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Bioenergy and Agriculture: Promises and Challenges

Developing Bioenergy: Economic and Social Issues

Daniel G. De La Torre Ugarte

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BIOENERGY AND DEVELOPMENT

Modern biomass energy services have the potential to make a significant contribution to a new energy paradigm. The world currently consumes about 400 EJ (exajoules) of energy per year but generates the equivalent of about 100 EJ of largely unused crop residues. It could produce an additional 180 EJ from energy-dedicated grasses and trees. Despite this potential, bioenergy must be viewed not as the single replacement for oil, but as one element in a wider portfolio of renewable sources of energy.

The production of energy from biomass involves a range of technologies that include solid combustion, gasification, and fermentation. These technologies produce liquid and gas fuels from a diverse set of biological resources—traditional crops (sugarcane, maize, oilseeds), crop residues and waste (maize stover, wheat straw, rice hulls, cotton waste), energy-dedicated crops (grasses and trees), dung, and the organic component of urban waste. The results are bioenergy products that provide multiple energy services: cooking fuels, heat, electricity, and transportation fuels. It is this very diversity that holds the potential of a win-win-win development path for the environment, social and economic development, and energy security.

There is a clear link between access to energy services and poverty alleviation and development. The first set of critical energy needs are those that satisfy basic human needs: fuel for cooking, heating and lighting, energy for pumping water, and electricity for health and education services. The second set of critical energy needs are those that provide energy for income-generating activities that help break the cycle of poverty.

The poor rely heavily on biomass as a source of energy, but traditional bioenergy—derived mainly from the combustion of wood and agricultural residues—has severe negative impacts. First, when combusted in confined spaces, these substances produce significant indoor pollution to which women and children are primarily exposed. This exposure has severe health consequences, including respiratory illnesses and premature death. Second, this kind of biomass use puts immense pressure on local natural resources, especially as communities must satisfy increasing demands for energy services.

THE POTENTIAL DEMAND

The potential economic and social benefits of modern biomass energy arise from the fact that agriculture could face enormous demand for feedstock. This feedstock will need to be produced, harvested, transported, converted into biofuels, and distributed for final utilization. The size of the potential demand can be easily illustrated by looking at transportation fuels, where biofuels are still the only renewable alternative compatible with the current combustion-engine infrastructure.

Each day the world consumes about 21million barrels of gasoline and another 21 million barrels of diesel. These amounts translate into a potential demand of about 30 million barrels of ethanol and 23 million barrels of biodiesel a day. For illustration purposes only, if potential ethanol demand is translated into hectares of sugarcane or maize, the two major feedstocks for ethanol, then it would require the planting of 300 million hectares of sugarcane or 590 million hectares of maize—about 15 and 5 times, respectively, of the current world plantings of those crops. In the case of biodiesel, the potential demand would be equivalent to 225 million hectares of palm, or 20 times the current world plantings. The opportunities and challenges involved in meeting this demand in a sustainable and cost-competitive manner should be a central concern in the development discussion.

In the 20th century, agriculture was characterized by a long-term trend of declining real prices. Steady advances in technology led global supply to expand more rapidly than demand, resulting in lower returns per hectare and an increase in farm sizes to allow for acceptable levels of returns, and fueling an exodus from the rural to urban areas. Biofuels present agriculture and rural areas with a long-term opportunity in which demand could actually outpace the growth in supply and generate the resources to increase income and capital in rural areas.

The most advanced countries in biofuels owe their progress to economic incentives and domestic policies that have fostered the development of a bioenergy industry. These policies do not have to be protectionist in nature, but rather can spur market growth by setting national production targets or gasoline blending volumes. Many countries are now discovering the potential role that bioenergy could play in their economies and in the economies of countries that could be markets for bioenergy services, such as Japan, as well as opportunities that tradable environmental goods may have for their economies.

SYNERGISM BETWEEN ENERGY PRODUCTION AND RURAL DEVELOPMENT

Thus far, the preferred path for using bioenergy in the transportation sector has been to convert traditional crops, like sugarcane and maize, into ethanol to be either blended with gasoline or used directly in internal combustion engines. Palm, soybeans, jatropha, and other oilseed crops can also be converted to biodiesel fuel and used to extend or substitute for fossil-derived diesel fuel. This path offers many developing countries that produce these crops a well-tested opportunity to build their biofuel sector and reduce their need for costly imported fossil fuel.

The specificity of the feedstock, the logistics, the conversion, and local economic conditions make it difficult to define a single break-even point for the production of biofuels. If technology improves and oil prices continue their current upward trend, however, the production of biofuels would be economically competitive in more countries and for a wider variety of feedstocks. Ethanol production in Brazil is economically viable without any government support at oil prices above US$35 per barrel; this experience, based on the use of sugarcane, is transferable to other countries. In the United States, the other major ethanol producer, maize-based ethanol can be profitable at oil prices above US$45 to US$50 a barrel.

A key motivation in the development of biofuels is the possibility of diversifying energy resources and displacing large oil import bills with spending on locally produced biofuels. But the opportunities for rural development should also be a key priority. Rural development benefits from a dynamic bioenergy sector, beginning with feedstock production. Because agricultural production in many developing countries is characterized by labor-intensive activity, additional de-

mand for agricultural products will increase employment and wages in the agricultural sector. Furthermore, the additional personal income generated has the potential to induce significant multiplier effects as it is spent by the rural population.

Given the weight and bulk of most biomass feedstocks, it is necessary to locate collection and conversion facilities in rural areas, close to where the feedstock is grown. Consequently, construction and operation of those facilities will generate additional economic activity in rural areas. This fact emphasizes the close link between the biofuels sector and rural development.

Local benefits, especially for the poor, can be enhanced by organizing small-scale producers to meet the throughput volume and reliability needs of conversion facilities. In Brazil and the United States, large corporations dominate the bioenergy industry, but farmer cooperatives play a useful role in linking these large firms to independent growers. Similar arrangements may be needed in other countries if the industry is not to develop in a vertically integrated way with only large-scale growing of biomass feedstocks.

Additionally, since certain energy crops like trees and grasses require few inputs, they sometimes can be grown on land too marginal for food crops. These energy crops have the potential to extend the land base available for agricultural activities and to create new markets for farmers. These positive impacts in the dynamics of the rural economy could have a substantial role in reducing the traditional exodus to urban areas and could create a more favorable economic environment for greater investment in rural infrastructure, health, and education.

THE INDIRECT CONTRIBUTION OF DEVELOPED COUNTRIES

Greater bioenergy production in developed countries would indirectly affect many developing countries by reducing exports of food and feed, leading to higher world prices for these goods. A study undertaken by the author has shown that between 15 and 30 million acres in the United States could shift toward energy-dedicated crops, leading to significant reductions in food and feed production and export surpluses. Given the weight of the United States in world markets, it is likely that world prices would also increase. Farmers in developing countries may benefit from the higher prices and expand their own production of food and feedcrops. Such a production increase would also raise the availability of crop residues in developing countries, and the bioenergy industry could gain additional strength based on this added energy feedstock. On the negative side, higher world prices would lead to higher food prices for the poor, but this impact might be offset in the longer term by the higher employment and incomes generated by agricultural-led growth.

Bioenergy could make multiple contributions to the fight to eradicate poverty and improve food security. In developed countries, shifting land use toward biomass for energy would reduce dumping in the commodity markets and give developing-country farmers access to higher prices. In developing countries, the production of energy in concert with sustainable food production and the sustainable use of local resources could also result in higher incomes for farmers and added energy services for the community, all of which would enhance the community's ability to develop economic activity designed to reduce poverty and enhance food security. ■

For further reading see S. T. Coelho, "Biofuels: Advantages and Trade Barriers," paper prepared for the session on biofuels at the United Nations Council on Trade and Development (UNCTAD) Expert Meeting on the Developing Countries' Participation in New and Dynamic Sectors of World Trade, Geneva, February 7-9, 2005; D. De La Torre Ugarte and C. Hellwinckel, "Commodity and Energy Policies under Globalization," paper presented at the conference "Agricultural Competitiveness and Change under Globalization," organized by the Center for Agricultural Policy and Trade Studies and the Freeman Center for International Economic Policy, Fargo, North Dakota, October 11-12, 2004; Intergovernmental Panel on Climate Change (IPCC), *Climate Change 1995: Impacts, Adaptations, and Mitigations of Climate Change: Scientific–Technical Analysis* (Cambridge: Cambridge University Press, 1996); S. Kartha and G. Leach, "Using Modern Bioenergy to Alleviate Rural Poverty," report for Modern Biomass Workshop, May 2001 (London: Shell Foundation Sustainable Energy Programme, 2001); and J. Woods and D. O. Hall, "Bioenergy for Development: Technical and Environmental Dimensions," FAO Environment and Energy Paper 13 (Rome: Food and Agriculture Organization of the United Nations [FAO], 1994).

Daniel G. De La Torre Ugarte (danieltu@utk.edu) is associate professor at the Agricultural Policy Analysis Center, Department of Agricultural Economics, University of Tennessee, U.S.A.

International Food Policy Research Institute
2033 K Street, N.W. • Washington, D.C. 20006-1002 • U.S.A.
Phone: +1-202-862-5600 • Fax: +1-202-467-4439 • Email: ifpri@cgiar.org
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