AGRICULTURE FOR DEVELOPMENT POLICY BRIEF

Biofuels: The Promise and the Risks

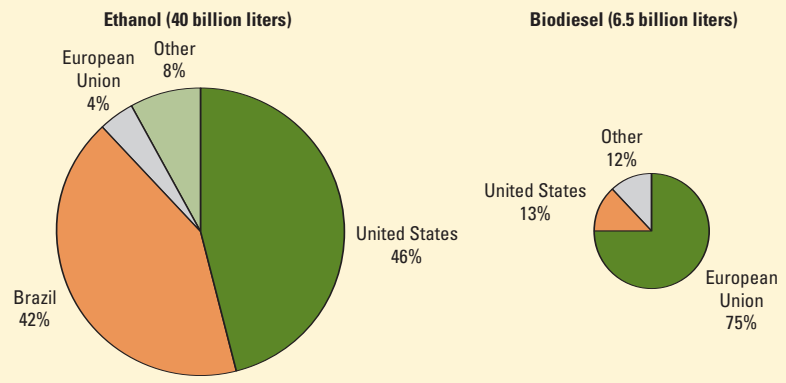
Biofuels offer a potential source of renewable energy and could lead to large new markets for agricultural producers. However, few current biofuel programs are economically viable, and most have social and environmental costs: upward pressure on food prices, intensified competition for land and water, and possibly deforestation. National biofuel strategies need to be based on a thorough assessment of those opportunities and costs. Globally, lower tariffs and subsidies in industrial countries will be essential for ensuring efficient allocation of biofuels production and guaranteeing social benefits to small farmers in developing countries.

Biofuels could become big markets for agriculture—with risks.

With oil prices near an all-time high and with few alternative fuels for transport, Brazil, the member states of the European Union, the United States, and several other countries are actively supporting the production of liquid biofuels from agriculture—usually maize or sugarcane for ethanol, and various oil crops for biodiesel. Possible environmental and social benefits, including mitigation of climate change, and contribution to energy security are cited as the main reasons for public sector support of the rapidly growing biofuel industries. As the economic, environmental, and social effects of biofuels are widely debated, they need to be carefully assessed before extending public support to large-scale biofuel programs. Those effects depend on the type of feedstock, the production process used, and the changes in land use.

Global production of ethanol as fuel in 2006 was around 40 billion liters. Of that amount, nearly 90 percent was produced in Brazil and the United States (figure 1). In addition, about 6.5 billion liters of biodiesel were produced in 2006, of which 75 percent was produced in the European Union (figure 1). Brazil is the most competitive producer and has the longest history of ethanol production.

Figure 1. Fuel ethanol and biodiesel production is highly concentrated



Source: F.O.Licht Consulting Company, personal communication, July 17, 2007.
Note: Percentages of global production of fuel ethanol and biodiesel in 2006.

The country uses about half its sugarcane to produce ethanol and mandates the consumption of ethanol. Many other developing countries are launching biofuel programs that rely on sugarcane or such oil-rich crops as oil palm, jatropha and pongamia.

Although assessments of the global economic potential of biofuels have just begun, current biofuel policies could, according to some estimates, lead to a fivefold increase of the share of biofuels in global transport—from just over 1 percent today to around 6 percent by 2020.

Are biofuels economically viable—and what is their effect on food prices?

Governments provide substantial support to biofuels so that they can compete with gasoline and conventional diesel. Such support includes consumption incentives (fuel tax reductions); production incentives (tax incentives, loan guarantees, and direct subsidy payments); and mandatory consumption requirements. More than 200 support measures, which cost around US$5.5 billion to US$7.3 billion a year in the United States, amount to US$0.38 to US$0.49 per liter of petroleum equivalent for ethanol. Even in Brazil, sustained government support through direct subsidies was required until recently to develop a competitive industry. Domestic producers in the European Union and the United States receive additional support through high import tariffs on ethanol.

Biofuel production has pushed up feedstock prices. The clearest example is maize, whose price rose by over 60 percent from 2005 to 2007, largely because of the U.S. ethanol program combined with reduced stocks in major exporting countries. Feedstock supplies are likely to remain constrained in the near term. However, unless there is another major surge in energy

prices, it is likely that feedstock prices will rise less in the long term. Farmers will respond to higher prices by increasing the planted areas and supply of these feedstocks. At the same time, rising prices will lower the demand for feedstocks because of the falling profitability of producing biofuels at these higher prices.

Rising agricultural crop prices caused by demand for biofuels have come to the forefront in the debate about a potential conflict between food and fuel. The grain required to fill the tank of a sports utility vehicle with ethanol (240 kilograms of maize for 100 liters of ethanol) could feed one person for a year; this shows how food and fuel compete. Rising prices of staple crops can cause significant welfare losses for the poor, most of whom are net buyers of staple crops. But many other poor producers, who are net sellers of these crops, would benefit from higher prices.

Future biofuel technology may rely on dedicated energy crops and on agricultural and timber waste instead of food crops, potentially reducing the pressure on food crop prices. But second-generation technologies to convert cellulose from these waste products into sugars distilled to produce ethanol or to gasify biomass are not yet commercially viable—and will not be for several years. Moreover, some competition for land and water between dedicated energy crops and food crops will likely remain.

Nonmarket benefits and risks are context-specific.

One of the main arguments cited in favor of expanding biofuel production is its potential to reduced reliance on imported oil, thereby contributing to energy security. The possible environmental and social benefits of biofuels are the other frequently cited arguments in support of public funding and policy incentives for biofuel programs. These benefits can be highly context specific.

Potential to enhance energy security. With current technology, biofuels can only marginally enhance energy security in individual countries because domestic harvests of feedstock crops meet only a small part of the demand for transport fuels. There are a few exceptions such as ethanol in Brazil. According to recent projections, 30 percent of the U.S. maize harvest could be used for ethanol by 2010, but it would still account for less than 8 percent of U.S. gasoline consumption. Second-generation technologies, using agricultural biomass could make a higher contribution to energy security.

Potential environmental benefits. Environmental benefits need to be evaluated on a case-by-case basis, because they depend on the greenhouse gas (GHG) emissions associated with the cultivation of feedstocks, the biofuels production process, and the transport of biofuels to markets. And a change in land use, such as cutting forests or draining peatland to produce feedstock such as oil palm, can cancel the GHG emission savings for decades, according to the 2006 EU Biofuel Strategy.

If Brazil's existing cropland were used and no land use change occurred, ethanol production in Brazil is estimated to reduce GHG emissions by about 90 percent. Biodiesel is also relatively efficient, reducing GHGs by 50 to 60 percent. In contrast, the reduction of GHGs for ethanol from maize in the United States is only in the range of 10 to 30 percent, at best. In such cases, fuel-efficiency measures in the transport sector are likely to be much more cost-effective than biofuels in reducing GHGs.

Benefits to smallholders. Biofuels can benefit smallholder farmers by generating employment and increasing rural incomes, but the scope of those benefits is likely to remain limited with current technologies. Ethanol production requires fairly large economies of scale and vertical integration because of the complexity of the production process in the distilleries. Likewise sugarcane production is generally large scale, although in Brazil outgrower schemes have succeeded in ensuring some smallholder participation. Small-scale production of biodiesel could meet local energy demand (for example, biodiesel use in stationary electricity generators), but wider markets require meeting consistent quality standards that can be achieved with large-scale production.

Public policies for biofuels must be defined.

To date, biofuel production in industrial countries has developed behind high protective tariffs on biofuels, in conjunction with large subsidies paid to biofuel producers. Such policies are costly to developing countries that are, or could become, efficient producers in profitable new export markets. Poor consumers also pay higher prices for food staples as grain prices rise in world markets, a rise that is largely induced by distortionary policies.

Can developing countries, apart from Brazil, benefit from developing biofuel industries? The favorable economic conditions and the large environmental and social benefits that justify significant subsidies are probably uncommon for first-generation technologies. In some cases, such as with landlocked countries that import oil and that could become efficient producers of sugarcane, the high costs of transport could make biofuel production economically viable even with current technologies. The much higher potential benefits of second-generation technologies, including technologies for small-scale biodiesel production, justify substantial privately and publicly financed investments in research.

The challenge for governments in developing countries is to avoid supporting biofuels through distortionary incentives that might displace alternative activities with higher returns—and to implement regulations and to devise certification systems that will reduce environmental and food security risks from biofuel production. Governments need to carefully assess economic, environmental, and social benefits and the potential to enhance energy security.

Reducing potential environmental risks from large-scale biofuels production could be possible through certification schemes to measure and communicate the environmental performance of biofuels (for example, a green index of GHG reductions). But the effectiveness of certification schemes requires participation from all major producers and buyers as well as strong monitoring systems.

This policy brief has been extracted from the World Bank's 2008 World Development Report, *Agriculture for Development*. Further information and detailed sources are available in the Report. The Report uses a simple typology of countries based on the contribution of agriculture to overall growth, 1990-2005 and the share of rural poor in the total number of poor (2002 US$2-a-day level). In agriculture-based countries (mostly Africa), agriculture contributes a significant (>20%) share of overall growth. In transforming countries (mostly in Asia), nonagricultural sectors dominate growth but a great majority of the poor are in rural areas. In urbanized countries (mostly in Latin America and Europe and Central Asia), the largest number of poor people are in urban areas, although poverty rates are often highest in rural areas.