participants in the discussions. At the end of the training course, participants expressed their gratitude and appreciation for the training course, and their interest to learn more about wood energy. Since it cannot be expected that after an eight-days training course participants will have a full understanding of wood energy, the course will be followed up by a case study on wood energy planning, to be implemented by IOE in cooperation with other agencies. The case study will include three levels of planning, i.e. national, provincial and district. The case study can be seen as on-the-job training and will institutionalise some mechanisms for wood energy planning.

## Integration of Woodfuel Production and Marketing

The Forest Management Bureau (FMB) of the Department of Environment and Natural Resources (DENR) of the Government of the Philippines in collaboration with the RWEDP organized a National Training Course on Integration of Woodfuel Production and Marketing in Baguio, Philippines, from 29 to 31 July 1997 as a follow-up of the sub-regional training workshop on Integrating Woodfuel Production into Agroforestry Extension Programs in Southeast Asia. Bogor, Indonesia, April 1995. The course was attended by 24 middle-level professionals, 20 from regional and district organizations of DENR, 2 from Affiliated Non-conventional Energy Centers (ANECs) and 2 from forestry/agriculture training institutions. There were 7 resource persons, 3 from the DENR, 2 from the Department of Energy (DOE) and 2 from other institutions related to forestry or agroforestry education. Many issues related to wood energy production, flow and utilization, such as findings of wood energy studies, the national woodfuel situation; the role of non-forest areas in fuelwood production; social, environmental and gender aspects of wood energy production; woodbased industrial commercial activities and their contributions to the rural socio-economy; etc. were discussed. The course was evaluated as a success by the participants. A summary report on the training course is being finalized by the FMB.

## Integration of Woodfuel Production and Marketing

The National Training Course on Integration of Woodfuel Production and Marketing in Punjab, Pakistan, from 28 to 30 October 1997 was a follow up activity of the sub-regional course on Integrating Woodfuel Production into the Implementation of Agriculture, Forestry and Rural Extension Programs in South Asia, Dhaka, Bangladesh, October 1995. It was organized in collaboration with the Punjab Forestry Research Institute (PFRI) and the Department of Agriculture Marketing, University of Agriculture (UOA). The lead agency for hosting the course was the PFRI. The course was attended by 28 participants, 25 from the Punjab Forest Service and 3 from the adjoining Sindh Province. Nineteen resource persons representing governmental and non-governmental organizations at different levels contributed to the course. The issues covered in the presentations included, among others, woodfuel in the national energy balance; woodfuel production and distribution systems in the Sindh Province; mangroves as a potential source of woodfuel in the coastal area; etc. The field visit programme of the course allowed participants to observe fast-growing tree plantations under agroforestry and block plantation schemes in private farms, and also gave the opportunity to interact with the farmers directly. The course was evaluated as a success by both participants and resource persons. The Chief Conservator of Forests from Sindh Province requested the RWEDP to assist in the organization of a similar training in the Sindh Province in 1998.

## Readers' Contributions

Readers will have noticed that recent issues of *Wood Energy News* have focused on specific themes. So far, these have been: gender and wood energy; modern wood energy; wood energy planning; wood energy resources; wood energy data; wood energy and environment, and wood energy outlook. We welcome suggestions, contributions and reactions from our readers, on this issue or any other subject related to wood energy.

# Events

| Event | Date and Venue |
|---|---|
| **Energy and Environment for Sustainable Development**<br>The overall objectives of the workshop are to make participants familiar with methods for data collection, with the aspects of setting up and executing energy projects, with efficient use of available energy resources and with the potential for reduction of environmental impacts. In addition participants will acquire the skills to write a proposal for an energy project. (UT) | May–June 1998<br>University of Twente, Enschede,<br>The Netherlands |
| **10th European Biomass Conference and Technology Exhibition**<br>This conference will focus on market exploitation opportunities and securing a greater share in the heat, electricity and transportation fuel markets. An additional emphasis will be placed on information relating to the use of solid biomass. In order to promote the transition from research results to practical application, a specific programme for political decision makers will be offered. (EBC) | 8–11 June 1998<br>Würzburg, Germany |
| **2nd Asia Pacific Conference on Sustainable Energy and Environmental Technology**<br>The conference aims to provide a forum and opportunity for all participants to interact, share information, report research in progress and identify opportunities in the fields of sustainable energy and environmental technology. (APCSEET) | 14–17 June 1998<br>The University of Queensland, Gold Coast, Australia |
| **17th Congress of the World Energy Council**<br>The Congress theme is "Energy & Technology: Sustaining World Development Into the Next Millennium". The program will feature Global Energy Addresses by heads of state of several nations, and chief executive officers of several of the world's largest corporations. Congress sessions will discuss advanced technologies to utilize existing energy resources more efficiently, and developments of unconventional resources. (WEC) | 13–18 September 1998<br>Houston, Texas, USA |
| **5th World Renewable Energy Conference**<br>Congress topics: Solar and Low Energy Architecture - Photovoltaic Technologies - Solar Thermal Applications - Wind Energy Generation - Biomass Conversion - Energy Resources - Wave and Tidal Energy - Hydrogen and Storage - Economics and Financing - Institutional Issues - Geothermal and Ocean Thermal - Climatic and Environmental Issues - Renewable Energy: Manufacturing. Hosted by the University of Florence, School of Architecture. (WRE) | 20–25 September 1998<br>Florence, Italy |
| **MSc. Course Rural Energy and Development**<br>To address the role of energy in rural development, ITC offers an MSc degree specialization in Rural Energy and Development. The programme is focused on the management of land resources while applying modern information technologies and procedures. It consists of a common block of applied geo-information followed by individual research. (ITC) | Start September 1998 (18 months)<br>Enschede, The Netherlands |

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APCSEET: APCSEET '98 Secretariat, Intermedia, P O Box 1280, Milton QLD 4064, Australia, ☎ +61-7-33690477, 🖷 +61-7-33691512, 💻 apc@cheque.uq.edu.au

WEC: Registration for the Congress will begin in late 1997. Please register in the WEC database, Internet: http://www.wec98congress.org/17regis.htm

WRE: Professor A.A.M. Sayigh; WRE Network; 147 Hilmanton, Lower Earley; Reading RG6 4HN, U.K.; ☎ +44-118-961-1364, 🖷 +44-118-961-1365

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# Misconceptions About Wood Energy

| Misconception | Fact |
|---|---|
| *Wood is not very relevant as an energy source* | In fact, wood supplies about 30% of total energy consumption in the RWEDP member-countries. |
| *Woodfuels are phasing out* | No. In all RWEDP countries the consumption of wood and other biomass fuels is still increasing in absolute terms, even when their share in national energy consumption is decreasing. |
| *Woodfuel has little value* | The total value of woodfuels amounts to some US$30 billion per annum for the RWEDP countries together. |
| *Only poor and rural households use woodfuel* | Surveys have shown that in many towns and even in some metropolitan areas woodfuels are widely used by both low- and high-income groups. |
| *Woodfuel is a traditional commodity only* | Generally not. Modern applications use modern fuels, which largely complement traditional fuel use. |
| *Woodfuels are being substituted by modern fuels* | At present, modern technologies are increasingly being applied to woodfuel development. Many industrialised countries are deliberately increasing wood energy use, for environmental and socio-economic reasons. |
| *Most fuelwood originates from forest lands* | This conflicts with many survey results revealing that some 2/3 of all woodfuels originate from non-forest land. |
| *Woodfuel use is responsible for destroying the natural forests* | This assumption dates from the 1970s. Now, plenty of evidence is available to show that woodfuel use is not a major cause of deforestation. |
| *Fuelwood is collected for free* | Some is, but a lot is not! |
| *Woodfuels are a gift from nature* | Many people, particularly in Asia, treat fuelwood as a commodity which can be, and indeed partly is, produced and harvested like rice or wheat, though with a much longer gestation period. |
| *Woodfuel production is a marginal sub-sector* | Woodfuel businesses are the main source of income for about 10% of rural households, supplying about 40% of their cash earnings. Woodfuel use generates at least 20 times more local employment than energy from oil products (per unit of energy). |
| *Wood energy cannot be planned because of lack of data* | Indicative planning does not require a full set of data. This type of planning can support policy making. |
| *Burning wood adds more $CO_2$ to the atmosphere than oil* | Sustainable re-growth of woodfuel captures the $CO_2$ back from the atmosphere. The net effect on the global atmosphere is zero, unlike that of fossil fuels. |
| *With respect to renewable forms of energy, R&D should focus on solar, wind and hydro energy* | Wood energy is renewable. Of the various renewable sources of energy wood provides by far the largest share in the region! |