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Opportunities of Using Pure Plant Oil for Running Stationary Diesel Engines in Rural Areas of Tanzania

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PISCES

Policy Innovation Systems for Clean Energy Security (PISCES) is a five-year Research Programme Consortium funded by the UK's Department for International Development (DFID) to develop new knowledge for the sustainable use of bioenergy to improve energy access and livelihoods in poor communities. PISCES is led by the African Centre for Technology Studies (ACTS), Kenya with lead partners Practical Action, M.S. Swaminathan Research Foundation (MSSRF), the University of Dar es Salaam and the University of Edinburgh, together with a network of national and international partners and collaborators.

Policy Working Group (PWG)

The Policy Working Group (PWG) of PISCES is an expert working group whose objective is to develop a consultative and participatory policy methodology to discuss the policy issues and guide policy statements on bioenergy. The group, with focus on Kenya and Sri Lanka, aims to achieve this by bringing together policy makers, stakeholders and experts to develop a combined methodology on participatory policy dialogue and apply the same in developing bioenergy policy.

Executive Summary

While there is no clear policy and legal framework for bioenergy in the country, a number of Jatropha-oil projects have been initiated in Tanzania. Jatropha is being considered by many as the plant suitable to supply feedstock for biodiesel production compared to food crops because of the concern of the likely negative impacts on food security if the latter is used. However, the majority of Jatropha projects are focusing on production of biodiesel particularly for the transportation sector use. In this regard, the accessibility of this clean energy by the rural poor is still doubtful. The Policy Innovation Systems for Clean Energy Security (PISCES) project is intending to address the use of such energy to improve access to energy by the rural communities. This is done by the College of Engineering and Technology (COET) of the University of Dar es Salaam. The COET carried out a study to alter the characteristics of the vegetable oil from Jatropha that make it difficult to use as pure plant oil in engines through modifying the physical and chemical properties of Jatropha oil by blending it with two different modifiers, for the purpose of lowering their viscosity and improving other qualities and removing gums using natural materials. The process does not involve the trans-esterification which is chemical intensive and cannot easily applied in rural setting.

Results show that it is possible to reduce the viscosity of the Jatropha oil by more than 60% and the resultant blend can be used directly as fuel in low and medium-speed stationary diesel engines. The study recommends that, because of the safety reasons necessitated by the modifiers used, the blends should contain at least 65% of vegetable oil.

Policy implication

The findings from this study are an encouraging step towards improving the quality of vegetable oils for direct use in stationary diesel engines (low- and medium speed) in rural areas of Tanzania. However, more research is required to confirm the results that may be needed to develop a robust policy on the use of vegetable oils and the modifiers that are locally produced. These initial results should therefore be used as an incentive for the government to put in more money to make sure that the results are used for the benefit of the Tanzanians.

The government, therefore should promote/support the scale up of this research, as this will provide direct benefits to rural communities than the current

trend of developing Jatropha plants, probably at the expense of livelihoods in the communities where the big plantations are being developed.

Introduction

Increasing demand for biofuels as a component of climate change mitigation, energy security, and a fossil fuel alternative have been attracting investors to the developing countries. In Tanzania the interest for developing biofuels from an oil-seed bearing plant Jatropha is growing. The plant is widely seen to have potential to help combat the greenhouse effect, help to stop local soil erosion, access to clean energy by the rural poor, create additional income for the rural poor,

and provide a major source of energy both locally and internationally. Nevertheless, despite the socio-economic and environmental justification of biodiesel, the quality and blending ratios have remained the big challenges in Tanzania. Some technical problems that may hinder the use of biodiesel include viscosity, gums and Free Fatty Acids (FFAs) (Meena 2008). Also the chemical composition of straight vegetable oil (SVO) makes it susceptible to reactions that may lead to a deterioration of the oil.

The COET of the University of Dar es Salaam has taken a step forward towards addressing the problem. The college conducted a study to modify the physical and chemical

properties of Jatropha oil by blending it with two different modifiers, for the purpose of lowering their viscosity. The experiments were performed based on two levels of Engines. One, applications in engines that do not require a high-volatility fuel e.g. Direct Ignition type (DI Engines). Two, slightly more viscous and may require fuel heating for proper atomisation of the fuel e.g. low and medium speed engines e.g. in Indirect Injection type (IDI) with prechamber like Lister engines. Pure Plant Oil (PPO) and the formulated blends were tested for physical, chemical and combustion or fuel properties.

Results

Results show that pure plant oils may not be

used as fuel in diesel engines because they exhibit higher values of kinematic viscosity and density and also most of their characteristics do not meet the standard limits. The study also suggests that the oil may require some modification to improve the properties and the extent of modification depended on the type of diesel engine. However, according to the study only some minor modification are enough to improve the key properties like viscosity. It has been observed that the viscosity should be reduced by more than 60% while properties such as ash and sulphur may not even need to be modified. Gums may easily be reduced to allowed levels through an adsorption process using natural materials. The findings further confirms that the

blends' obtained can be used as fuel in low and medium-speed stationary diesel engines.

Policy implication

The findings from this study are an encouraging step towards improving the quality of biodiesel for stationary diesel engines in rural areas. The research is ongoing and more research is required case by case to come up with robust policy implication. Vegetable oils of different plants vary in composition of their fatty acid chains, which make each type of vegetable oil unique (Fürstenwerth et al 2009; Campbell and Members 2009) and therefore may require slightly different mixing ratio and treatment.

The government in collaboration with develop-

ment partners should scale up funding on the production and processing of the modified PPO especially from non edible sources like jatropha as strategy to

reducing conflicts with food security and for enabling the accessibility of rural poor.

The Government should speed up the development of bioenergy standards and

blending ratios for quality control.

The long term policy strategy should be to increase importation/manufacturing of stationary engine for rural use.

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