RENEWABLE ENERGY FOR DEVELOPMENT

SEI STOCKHOLM ENVIRONMENT INSTITUTE

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RED – reporting on energy and development since 1988

By Francis X. Johnson, SEI

Welcome to this jubileum issue of the RED newsletter. On this occasion of the 20th Anniversary of SEI, we present key aspects of the energy-environment-development nexus.

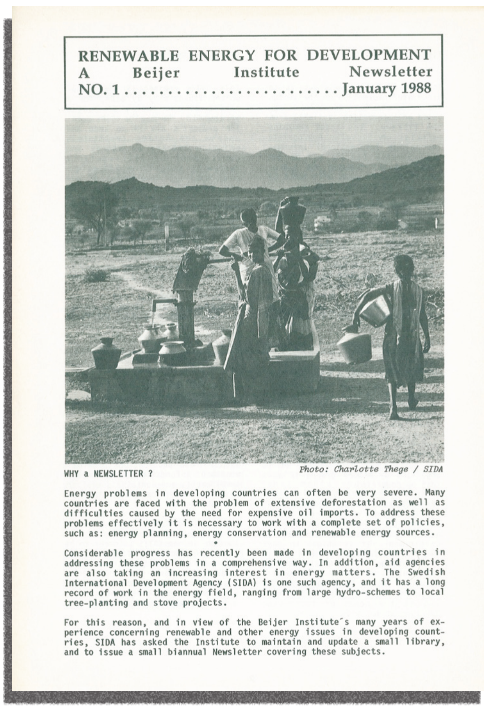
Rob Bailis evaluates the transition away from traditional biomass use in developing countries, in terms of health, climate, energy access, and rural development.

We have also gone back further in history to SEI's predecessor—the Beijer Institute. Karin Lange reflects on some groundbreaking projects at Beijer, supported through Sida's special programme on small-scale energy. These projects included detailed household energy end-use studies as well as the now-famous work of Nobel Laureate Wangari Mathai through her Green Belt movement.

A broader goal at SEI has been to support developing countries in the transition towards climate-friendly energy/development technologies and policies. Sribas Bhattacharya evaluates the role of SMEs as an entrepreneurial force that generates income and creates new livelihoods while also transforming energy production and end-use.

Noim Uddin looks at the policy domain for climate strategies and draws some lessons from OECD countries for cost-effectiveness and sustainability, which can be applied in developing countries.

Looking toward future potential, the special role of biofuels is examined by Norm Miller. There is tremendous potential for bioenergy in the sun-soaked tropical regions of Africa, Asia and Latin America. However, the realizable potential requires detailed analysis if conflicts over land and water are to be minimised. As with most long-term sustainability issues, assessments on the local reality – physical and economic – must be combined with national, regional, and global data in order to prioritise alternative development paths.



RENEWABLE ENERGY FOR DEVELOPMENT
A Beijer Institute Newsletter
NO. 1 .... January 1988

Photo: Charlotte Thege / SIDA

WHY a NEWSLETTER ?

Energy problems in developing countries can often be very severe. Many countries are faced with the problem of extensive deforestation as well as difficulties caused by the need for expensive oil imports. To address these problems effectively it is necessary to work with a complete set of policies, such as: energy planning, energy conservation and renewable energy sources.

Considerable progress has recently been made in developing countries in addressing these problems in a comprehensive way. In addition, aid agencies are also taking an increasing interest in energy matters. The Swedish International Development Agency (SIDA) is one such agency, and it has a long record of work in the energy field, ranging from large hydro-schemes to local tree-planting and stove projects.

For this reason, and in view of the Beijer Institute´s many years of experience concerning renewable and other energy issues in developing countries, SIDA has asked the Institute to maintain and update a small library, and to issue a small biannual Newsletter covering these subjects.

The first issue of RED was published in 1988, by The Beijer Institute. SEI was born out of the Beijer Institute in 1989, when it took over publication of the newsletter.

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SEI AND 20 YEARS OF RENEWABLE ENERGY WORK

Stockholm Environment Institute was formally established in 1989 by the Swedish Government. Since then SEI has established a reputation of rigorous and objective scientific analysis in the field of environment and development.

SEI's work on renewable energy has its roots in SEI's early days, and this newsletter has been there right from the start. Follow this link to view a film on SEI's work in the past 20 years: http://sei-international.org/index.php/twenty-years

RED IN BRIEF

SEI Energy and climate seminar: With the official opening of SEI's new Africa centre the 4th of June 2009, the institute's work in Africa and efforts to create partnerships in Africa have intensified. Last November a seminar was held at the Swedish Embassy in Mozambique to introduce the Africa centre's work and present the results of the implementation of the Household Energy Economic Analysis in Mozambique. The seminar was attended by delegates from embassies, Donor organisations, NGOs, Ministries and others.

Climate and health co-benefits: In September SEI held a symposium on the potential climate and health co-benefits of switching to cleaner fuels and stoves in developing countries. More than 2.5 billion people depend on traditional biomass to meet their basic energy needs, causing an estimated 1.6 million annual deaths due to exposure to indoor smoke. Black carbon is thought to be the second largest contributor to global warming after carbon dioxide – it is estimated that 18 % of black carbon emissions are a result of burning biomass in the home. The symposium brought together experts in climate change mitigation and household energy and health to analyse the use of traditional biomass use for cooking, and its impacts on climate change and health. Among the speakers were Dr. Ruth Etzel, from the World Health Organization, Prof. Örjan Gustavsson, from Stockholm University, and Prof. Sribas Chandra Bhattacharya, from Asian Institute of Technology

VIEWPOINT

The household energy access challenge

Rob Bailis, Yale University

Globally, biomass energy accounts for approximately 11% of primary energy supply. This is a larger contribution to the world's energy needs than from all other forms of renewable energy.

Impacts

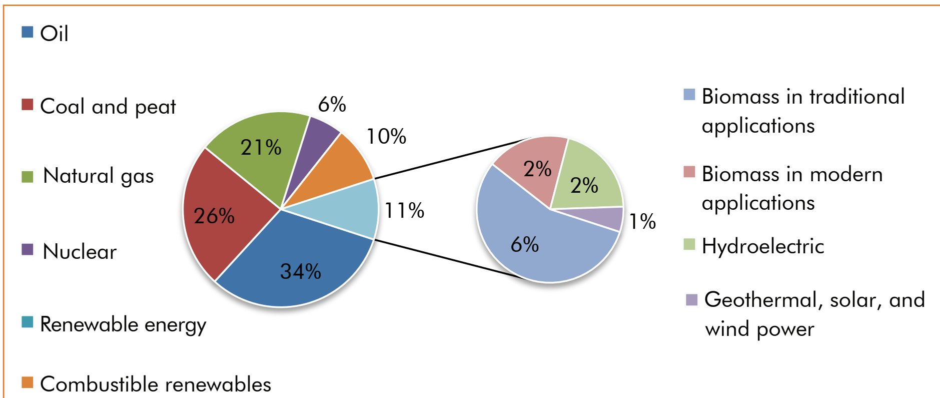
The overwhelming majority of biomass energy is derived from solid biofuels such as wood, agricultural residues and dung, which are burned directly by end users for cooking and heating throughout the global south (see box, right). The health and environmental burden of this heavy dependence is borne by the world's poorest families, making the transition to modern energy vital to human development.

Dependence on traditional biomass for household energy is most prevalent among the rural poor in sub-Saharan Africa and south Asia. Typically, solid biofuels are burned in open fires or simple metal stoves, which are often inefficient and highly polluting compared to fuels like kerosene, cooking gas, or electricity.

The pollution released consists of compounds like carbon monoxide (CO) and particulate matter (PM), which directly damage human health. The WHO estimates that exposure to emissions from solid-fuel combustion contributes to nearly 3% of the global burden of disease each year. Moreover, CO, PM, and other compounds, like methane (CH4) and many non-methane hydrocarbons (NMHCs) also contribute to global warming. Furthermore, biomass fuels are often harvested from a dwindling resource base, contributing to environmental degradation, and because this represents a net loss of ecosystem carbon, this degradation also contributes to climate change. The costs of dependence on solid biomass include severe public health impacts, depletion of forest resources, greenhouse gas emissions, as well as large demands on household labour.

Funky Chickens / Flickr

Cooking with woodfuel in a cafe in Gambia



GLOBAL PRIMARY ENERGY SUPPLY IN 2006

Cleaner fuel options

Solid biomass can be used more efficiently in ways that lead to less pollution and fewer impacts on public health. For example, improved woodstoves allow end-users to burn wood more cleanly. Chimneys or other forms of ventilation channel pollution outside the house, lowering the concentration of harmful pollutants by as much as two thirds. This creates a far healthier indoor environment. Solid biomass can also be converted into cleaner, more efficient forms of fuel. For example, wood chips may be converted into a combustible gas via small-scale gasifiers. The gas may be used to run a diesel generator to produce electricity. Non-woody biomass can be digested anaerobically to produce a methane-rich gas that can be burned directly to provide heat and light, or run through a generator to produce electricity. Biomass crops can also be cultivated for advanced energy production. Starch and sugar-based feedstocks can be converted into ethanol, and oil-bearing crops may produce a replacement for kerosene or diesel. Both ethanol and oil-based biofuels may be used for cooking, lighting or power production. However, both ethanol and oil-based fuels can also be used for transport, and to access them poor rural consumers would have to compete with the transportation market.

Challenges of scaling up

The challenge of scaling up to advanced bioenergy in the global south requires big changes to the ways in which energy is accessed and provided, particularly in the residential sector. As is the case for fossil fuels, advanced forms of biomass energy cannot be accessed without substantial financial investment and, in most cases, additional technical capacity.

These problems are compounded by the fact that in many areas solid biomass fuel is gathered for free by the user (although the labour and opportunity costs are often significant). Household dependence on solid biomass across the global south might be considered a symptom of a broader state of poverty in which users of solid biomass live. However, this view ignores socio-cultural determinants of energy consumption. For example, people place a positive value on food cooked with woodfuel, and the presence of fire in the home is also seen as desirable. Second, although access to energy resources at the grassroots depends on specific conditions in rural communities, it also depends on structural factors determined well outside of communities. These factors include things that directly affect energy options, such as national investment in infrastructure, trade policies and tax structure, as well as factors that affect energy options indirectly, such as health and education policy.

New financing

Numerous attempts have been made since the 1970s to initiate an energy transition away from solid biomass for domestic use, with varying levels of success. Most usually these take the form of grass-roots campaigns to encourage the use of improved cookstoves in individual households and communities. There are also instances of broader policy efforts, including subsidies for liquid petroleum gas (LPG) or electricity.

More recently, the potential for reducing carbon emissions by shifting from biomass has been used as leverage to introduce new bioenergy technologies, such as improved cookstoves, biogas digesters, liquid biofuels, and so on. Both charitable and commercial players have attempted to market carbon offsets generated by shifts away from traditional use of biomass energy. These developments offer new financing opportunities that may offset the additional costs associated with cleaner forms of biomass energy. However, carbon offsets bring new challenges. Although there are many good stove designs adapted to different local conditions and requirements, the real challenge is to establish a sustainable infrastructure for manufacturing, distribution, training and support. Rigorous monitoring is also needed to obtain carbon credits for the 'avoided' greenhouse gas emissions. Other questions also arise, such as who owns the carbon credit, who has the right to decide to whom it should be sold, and how should the revenue be used?

Commercialization

There is now growing interest in the issue, this time around from a health and climate co-benefits angle. Donors are emphasizing that improved stove programmes should be more business-like, and for their scale up to be market driven. While opportunities are emerging for stove promoters and businesses to market carbon offsets, the challenges are often insurmountable, particularly for smaller actors. It would seem that a balanced approach is crucial for addressing this complex issue. Given that a heavy reliance on solid fuels takes such a serious toll, external support is needed for interventions to bring about this transition to commercialization.

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SUSTAINABLE ENERGY STRATEGIES FOR DEVELOPING ASIAN NATIONS, Noim Uddin and Ros Taplin

Developing nations can draw lessons from developed nations in devising effective and appropriate sustainable energy policy, as well as build on successes at home.

Since early 2000, as a result of climate change mitigation and adaptation efforts, many governments have directed both their global and national level energy initiatives towards advancing renewable energy. However, most developing nations are only beginning to realise such strategies, and despite successes (see the examples of Bangladesh and Thailand below) the potential for renewables remains largely untapped. Although a favourable socio-economic structure specific to a nation's geo-political settings are key to a renewables strategy, approaches taken in the developed world can be copied or adapted.

In *Bangladesh*, the financing of renewable energy projects is administered through the Infrastructure Development Company Limited (IDCOL), a state-owned non-banking financial institution, in association with international organizations. IDCOL engages local partners in projects, such as NGOs, community groups and end users. The diagram on the right shows IDCOL's successful approach to implementing micro-finance.

Thailand has abundant renewable energy sources which have contributed around 17% of total energy generation in the country since the early 2000s. The 2003 Energy Strategy for Thailand's Competitiveness aims at renewables comprising 8% of final energy consumption in 2011 and 10% by 2020, from 0.5% in 2002 (PRET 2006). Thailand has so far been successful in designing and implementing this technology-specific renewable energy strategy.

Australia has been slow to harness its rich renewable energy potential, mainly because of the availability of low-cost fossil fuel, a strong fossil fuel lobby, and conservative energy strategies. In 2003, renewable energy contributed around 6% of Australia's total energy supply and 10% of electricity generation. The most important legislation on renewables is the 2001 Renewable Energy (Electricity) Act, a key measure of which was the Mandatory Renewable Energy Target (MRET) – a 2% contribution of renewable electricity by 2010. Although the MRET has very low targets on renewable electricity, it is the world's first mandatory (rather than merely aspirational) regime for renewable energy targets.

In *Finland*, biomass is the largest source of renewable energy,

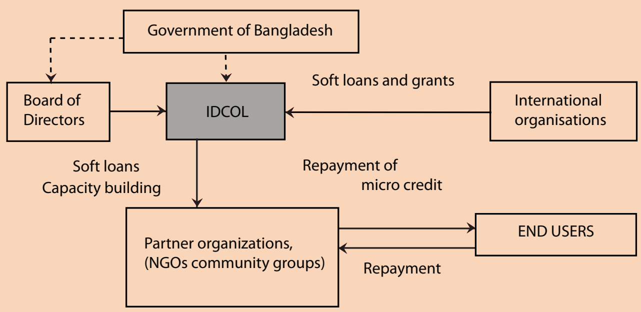

Figure 1: Implementation approach of the IDCOL programme

(85% of total renewable energy supply), followed by hydropower. The Finnish Government has provided long-standing support for renewables through investment grants and environmental taxes. For more than a decade, Finland has implemented a tax on CO_2 emissions focused mainly on fossil fuel emissions. A further tax based on carbon content has been levied on fossil fuels. The main aim of new tax systems is to support the use of renewables.

Options and lessons for developing countries

Developing countries could take a number of approaches to underping sustainable energy strategy. Finland's carbon taxes and Australia's MRET provide examples from the developed world. Other approaches could include adjusting the premium price for electricity from renewables; providing investment incentives; and developing timeframes for expanding the use of renewable energy technologies. Despite uncertainties over the future of CDM and the Kyoto Protocol (post 2012), strengthening the CDM approach via reinforcing targets for renewables could enhance energy sustainability. Early successes in renewables, either via top-down or bottom-up approaches, should also be built on (an approach greatly helped by supportive institutions and good governance). Finally, development assistance through capacity building, policy learning and policy intervention, and enhancing institutional settings.

This article is based on the paper 'Towards sustainable energy strategies development for developing Asian nations: learning from industrialised nations', by N. Uddin and R. Taplin, 2009.

ASIA FOCUS

A changing climate for Asian small business

Sribas Chandra Bhattacharya, President, International Energy Initiative

Climate change has particularly serious implications for the developing countries of Asia. SMEs form a big part of the manufacturing sector across the region. They have a vital role to play in reducing emissions from the industrial sector.

Carol Mitchell / Flickr

Block printing in India. SMEs account for around 83% of all textile production in the country

Asia – vulnerable to climate change

In South Asia, rising sea-level as a result of climate change is threatening populations in low-lying coastal regions as well as the very existence of the island nations of the Asia-Pacific region. Rising temperatures and variability of rainfall are already having impacts. Melting glaciers are threatening future water supplies, and extreme climate events, like floods, cyclones and heat waves, are on the rise. Melting Himalayan glaciers are also poised to affect water flow to the major rivers of the region. To limit long-term global warming to a rise of 2°C to avoid catastrophic impacts calls fordrastic reductions in global emissions. This challenge can only be met with active GHG reduction measures in Asia.

SMEs and emission reduction

Small and medium enterprises (SMEs) are a dynamic and vibrant sector of national economies in Asia. The box on the right shows the main features of the Indian SME sector. A large number of actors, substantial contribution to employment, large share of export earnings, and high growth rate are typical characteristics of the SME sector in most Asian countries. By some estimates, SMEs account for around 85% of manufacturing establishments in Asia. The table on the right shows SMEs' share of production in key sectors across five Asian countries.

Share of types of SME of total national production, by country

Type of SME	China	India	Phillippines	Sri Lanka	Vietnam
Foundry	63%	~80%	90%		
Brick / tile ceramic	95%	~100%		~100%	93%
Dessicated coconut				87%	
Tea		~100%		~100%	
Textile		~83%			

Source: Kumar et al., 2005

Key features of India's SME sector

Number of SMEs: ~ 3million
Share in the total number of industrial enterprises: > 80%
Number of SME clusters: 600 modern SME Clusters and 2000 rural clusters
Employment: > 30 million jobs
Share in total direct export: ~35%
Sector growth: 20-25% per year

In general, Asian SMEs use old and inefficient technologies with poor operation and maintenance practice which results in high emissions of GHGs and air pollutants. Considering SMEs' large share of industrial production in Asia, measures to reduce GHG emissions from SMEs are vital to reduce emissions from the industrial sector. Moreover, such measures are likely to bring greater profits for SMEs and, in the longer term, improved welfare for millions of workers.

The most effective way to reduce GHG emissions from SMEs is to improve energy efficiency by replacing inefficient and obsolete technologies with energy efficient technologies, and improving operation and maintenance practice. Further options include greater use of renewable energy, and switching from high carbon fuels (e.g. coal) to low carbon fuels (e.g. natural gas). Micro and small enterprises often rely on inefficient, locally designed technologies, such as traditional stoves for making palm sugar or raw cane sugar, and 'clamps' for small-scale brick-making. Switching to more efficient technologies would greatly improve energy efficiency. SME's can also cut GHG emissions by replacing fossil-fuel based or inefficient biomass energy systems with clean, efficient biomass-fired systems. The biomass fuel saved can then be used to replace coal and other fossil fuels to further reduce emissions.

Replacing an inefficient biomass or coal-fired system with a cleaner modern system also reduces emissions of black carbon (soot). Black carbon heats the local atmosphere by absorbing solar radiation and is the second most important climate forcing pollutant after CO2. There is great potential for such measures in cottage and small-scale industries, most of which use coal and biomass fuels inefficiently in traditional systems. A number of organisations in the region have recently developed gasifier stoves that can provide heat for small enterprises. Thailand's Asian Institute of Technology (AIT) has developed a gasifier stove under a Sida-funded project which has been disseminated in the region through workshops and training programmes. An NGO in Cambodia has developed the Vattanak gasifier stove, used for making palm sugar, while Gasifier stoves developed by The Energy and Resources Institute are used widely in India as well as abroad (see box).

Large-scale thermal gasifiers are also commercially available in India and China. These systems are sound investment: the payback period for replacing liquid fuel or traditional biomass-fired systems by gasifier systems is reported to be six months to two years.

Renewables and energy efficiency

Asian countries must play a key role in any global effort to reduce GHGs post-Copenhagen. Such efforts will also be important for tackling the energy crisis that is likely to be triggered by the rapid depletion of fossil fuel reserves as the global economy recovers. This is particularly important for Asian countries, which depend heavily on imports to meet their energy demands. The need to reduce GHG emissions as well as dependence on fossil fuels will put a great deal of pressure on Asian SMEs to improve energy efficiency and step up use of renewable energy. Many micro and small enterprises have already begun to switch over to renewables, boosting productivity and extending business hours.

Technology cooperation

SMEs across developing countries have much in common, including their state of development, so cooperation among them to harness existing capacities could bring many benefits. Real strides can be made in upgrading SME technology, and in reducing GHG emissions, through improved transfer and exchange of efficient technologies. The private sector and NGOs could play a key role in this effort. One interesting technology that was developed in China and has found application in a number of Asian countries is VSBK technology (see box below).

When small and micro enterprises (SMIs), which produce and sell related or complementary products, are clustered (located close to one another) they can upgrade and improve their competitiveness more effectively. A large number of SMI clusters already exist in India. Clustering provides networking opportunities to reduce production costs and gives SMIs a stronger voice in the policy process. Clusters are particularly important in developing countries because it is easier for governments to provide support to them, such as access to modern energy services and capacity building. The demand for carbon credit is likely to soar after 2012 as the world takes steps to reduce GHG emissions on a large scale. This should offer a unique opportunity to modernise SMIs, including overhaul of their energy systems. Trading carbon credit from an isolated business might not normally be feasible because of high transaction costs, but clustering would allow SMEs to participate in the growing carbon market and could boost future profits.

Concluding remarks

The SME sector is a fast growing and vital sector in Asia's developing countries. There is tremendous scope for modernising SMEs and promoting energy efficiency and renewable energy. Technology cooperation among developing countries, clustering of SMIs and SMEs, and taking advantage of the growing demand for carbon credit can all accelerate this process. National governments, donor agencies and industry associations must play lead roles to ensure that this enormous potential is realized.

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Tdietmut / Flickr

Cigars from Myanmar. TERI's gasifier stove reduced fuel consumption by 75% when used for curing in tobacco production.

Sachin Kumar / TERI

A brick kiln in India. VSBK a clean technology for brick kilns, has been successfully transferred from China to other developing countries.

The Energy and Resources Institute (TERI), along with other organisations in the region, have developed gasifier stoves that can provide efficient heat for SMEs. TERI's stove is already used widely in India and throughout the region. TERI recently introduced its gasifier stove technology for use in tobacco production in Myanmar, specifically for curing tobacco (3500 kg per batch). In Myingyan district in central Myanmar, the gasifier-based system reduced fuel consumption by more than 75%. Significant reductions were also achieved in time and labour requirement, while the quality of the final product also improved.

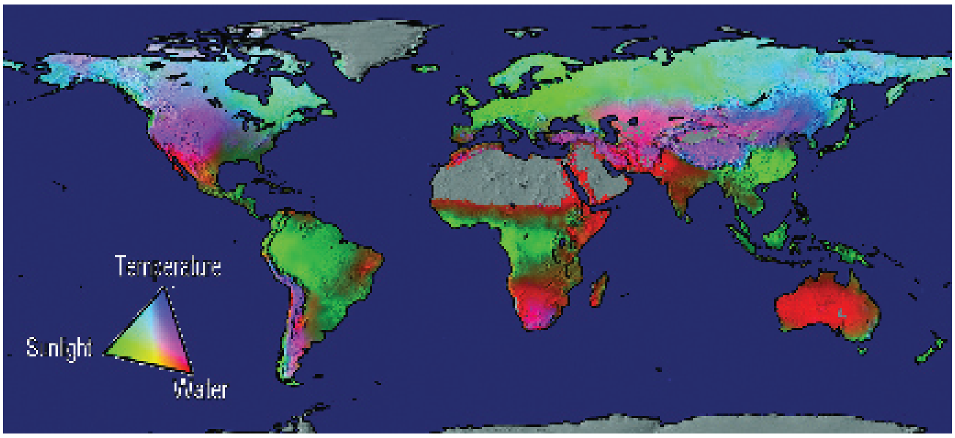
VSBK technology is a clean and efficient way to make bricks. It requires around 0.9 MJ per kg of fired brick, compared with about 1.3 MJ per kg for a bull's trench kiln (BTK), the most commonly used type of kiln in India, and about 3 MJ per kg in clamps and other batch kilns that are used for small-scale brick making in some countries (e.g. Thailand). VSBK technology is also much cleaner compared with these types of kiln: a VSBK unit emits around 80% less particulate matter than BTKs. VSBK technology was developed in China, where more than 50,000 units were operating in the year 2000. VSBK technology is a successful case of technology transfer from one third-world country to other third-world countries. So far the technology has been transferred to a number of Asian countries, including Indian, Nepal, Thailand and Vietnam

NEW RESEARCH

An optimal space for bio-energy crops

Norman L. Miller, Berkeley National Laboratory

Norman L. Miller presents research on biofuel crop modelling and methods for prioritising land use to improve cost-effectiveness and support better outcomes for sustainability and local cultures.



Satellite data showing potential net primary production limits based on fundamental physiological limits imposed by solar radiation, water balance, and temperature.

Best results

To achieve optimal bioenergy crop production (i.e. the best results for energy security, climate mitigation and economic development) requires consideration of many different variables, such as energy productivity, carbon sequestration, radiative forcing, food security, water availability, domestic versus export products, soil conservation, biodiversity, and social equity. Marginal and/or abandoned lands that may be suitable for biofuel crops need to be evaluated, including assessments of trade-offs and synergies in land use within a given region.

Modelling approaches

To make large-scale assessments of bioenergy potential it is important to link the results from a range of models (e.g. biophysical models, dynamic land use models, economic and trade models, and climate scenarios from global climate models). Only integrated assessment models provide the full suite of model components. However, a number of groups are now contributing model results outside of a fully integrated framework that do not link dynamic results or scenarios from the full range of model components. Global models of this kind are necessarily coarse and omit much of the local texture, such as opportunities for technical innovation or effective use of waste products. In this context, we are advancing three research areas:

1. Bioenergy crop model intercomparisons: including controls and coupling between components to incorporate process-level details and local-to-regional scale land-surface models of bioenergy potential.
2. Confronting global models with local observations: Global models are invaluable for producing the big picture, but require testing and evaluation at local-to-regional scale.
3. Quantifying the full radiative forcing consequences of bioenergy: In addition to replacement of fossil fuels, biophysical models are needed to address other climate impacts due to land use change, albedo changes (direct and also indirect, e.g. cloud response) and agricultural or system impacts such as N2O releases. Systematic assessments are needed both globally and regionally, with implications for multi-sector target setting and emissions trading.

We are developing a research programme using all three approaches. The optimal bioenergy space is evaluated as a function of quasi-steady state climate and policy, followed by combinations of prescribed pathways, probabilistic climate change patterns, and combinations of land use and climate change. An important outcome from this work is a contribution to the Intergovernmental Panel on Climate Change Assessment Report 5 (IPCC AR5). Bioenergy targets can be evaluated with respect to the impacts of land use change and the net GHG balances.

EBI projects

The BP-supported Energy Biosciences Institute (EBI) is leading the bioenergy crop model intercomparison effort through local-to-regional pilot studies. The institute is also archiving information on local-to-regional scale bioenergy plant distributions, ecophysiological parameters, and other essential data.

From a biophysical perspective, a vital question is how much land can be potentially used for bioenergy production without competing with other land uses, especially food crops. Land that is currently not used or deemed wasteland leads to an initial and simple sustainability criterion, to which socio-economic and technical dimensions are added, to determine the realisable potential.

The EBI approach to land prioritization is based on high-resolution spatial analysis of water availability, ground relief, soil fertility, temperature, and sunlight. Using satellite data from Landsat and MODIS, an initial construction of the physical constraints can be readily quantified (see figure above). Available land for agriculture is defined as a function of sunlight, water, and temperature. Water is the limiting factor over 40% of land surface, while temperature is limiting for 33% of land surface. Incident solar radiation is the limiting factor for 27% of global vegetated areas, mostly in wet tropical regions where temperature and water are adequate.

Defining whether land is marginal or wasteland is complicated and can be subjective. The process must be based on biophysics as well as environmental, conservation, economic, and cultural requirements, and needs to be flexibly and dynamically defined from year to year.

Mappings and pilot studies

Initial evaluations of land available for bioenergy crops typically use one of two approaches. The first is mapping potential marginal land through modification of existing land-cover data. This approach recognizes explicit and potentially dramatic land use tradeoffs (e.g. bioenergy, food production, economic drivers, conservation, species protection) by integrating data from each domain to generate a flexible index of suitability. Such an interactive tool highlights the inherent tradeoffs and can promote a dialogue between the different land stakeholders in order to identify a consensus on suitability.

The second approach uses direct remotely sensed measurement. Seasonal changes in vegetation are measured over time using new multitemporal and spatially rich satellite data (such as Landsat and MODIS vegetation indices). The approach targets potentially marginal lands using a direct spectral response over time. Expanding such land use analysis for regions rich in data is our first research goal, and it will provide the input that is needed for intercomparisons of bioenergy crop models.

The US and Brazil are the main countries subject to initial target studies. Results from models and data can provide decision-makers with a richer set of information for designing bioenergy systems. This information can enhance socio-economic development and contribute to the goals of sustainability and energy security.

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NEW RESEARCH

Household energy – an issue of choice

Takeshi Takama, SEI

Why is it that so often well designed, efficient and clean stoves fail to penetrate the market in developing countries? SEI's new approach could have the answer.

SEI has recently designed and applied an economic choice model in Ethiopia, Tanzania, and Mozambique, in order to better understand how consumer preferences can be linked to policy and programme design for the household energy sector. A new economic model – discrete choice analysis (DCA) – was successfully applied to estimate the market for clean cooking stoves in each case.

To design effective policies and programmes to scale up the use of cleaner cooking alternatives, the barriers to these alternatives at the household level must be understood. To date, research on household stove choice has focused mainly on socioeconomic factors (e.g. income, age, gender and education), while the role of product-specific factors such as safety, indoor smoke, usage cost and stove price have been largely ignored. This approach overlooks the fact that all households, even poor ones, make choices about the products they purchase. Understanding these decision-making dynamics at the household level is essential to accurately predict the market for improved stoves. This is crucial both for stove programme designers and for policymakers.

What is needed is an approach that takes in both socioeconomic and product-specific information.

SEI's innovative approach

To address this knowledge gap SEI, in cooperation with local partners, conducted a study from July 2008 to October 2009 on household stove choice in Addis Ababa, Ethiopia; Dar es Salaam, Tanzania; and Maputo, Mozambique. In each case the study used the DCA to evaluate the tradeoffs involved in choice of cooking stoves and fuels. This model allows socioeconomic and product-specific factors to be measured, and reveals not only whether a given product-specific factor is important, but also how important it is in relation to other factors.

People choose a particular type of stove for two reasons: its use value and its price. SEI designed its study to work out the relative weight that consumers give to different attributes of use value. The socioeconomic factors included in the study were age, gender, education and income. The product-specific attributes considered were price, usage cost per month, smoke and safety. 200 households participated in the study, which was carried out in two steps: first, respondents compared existing stoves such as a wood stove and a kerosene stove, and second, a chosen stove was compared with an ethanol stove. In addition, three focus groups were conducted: one with cooking fuel consumers from each socio-economic group, one with a group of energy experts, and one with professional cooks and randomly selected survey respondents.

Categories of determinant for fuel/stove choice

	Product specific factors	Socioeconomic factors
Specific to:	Product	Person
Characteristics:	General in nature	Specific to context
Variation in choice:	Within individuals	Between individuals or groups
Change in short term:	Relatively easy	Difficult
Useful for:	Product design, demand forecast, policy formulation	Market segmentation/profiling and policy formulation

The findings

The study found that when compared to a low-income group, a high-income group was willing to pay 10 times more for a unit reduction in indoor smoke, twice the amount for increased efficiency, and in Addis Ababa, 10 times more for increased safety. Moreover, the results showed that for all respondents, the first preference was for ethanol, followed by wood, with kerosene the least preferred fuel. This indicates that, other things being equal, people prefer ethanol over wood and kerosene. It also shows that everyone except the lower income respondents prefer wood over kerosene.

It appears that the effect of product-specific factors on household choices remains reasonably consistent across all other tested socio-economic factors. Crucially, the difference is in the trade-offs across factors. By examining the trade offs between product specific factors, one can select a stove design to fit specified markets. This is not possible by considering socioeconomic factors alone. When the various trade-offs are understood, it is possible to predict the market for specific products given certain conditions, for example, under different fuel price scenarios. This type of information is especially interesting to countries such as Ethiopia, where biofuel resources (ethanol, in the case of Ethiopia) are currently being allocated to different sectors (e.g. export, transport, household). Policymakers need firm guarantees on the existence and size of a household market for the fuel at a given price to allocate sufficient quantities to support the development of this sector.


Linda Nilsson

Cooking on a charcoal stove in Dar es Salaam, Tanzania.

The advantages of this approach

A conventional approach would demonstrate that compared to middle and higher income households, lower income households are more concerned about the initial cost of the stove than about the usage cost (fuel). Here, socioeconomic factors (in this case, income level) were useful for identifying lower, middle and higher income segments. But by taking into account product-specific factors, SEI's study has revealed how much more important the initial cost of a stove is for lower income families. Policymakers and designers of stove programmes can use this information as a guide for how best to penetrate markets. For example, in Ethiopia, it seems that subsidising ethanol stoves for lower income households would be a successful policy.

The study has generated great interest, particularly among stove practitioners that need to more accurately predict the market share for their stoves in relation to other variables, such as the price fluctuation of fuels. The research provides stronger information on the household market for improved fuels and stoves, and helps policymakers make better decisions on biofuel strategy. It can also contribute to better programme and product design.

The report from the study will be available in full from the SEI website in the new year. For more information, contact takeshi.takama@sei.se

RETROSPECTIVE

Early work on biomass and household energy

Karin-Wohlin Lange

Karin-Wohlin Lange led the Special Programme on Small Scale Energy at the Swedish International Development Cooperation Agency (Sida) from 1981 to1987. She worked closely with SEI's predecessor, the Beijer Institute, and Gordon Goodman (SEI's first director) on ground breaking studies on renewable energy in Africa. Here she reflects on her work with Goodman's team. This early research remains relevant today, particularly given that many of the same energy access problems persist in Sub Saharan Africa.

On August 11, 1981, the second day of the UN Conference on New and Renewable Sources of Energy (UNERG) in Nairobi, Kenya, a crowd of 1000 people marched through the streets carrying seedlings and bundles of firewood. They approached the entrance of the huge conference centre and laid their burden, and their challenge, at the feet of Prime Ministers Pierre Trudeau of Canada and Fälldin of Sweden. To the marchers, mostly women and children, carrying placards with slogans such as 'Day-long journey for fuel - relieve us of backbreaking labour,' Trudeau said 'It is nice to feel that what we are doing inside there is connected to the needs of the people we were elected to serve.'

The Conference highlighted the potential of new and renewable energy sources for politicians and led a number of donor agencies, including Sida, to establish special programmes to address this growing interest. It was through a new Sida programme on small scale energy that I first came in contact with the Beijer Institute and Professor Gordon Goodman and his team of young, international researchers. I had been given the task of leading the energy programme for Sida and with that, the freedom to shape the programme with external assistance.

Goodman's team had already laid foundations by conducting an assessment of energy needs for Kenya. The Kenyan Government had earlier indicated an interest in nuclear power for electricity production; however the Beijer analysis showed that the real shortages were in terms of fuelwood for household energy and that electricity was simply not a feasible option for the majority of Kenyan households. At that time, up to 75% of Kenya's total energy demand was met by fuelwood, with 95% of the population relying on fuelwood and charcoal for their energy needs – a situation which remains largely unchanged today. The Beijer Institute's application of end-use analyses to understand Kenya's energy situation proved extremely useful as an innovative and unconventional approach to tackling complex energy problems in developing countries.


Wangari Maathai:

Plantera ett träd och se till att det växer!

Kenya måste plantera mängder av skog och hejda jorderosionen om inte landet skall drabbas av en katastrof. För att klara detta krävs ett engagemang från stora delar av befolkningen. Regeringen, som har ansvaret för marken kan varken motivera folket till att plantera träd eller finansiera ett så omfattande projekt. Däremot kan de enskilda organisationerna göra betydelsefulla insatser.

Ett exempel är The Green Belt Movement, en rörelse som planterar träd runt samhällena i Kenya. Programmet administreras genom den nationella kvinnoorganisationen National Council of Women och leds av en eldsjäl: professor Wangari Maathai. För sina framgångsrika insatser fick hon 1984 års "alternativa Nobelpris".

Det handlar inte bara om att plantera träd. Wangari Maathai berättar om tankarna bakom The Green Belt Movement:

— Det är ett stort miljöprogram som folket på gräsrotsnivå genomför i Kenya. Vi vänder oss i första hand till kvinnorna, för det är de som brukar jorden. Kvinnor på distriktsnivå utbildas i skogsskötsel och trädplantering för att gå ut och undervisa folket på bynivå. Där är även männen engagerade i trädplanteringen, men kvinnorna är den drivande kraften.

Foto: Anna-Lena Ehrman/SIDAs bildarkiv.

— Vi uppmanar folk att använda den odlingsmetod, agroforestry, som var bruklig innan europeiska metoder tog överhanden. Olyckligtvis finns inte den gamla traditionen kvar hos dagens befolkning. Den måste läras ut på nytt. Alltså sprider vi inte enbart kunskap om trädskötsel. Förståelse för trädens betydelse är minst lika viktig. Kvinnorna inser hur nödvändig veden är och de måste se till att den inte tar slut. Annars tvingas de ändra familjens kostvanor med följd att barnen blir undernärda.

— The Green Belt Movement går också ut i skolorna för att engagera barnen. Om kunskapen skall leva vidare måste de lära sig att ta ansvar för trädplanteringarna och därmed Kenyas framtid.

Trädplantan behöver skugga

Den behöver skydd mot betande djur

8

An early issue of RED reports on the nascent Green Belt Movement

Although many of my colleagues at that time were engineers, focusing primarily on energy supply side issues, I was convinced by the Beijer approach and insisted that tree-planting and improved cooking stoves be considered together with the development of small scale energy technologies. I accompanied the Beijer researchers as they conducted fieldwork, and managed to fund the publication of this important work.

> **"The Beijer Institute, under the leadership of Professor Goodman, laid the groundwork for research in this field which continues today at SEI"**

We soon realized the need to highlight the enormous potential of new and renewable technologies for economic development, which led Sida to commission a number of research projects. The Beijer Institute compiled the research findings in one handbook: *New and Renewable Energy Technologies: their Application in Developing Countries*. This was a well referenced and truly comprehensive overview of the available rural energy technologies and was aimed at practitioners in the field. It presented, in appropriate detail, the technology and economics of bioenergy, solar energy, hydro and wind power, and water pumping.

Although it was not always easy for Sida to directly fund small-scale technology, we managed to support a number of promising projects, including Wangari Maathai's Green Belt Movement in Kenya, and a very successful cooking stove project in India led by Madhu Sarin, by facilitating their participation in high level international conferences and seminars and supporting the publication and dissemination of their work. The research findings of the Beijer Institute were widely appreciated by developing country partners, as were the events which brought field workers and researchers together. In my opinion, this is how developing country partners can best be supported and how the Beijer Institute then and SEI can now really make a difference.

During the seven years that the Sida special programme for small scale energy operated, the Beijer Institute, under the leadership of Professor Goodman, laid the groundwork for research in this field which continues today at SEI. Undoubtedly, the Beijer Institute would have succeeded without the support of Sida, but I would not have been able to conduct my work without Gordon Goodman and his team. The character of the Beijer Institute has clearly carried over into SEI, both in terms of its strong research-based approach to addressing complex environment-development challenges but also, crucially, in the value given to partnership and cooperation with local actors who are directly involved with the issues in question.

This newsletter has reported on energy and development issues since 1988.

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