Biodiesel as an alternative to Petroleum diesel- A case study of Hassan district, India

Avinash Narayanaswamy, CSTM Department, University of Twente, Enschede, the Netherlands
Balakrishna Gowda, Department of Forestry and Environmental Sciences, University of Agricultural Sciences, GKVK Campus, Bengaluru, India
Joy Clancy, CSTM Department, University of Twente, Enschede, the Netherlands
Please address all correspondence to avibvs@gmail.com

One of the renewable energy sources that come to the forefront for replacing if not partially substituting petroleum diesel globally is biodiesel. The hazards such as environmental pollution, global warming, climate change etc. caused by the use of conventional sources of energy like petroleum fuels and coal has already been well documented and proven. To the contrary, biodiesel is a clean fuel that can be produced from both animal fat as well as plant oils (edible and non-edible) by a chemical process known as Transesterification. Further this fuel can be used in existing diesel engines directly or with little modifications and also in generators for electricity production. Since animal fat and other plant based edible oils such as sunflower, soyabean, palm etc. go for mainly human consumption; non-edible plant oils such as Jatropha curcas, Pongamia pinnata, Madhuka Indica etc. are a better bet for biodiesel production since there would be no competition with food. In spite of being replenishable, biodiesel could also provide mainly environmental and economic benefits especially to the poor. This is exactly what needs to be understood by taking the case study of a mega model being developed in Hassan district, Karnataka state in southern India.

However, the introduction of biodiesel as an alternative source of energy is a challenge by itself as it involves a number of factors that are interlinked. These include technical, environmental, economic, social and political factors which need to be integrated in such a way that biodiesel production and its use is sustainable. Sustainability requires answers to a number of questions such as: what are the ideal biodiesel crops, on what kind of lands would these crops be grown, who would cultivate these crops and further extract the oil, what are the benefits and who would get these benefits (men or women or both) and how could they avail of these benefits, how could the biodiesel be marketed, what role could the local/state government play are some of the several important questions associated with the introduction of biodiesel in rural day to day life.

The paper outlines a biodiesel model (in line with India's famous Milk Union model) which indicates how different kinds of land holding patterns of farmers (bunds and hedges of farmers' agricultural fields and the their household backyards) along with different kinds of intercropping practices as well as efficient water usage can help in biodiesel generation and in the process provide much needed income to the farming community mainly focusing the women folk without impacting their basic source of livelihood and at the same time help in substituting for petroleum diesel leading to foreign exchange savings for the country. The biodiesel model takes in to account several factors (mentioned below) and is implemented in four major steps namely initiation of Awareness programmes, provision of Training programmes, setting up of Farmers association in the respective villages and finally monitoring the progress. These activities are carried out by the Biofuel Park, a Government based institution in Hassan.

Hassan is one of the few places where a number of agro climatic zones (5 zones in total namely wet, semi wet, transition, dry and dry with irrigation) are present within its territory. Since each zone is different both in terms of climate as well as the kinds of crops grown and soil fertility, the study involved carrying out surveys and assessing the various factors such as the types of farmers (large, medium, small, very small and landless) and their income, the kind of lands they owned and their area, the extent of waste lands present in different zones, the kind of crops they grow and the places where they can be grown without impacting food production, activities of women and their income and farmers interest in cultivating biodiesel crops.

The study involved choosing villages randomly across the five zones. A questionnaire was prepared involving the above mentioned response factors. One of the major outcomes of the study was the realization of the financial plight of farmers and the various activities performed by women. The project study included 33 villages as a part of the survey.

The study showed that the biodiesel quantity produced depends completely on the crucial participation of both men and women alike as well as the extent of acceptance of biodiesel crop cultivation by the farmers (both men and women) which in fact vary from village to village, apart from the potential areas available for growing biodiesel crops. Thus, the mindset of the farmers (both men and women) as well as the co-operation between the two genders belonging to the same class as well as the different classes of farmers continue to remain one of the major challenges for the success of the model.

Estimating the income potential of the model for Hassan district depends on the sale of the different types of produce such as from biodiesel, oil cake, plant prunings sale and potential carbon savings.

The study also showed that the possible roles that rural women could play in the field of biodiesel are quite vast. The women are versatile and they are involved in harvesting the seeds from the biodiesel plants, de-shelling seeds, expelling the oil from the seeds to ultimately marketing the final produce which could be oil, oil cake etc. It can be thus said that women in the rural areas are best suited to make the model a success.

The final outcome is to depict the approach adopted in determining the extent of sustainable production of biodiesel based on the land availability and the income it is most likely to generate for the farmers of Hassan district by the year 2020 taking into account several factors which form the basis of the model.

A. Narayanaswamy. (2008, December). "Biofuels Production, Land use and Land Cover Change Scenarios and Implications for Green House Gas Emissions – An overall analysis on India".

FAO, & Pisces. (2009). Small-Scale Bioenergy Initiatives:Brief description and preliminary lessons on livelihood impacts from case studies in Asia, Latin America and Africa. Rome and Nairobi:Food and Agriculture Organisation of the United Nations (FAO) and Policy Innovation Systems for Clean Energy Security (PISCES).

Lambrou, Y., & Rossi, A. (2008). Gender and Equity Issues in Liquid Biofuels Production – Minimizing the Risks to Maximize the Opportunities. Rome

Small-Scale Bioenergy Initiatives: Brief description and preliminary lessons on livelihood impacts from case studies in Asia, Latin America and Africa. (2009, July 8). Retrieved July 24, 2009, from FAO: http://www.fao.org/bioenergy/home/en/

Jatropha Plant Based Biofuel as a Cleaner Alternative to Commercial Diesel: A Case Study of Nepal

Maya Shrestha

Research interest on the importance of Jatropha plant based oil as a substitute for commercial fuel and its positive impact on the environment has significantly increased in recent years. The use of such plantbased biofuel especially in developing countries like Nepal, which heavily relies on imported petroleumbased fuel, can be very promising. This can not only reduce the reliance on imported fuel but also provide an opportunity for earning emission credits under Kyoto Protocol›s Clean Development Mechanism.

To study the impact of this plant-based biofuel on carbon dioxide (CO2) emissions, the transesterified oil from this plant was blended with commercial diesel in varying proportions and each blend was used in turn to run a single cylindrical diesel engine. Tests were done at 4 different load conditions (480 kW, 960 kW, 1440 kW and 1920 kW) and the resulting CO2 emissions from each blend at each load condition were measured with gas analyzer at the Center for Energy Studies laboratory in Kathmandu.

Our test results showed that CO2 emission reductions from all three blends: B10 (mix of 10% biofuel and 90% petroleum-based commercial diesel), B20 and B30 relative to commercial diesel without blending were significant. Similarly the emission reduction with B20 and B30 relative to B10 were also noticeable. However the emission reductions with B30 relative to B20 was insignificant, especially at higher load conditions. Our experiment also showed that B20 reduced emissions as much as B30 without much compromising the calorific value found in commercial diesel. Given its commercial fuel consumptions, Nepal could have reduced 7.7 million tons of CO2 emissions in 2008 had it replaced commercial diesel with B20. Besides, the plantation of *Jatropha Curcas* in Nepal can sequester over 55 million tons of carbon dioxide.