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Biofuels: Potentials, Problems & Solutions

Richard L. Ottinger
Elisabeth Haub School of Law at Pace University

ARTICLES

BIOFUELS - POTENTIAL, PROBLEMS & SOLUTIONS

*Honorable Richard L. Ottinger**

I. INTRODUCTION

Biofuels[1] have the exciting potential of mitigating the grave threats of global warming, reducing the world's dependence on imported oil from insecure sources and of reducing the skyrocketing costs of oil that are threatening to undermine the world's economies and devastating the people in non-oil producing, developing countries.[2] For

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* Richard Ottinger, Dean Emeritus at Pace University School of Law. Dean Ottinger went to Pace when he retired from Congress in 1984. As a professor he taught in the environmental law program. As co-director of the Center for Environmental Legal Studies, he started an Energy Project, which raises $900,000 per year, advocating utility investment in conservation and renewable energy resources. In his 16 years as a member of the United States House of Representatives, he authored a substantial body of energy and environmental laws. As chairman of the Energy Conservation and Power Subcommittee, Energy & Commerce Committee, he was instrumental in adopting key energy and environmental legislation. Dean Ottinger was a founding staff member of the Peace Corps, serving it during 1961-1964. He was appointed Dean in December 1994. He retired as Dean in July 1999, and has his office at the Energy Project.

1. As used here, the term, "biofuels" includes only liquid and solid fuels derived from biological feedstocks. It includes ethanol and biodiesel, but does not include biogas. First generation currently commercially produced biofuels are derived primarily from agricultural feedstocks. Second generation biofuels are projected to be derived from cellulosic materials such as switchgrass and agricultural wastes.

2. *It is worth noting,* "Of the world's 50 poorest countries, 38 are net importers of petroleum and 25 import all their petroleum requirements. Recent oil price increases have had devastating effects on many of the world's poor countries, some of which now spend as much as six times as much on fuel as they do on health. Others spend twice the money on fuels as on poverty reduction. And in still others, the foreign exchange drain from higher oil prices is five times the gain from recent debt relief." U.N. Energy, *Sustainable Bioenergy: A Framework for*

the people in these countries, biofuel offer a promising road to enhance development since they use local materials, can provide local jobs, and do not require the import of expensive equipment and expertise.

Brazil has been the pioneer in the use of biofuel, allowing it to eliminate its oil imports, becoming completely energy independent, and demonstrating to the world the potential benefits of substitution of biofuels for fossil fuels. Indeed, inspired by Brazil's example, the United States in recent years has developed a strong biofuel industry, albeit from the disadvantageous feedstock of corn. The United States has just created an alliance with Brazil to make major purchases of its biofuels. The European Union and countries around the world are rapidly developing their own biofuel potentials.

But Brazil and its replicators have to exercise great care in designing and implementing biofuel programs. The environmental and social risks of biofuel development, also demonstrated in Brazil, are great and could well undermine all of the potential advantages if not done right.

These concerns are particularly pertinent to Brazil if its biofuel program meets current projections for biofuel exports to the United States and other countries. Brazil's ethanol-industry estimates that the extent of land devoted to sugarcane cultivation, 13.6 million acres in 2006-2007, will reach 20.5 million acres by the 2012-2013 harvests,[3] an area bigger than the very large U.S. State of Maine. "Brazil produced 65% of world's ethanol exports [in 2006], shipping 898 million gallons, or 31% more than in 2005."[4] "Processors estimate the country's annual ethanol exports will more than double to reach 1.85 billion gallons ... by 2013."[5] This vast and rapid expansion will put tremendous pressure on Brazil's pasture land, presently the primary source of its biofuel production, and on its invaluable forest lands and its Amazon basin treasure chest of biodiversity.

Decision Makers, 39, U.N. Doc. TC/D/A/1094E/1/4.07/2000 (Apr. 2007) [hereinafter UN-Energy].

3. Michael Kepp, *Brazil's Ethanol-Fuel Industry Going Global*, ECO AMERICAS, Mar. 2007, at 7.

4. *Id.*

5. *Id.*

II. MAJOR BIOFUELS' RISKS THAT MUST BE ADDRESSED

A. Food Impacts

Selection of crops or use of land for biofuel production that will jeopardize food supplies or increase its price should be avoided, particularly because of the dire impact on the people in poor, developing countries. When farmers can obtain greater profits by using their land for biofuels than for food, the risk becomes apparent. Price increases already have occurred in biofuel feedstock markets for sugar, corn, rapeseed oil, palm oil and soybeans.[6] There is great international concern that the expanded use of first generation biofuel feedstocks of crops and land used for food production will have serious adverse effects on food supplies.[7]

B. Water Impacts

Depletion and contamination of water supplies can have profound effects on human and animal health. Many biofuel crops require large amounts of water for their cultivation, which is particularly harmful in areas where water is scarce. Experts cite the increased danger of spills of ethanol and vinhoto, a liquid byproduct of ethanol production used to fertilize and irrigate sugarcane plantations. Vinhoto spills have contaminated rivers, occasionally causing large fish kills. A Vinhoto spill in Sao Paulo state in 2003 killed off the fish population along a 95-mile stretch of the Rio Grande River.[8]

C. Forest Impacts

The cutting of forests in order to create land available for the growing of biofuel crops would have grave impacts on greenhouse gas reduction as well as on biodiversity, land erosion, and the availability of wood for housing and other local necessities.[9] In the sugarcane area of Pernambuco province only 2.5% of the original forest of the sugarcane region remains, although it should be noted that this occurred over a number of years as a result of sugar cane development both before and after the development of biofuels. "In order to

6. UN-Energy, *supra* note 2, at 34.
7. *Id.* at 31.
8. *See* discussion, *supra* note 2.
9. *See* UN-Energy, *supra* note 2, at 43.

satisfy future global demand, Brazil will need to clear an additional 148 million acres of forest, according to Eric Holt-Gimenez of the NGO FoodFirst."[10]

D. Monoculture Impacts

Monoculture biofuel cultivation would degrade the productivity of affected land. The monoculture of sugarcane could lead to massive environmental destruction. To protect against such destruction, the State of São Paulo has adopted and enforced legislation for the conservation of native and riparian forests, together with crop rotation requiring that 20% of the area be diverted from sugar production every year for the planting of other crops before returning to sugarcane – so crops like peanuts, beans and others are used in 20% of the total area every year.[11]

E. Genetic & Invasive Species Impacts

Other environmental risks include the use of genetically altered crops to increase biofuel production, with the danger that the genetic alterations will migrate to the detriment of other agricultural crops, and that the introduction of invasive species through feedstock cultivation could also harm existing agriculture.[12]

F. Impacts of Second Generation Biofuels

The introduction of second-generation biofuels that are derived from non-food feedstocks such as switchgrass and agricultural waste have their own environmental problems. Switchgrass can be valuable for flood protection and the prevention of erosion. Agricultural waste removed from the land can result in the deterioration of the land's productivity, which could possibly be remedied by crop rotation. [13] They also might create incentives to plow up rangelands and

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10. Isabella Kenfield, *Is Ethanol the Solution or the Problem?*, ENVIROHEALTH, Mar. 12, 2007, *available at* http://www.alternet.org/environment/49138.

11. UN-Energy, *supra* note 2, at 44, 46.

12. Jeffrey McNeeley, GOVERNING THE RISKS AND OPPORTUNITIES OF BIOENERGY: RISKS AND OPPORTUNITIES OF SIGNIFICANTLY INCREASING THE PRODUCTION OF BIOMASS ENERGY 6 (May 24, 2007), *available at* http://www.irgc.org/IMG/pdf/IRGC_ConceptNote_Bioenergy_1408.pdf.

13. UN-Energy, *supra* note 2, at 44.

savannas to plant from non-food feedstocks and displace cereals and subsistence crops.[14]

G. Concentration

A serious socio-economic problem with the expansion of biofuel that needs addressing is the increasing concentration of sugarcane lands and the ownership by a few large landowners in Brazil and many other developing countries, combined with the takeover of land for biofuel cultivation by large international agribusinesses. The uncertainty of individual land ownership eases this take-over of the land of small rural farmers that now harvest most of the sugarcane.[15] These large agribusinesses, local and international, have little respect for the environment and are removing small farmers from their lands, throwing them into poverty; they are mechanizing the harvesting of sugarcane, thus throwing local labor out of their jobs and eliminating the prospect of local economic growth from biofuel cultivation; they are paying substandard wages and siphoning off most of the profits from biofuel production and processing. They threaten to destroy the established way of life and the livelihoods of many thousands of the local populations.[16]

> "A recent declaration from the Forum of Resistance to Agribusinesses, a consortium of non-governmental organizations (NGOS) through South America, states, 'The implementation of the model of production and export of biofuels represents a grave threat to our region, our natural resources, and the sovereignty of our people.'"[17]

The Forum states that with respect to the intrusion of international agribusiness, "[t]he era of biofuels will reproduce and legitimize the logic of the occupation of rural areas by multinational agribusinesses, and perpetuate the colonial project to subvert ecosystems and people to the service of the production and maintenance of a lifestyle

14. *Id.* at 24, 33.

15. *Id.* at 4, 7-8.

16. *Id.* at 4, 24. "The transition to liquid biofuels can be especially harmful to farmers who do not own their own land... At their best, liquid biofuel program[s] can enrich farmers by helping to add value to their products. But at their worst biofuel program[s] can result in concentration of ownership that could drive the world's poorest farmers off their land and into deeper poverty." *Id.* at 24.

17. Kenfield, *supra* note 10 at 2.

in other societies."[18] And the local consequence, it states, is that "[a]gro-export [will generate] vast amounts of wealth for a few Brazilians, and exploitation and poverty for many others. Brazil's high rate of income inequity is inseparable from the fact that it also has one of the most unequal rates of land distribution. The sugar industry is stated to be a classic example of Brazil's land and income inequality."[19]

According to Mari Aperecido de Morães Silva at the State University of Sao Paulo, "Brazil has the lowest cost of production in the world because of the industry's dependence on labor exploitation, including massive slave labor, and its refusal to implement environmental regulations."[20]

According to Marluce Melo of the Pastoral Land Commission (CPT) in the northern Brazilian city of Recife, Pernambuco, "In the last two decades, practically all of the small properties in the region have disappeared, with ... the expulsion of the workers... in this same period, about 150,000 jobs were lost when 18 companies closed and lands and sugarcane processing was concentrated in the 25 sugar mills and distilleries that remain...This has provoked a generalized 'slumming' of the workers, which has aggravated hunger."[21]

These domestic inequities and foreign agribusiness threats require redress. Certainly the foreign agribusinesses should be taxed sufficiently so that local communities and their people will benefit from the exploitation of their resources.

To address some of these concerns, "Brazil recently introduced a 'social biodiesel' program focused on small rural cooperatives which is targeted specifically at poverty reduction."[22]

III. OTHER RISKS

The United States and Europe in particular have accompanied domestic subsidies for the production of biofuels with tariffs on biofuel

18. *Id.*
19. *Id.*
20. *Id.* at 3.
21. *Id.* at 4. This phenomenon was only partly attributable to the introduction of biofuels, however.
22. UN Energy, *supra* note 2, at 35.

imports to protect local farmers. These tariff barriers impede the development of biofuels in developing countries.[23]

Financing of biofuel production, processing, marketing, the training of personnel and the education of farmers and the public on the costs and benefits of biofuel in developing countries is a major challenge. Temporary subsidies are required to make biofuels affordable to poor populations, as are micro-financing, cooperative purchasing and other market interventions.

Electric utilities and oil company owned fueling stations often resist the marketing of biofuels, requiring regulatory provisions.[24]

The failure to perform life-cycle assessments of the costs and benefits of biofuel projects with full result disclosure and to provide for public participation in biofuel planning and implementation decisions jeopardizes the success of biofuel projects.[25]

IV. SOLUTIONS

The feasibility of legally binding, enforceable standards should be considered for the cultivation and processing of biofuel with respect to the risks listed above – i.e. the protection of food and water supplies; access to land; biodiversity conservation; treatment of labor; technology transfer; etc. This should include consideration of the potential to incorporate such standards into international law.[26]

Meanwhile, voluntary guidelines, best practice standards and credible certification/labeling schemes for different biofuel feedstocks and production practices should be quickly developed and promoted,[27] such as those being formulated by the Roundtable for Sustainable Biofuels sponsored by the Ecole Polytechnique Federale de Lausanne, the Dutch Government and its Cramer Commission,

23. *Id.* at 40. It is ironic that there is free international trade in oil while trade in biofuels is severely restricted.

24. *Id.* at 18.

25. "[O]ne thing is clear: the more involved farmers are in the production, processing, and use of biofuels, the more likely they are to share in the benefits." *Id.* at 24.

26. "International standards and certification/assurance systems are critical to ensure that bioenergy is produced using the most sustainable methods possible." *Id.* at 46.

27. *Id.* at 49.

the UK, and FAO, UN-Energy, UNEP, UNIDO, UNCTAD and the WTO, among others.[28]

Biofuel production that jeopardizes the price and supply of food and crops essential for animal feed and local construction materials for the people of developing countries should not be permitted.[29]

Exporters and Importers of biofuel should be informed about and required to respect all environmental and labor laws and relevant local, national and international biofuel standards, guidelines and/or certifications. Tariffs restricting the purchase of biofuel from developing countries should be eliminated.

The introduction of foreign agribusinesses in developing countries should be accompanied by measures to assure their observation of national and local environmental and labor protections, and where these do not exist, of international requirements. They should be required to pay taxes sufficient to compensate developing country governments and communities for the exploitation of their resources.

Provision should be made for formal social and environmental assessments of biofuel development projects, with thorough studies of all the life-cycle costs including externalities, impacts and risks enumerated above, full public disclosure, public hearings, and community involvement at all stages of development.[30] Such provisions should account for the relative magnitude of anticipated impacts and differences in regulatory capacity. Comparison should be made with the experiences of the introduction of biofuels in other countries, both their successes and failures.

Provision of education and training to biomass producers, managers, policy-makers, farmers and the public is essential. Agricultural extension services can play an important role.

Measures should be adopted to prevent the deterioration of land used for biofuels through monoculture utilization. "A variety of management practices, such as the use of bio-char, intercropping, crop rotation, double cropping and conservation tillage can reduce

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28. *Id.* at 47, 49, 55.

29. The importance of such a requirement is illustrated by the fact that: "According to FAO data for 2001-02, there are approximately 854 million undernourished people in the world...Hunger claims up to 25,000 lives every day, two thirds of them children under the age of five, and it is currently the leading threat to global heath, killing more people than AIDS, malaria, and tuberculosis combined." *Id.* at 32. "Price increases have already occurred in major biofuel feedstock markets, for example, sugar, maize, rapeseed oil, palm oil and soybean." *Id.*

30. "Thus the entire bioenergy chain needs to be analyzed in order to identify and overcome actual and/or potential barriers and inefficiencies." *Id* at 25.

soil erosion, improve soil quality, reduce water consumption, and reduce susceptibility of crops to pests and disease – thereby reducing the need for chemical fertilizers and pesticides. It is important to note that...these benefits are gained only if sufficient soil cover, mostly from crop residues, is left on the ground."[31]

It is essential that forests and other habitats essential for biodiversity be protected.

Measures should be adopted to protect the land rights and the ways of life of existing farmers and ranchers.

Regulations must be adopted to protect water supplies and to protect against water and air pollution from the growing and processing of biofuel feedstocks. Feedstocks such as jatropha and sweet sorghum that require minimum water, fertilizers and pesticides should be promoted.

Electric utilities should be required to remove barriers to use of biofuel, and oil companies should be prohibited from banning sale of biofuel at their company-owned service stations.

Further research should be urgently pursued on second generation biofuel technologies and feedstocks that do not compete with food production as well as on regulatory provisions to prevent degradation of the land from their utilization.[32] Investment should be promoted on those technologies that are already established. Particular attention should be paid to "cascading" biomass, using biomass materials for various uses and recycling the wastes for energy.[33]

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31. *Id.* at 44. "Ultimately the problems associated with bioenergy land use (particularly of virgin lands), including deforestation, biodiversity loss, soil erosion and nutrient leaching, will be the most vexing and deserve the most attention." *Id.*

32. "Much research remains to be done to determine which crop and crop species are most suitable for different liquid biofuel applications, soil types, farming systems, and cultivation contexts. Key factors to be considered when electing feedstock include economic viability, suitability for different biofuel applications, yield per hectare, input requirements, yield increase potential, crop versatility, drought and pest resistance potential, competing uses, price volatility, and opportunity costs." *Id.*

33. "In the future, cascading biomass over time ... will maximize the CO2 mitigation potential of biomass resources... Studies of the climate and economic impacts of cascading biomass have concluded that this practice could provide CO2 benefits of up to a factor of five compared to biomass used for energy alone." *Id.* And, of course, there would be concomitant energy and cost savings.

Combined heat and power (cogeneration) should be considered to facilitate maximum fuel utilization and the minimization of costs.[34]

In rural areas, consideration should be made for the use of cooperatives and other forms of collaboration to permit projects of viable scale.

Temporary and strictly targeted subsidies to promote the introduction of biofuels that meet established standards, guidelines or certification should be promoted, along with the possibility of funding them by redirecting existing subsidies for fossil fuels. All subsidies should be transparent and linked to the economic development they are designed to promote.

Availability of financial and technical assistance from international agencies and the private sector should be explored. Assistance on the sustainability of biofuels is obtainable from The International Bioenergy Partnership (IBEP), The Global Bioenergy Partnership (GBEP), The Biofuels initiative of UNCTAD, and The Global Village Energy Partnership (GVEP) that also provides financial support, capacity building and technical assistance to small bioenergy projects.

V. CONCLUSION

The potential is great for the use of biofuels to relieve world dependence on scarce and uncertain supplies of oil[35] and to reduce the emissions of greenhouse gasses. Particularly in developing countries where national and individual resources are too low for the introduction of modern energy resources essential for their development, biofuels have the potential to provide energy from local crops, creating jobs and alleviating poverty.[36]

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34. "Current research concludes that using biomass for combined heat and power (CHP) rather than for transport fuels or other uses, is the best option for reducing GHG emissions in the next decade – and also one of the cheapest." *Id.* at 49.

35. "Diversifying global fuel supplies could have beneficial effects on the global oil market. By some estimates, rising production of biofuels could meet most and perhaps all of the growth in liquid fuel demand in the next few decades..." *Id.* at 39.

36. "Excellent examples of energy self-sufficiency and even selling power to the grid come from the sugar industries of Australia, Brazil, Cuba, Guatemala, India, Mauritius and several other countries." *Id.* at p. 15

None of these potentials will be realized, however, if standards are not adopted to provide against the substitution of fuel for food crops, the endangerment of clean water supplies, the deterioration of the land and the inequitable distribution of profits from biofuel production. Introduction of biofuel is proceeding so rapidly, however, that the environmental and social risks of biofuel production are too often being ignored. Without careful and thorough assessment and regulation, the promise of biofuels may well be lost. [37]

37. A reviewer declares that: "The paper is a one-sided polemic" in favor of biofuels, asserting that "several studies show that the pressures of subsidies for biofuels encourage systems that negate the potential benefits of biofuels." RICHARD DOORNBOSCH & RONALD STEENBLIK, BIOFUELS: IS THE CURE WORSE THAN THE DISEASE?, Roundtable on Sustainable Development, Paris, OECD 11-12 September 2007. Actually, the paper devotes far more attention to the environmental and social risks of biofuels that it does to the potential benefits, and fully agrees with the reviewer that the rush towards massive biofuels production without adequate research or adoption of measures addressing the risks pose the danger that the potential benefits will be obscured. The reviewer also asserts that the paper "ignores the fact that legal enforcement of such standards is practically impossible in most of Brazil," but in fact Brazil is adopting and enforcing standards addressing most of the risks, for instance prohibiting the cutting of forests and invasion of the Amazon for biofuels production, protecting the small farmers, and requiring that 20% of all sugar plantations be planted each year in non-sugar crops to prevent deterioration of the soil. *Id.* The paper does advocate the potential of biofuels for developing countries, with proper environmental and social protections, because biofuels may be the only energy resource that is affordable for poor countries and areas to acquire the energy they need to promote their economic development. In fact, Brazil has succeeded through its biofuels program in becoming completely independent of oil imports. This potential is confirmed in the most comprehensive biofuels study, *Sustainable Biofuels: A Framework for Decisionmakers*, in finding, with the same qualifications as in the paper, that "The development of new bioenergy industries could provide clean energy services to millions of people who currently lack them, while generating income and creating jobs in poorer areas of the world." UN-Energy, *supra* note 2, at 4.