Social and Distributional Impacts of Biofuel Production

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Introduction

Current large-scale biofuels production in Brazil (and to a lesser extent other countries) has done little to improve the economic situation of the average fuel consumer or promote sustainable rural development that benefits small-holder farmers or the urban poor (Rodrigues and Moraes 2007; Sawyer 2008), the most vulnerable segments of Brazil's population. Reasonable evidence and arguments suggesting that future large-scale biofuels production will have any such positive effects are largely absent from the literature. Indeed, the small body of extant research on the socio-economic impacts of biofuels, as well as extrapolations based on the larger agricultural and rural development literature, strongly suggest that an expansion of the areas under feedstock cultivation for biofuels will benefit large land owners, speculators, and urban elites in developing countries, while having deleterious impacts on small-holders and the poor in developing countries and relatively minor impacts in developed countries. In contrast, very small-scale biofuels production for local consumption shows some promise in the provision of energy security and improvements in human well-being and equity (EEA 2006).

This chapter considers the available evidence on the social and economic impacts of current biofuel systems in Brazil and the United States, and anticipates future impacts of expanded ethanol (including the transition to cellulosic ethanol) and biodiesel (from oil seeds) production based on existing social science literature on rural socio-economic development, land-use change, and agriculture. In particular, the chapter focuses on impacts on the most vulnerable populations: poor residents in developing countries and small-holder farmers in such countries. I discuss the ways in which the expansion of biofuels production will directly impact small-holder agriculturalists, including influence in land use decision-making and income (the value

van Wey, L. 2009. Social and distributional impacts of biofuel production. Pages 205-214 in R.W. Howarth and S. Bringezu (eds) Biofuels: Environmental Consequences and Interactions with Changing Land Use. Proceedings of the Scientific Committee on Problems of the Environment (SCOPE) International Biofuels Project Rapid Assessment, 22-25 September 2008, Gummersbach Germany. Cornell University, Ithaca NY, USA. (http://cip.cornell.edu/biofuels/)

of the land), as well as indirect impacts to the poor more generally in developing countries, including effects on prices for fuel and food, and transformation of the rural economy (e.g. changes in the organization and productivity of agriculture).

A complete consideration of the human impacts of biofuels production requires the recognition that effects operate through social, economic and political systems, and that these systems are intimately connected and characterized by high levels of inertia particularly in the developing world. All decisions regarding planting, production and consumption take place in the context of the regional or national position in the global political economic order. This position can close or open options for individuals, families or businesses. Political systems have evolved over time in response to internal population and production changes as well as external threats and interactions, and many have not yet developed effectively for participation in the modern global economy. Because of the resulting differences across countries with different histories and positions in the world economic order, there can be no one-size-fits-all policy, or even a predictable common on-the-ground response to the same policy in multiple countries.

At a finer scale, imperfect information and market failures abound in rural areas of the world, meaning that potential benefits are often not realized. Simple economic projections of the profitability and distributional effects of biofuels are not possible. Such projections, and the analyses upon which they are based, are generally predicated on perfectly functioning markets and friction-less transfer of information to all producers. With imperfect information and market failures, production and transaction costs are dramatically higher for crops in many parts of the world (de Janvry and Sadoulet 2006). Beyond that, it is not even possible for farmers in all (ecologically and climatically appropriate) parts of the world to participate in a biofuels or feedstock market because of such market failures. Social attitudes and values further muddy the picture by inducing landowners to act not always in the economically optimal way. Because simple models projecting the economic impacts both locally and economy-wide of increases in biofuels production do not account for the uneven access to markets and the sometimes economically perverse actions of individuals, such simple models will not do a good job predicting the future. Such predictions will miss the tendency for elites to co-opt rents, the inability of large segments of the population (usually the poor) to participate in national and international markets for bio-fuels, and the focus of small farmers on non-economic motivations for land use decisions (e.g. culturally appropriate or traditional land uses in place of biofuels). These oversights all lead to a simple economic analysis over-estimating the benefits of biofuels to the poor and therefore the reduction in inequality in incomes.

Current Trends

Production of biofuels feedstocks is most prominent in Brazil (sugarcane ethanol) and the United States (corn ethanol). Because of Brazil's long history with biofuels, I focus here on evaluating the impacts of their government-sponsored and industry-led programs. As discussed elsewhere in this volume, the Brazilian sugarcane ethanol industry is the most energy-efficient producer of ethanol in the world and is often proposed as a model for integrated and

efficient bio-fuels industries elsewhere. Brazil has taken advantage of their abundant labor and tropical climate to promote the production of sugar-cane, generate income and employment, and increase national energy self-sufficiency. However, there is some debate about the beneficiaries.

The available literature shows that benefits have been unevenly spread across countries and between large and small producers of feedstocks. Most benefits from the Brazilian ethanol market have flowed to large and highly capitalized producers in the South of the country (Rodrigues and Moraes 2007), while workers earn low wages for unhealthy and backbreaking labor (Sawyer 2008). Current trends towards increased efficiency and the replacement of laborers with mechanized harvesters suggest that even the employment benefits of sugarcane production for landless rural workers will soon be gone (Moraes 2007). Large-scale investment in ethanol production in the United States is relatively recent, but early data on the structure of the industry, efficiency of production, and impacts on prices suggest that benefits there are concentrated and small. Even in this situation, 20% of subsidies are captured by multinational corporations, and farmers receive less of the subsidy than would be optimal for stimulating production. Corn ethanol production in the United States has also resulted in the diversion of corn from food production to fuel production, con--tributing to a rise in prices for consumers, though the amount of the food price rise that is attributable to biofuels is difficult to estimate and clearly not a majority (FAO 2008).

In this context, I refer to large producers as those producing completely for sale rather than consumption, who have invested substantial financial capital in the purchase of agricultural technology, and who compete in international commodities markets (even if the sale of crops is local). Small producers, in contrast, produce for subsistence or a combination of consumption and sale, tend to be under-capitalized and use less modern technology than larger producers, and are only partially linked to international commodity markets. The exact area of land owned or used by these groups varies spatially.

To date, feedstock production is not profitable for small-holders even with subsidies, thus the market remains dominated by large-holders. This is true within countries (i.e. favoring the larger farmers in Brazil), as well as between countries. The international market for ethanol is characterized by high tariffs and import regulations in the United States and Europe (large consumer markets) designed to prevent domestic producers from being out-competed by tropical, particularly Brazilian, ethanol producers. Within the developing world, efficient production has also been hampered in some areas by high transportation costs and lack of government support, favoring already developed agricultural areas over poorer and under-utilized arable land (Singhet al.1986; Jalan and Ravallion 2002; de Janvry and Sadoulet 2006). The exception in which small-scale production of biofuels feedstocks has been profitable for producers is rural Europe. In some areas of Europe, government subsidies promoting the use of biofuels in the interests of energy security and environmental protection have made production of feed-stocks profitable for farmers (EEA 2006).

Potential Futures

Turning to the possibilities for the future, I first consider whether countries will be able to implement successful biofuel production programs for large domestic markets and for export. I then consider the potential for small-scale production for local consumption. There is relatively little literature directly evaluating the social impacts of large-scale production, and even less on that of small-scale production. I therefore draw on larger social science literatures to speculate about likely futures, and to focus on the best futures for rural development and equity.

Low labor costs and long growing seasons should provide many developing countries a competitive advantage in biofuels production with currently dominant feedstocks. Increased production, in turn, should translate into increases in the purchasing power (through exports and access to foreign exchange), over-all increases in income, and financially viable energy security. However, significant barriers exist to the realization of these increases. For one, not all countries will have the capacity, either financial or institutional, to implement subsidies for the production of biofuel feed-stocks, leaving that role open to multi-national corporations and leading to profits leaving the country. Additionally, fair competition on the inter-national market depends on the liberaliza-tion of trade policy for agricultural products, in particular the elimination of the pro-tectionist policies of the United States and the European Union. While there was optimism in recent years that such barriers would be eliminated during the Doha round of trade negotiations under the auspices of the World Trade Organization, the recent failure of the negotiations to produce agreement largely on issues of agricultural products suggests that the near future will not bring significant changes to international agricultural trade policy (Economist 2008). In this institutional context, we can anticipate the likely trajectory of large-scale biofuels feedstocks production in developing countries.

While producers in these countries will be disadvantaged by the unequal international terms of trade surrounding agricultural products, rising oil prices could allow biofuels to still be competitive. The resulting increases in the prices commanded by sugarcane, soy, palm oil, and other feedstocks will fuel a boom in production. It is important to note that in this boom, as in other booms, the early adopters will be larger farmers in areas with well-functioning markets, as currently seen in Brazil (Rodrigues and Moraes 2007). These farmers can afford the startup costs of converting land to another crop, expanding land under production, or changing the technological or labor inputs. Both the level of capitalization of these farmers and the functioning of markets allow these farmers to manage risk in a way that is not open to under-capitalized small farmers in areas with non-functional markets (de Janvry, Fafchamps and Sadoulet 1991; World Bank 2008). These early adopters are likely to do very well in the market, taking advantage of the high levels of demand for and low supply of biofuels feed-stocks as many countries struggle to quickly meet targets for non-fossil fuel energy production. Later adopters, more likely to be small farmers who take a longer period to accumulate startup costs, access information, and convert production, will enter a more crowded field of producers, leading to lower profits (or even losses). The boom therefore has the potential to exacerbate existing in-equalities between large producers and small producers.

Booms are virtually inevitably followed by busts. Prices rise as demand for a product increases, enticing more and more producers into the market leading to overproduction and a price crash. This situation is likely to be exacerbated in the case of biofuels feedstocks production by the likely short-term nature of the demand for many of the feedstocks in which many farmers will invest. As discussed elsewhere in this volume, most signs point to cellulosic ethanol being far superior in terms of energy balance to ethanol produced from sugar-cane, corn or other food crops, and to it being viable in the medium term. Thus an investment in production (of both feed-stocks and ethanol from feedstocks) based on carbohydrate ethanol will have high returns for only a limited time. Production of oilseed crops for biodiesel will not have the same limited time horizon, but will still be subject to the usual boom and bust cycle. Because the bust will come at a time when the later adopters, the more risk-averse and under-capitalized smaller farmers, are entering the market, the price drops will disproportionately affect this more vulnerable group.

In addition to these impacts on the distribution of agricultural income, the expansion of production of any biofuel feedstocks will accelerate the transformation of the rural economic landscape through favoring large producers. Mechanized monoculture agriculture favors large pro-ducers who are able to take advantage of economies of scale, particularly in areas in which capital markets are poorly function-ing (meaning credit for the purchase of agri-cultural machinery or other inputs is inaccessible) (Sarris et al. 2004; Boucher et al. 2006; World Bank 2008). Because rural farmers often are unable to save money in a liquid form for investments in agricultural improvements, and banks see them as poor risks and will not extend credit, such farmers are often unable to take advantage of technology that is easily available in much of the developed world. This is not inevitable, as promotion of growers' co-operatives and rural credit schemes can allow small-holders to transform social capital and place-specific human capital into credit. Growers' co-operatives are be-ing promoted with tax incentives to the purchasers of biofuels feedstocks in Brazil (GBEP 2007). Credit cooperatives allow small farmers to borrow on the strength of their membership in a social group. In addition to credit constraints, the high transportation costs for the raw pro-ducts and the economies associated with the use of byproducts of biofuels production (e.g. soy meal as a livestock feed) will encourage the agglomeration of production into larger, horizontally integrated businesses (Reardon et al. forthcoming; see Moraes et al. 2005 for a Brazilian example).

While agglomeration and investment of capital have the potential to increase the efficiency of production and produce employment in the rural sector, they will also likely displace a substantial number of small producers (Cotula et al. 2008). With careful planning, this might be avoided through mandates or encouragement of arrangements that integrate small farmers with processing plants. Alternatively, such displacement could have positive impacts for small farmers, allowing them to sell land for a high enough price to establish themselves elsewhere. Past experience, however, suggests that land is bought by speculators in advance of the largest price increases, and that small-holders often do not receive the true value of the land they

sell. Without programs that keep small farmers on the land or provide them a large buyout of their farm, and because rural areas that are home to most small farmers are also characterized by poor educational infrastructure, with difficult-to-access, poorly equipped, and poorly staffed schools, the population has few immediate prospects for skilled employment (World Bank 2003; Hall and Patrinos 2006; Zezza et al. 2007). Unless substantial government or non-governmental organization effort is put into training these displaced workers to take the new jobs created in the agribusinesses, or to take new jobs in urban areas, this displacement will increase the size of the urban poor in developing countries as displaced rural poor migrate to cities and cannot compete for good jobs (Massey 1988).

The land use transformation that would go along with increased production of biofuels, if on prime agricultural land, will also have a direct impact on food security (as well as on greenhouse gas emissions, see Fargione et al. 2008 and Searchinger et al. 2008 for estimates of the area of new agricultural land conversion necessary to replace displaced food production). The displacement of small farmers will lessen food security for both the displaced farmers and those connected to them through networks of social exchange. Rural subsistence crops provide food security both for the small-holders who grow them and for out-migrants from the farms (Frankenberg et al. 2003; Macours and Swinnen 2006). While out-migrants do not return to the farm to eat every day, or even every season, the food produced on the farm is insurance against starvation or undernourishment resulting from job loss or income shortfalls in migration destinations (de Haan 1999; World Bank 2008). Because of the same poor functioning of economic markets, in this case insurance markets, families self-insure by diversifying activities across sectors (Stark 1991). The food produced on the farm insures the urban migrant while the income of the urban worker insures the farm against crop failure. This form of non-market insurance would be lost were the farmers displaced into the urban sector, where their chance of income shortfall would be positively correlated with the chance of family member's income shortfall.

In addition to these impacts of land use transformation, there will be both direct and indirect impacts of biofuels production through price effects (dealt with more completely in chapter 11, Bento 2009). Directly, the large-scale production of ethanol and biodiesel has the potential to keep personal fuel costs lower than they would otherwise be. This potential will only be realized if biofuels can become more competitive through lowered production costs or increased subsidies. Without such improvements in the cost of biofuels, the price point at which they will cost the same as petroleum-based fuels will be higher, leading to a higher equilibrium price for the consumer. This effect will also be uneven internationally, because of variation in import policy (tariffs) that makes biofuels more expensive in some countries, and will ultimately be limited by the proportion of biofuel tolerated by the world auto-motive fleet. With (relatively low) limitations on the total amount of biofuels that can be blended with gasoline or diesel for engines to tolerate the fuel, biofuels can only replace a small proportion of the world's liquid fuel consumption. Improvements in productivity will therefore not have the dramatic price effects that they might if biofuels and petroleum-based fuels were fully substitutable.

Finally, increased biofuels production will have impacts on food prices as long as the fuels are being made from food crops or the biofuels feedstocks are being grown on agriculturally productive land (IFPRI 2006; OECD-FAO 2007; FAO 2008). Current estimates suggest that a meaningful portion of recent food price increases are due to competition for crops from biofuel processing, though other causes probably account for more than half of price increases (FAO 2008). This effect will be short-lived if the transition to cellulosic biofuels happens in short order, and if producers are able to grow feedstocks primarily on land that is marginal for agriculture (leaving aside the environmental implications of that absolute increase in the area under cultivation for the moment). Technology does not currently permit this, and large-scale investments are now focusing on current (food and biofuels) feedstocks. A price increase on a basic food commodity will have the largest impacts on the most vulnerable segments of the population worldwide because these groups spend a much higher proportion of their income on food (FAO 2008).

Looking at all impacts together, we can think broadly about the positives and negatives of large-scale biofuel production for the developing world and the developed world. For the developed world, agile and well-capitalized agribusinesses operating in well-functioning economic markets (available and affordable credit, insurance and futures) will be able to take advantage of subsidies, protectionism and rising international prices for biofuels feedstocks. Consumers will benefit from reduced (relative to what they would have been) fuel prices and slightly lower consumer goods prices (because of lower fuel prices), but will pay slightly higher prices for food and taxpayers will subsidize the lower fuel prices. Overall, these changes will cost consumers and could have negative effects on the well-being of disadvantaged segments of the population. In the developing world, the impacts will be virtually uniformly negative. The most capitalized producers will be able to compete on the international market and make money selling biofuels feedstocks or processed biofuels, but at the cost of displacing small farmers, increasing prices for food, and decreasing food security. A focus on biofuels feedstocks production in developing countries has the potential to bring about another in a series of boom and bust cycles, one which many countries are ill-prepared to weather.

Small-scale production for local consumption has a different set of potential positive and negative impacts, with a more positive overall balance. While production for a national or international market entails high levels of technology, capitalization, and usually integration of production and processing, in order to ensure profitability, local production requires much less of any of those. Small amounts of biofuels feedstocks on small (and possible currently marginal for agriculture) pieces of land can provide easily processed and adequate fuels for local consumption. Negative impacts are largely absent as long as this production does not compete with food production for land. Small-scale production avoids other negative impacts of large-scale production by not advantaging the already advantaged large companies or wealthy land-owners, and having no impact on food prices. It has the potential to have positive impacts through bringing energy to locations where current infrastructure is lacking. This is dependent to a certain extent on technology transfer from the developed world, especially Europe, to rural areas of the developing world where such energy provision would have the largest

impacts. This technology transfer should be straightforward, as the technology is inexpensive and well-understood. We must be careful, however, not to overstate the value of such programs; bringing locally produced electricity to some small towns and villages will not substitute for other development programs to bring to those communities and their residents the benefits of economic development. It instead can facilitate health and education investments by providing stable and low-cost energy.

Conclusion

While there is the potential to provide more energy self-sufficiency for many tropical countries through the production of biofuels, the costs of large-scale production are high in both monetary and social terms. Investment in biofuels means less investment in other renewable and local energy sources, and many current biofuels feedstocks and processing technologies have a limited time horizon for competing with other energy generation methods. In addition, large-scale production of biofuels and feedstocks is likely to exacerbate existing domestic and international inequalities, do little for income or employment, and lead to a further concentration of landholdings and transformation of the rural landscape.

In contrast, small-scale production of biofuels can provide local energy security or access and, if managed properly, can have no adverse impacts on food production. If development programs target small communities for the local production of electricity using biofuels, intra-country inequalities in lived experience can be reduced. Similarly, if access by an entire community is ensured, programs can improve intra-community equality as well. Europe has examples of such small-scale production that is sustainable in both social and environ-mental terms that could be adapted for the development of similar programs using varied feedstocks and management practices in communities in Africa, Asia and Latin America. For example, eco-friendly energy farms have been promoted in Norway, and other Nordic countries, where small farms produce their own energy (mostly heat and biodiesel) by using biofuels produced locally. This model may be applied in local communities in some developing countries to satisfy their local energy needs.

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