Is the environment paying the price for renewable biofuels?

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Biography

ZeynepZaimoglu has earned her PhD in the field of Agricultural Structures and Irrigation at Cukurova University, Adana, Turkey. She has published, in English and Turkish languages, of more than 40 international and national articles as well as two educational textbooks. Her expertise includes watershed management, water resources development, constructed wetlands and water treatment in constructed wetlands, soil and ground water pollution and renewable energy and climate change issues. She is an ERA-NET on Sustainable Animal Production evaluation committee. She is currently Professor at Cukurova University since 2013 and engaged extensively in teaching and leading research projects.

Current energy policies address environmental issues including environmentally friendly technologies to increase energy supplies, usage of sustainable energy and encourage cleaner, more efficient energy use, with special attention to air pollution, greenhouse effect, global warming, and climate change. The biofuel policy aims to promote the use of fuels made from biomass,as well as other renewable fuels in transport and to produce electricity. Although biofuels do not have the potential to overcome the escalating oil problem, for some people it is the forerunner of a new and environment-friendly life style. This apprehension is partly true because, like everything else, biofuels have their advantages and disadvantages. Therefore, before presenting new policies regarding biofuels, their effects should be meticulously and carefully examined. Biofuels have negative effects on food safety, in two ways. First and the most important of these effects is biofuel sector's high demand of agricultural produce, whichwould result in shortage of global food supply. Secondly, it is understood that biofuel sector's agricultural produce demand play an important role in the rise of food prices, and it poses a threat to food availability and accessibility. Concerning biofuel and agricultural environment interaction, increased land usage and intense agricultural production of biofuels cause erosion and pollution. While increased land usage and intense agricultural production causes the organic and inorganic components to be depleted within the soil and therefore the minerals become deficient, agricultural processes that use fertilizers, pesticides and similar chemicals cause the soil to be polluted faster. According to the data acquired, more than 20 million hectares of agricultural land worldwide is marked as areas for biofuel raw material production. This leads to additional land use and intensive agricultural production, which also has negative effects on soil quality. Moreover, agricultural production needs water. Water is an important a part of agricultural production, and as an environmental concern, it faces depletion. Additional agricultural processes to produce especially sugar cane, sugar beet, palm oil and corn for biofuel production, which consume more water compared to other agricultural processes, result in excessive amount of water consumption, which will result in water scarcity. Additionally, in the process of biofuel production, agricultural products are washed and dried using vapor, which also results in excessive amount of water requirement, which also results in water scarcity problem to deepen.

There is rising scepticism about the potential positive environmental impacts of first generation biofuels. Aside from findings about their role within the recent food price crisis, doubts are raised about their real contribution to global climate change mitigation. This debate happens at a time when government commitments for biofuel production have even strengthened for the last couple of years. In the United States (US), the Energy Independence and Security Act signed in 2007 set an objective of 36 billion gallons of production in 2022. In the European Union (EU), the directive on the promotion of the use of energy from renewable sources, endorsed in December 2008 by the European Parliament, confirmed the objective of a ten document of bioenergy in EU transportation by 2020

Indeed, the environmental impacts of biofuels rely heavily on the type of pathway used to produce ethanol and biodiesel. First generation biofuels, supported usual food crop transformation, are land demanding and need intensive use of farming input. More advanced production technologies (cellulosic ethanol, Fischer-Tropsch diesel, etc) are expected to be more beneficial to the environment but most of them are still at the development stage. Because recent life cycle assessments (LCA) show high variation in the benefits of the different production pathways (Zah et al., 2008; Mortimer et al., 2008), the choice of biofuel feedstock is particularly important to achieve a sustainable policy. Some production pathways, such as for US corn ethanol, have indeed been criticized for their negative environmental impacts because of the high emissions of some ethanol refineries

However, apart from the direct emissions generated by crop production, transformation and distribution, a more particular concern has emerged with the question of indirect land use impacts. Indeed, several studies recently argued that the land use changes thanks to biofuels production would cause negative overall impacts on the environment (Searchinger et al., 2008; Fargione et al., 2008). Growing biofuels crops would induce diversion of other crops dedicated to food and feed needs. The relocation of production could increase deforestation and convey about significant new volumes of carbon within the atmosphere under more intensive agricultural management on previously uncultivated lands

Representing all these various dimensions is a complex task and the development of analytic tools to properly address such questions is at its early stage. Research requires an integrated framework to require under consideration both agricultural and energy markets and their interactions, also as emissions impact and global climate change feedback. For this purpose, computable general equilibrium models are particularly appropriate as they explicitly incorporate the economic linkages between sectors. Several exercises are conducted using such models to represent biofuels policy effects (Banse et al, 2007; Gurgel et al., 2007; Hertelet al., 2008).

The representation of land use and production possibilities remains a major challenge for studying land use change effects. Most computable general equilibrium models rely on a land rent approach (describing land as land rent uniquely and not accounting for physical aspects of land, notably in terms of expansion) and don't appropriately model land without economic use. Several sorts of substitution effects for economic use of land have however been tested. Darwin et al. (2002) proposed an approach relying on Constant Elasticity of Transformation (CET) functions to represent substitution among crop sectors. The GTAP-PEM model (OECD, 2003) also follows this approach; it relies on a review of the literature concerning estimated elasticities of substitution for OECD countries (Salhofer, 2000; Abler, 2000). Golub et al. (2006, 2007) also implement this framework but they distinguish land substitution between different zones within each country using data on the agro-ecological characteristics of land to more precisely represent the potential reallocation of land.

The impacts of biofuels expansion on non-economic land are not incorporated in standard Computable General Equilibrium (CGE) models. More advanced agricultural versions of such models have developed approaches to represent expansion possibilities. For example, the LINKAGE model from the World Bank incorporates some possible land expansion (van der Mensbrugghe, 2005): land endowment can vary according to aggregated land price, under an iso-elastic function or a logistic function with a maximum possible land endowment. Tabeau et al. (2006) study the implementation of a land supply curve based on marginal productivity information. This allows them to more explicitly represent asymptotic limits to land expansion and to account for decreasing returns to scale.

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