Bioenergy and Agriculture: Promises and Challenges

Developing Bioenergy: A Win-Win Approach That Can Serve the Poor and the Environment

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2020 VISION FOR FOOD, AGRICULTURE, AND THE ENVIRONMENT

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The promise of bioenergy is that it may help cope with rising energy prices, address environmental concerns about greenhouse gas emissions, and offer new income and employment to farmers and rural areas. In principle, there is a high degree of congruency between these three objectives for bioenergy production and the poverty reduction targets embodied in the Millennium Development Goals. But the development of bioenergy also poses risks and has the potential to result in difficult trade-offs for the poor and the environment. There is, for example, a chicken-and-egg conundrum that makes it difficult for the private sector to grow the industry before sufficient demand is forthcoming, yet demand depends on an ample and well distributed supply. Moreover, because most of the environmental and social benefits and costs of bioenergy are not priced in the market, leaving bioenergy development entirely to the private sector and the market will lead to levels and types of bioenergy production that fail to achieve the best environmental and social outcomes. To ensure better outcomes, the public sector has important roles to play.

GROWING THE INDUSTRY

Launching and developing a new industry like bioenergy poses difficult challenges for the private sector. The substantial investments that must be made up front can yield little return until sufficient scales of production and demand have been achieved to slash unit costs. But achieving those scales depends on complementary investments throughout the market chain, and these investments may not be forthcoming until bioenergy costs have fallen to a level competitive with alternative energy sources. The biofuel industry is a good example. A viable biofuel industry requires large and coordinated investments not only by farmers and processors, but also by car manufacturers, consumers, fuel distributors, and garages. Until these investments are in place, biofuel sales are destined to be low, and economies of scale in production and distribution cannot be exploited. Given higher costs, biofuels may remain uncompetitive with oil.

The solution to this problem is for governments to provide initial incentives to help launch the industry. The public sector can help achieve critical market size by offering tax rebates on biofuels (but not on oil-based gasoline and diesel), by mandating fuel blending requirements (like the European Union's current requirement that diesel contain at least 2 percent biodiesel), by offering investment incentives such as tax exemptions or holidays on bioenergy investments by industry and subsidies to consumers (to buy flex-fuel cars, for instance), and by investing directly in research and development and relevant infrastructures. Brazil began using these kinds of interventions in the mid-1970s and has now built up a viable biofuels industry that not only contributes a significant share of the country's energy requirements for transportation, but also exports to other countries. The European Union and the United States began later and are in the process of building up their own domestic industries. Many other countries seem likely to follow.

BENEFITING THE POOR

Although biofuel production has clear benefits for the agricultural sector, the net impact on poverty and food insecurity in developing countries is less clear. Not all countries have the natural resource base to justify significant production of bioenergy crops, but for those that do, the diversion of land and water away from the production of other agricultural outputs, especially food and feed, needs to be considered. Although current levels of bioenergy production are too small to have much impact on world food prices, any rapid and widespread expansion within the constraints of existing technologies could lead to significant food price increases. Such price increases would be beneficial to farmers who produce a net surplus of food, but they would be detrimental to poor consumers and food-deficit farmers, who would have to balance more expensive food against less costly energy. Since the poor typically spend much larger shares of their consumption budget on food than energy, this trade-off is unlikely to be favorable.

There are several ways to reduce the trade-offs between bioenergy crops and food production:

- Develop biomass crops that yield much higher amounts of energy per hectare or unit of water, thereby reducing the resource needs of bioenergy crops.
- Focus on food crops that generate by-products that can be used for bioenergy, and breed varieties that generate larger amounts of by-products.
- Develop and grow biomass in less-favored areas rather than in prime agricultural lands—an approach that would benefit some of the poorest people. Second-generation technologies that enable cost-effective conversion of cellulose-rich biomass, like fast-growing trees, shrubs, and grasses that can grow in less fertile and low-rainfall areas, will greatly expand this option within the next 10–15 years.
- Invest in increasing the productivity of the food crops themselves, since this would free up additional land and water for the production of bioenergy crops.
- Remove barriers to international trade in biofuels. The world has enough capacity to grow all the food that is needed as well as large amounts of biomass for energy use, but not in all countries and regions. Trade is a powerful way of spreading the benefits of this global capacity while enabling countries to focus on growing the kinds of food, feed, or energy crops for which they are most competitive. Trade would also allow bioenergy production patterns to change in the most cost-effective ways as new second-generation technologies come on line.

The benefits for the poor can also be enhanced by choosing appropriate scales and techniques for producing and processing biomass. So far most attention has been given to large-scale

production and processing of bioenergy for the market, which is often the most cost-effective approach for private firms. This is because biomass crops lend themselves to economies of scale in growth and processing. Yet the scale benefits need to be balanced against the costs and energy loss of transporting biomass products, given their bulk and weight. This situation opens up opportunities for smaller-scale and rural-based production and processing, which would be much more beneficial for the poor than large-scale and urban-based processing. In many developing countries it may also be inappropriate to consolidate land into heavily mechanized farms for growing biomass. A better approach is to organize smallholders so that they can grow and market biomass crops to large processing firms. Small-scale processing of biomass to produce, for instance, electricity or biogas already helps meet local energy needs in rural areas in many developing countries, and these options can be expanded in the future. The agricultural research systems in developing countries have a key role to play in addressing these issues to make biofuels pro-poor. This is a promising area for public-private partnership in research. The Consultative Group on International Agricultural Research (CGIAR) could also play a key role in strengthening international knowledge and facilitating the exchange of information on pro-poor development of biofuels.

BENEFITING THE ENVIRONMENT

Even if bioenergy proves to be a cost-effective substitute for oil, it may not necessarily be much better for the environment. Biofuels can, for example, use a great deal of fossil energy in their production, leading to little if any net reduction in greenhouse gases. Different crops and growing and processing technologies lead to different environmental outcomes. For example, ethanol produced from sugarcane not only is competitive with oil at today's prices, but also has favorable energy and carbon balances. In contrast, biodiesel produced from oilseeds and ethanol produced from maize and sugar beets are less competitive on price and have less favorable energy and carbon balances. Second-generation technologies based on cellulose-rich biomass should be more energy efficient, and there remains great scope for developing additional technologies that lead to larger carbon savings. Considerable research is being directed at this problem in Europe and the United States.

Bioenergy feedstocks can also pose environmental risks in the areas in which they are grown. For example, removing all the biomass can exacerbate shortages of organic matter for returning to the soil, leading to nutrient mining and land degradation. Cultivation of bioenergy feedstocks can mine water resources, expose land to greater erosion, pose problems with the intensive use of pesticides and fertilizers, and threaten local biodiversity. On the other hand, grown under the right conditions, bioenergy crops can contribute to better environmental management. For example, dedicated energy plantations grown on degraded lands may actually help restore the soil and biodiversity. As with all crops, bioenergy crops need to be grown and managed responsibly, and farm-level incentives for sustainable farming (such as secure property rights and locally managed externalities) need to be in place.

BIOENERGY AT WHAT COST?

Not all countries can grow bioenergy feedstocks at costs that are competitive with fossil fuels. Brazil, for example, can produce ethanol from sugar at the equivalent of US$30–35 per barrel of oil and is now growing its industry to the point where it is becoming a major exporter of biofuels. Several other countries with favorable climates and abundant resources may well follow suit. Producing ethanol in Europe, however, costs the equivalent of about US$80 per barrel of oil, and in the United States, about US$55 a barrel. The domestic biofuel industries that are being so carefully nurtured in these countries may not be able to compete in the future without trade protection. The cost of achieving net reductions in carbon emissions from biofuels can also be high, and there may be more cost-effective alternatives. A key question for policymakers is how much they are willing to pay to achieve the perceived benefits of bioenergy. These costs should decline over the next 10–15 years as second-generation technologies come on line, but for many countries, especially in temperate climates, it may prove more cost-effective to continue to use fossil fuels and buy carbon offsets, or to import biofuels from countries that can grow them more competitively. Rich-country policymakers can afford to contemplate taking on the higher costs of domestic bioenergy production if this helps reduce the cost of supporting their farm sectors. But even here it is relevant to ask whether there might not be more cost-effective alternatives.

CONCLUSIONS

With oil prices in excess of US$60 a barrel, interest in bioenergy is running high. The energy needs of rapidly growing countries like China and India, together with unstable oil supplies, suggest that the days of cheap oil are over. Bioenergy offers an attractive alternative for many industrial and developing countries, but if its full potential is to be captured, then both the public and private sectors, working as partners, must make long-term commitments and investments in innovation. ■

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