International Seminar on Bioenergy & Sustainable Rural Development

Casa de Gobierno
Paseo de la República 1500 Col. Oviedo Mota

Morelia, México
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SUMMARY and CONCLUSIONS

ANES

Bioenergy
LAMNET

The International Seminar of Bioenergy and Sustainable Rural Development was held in Morelia, Mexico, from June 26 to 28 2003. It was organized jointly by the Latin American Thematic Network on Bioenergy (LAMNET), the Center for Ecosystem Research (CIECO) from the National Autonomous University of Mexico, the Food and Agriculture Organization of the United Nations (FAO), the National Association for Solar Energy (ANES) and the State Government of Michoacán, Mexico.

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Updated information on this workshop is available at http://www.bioenergy-lamnet.org, http://bioenergia.oikos.unam.mx and http://www.anes.org/bioenergia/index.html.

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Seminar Conclusions

The International Seminar on Bioenergy and Sustainable Rural Development was held in Morelia, Mexico, from June 26 to 28 2003. It was organized jointly by the Latin American Thematic Network on Bioenergy (LAMNET), the Center for Ecosystem Research (CIECO) from the National Autonomous University of Mexico, the Food and Agriculture Organization of the United Nations (FAO), the National Association for Solar Energy (ANES) and the State Government of Michoacan, Mexico.

The Seminar was attended by 160 people coming from over 30 countries. Participants represented the academic, non-governmental, official, social, and private sectors. Seminar activities were organized in plenary presentations, where general topics of interest in the area of bioenergy and rural development were addressed and discussed, as well as in five working groups. These last were devoted to analyze the topics of: electricity generation from biomass, liquid fuels, gasification, biomass resources, and small scale applications.

The Seminar had also a high policy impact. The Governor of Michoacan State gave the opening address and underlined the State strategic interest in the development of bioenergy as a source of local sustainable rural development, and technology innovation. Several other high-level officials from Mexico also attended the sessions.

The opportunities

- Efficiently used, bioenergy represents a versatile, clean, widely available and carbon neutral energy source. World biomass resources are estimated to be roughly 400 PJ/yr,
- Future scenarios show that biomass may account for about 30% of total energy use and 25% of electricity generation by 2050 without compromising land for food production. Also, bioenergy has a large role in future strategies directed to the mitigation of climate change.
- Currently, most bioenergy resources are used inefficiently; however, with improved technologies, the useful energy derived from biomass fuels may be easily quadrupled.
- Adequately implemented, modern bioenergy technologies can support local rural development by creating employment, income generation opportunities and better living conditions in poor areas.
- Promising, commercially available, alternatives exists in almost every field of application, ranging from efficient woodburning cookstoves, gasifiers, ethanol production as an alternative transportation fuel, to electricity generation in sugar mills, landfills, and others. Many of these alternatives, such as ethanol, are already competitive with fossil fuels.

The barriers

As with other renewable energy sources, the main barriers for a more intensive use of these fuels continue to be:

- Subsidies to fossil fuels
- Lack of sustained support for applied R&D
- Lack of incentives and financial schemes that support the early stages of commercialization of bioenergy technologies.
- Also, in many countries, current legislation (e.g. for transport fuels and additives, or for electricity cogeneration) preclude a larger penetration of biomass fuels in many countries.

The role of governments

Market oriented approaches and innovative schemes that favor a larger involvement from the private sector are essential. However, the market alone will not do the job.

- Experience from Brazil, Colombia, and other countries, indicate that it is critical that National Governments **commit resources and provide definite timetables and targets** for the deployment of specific technologies.
- It is also important to sustain R&D efforts targeted to specific applications; a much stronger effort in capacity building and in the formation of human resources is needed to meet the challenges.

Other important issues

Top-down schemes for technology development and dissemination, particularly for small applications within rural areas, need to be replaced by participatory, gender-sensitive approaches. These approaches should take into account the variety of user needs and priorities and emphasize local technology adaptation and appropriation.

Substantive progress has been made in the quantification of biomass energy resources and in the determination of the environmental impacts associated to traditional bioenergy use patterns. In Spain, Italy, Mexico and Senegal, spatial explicit methods and models have been developed using geographic information systems, which allow for strategic planning and more efficient project implementation.

Bioenergy in Mexico

Currently, bioenergy amounts to 8% of total primary energy use in Mexico. The dominant biofuels are fuelwood, mostly used for cooking within rural and peri-urban areas, and bagasse, used to generate heat within sugar mills.

The present contribution of bioenergy can be enlarged to about 30% of Mexico´s primary energy through an integrated approach based on improved technologies and a more comprehensive use of biomass resources, including urban wastes, agriculture and animal residues, multi-purpose energy plantations and forest residues. Despite the lack of government support to bioenergy for more than a decade in Mexico, a growing experience has accumulated regarding improved woodburning cookstoves and other devices for small rural industries, electricity production from landfills, and biogas digesters. There is an active group promoting the use of ethanol as additive to gasoline. Specific incentives, linked to definite time tables and targets are urgently needed to speed up the process of adoption and dissemination of bioenergy technologies.

Outcomes from the Seminar

A major outcome from the Seminar was the creation of the **Mexican Network on Bioenergy** (Red Mexicana de Bioenergía), which will provide a forum to catalize projects, information exchange and activities in the field of bioenergy. The coordination of the network will be initially organized by Dr. Omar Masera from the National University of Mexico (UNAM), and the network will be based within the National Solar Energy Association of Mexico (ANES).

The Seminar contributions, the final list of participants and all information about the Mexican Network on Bioenergy can be found at the following web sites by September 1st 2003:

- http://www.anes.org/bioenergia/index.html
- http://www.bioenergy-lamnet.org

Seminar Organizing Committee

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Summary from the Working Groups

Working Group on Gasification

Chairs: Dr. Rainer Janssen and Dr. Javier Aguillón

Within the working group session on gasification more than 20 participants of the International Seminar on Bioenergy and Sustainable Rural Development discussed crucial topics of the two main gasification technologies, namely the thermochemical and the biochemical conversion of biomass.

It is commonly agreed upon that biomass can play an important role in a sustainable future energy supply due to its availability in abundant quantities around the world throughout the year. However, the application of biomass should be shifted from its traditional low-efficiency applications for heating to high-efficiency applications for heat and power production (CHP). Gasification of biomass has the potential to contribute to this aim, as it converts a solid renewable fuel to a gas that can be used in modern conversion devices for electricity and heat production such as gas turbines or engines. Among the advantages of gasification technologies are the high efficiency for electricity production, good prospects for the use in CHP applications as well as a cost-effective reduction of emissions with respect to biomass combustion.

In the last 10 years good technical progress has been made in the field of thermochemical biomass gasification, although at a commercial level major achievements still have to be attained. Today only heat gasifiers constitute a commercially viable technology. A new market area is the application of gasifiers for the pre-treatment of biomass fuels in order to use these fuels for cofiring in existing power plants. This concept has been commercially demonstrated for coal-fired and natural gas-fired power plants in the Netherlands, Finland, Austria and the USA. Thereby, this new market area could pave the way for future applications in integrated gasification combined cycle systems (IGCC). This IGCC concept is regarded as the potential future star of all biomass gasification applications and as the final concept of biomass-to-electricity systems due to its high overall conversion efficiency at low emission levels. Up to date the IGCC concept has been demonstrated with success in Värnamo, Sweden. However, the Värnamo pressurized gasifier was mothballed after positive operation results as the capacity of the IGCC unit was too small for commercial operation and the future of this demonstration plant has not been decided upon.

In the field of thermochemical biomass gasification the R&D focus currently is on the gasifier itself, a better understanding of the gasification process for various kinds of fuels and the cleaning of the produced gas. The latter includes the important aspect of tar removal from the gas which is required for application in gas turbines and engines as well as the reduction of the ammonia content in the gas due to NO_x emission constraints.

Finally, the applications of thermochemical gasification technology today include hundreds of small-scale systems in India and China for heat and electricity production at local level which are in operation at farms and small industries.

On the other hand, anaerobic digestion (AD) as the second main biomass gasification technology means the bacterial breakdown of organic materials in the absence of oxygen. This biochemical process produces a gas principally composed of methane and carbon dioxide. Anaerobic digestion provides the opportunity for decentralised production of renewable energy from waste. Additional benefits offered by AD plants include the strengthening of closed loop recycling management systems, the reduction of emissions from manure storage as well as the production of a valuable organic fertiliser. Therefore, the income revenue of AD plants not only relies on energy sales, but on fertiliser sales and gate fees for waste disposal, thereby creating further sources of income in the agricultural sector.

However, today only a very small fraction of the potential for AD applications is used in Europe. This is due to economical as well as legal constraints. The actual costs for electricity from biogas produced by AD are significantly higher than conventional electric power costs and AD sites are complex systems which interact with a variety of laws and regulations involving different authorities. For this reason, AD technology still requires supportive legislative framework conditions including financial incentives in order to stand the chance to become an important element for the future supply of sustainable energy. In Europe countries like Denmark, Germany, Austria and Sweden promote effective mechanisms to produce biogas from organic wastes by political measures.

An impressive success story is currently on its way in China where anaerobic digestion applications are experiencing a tremendous up-take. In 2002, 1.7 million households became new biogas users and there were 11 million biogas digesters in operation. Additionally, about 2000 medium-scale AD plants are used for the treatment of waste from large livestock farms and the total number of household water treatment plant amounts to 110000. This development is actively supported by the Ministry of Agriculture through its Biogas Construction Plan in Rural Areas of China (2003-2010). The implementation of this ambitious plan will result in significant progress in the field of biogas technology and it will lead to about 50 million rural households in China using biogas as their daily fuel by 2010.

In Mexico, however, up-to-date experiences with AD plants used for the digestion of cow and pig manure were less successful. The electricity production costs were greatly exceeding that of conventional plants and the acceptance of the biogas technology by rural communities was rather low. It was therefore concluded by the participants of the working group, that close links shall be established between AD experts from China, Europe and Mexico aiming at the transfer of suitable best-practice experiences in order to stimulate the development of this technology in Latin America.

Working Group on Liquid Fuels

Chairs: Dr. Gustavo Best and Dr. Peter Helm

The workshop was attended by 35 persons. Six presentations were given on different aspects and technologies related to liquid fuels derived from biomass. The discussion can be summarized in four main points:

Biomass resources

It is important to assure the sustainability of biomass resources, taking into account both its availability and an adequate biodiversity. Extensive areas under monocultures should be avoided.

Crop rotations and intercropping are promising agriculture practices that will help keep adequate nutrient levels and diversification.

The intensification of biodiesel production represents a big challenge from the perspective of biomass resources.

Acid or enzimatic hydrolisis of cellulosic material will open new potentials; there are currently several technical options, but the costs are still too high.

More support is required from Governments regarding technology R&D.

Policy Issues Regarding Fuel Blends

Apart from technology limitations, the importance of decisions regarding sugar and oil prices, both nationally and internationally, together with their implications for the balance of payments and markets were discussed.

It seems that decisions on levels of blending (e.g. ethanol versus gasoline) respond more than anything to macroeconomic considerations.

Agriculture institutions and oil companies should collaborate more in the field of ethanol-gasoline blends. There is a strong need to develop interdisciplinary teams to tackle the specific issues.

In the case of Mexico, it is important to identify organizations that can put forward issues related to biofuels. The Free Trade Agreement (NAFTA) has had a negative impact in the sugar sector, and has thus inhibited the development of liquid fuels.

Climate change issues

Discussions centered in the Clean Development Mechanism and the Kyoto Protocol.

Projects aiming at participating in the CDM should carefully address the issue of additionality, in order to avoid being non-eligible. The opportunities offered by the GEF, and the Carbon Prototype Fund from the World Bank should be carefully examined.

Sustainable Development Issues

Participants stressed the importance of promoting bioenergy in such a way that it clearly responds to the local agendas. For example, in the case of Mexico, municipal and state authorities are gaining decision-making power. Many new investment opportunities, including issues associated to liquid fuels, need to be negotiated at the local level.

A critical point in the development of liquid biofuels is the potential positive impact in the generation of new jobs.

Working Group on Electricity Generation

Chairs: Franceso Cariello and Pablo Mulás

Using biomass for electricity generation is widely recognized as a key issue for sustainable development both in industrialised and developing countries.

Nowadays biomass is used as a primary energy source (cooking fuel) especially in the southern hemisphere, but this use is generally considered as non sustainable, as it depletes the resource and the combustion process is often inefficient and heavily polluting; biomass could play, instead, an important role in rural electrification, where modern conversion technologies could be adopted, combining energy production and low polluting gas emissions. Biomass in fact has a huge potential as it represents a distributed feedstock, generally available where the power production is required, and its combustion is potentially CO_2 free.

The passionate discussions during the Electricity Generation working group of the International Seminar on Bioenergy & Sustainable Rural Development were concerned with the investigation of possibilities for an effective exploitation of biomass for power production with particular interest on the Mexican framework.

Mexico is in fact rich in Biomass but it is not clear whether this will ever result in a distributed renewable bio-electricity generation. Several different scenarios on the future portfolio of energy sources in Mexico have been discussed, but even the most promising from the sustainable development point of view, predicting a 59% RES penetration in 2025, confines biomass to a minor role (about 3% of total power generation). Therefore, the challenge to face during the next years is, for Mexico and world-wide, to increase this percentage by pushing further the research of new conversion technologies, providing new cost effective solutions and identifying the best possible policy options.

The 30 international Bioenergy experts gathered for the seminar Working Group suggested different possible scenarios and technologies to be adopted.

One possible solution is represented by energy dedicated crops such as trees and perennial grasses grown specifically to provide feedstock for energy production. In particular bamboo (100 ton/ha) and some species of eucalyptus offer promising opportunities for biomass production in Mexico. Dedicated crops, however, often arise opposition as they are seen as a menace for bio-diversity. Additionally, it is difficult to regard dedicated crops as the only solution for a wider Bioenergy production as they involve high costs for production and processing.

Another possible option identified within the working group has been that of increasing the efficiency of existing power plants using biomass as a feedstock. In particular, old sugar cane bagasse power plants which are operating in Mexico at sugar mills could be turned into efficient CHP plants with low investment costs, thereby maximising the exploitation of what is generally considered as a production waste. The example of countries such as Brazil and South Africa, where bagasse plants are growing in number and efficiency, should be followed. Finally, it is important to highlight once more the importance of providing a policy framework able to maximise the productivity of the plants, allowing them to feed in the electrical grid.

Another feedstock to be taken in consideration is biogas. Biogas can be produced from Municipal Solid Waste degradation or from anaerobic digestion of animal manures.

Two good example of existing projects have been presented: a plant in Costa Rica, burning biogas derived from MSW degradation and a project for a 75 MW power plant burning biogas derived from anaerobic digestion of animal wastes.

An important role in distributed generation future scenarios could be played also by biofuel burning microturbines, being small gas turbines with a capacity of 20-100 kWel. Thereby, it is important to investigate the possibilities of feeding these microturbines with both liquid and gaseous biofuel, as this would allow to achieve a faster and "renewable" rural electrification. However, at present there are several barriers to overcome: first of all the high costs of the technology and high sensitivity of turbine materials to common chemical compounds present in biofuels such as H_2S and SiH_4.

The working group analyzed different possible scenarios for future power distributed generation utilising biomass as feedstock. At present no technology can be classified as the future leader in the power production sector. Therefore, different technological solutions have to be carefully analysed addressing both main advantages and critical aspects.

Working Group on Small Scale Applications

Chairs: Lisa Buttner and Rodolfo Diaz

The key elements identified for achieving sustainable solutions to household energy and health are:

- Understand user needs and conditions influencing the use and management of biomass for cooking, heating and small industries.
- Determine from the BEGINNING the measures of project impact and establish a baseline with which to compare on periodic basis during and beyond project timeframe.
- Take advantage of regional synergies, such as those between Mexico and various countries in Central America; some countries have more experience with indoor air pollution and health monitoring, while others have recent experience with technology development that is participatory, user responsive while focused on technology performance and efficiency.
- Include economic incentives to stimulate technology adoption. If dependence on full subsidies is to be reduced, people need to see a tangible benefit for changing behaviour. Health concerns may or may not be sufficient for self-replicating technology dissemination.
- Involve participatory processes for ensuring that technological solutions satisfy user needs, and fostering ownership of long-term maintenance responsibilities.
- Involve multiple disciplines in technology promotion and transfer, including in particular anthropology and other social sciences that enable a solid understanding of human behavior and preferences.
- Implement comprehensive planning, emphasizing complementary or synergistic activities, such as reforestation and water resource management.

- Innovate with micro-credit and finance mechanisms, including revolving funds at community level, to stimulate establishment of micro-entrepreneurs in cottage industries including tortilla-making, pottery, brick-making, bakeries, etc.
- Finance not only for technology but for planning and social processes and research (e.g. socio-economic and health impacts).
- Ensure proper DOCUMENTATION. Many lessons learned are lost for lack of documentation. Documentation should reflect the perceptions of the women and men who have participated in the projects, as these perspectives are often not captured through simple project assessment.
- Structure an approach to promotion that includes awareness-building (e.g. of health impacts, time and economic burdens, environmental impacts, and possible solutions); promoter development; and follow-up strategies including monitoring of measurable indicators.
- Consider various technological alternatives to inefficient use of biomass. These include improved biomass stoves, biomass gasification, solar stoves and ovens, biogas, LPG where appropriate, etc. The appropriateness of each of these options will depend in large part on their responsiveness to the needs and traditions, their ability and willingness to pay, their flexibility in making changes, and the social processes involved in transferring the technology.
- Be aware of risk when continuity of program support is lost. Implies emphasis on building local capacity, promoters, financial incentives and credit mechanisms.
- Include rural inhabitants as key participants in seminars of this nature.

Next steps…

- Establish an information network among participants of the International Seminar on Bioenergy in Morelia, in particular the participants of the working group session on small-scale applications.
- Develop an inventory of current and planned small-scale biomass/biogas projects in Mexico.
- Seek to build collaborations among participants and with other institutions.
- Develop project concepts that take an integrated approach, for possible funding (including under EPA's Partnership for Clean Indoor Air).

Working Group on Biomass Resources

Chairs: Biol. Adrián Ghilardi and Dr. Nassir El Bassam

The widespread use of bioenergy, under appropriate technologies, may combat actual social inequities and alleviate poverty, as this rather cheap and secure energy source would be accessible for most people, in particular for the rural poor.

Although "appropriate" technologies seem available, transition to renewables at a broad scale is been delayed because major economic groups are still benefiting from fossil fuel use.

National economies should be guided by their energy budget rather than by their financial budget.

Sustainable development issues should focus on community level. Without local development, there is no true development.

Many renewable energy programs in Mexico are subject to frequent changes in government policies. Implementation of policies for bioenergy projects need to last beyond changes in government. The Brazilian model for promoting biofuels could be taken as a first example for Mexico.

Developing countries can greatly benefit from the sustainable use of biomass as an energy source. In Senegal, for example an intergrated government project has been able to assure the use of 860.000 ton/yr of woodfuel in a sustainable way and 19.000 improved cookstoves have been installed since the starting of the project.

Detailed studies show that fuelwood is not a major cause of deforestation worldwide. In fact, the fuewood gap theory (FAO) has no consistent evidence so far.

GIS are very useful tools for assessing bioenergy possibilities at multiple spatial scales, as they may help in estimating national overall biomass productivities, while priorizing specific locations where actual fuelwood shortages might appear.

The carbon mitigation potential from the use of bioenergy is a key issue in order to achieve the transition from fossil fuels, as this environmental service may provide extra financial benefits.

Main conclusions:

The more intense use of biomass resources represents several challenges for the preservation of the resource in the long term. Assessing and assuring the sustainable use of biomass resources is therefore critical.

Multi-scale spatially explicit approaches provide very useful options to accomplish the previous goal globally, as biomass use patterns and trends are site specific.

Assessing the carbon mitigation potential of biomass energy resources is now an essential issue to be addressed in the transition from fossil fuels to renewables, as global policy mechanisms trying to prevent further increasing in GHG emissions are actually in the process of implementation.