Biofuels

Big potential for some...but big risks too

BY MASAMI KOJIMA AND IRINA KLYTCHNIKOVA

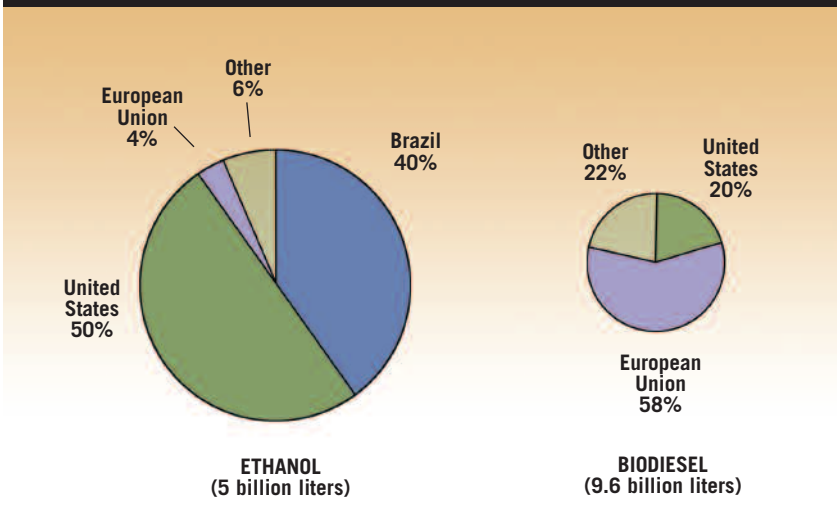
RECORD-BREAKING OIL PRICES have reinforced an existing push to reduce dependence on foreign oil, and a number of countries are turning to biofuels as a means of enhancing energy security. Concerns about climate change have also led to increasing support for the biofuels sector. Brazil, the European Union, and the United States, among others, have policies that promote greater production of sugarcane, maize, and starch crops for ethanol, as well as oilseeds for biodiesel.

But this growing demand for maize and other feedstock crops to produce biofuels has also been an important driver of surging food prices worldwide. The interaction of spiraling oil and food prices—and its often harmful impact—underlines the urgent need for national biofuel strategies based on thorough assessments of likely positive and negative economic, social, and environmental outcomes.

Brazil and the United States accounted for almost 90 percent of global ethanol production—50 billion liters—in 2007 (Figure 1). In the same year, the EU countries produced nearly 60 percent of world's total biodiesel output of 9.6 billion

New federal legislation and tax incentives in the USA are aimed at boosting interest in ethanol as an alternative to foreign oil and gasoline.

FIGURE 1: FUEL ETHANOL AND BIODIESEL PRODUCTION IS HIGHLY CONCENTRATED



Source: F.O.Licht Consulting Company, personal communication, June 12, 2008.
Note: Percentages of global production of fuel ethanol and biodiesel in 2007.

liters. Brazil is an ethanol pioneer, with production starting in the 1930s; it remains the world's most competitive producer, as well as the lowest-cost sugarcane producer. Half of Brazil's sugarcane is devoted to ethanol, for which a market has been guaranteed by legislation requiring ethanol-gasoline blends. The United States used 24 percent of its maize crop to produce ethanol in 2007–08, and extends generous support to the industry through tax incentives and subsidies for biofuel production and consumption, coupled with consumption mandates. Many developing countries are launching biofuel programs that rely on molasses, sugarcane and oil-rich crops such as soybeans, oil palm, and *Jatropha curcas.*

Feedstock costs account for more than half the costs of producing biofuels. Despite remarkable reductions in production costs, the biofuels industry in most of the world has struggled financially until recently. It has been able to stand on its own in purely economic terms in just a handful of cases, such as Brazil in 2004–2005 (but not 2006) and 2007–2008. In most other countries, biofuels production has not been financially viable without government support and protection—U.S. and EU producers receive protection through high import tariffs on ethanol.

In addition, despite the potential of biofuels both as a source of renewable energy and as a direct source of support for some agricultural producers, there is mounting evidence that they carry social and environmental risks. These include upward pressure on food prices, intensified competition for land and water, and land-use change that may outweigh the greenhouse gas (GHG) benefits of fossil fuel substitution.

Potential trade-off between food and fuel?

RISING PRODUCTION OF BIOFUELS has important implications for food security in many developing countries. Sugar's importance in food consumption is limited because it does not contain vital nutrients and is not used as animal feed. In contrast, diversion of maize and oilseeds to the biofuel sector has had a significant effect on global food prices in recent years. The link between the rising demand for biofuels and surging food prices has prompted a debate about the potential conflict between food and fuel. Among the statistics cited is that it takes the same amount of grain to fill a sport utility vehicle's tank with ethanol as it does to feed one person for a year.

Rising energy prices, among several factors, have contributed to food price increases, but biofuel production has also pushed up feedstock prices. The clearest example is maize, whose price rose by 87 percent from January 2005 to December 2007. Driven by subsidies, mandates, and import barriers, a rapidly rising proportion of the U.S. maize crop is devoted to ethanol production, coinciding with a sharp drop in U.S. maize reserves.

Biodiesel production in the European Union—also driven by subsidies and mandates—and elsewhere, among other factors, has contributed to similar price increases for vegetable oils (canola, soybean, and palm). The increased demand for feedstock crops by biofuel industries, by some estimates, has accounted for about 20 percent of the overall increase in real rice and wheat prices and around 40 percent for maize from 2000 to 2007.[1] Rising food prices have hit many food-importing countries hard, causing significant welfare losses for the poor, many of whom are net buyers of staple crops.

In the near term, cereal supply is likely to remain constrained. Prices are subject to upward pressure from further supply shocks. However, unless there is another major surge in energy prices, the pace of increases in feedstock prices should ease over the long term. Farmers will respond to higher prices by increasing the planted areas and supply of these feedstocks.

Second-generation technologies could attenuate the tradeoffs between food and fuel. Future biofuels technology may enable a shift from reliance on food crops to dedicated energy crops, as well as the use of agricultural and timber wastes and even algae for biofuel production. This could reduce pressure on food crop prices, but only if cultivating these alternative feedstocks and raw materials use less land and water than that used for biofuels at present. Such technologies are not yet economic—and are unlikely to be for at least several more years.

Other benefits and risks of biofuels depend on the context

OTHER REASONS CITED for expanding biofuel production are that biofuels will reduce reliance on imported oil, lower overall fuel costs, enhance energy security, and create domestic jobs by stimulating local economies. And, unlike oil, biofuels are renewable and generally a "cleaner" source of energy than oil. However, these potential gains—enhancing energy security, mitigating climate change, and creating jobs—depend on the context.

Except for Brazil, current domestic harvests of feedstock crops meet only a small fraction of the demand for transport fuels in the producing countries. Because, global biofuel production will remain small in contrast to petroleum fuel production, biofuels will continue to be "price-takers" in the market rather than drivers of transportation fuel prices. As a result, average biofuel prices on the international market are unlikely to be much lower than those of petroleum for long. This trend will be reinforced as countries try to force biofuel production to higher levels, thereby potentially pushing up feedstock prices further. Second-generation technologies, using agricultural biomass, raw materials, municipal and other wastes, or algae, could transform the biofuels industry away from one dependent on food crops, and thus make a larger contribution to energy security without the consequent adverse effects of today's industry.

As for reducing GHG emissions through the use of renewable fuel—frequently cited as an important reason to support biofuels—the jury is still out. Scientists differ on the magnitude of the prospective reduction in GHG emissions as a result of more widespread biofuel use. Estimates of gains vary, depending on the type of feedstock and production process used, with ethanol from established sugar cane fields ranking among the highest in net GHG emission reduction. The extent of the reduction in GHGs depends on the entire cycle of biofuel production, from the cultivation of feedstocks and the biofuels production process to transport of biofuels to markets. An important, and often overlooked, source of additional GHG emissions is land use change.

If feedstock production in one area prompts another area to change its land use practices, global GHG emissions may actually rise. Furthermore, the environmental cost of cultivating some types of biofuels could be high. A recent assessment of 26 different biofuels showed that many of them generate GHGs at a volume more than a third lower than gasoline. However, these benefits fall after accounting for environmental effects associated with production of biofuels: depletion of natural resources, razing of forests and peat surfaces to open land for cultivation, and damage to ecosystems. Environmental costs of nearly half of these biofuels, including the economically most important ones—such as U.S. maize ethanol, soy diesel, and Malaysian palm-oil diesel—may even have greater environmental costs than fossil fuels.

Biofuels can benefit smallholder farmers by generating employment and increasing rural incomes, but the scope of those benefits is likely to remain limited. With the exception of first-generation biodiesel production to meet local fuel demand, the economies of scale required in commercial production of biofuels, and especially with second-generation biofuels, favor large plantations over small farms. For example, although *Jatropha curcas* has a reputation for surviving on marginal land with little rainfall, some corporations that have invested in it seek to make it financial viable by growing it on large plantations with sufficient fertility and irrigation to achieve high enough yields. If feedstock production uses natural resources that could otherwise be used for food production, then that risks competing for the same resources, thereby putting further upward pressure on food prices even if the feedstock itself is not consumed as food or feed. It can also have a damaging social impact, by undermining access to land by poor people in rural areas, a concern especially in Africa. Increased demand for land can affect security of tenure and land use; powerful interests may seek land currently used by smallholder farmers or held in communities, to convert it to large-scale biofuel plantations.

Public policies for biofuels must be defined

CAN A BROAD RANGE of developing countries benefit from developing biofuel industries? With current technologies, the government support required for investment and consumption incentives is generally significant, while the potential environmental and social gains may not be sufficient to justify large subsidies. In some cases, however, such as landlocked oil-importing countries with the right conditions to produce feedstocks efficiently, the high cost of transporting oil could make biofuel production viable even with current technologies. If the price gap between ethanol from sugar cane and gasoline prevailing in the second quarter of 2008 persists for a prolonged period of time, efficient sugar cane producers may find bioethanol manufacture profitable without subsidies even if they are not landlocked. Some developing countries may have a comparative advantage in producing biofuels for export, but this depends on a substantial reduction in tariffs by the importing countries as well as consumption mandates and even subsidies being retained in these markets.

The challenge for developing-country governments considering incentives for biofuels is to ensure that the required government support does not displace alternative activities that can deliver higher returns in energy security, rural employment, or climate change mitigation. Other—often more cost-effective—ways of delivering environmental and social benefits also need to be considered, for example through improvements in fuel efficiency and alternative technologies for producing clean fuels. Governments need to carefully assess the economic, environmental, and social implications and risks, as well as the potential energy security benefits.

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Unemployed men look at job posting in the center of Sao Paulo, Brazil.

rarely followed elsewhere. There are also a number of examples of vocational training programs specifically targeted at inserting the rural workers into the non-agricultural sector. Yet, good evaluations of such programs are scarce, and much remains to be learned about their effectiveness.

As agriculture intensifies and diversifies, and economies develop, well-functioning rural labor markets and migration are crucial in reducing rural poverty and reducing rural-urban income disparities. Yet, little policy attention has been given to the structure, conduct, and performance of rural labor markets and how they can facilitate successful transitions out of agriculture. These labor markets need to be studied more deeply, to identify their strengths and weaknesses, and develop policy interventions. On the workers' side, special attention is needed to provide, among others, training programs enabling workers to secure good jobs, both in the regions where they currently live, and elsewhere.

On the demand side, policies can be developed to favor employment creation through better investment climates and decentralization of economic activity toward rural areas. Current regulation of rural labor markets often tends to be out of tune with the reality of these markets, and is typically not enforced. As the trend towards a proportionately smaller labor force in agriculture grows more pronounced, it is clear that displaced, often poor, and poorly-educated, rural workers will need new options. Effective preparedness of those who choose to leave agriculture is a critical part of an overall strategy to mobilize agriculture for development.

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Notes

1 Estimates are computed assuming that, in the absence of migration, natural population rates for urban and rural areas would be equal, thus providing a conservative measure of migration. Reclassification of rural areas into urban has not been taken into account, although it may account for some of the urbanization, independent of migration.

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A knowledge gap exists as to how much second-generation biofuel technologies would change the cost-price dynamics of biofuel production. Bridging this gap with research investments, by both private companies and public authorities, should be a priority, especially in the developed countries.

Biofuels trade liberalization would increase competition in the sector. This would improve efficiency, bring down costs, and enable the world's most efficient producers—a majority of which are developing countries—to expand their share of the biofuels market.

But for this to deliver net gains in welfare for developing countries, efforts to remove trade barriers must be accompanied by a commitment by rich countries to reduce or eliminate domestic protection of feedstock producers and biofuels industries. The biofuel industry's current dependence on subsidies, especially in the United States and the European Union, distorts market behavior and hides real costs. A level playing-field for biofuels would resolve some of the dilemmas, attenuate the risks, and clarify the choices for policymakers seeking welfare gains from biofuels.

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