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Environmental Challenges with the Production of Biofuels in India and its Implications for Food Security: A Preliminary Review

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Abstract
In the recent time production and use of biofuel has increased globally due to soaring of fossil fuel price and to secure sustainable energy supply for the future. Biofuels can help reduce global warming by curbing green house gas emission and create employment opportunity and increased income for the rural poor in many developing countries. Bioenergy is the subject of increasing attention around the world and represents a controversial issue. The rise of commodities prices, the negative impact on food security, and climate change represent different challenges to be overcome before the full potential of bioenergy can be realized. The ever-increasing population in the developing and less developed countries is also a major constraint. With climate changes in future, natural calamities (drought, flood, forest fire, fluctuation in rainfall pattern, etc.) will be a serious threat to human survival by way of availability of foods. Moreover, if food plants (cultivated and wild species) are utilized for the production of renewable liquid biofuel, there would be enormous changes in agro ecosystems, destabilizing the natural balance and leading to lower productivity of food crops.

Key words: *Biofuels, Food Securtiy, Environmental Challenges, Bioenergy, Climate changes*

Introduction

In the recent time production and use of biofuel has increased globally due to soaring of fossil fuel price and to secure sustainable energy supply for the future. Biofuels can help reduce global warming by curbing green house gas emission and create employment opportunity and increased income for the rural poor in many developing countries. At the same time skeptics argue that benefits may be offset by increased food insecurity for the billions of hungry people in poor country and may create serious environmental problems.

Biofuels, which are made from agricultural crops and other plants e.g. corn (maize), palm oil, sugar cane, *Jathropa* (a biofuel yielding plant) , etc. have been seen by many as a cleaner and cheaper way to meet the world's soaring energy needs than with greenhouse gas emitting conventional fossil fuels. The most common use for biofuels is automotive transport. Biofuel can be produced from any biological carbon source. The most common by far is photosynthetic plants that capture solar energy. Many different plants and plant-derived materials are used for biofuel manufacture. In the preparation of biofuel, it is usually grow agricultural crops like sugarcane, sugar beet, maize etc. and then converted it into ethanol by yeast fermentation. It can also done by producing oil yielding plants such as *Jatropha*, *Pongam* seed or rape seed and then oil are heated to reduce their viscosity and they can be directly burn in the diesel engine.

Conventional fossil fuels still account for more than 95 percent of the global transportation fuel market, biofuel production is gradually increasing 15 percent per year, a rate over ten times that of fossil fuel". Brazil is the world's largest producer of sugar-based ethanol, producing about 16 billion litres a year and US, the world's biggest oil user, is the second-largest biofuel producer after Brazil. Brazil plans to increase biofuels share from 37% to about 60% by 2020. According to recent UN-Energy report on "Sustainable Bioenergy", global biofuels production has doubled in the last five years and will likely double again in the next four years. Some of the countries enacted new pro-biofuel policies in recent years are: Australia, Canada, China, India, Indonesia, South Africa, Thailand etc. In China, the government is making E10 (a fuel mixture of 10% ethanol and 90% gasoline) blends mandatory in five provinces that account for 16% of the nation's passenger cars. In Southeast Asia, Thailand has mandated an ambitious 10% ethanol mix in gasoline starting in 2007. India is extending plantations of *Jatropha* and the Indian sugar ethanol program sets a target of 5% bioethanol incorporation into transport fuel.

However, not everyone, particularly the developing country is enthusiastic about the booming of biofuel production. Critics are highlighting the potential environmental and social costs of biofuels, including the consequences of increased food insecurity on the billions of poor of the developing country.

Impacts on food security

Food security relates more to people's access to food rather than whether there is enough food available to feed the world. Overall, food security will be affected differently for different people. There are four factors that encompass the issue of food security:

• **Availability** of food relates to agricultural production of food crops. This can be threatened by a diversion of food production to biofuels production, though this hinges on factors such as the crop selection, farming techniques, agricultural yields and the development of new technologies. In some instances, biofuels markets may stimulate new investment in agriculture research and infrastructure development, possibly leading to improved food production.

• **Access** to food primarily refers people's ability to afford and overcome barriers such as remoteness and social marginalization. Food prices and income level are the main factor related to access. Food prices can increase due to resource competition. Alternatively, farmers could benefit from these higher prices, and bioenergy growth could revitalize agriculture and create employment opportunities.

• **Stability** of food refers to events that may lead to populations losing access to food such as conflict, loss of resources, market failure, environmental degradation and disasters. The diversion of food crops to biofuels could indirectly increase the volatility of food prices and will particularly impact vulnerable countries if their food import dependency increases to cover the food deficit.

• **Utilization** of food refers to people's ability to absorb the nutrients within the food. Biofuels can affect people's health if its production competes for water. Alternatively, small scale biofuels production may reduce the reliance on other traditional fuels such as wood, which would provide more time for other activities, particularly for women and children, and reduce the health risk of using traditional fuels.

Wide around 852 million people are without enough food to eat on a regular basis and two billion, face intermittent food insecurity (SOFI 2004). Progress in reducing poverty and hunger has been limited in many developing countries in recent years despite the development efforts. International Food Policy Research Institute (IFPRI) projections suggest that, the number of food-insecure people in the world would rise by over 16 million for every percentage increase in the real prices of staple foods. That means that 1.2 billion people could be chronically hungry by 2025.

The IFPRI, project that given continued high oil prices, *the rapid increase in global biofuel production will push global corn prices up by 20 percent by 2010 and 41 percent by 2020*. "The prices of oilseeds, including soybeans, rapeseeds, and sunflower seeds, are projected to rise by 26 percent by 2010 and 76 percent by 2020, and wheat prices by 11 percent by 2010 and 30 percent by 2020". In the poorest parts of sub-Saharan Africa, Asia, and Latin America, where cassava is a staple food, its price is expected to increase by 33 percent by 2010 and 135 percent by 2020. The projected price increases may be mitigated if crop yields increase substantially or ethanol production based on other raw materials (such as trees and grasses) becomes commercially viable. But unless biofuel policies change significantly, neither development is likely. The production of cassava-based ethanol may pose an especially grave threat to the food security of the world's poor... *Several studies by economists at the World Bank and elsewhere suggest that caloric consumption among the world's poor declines by about half of one percent whenever the average prices of all major staples food increase by one percent. When one staple food becomes more expensive, people try to replace it with a cheaper one, but if the prices of nearly all staples go up, they are left with no alternative*.

Many of the crops currently used for producing biofuel require high-quality agricultural land and significant inputs of fertilizers, pesticides and water. In most cases, biofuels crops are grown on the food crop land. "*Jatropha*" is being pushed as one of the new smart crops for African small farmers to produce fuel, and the impact is already being felt around the continent. In Tanzania, thousands of farmers growing rice and maize are already being evicted from fertile areas of land with good access to water, for biofuel sugar cane and *Jatropha* plantations on newly privatised land. This topic is internationally controversial, with good-and-valid arguments on both sides of the ongoing debate. Prices on a number of food types used for biofuel have doubled in the last couple of years. If the use of food crops for biofuels (corn) increases, commodity prices will increase, making these crops less accessible to the poor. There are those that say biofuel is not the main cause. Some say the problem is a result of government actions to support biofuels. Others say it is just due to oil price increases. Whatever may be the cause, the impact of food price increases is greatest on poorer countries.

Without technologies to improve productivity, the prices changes would adversely affect poor, net-food-purchasing households and would probably exceed the possible income gains by many small farm households. In general, biofuels that use food sources are costly to the poor and raise prices on the basic foods that already represent a large share of poor people's household spending. Therefore, the crop subsidies that encourage the production of biofuels from certain food sources have a welfare burden on the poor, as well as on producers of those crops in other countries.

Impacts on Environment

One of the arguments in favor of biofuels is that they could positively affect net carbon emissions as an alternative to fossil fuels. However, the rapid growth of biofuel industry have unintended impacts on the environment e.g. it can lead to deforestation, a loss of biodiversity, and excessive use of fertilizers and pesticides, thereby degrading the land and water that poor people depend on.

In October 2007, Nobel Laureate Paul Crutzen published findings that the release of Nitrous Oxide (N_2O) from rapeseed oil, and corn (maize), contribute more too global warming than the fossil fuels they replace. However, the Crutzen paper goes on to say that crops with less nitrogen demand, such as grasses and woody coppicing will have positive but lower climate impacts. In February 2008, two articles were published in *Science* concluding that clearing land for biofuel production produces twice as much greenhouse gas than the IPCC had previously estimated.

Presently, ethanol and biodiesel are the most important biofuels. These are produced from different plants such as sugar cane, palm oil jatropha and soybean oil and are considered "first generation" because the crops are grown specifically for the purpose of transformation into these fuels. "Second-generation" biofuels are not commercially viable at this stage though have the potential to increase energy yields and reduce environmental impacts significantly. "Second-generation" production involves using waste materials and transforming it into oil products through different processes such as gasification, which involves the combustion of materials in the absence of oxygen. The growth in biofuels production has been stimulated mostly by the rising fossil fuel prices, agricultural feedstock prices and national policies for the purpose of energy security, climate change mitigation and rural development. Agricultural and energy markets are closely linked since agriculture both produces and consumes energy. Therefore, the rise in energy prices has had a large impact on the rise in agricultural commodity prices. This has provided an opportunity for some farmers who have generated more income by switching to fuel crops; however the change from food crops has adversely impacted the food prices as well. However, the link between biofuels production and food security is complex and should not be made directly.

A Policy Alternative

Still the issue of producing biofuel in the developing country is a sensitive issue where land is very scarce and poor spend their lion share income for purchasing food. Before go for commercial production of biofuel, the socio-economic and environmental issue should be taken into consideration including food security issue. Besides these, there are other concerns regarding efficiency. First, biofuels must be produced in a way that results in an output of energy greater than the amount of energy used to produce them—that is, they should have a highly positive energy balance. Second, biofuel production must be managed in a way that substantially reduces greenhouse gases compared with petroleum. Biofuel crop production can be a suitable alternative if designed in a participatory manner with those whose livelihoods will be affected.

There is recent advancement in the production of biofuel. Second-generation technologies can solve the food security issues as ethanol is produced from residues such as stalks and leaves. Third generation bio-fuel is also promising as it produces from Algae which will not threat to food crop production. The development of cellulosic ethanol could dispel some of these concerns, but additional research and investment are needed to make this technology commercially viable and environmentally sustainable. Cellulose conversion technologies will open up enormous potential for broadening the kinds of feed stocks that can be used for biofuel to include trees and grasses that produce large amounts of usable biomass per hectare and that can be grown in areas where biofuel crop is less likely to compete with agricultural production for food and feed supplies. These technologies will enable greater use of existing agricultural waste and crop by-products and will also encourage growth of dedicated feedstock plantations, including tall grasses like switch grass and *Miscanthus*, and plants rich in non-edible oils like *Jatropha curcas* and *Pongamia pinnata* (Karoch) that grow in low-rainfall areas and on poor soils. *Pongamia* and *Jatropha* are non food crops and can be also grown in marginal, degraded or unproductive land of the country.

The future of biofuels is uncertain, depending largely on the price of oil, agriculture and energy policies, and technological developments. The potential social and environmental risks associated with biofuels must be carefully weighed when deciding how much to produce, what types of land will be used and in what types of feedstocks to invest. One can be certain that ethanol and biodiesel cannot solve all of the economic and environmental problems associated with fossil fuels. In that case we can explore and adopt improved technology and invest more for CNG transport, LPG vehicle, battery-electric car, hydrogen fuel cell buses, etc. to meet energy balance for automobile.

Conclusion

Biofuels affect the environmental pillar in several ways that can be positive or negative depending on the agricultural methods employed. One of the key factors driving biofuels is the potential to mitigate climate change, however, this varies broadly depending on the technologies used, the location and production methods. The key sources of carbon emissions are land conversion, mechanization, fertilizer use, and the use of fossil fuels for processing and transport.

The removal of land with a high carbon content and biodiversity, such as forests or peat land would immediately result in a negative carbon balance that would take years to offset through growing crops. The threat of biodiversity loss is also related to land-use change. Though, extensive monoculture biofuel production could also affect agricultural biodiversity. Many crops are also highly water intensive which could create an even greater competition for an already scarce resource.

Ideally, these issues may produce positive results with good agricultural practices and strong policies to protect land of a high biodiversity. A full life-cycle assessment is required to fully consider whether the production of biofuels would create a net positive climate mitigation impact. Without a holistic policy framework, biofuels opportunity can go terribly wrong for the poor in the country. Only in the presence of appropriate *agricultural*, *economic, trade, energy and social policies* will biofuels contribute to energy security without jeopardizing food security of the poor. In the conclusion a framework will be required for policy and action needed to achieve win–win outcomes in terms of economic development, energy security, and food security for the billions of poor.

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