Biomass and Bioenergy xxx (2016) 1–14

Contents lists available at ScienceDirect

Biomass and Bioenergy

journal homepage: http://www.elsevier.com/locate/biombioe

Research paper

Multi-dimensional poverty effects around operational biofuel projects in Malawi, Mozambique and Swaziland

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ARTICLE INFO

Article history:
Received 17 May 2016
Received in revised form
21 July 2016
Accepted 5 September 2016
Available online xxx

Keywords:
Biofuels
Jatropha
Sugarcane
Multidimensional poverty
Sub-Saharan Africa

ABSTRACT

There is a long-term concern that the cultivation of biofuel feedstocks could have negative impacts on communities involved in, or adjacent to, such projects. In southern Africa, the acquisition and allocation of large blocks of land for biofuel feedstock production has been especially contentious. The present study investigates the local multi-dimensional poverty effects of growing biofuel crops using the Oxford Poverty & Human Development Initiative's Multidimensional Poverty Index. It investigates different modes of production (large-scale vs. smallholder-based) and different feedstocks (sugarcane vs. jatropha) in four study sites in Malawi, Swaziland and Mozambique. In the sugarcane growing areas, those who participated in its value chain as farmers or workers had lower poverty than those who were not involved. However, for jatropha growing areas, there were no clearly defined differences between the controls and the jatropha farmers in Mangochi, while in Mozambique the plantation workers had slightly lower poverty than the control groups. Although it was not possible to make direct comparisons between all projects, sugarcane areas seem to be better off than non-sugarcane areas. In all projects there was generally high incidence of deprivations in indicators related to living standards, particularly, access to electricity and cooking fuel.

1. Introduction

Biofuels production and use has been gaining prominence and significance globally. In Africa, Malawi started producing ethanol from sugarcane molasses in the early 1980s [1], and its biofuel programme has been sustainably integrated into the country's agricultural sector and economy since then [2]. Though various African countries are at different stages of adopting biofuels, the interest in biofuel production and use across the continent has been rising since the mid-2000s [3]. Several countries support biofuel blends of roughly 10% volume fraction in gasoline, including Ethiopia (E10), Kenya (10%), Malawi (varying between 10% and 20%), and Zimbabwe (varying between 5% and 15%) [4,5].

Key reasons that have been cited for this biofuel expansion include energy security, oil price volatility, export potential, poverty reduction, economic development and climate change mitigation [3,4,6,7]. Moreover, biofuels have offered an opportunity to transform Africa's traditional dependence on biomass energy sources to liquid biofuels [8], as well as exploit its under-utilised agricultural land and abundant labour [2,7,9,10].

Jatropha (*Jatropha curcas* L.) and sugarcane *(Saccharum officinarum* L.*)* are the two most prominent biofuel feedstocks in Sub-

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http://dx.doi.org/10.1016/j.biombioe.2016.09.003
0961-9534/

Saharan Africa (SSA) for biodiesel and ethanol, respectively [4]. Of the two, sugarcane is a well-established crop, and the sugar derived from it has been an important global commodity for hundreds of years. Now, sugarcane is also increasingly being promoted for biofuel. By contrast, jatropha is a recently introduced oil crop whose oil can be directly blended with diesel in small quantities, or be transformed into biodiesel. Since 2000, Jatropha has been widely promoted as a biofuel crop in countries such as Ghana [11], Mozambique [12], Tanzania [13] and Zambia [14] among others. Only recently jatropha has reached harvestable age in some of the areas where it was consciously introduced. Jatropha was strongly promoted as a crop with development potential, both in smallholder and industrial plantation settings [15]. However, only a handful of projects have shown signs of long-term viability in southern Africa [3,16,17].

Biofuel development in the African context eventually became a contentious issue with stakeholders including policymakers, development practitioners and donors having different interests [2,4,7,18]. Concerns have been raised that biofuels might have unintended negative social, economic, and environmental consequences [8,10,19], such as land tenure conflicts, food security decline, and a host of environmental impacts [4,7]. Furthermore, several biofuel projects in African countries have been based on industrial plantations which are likely to lead to inequitable sharing of benefits, increased rural poverty and food insecurity as land is taken away from rural dwellers [1,2,8]. Recently, some studies have attempted to identify the links between the environmental and socioeconomic impacts of biofuels in Africa. Some of these studies have tried to show how biofuel production can be a significant driver of ecosystem change and landscape conversion, and as an extent how it can affect different ecosystem services and constituents of human wellbeing [3,16,20].

Poverty alleviation is a significant dimension related to the human wellbeing aspects of the biofuel debate in Africa, featuring both as a driving force and as an impact of biofuel expansion [4]. In this context, it is necessary to understand the potential for poverty alleviation within biofuel projects in Africa, especially at the local level [2,4,6,21,22]. However, most of the literature about the poverty alleviation effect of biofuels remains theoretical, with little or no empirical data to support the analysis [22]. Quantifying the impact of biofuels on poverty alleviation is important to better understand the impacts of these projects on the local rural communities.

When assessing the poverty outcomes of different interventions, measures can be broadly categorised into unidimensional (which are typically based on financial indicators such as income) and multidimensional (which consider broad access to multiple resources). Recognition for the need to apply multidimensional poverty measures dates back to the 1970s [23,24], and is now receiving renewed attention [25].

There are several advantages related to the use of multidimensional poverty measures. First, a single indicator cannot adequately identify the multiple disadvantages that contribute to poverty whereas a multidimensional approach can include more relevant/comprehensive indicators, such as health, education and living standards [26,27].

Second, a study focusing solely on income poverty can exclude a considerable proportion of people living in multidimensional poverty [28]. Income as a measure of poverty pre-supposes markets for all basic needs, yet such markets do not always exist [29]. In most rural areas of developing countries, and especially in the African context, access to commodity markets can be weak or non-existent. Most households in such areas produce food for their own consumption (as in our study sites, Section 2.1), which would be neglected in an assessment merely based on income.

Third, poor people themselves view their poverty much more broadly to include various dimensions [30]. As pointed out by Bourguignon and Chakravarty [31], poverty is a multidimensional phenomenon which manifests "*as the failure to reach 'minimally acceptable' levels of different monetary and non-monetary attributes necessary for a subsistence standard of living*". Finally, income tends to neglect the actual command over resources [33], that is to say that to have an income does not imply that the income will be used to access various needs. A person or household can be poor in terms of income but not multidimensionally poor and/or vice versa [27], thus, multidimensional poverty measures need to be applied [32].

The aim of this study is to investigate the local multidimensional poverty effects of growing jatropha and sugarcane as biofuel crops. Considering the strong linkages between changes in ecosystem services and poverty [34–37], the study will also offer insights on whether current multi-dimensional poverty approaches can be used to capture how changes in ecosystem services from biofuel expansion can affect human wellbeing.

Our study adopts the multi-dimensional poverty approach which has been widely applied [23,27,30,32,38,39] as a means of quantifying whether growing biofuel feedstock (a provisioning ecosystem service) has a positive or negative impact on the local population. The study sites are located in Malawi, Mozambique, and Swaziland, and consist of both large-scale commercial plantations and smallholder-based projects where community members are owners of the projects. In addition, it considers a long established feedstock (sugarcane) versus a newly promoted feedstock (jatropha). In this respect the study captures the main biofuel options promoted in southern Africa [4,15].

The paper is structured as follows. Section 2 outlines the study sites and the methodology used to quantify multidimensional poverty. Section 3 outlines the key results, focusing on the comparisons between different groups and the robustness of the results. Finally, Section 4 discusses the main findings in respect to whether biofuels can be successful strategies to alleviate poverty in southern Africa, as well as the limitations and research gaps.

2. Methods

2.1. Study sites

The projects listed in Table 1, represented both large-scale and smallholder-based models of production.

In Malawi, the sugarcane study site was located at Dwangwa in the Nkhotakota district and the jatropha site in the Mangochi district. Dwangwa is in the Central region of Malawi. The sugarcane production industry is primarily controlled by Illovo Sugar Company, which owns a large irrigated plantation and a mill that processes the cane into sugar. Molasses by-products have been sold to Ethanol Company Limited (EthCo) for ethanol production since 1982 in response to the 1970 energy crisis [40].

At Dwangwa, there are also different community outgrower projects. The small-scale outgrower scheme started in 1996 [41], whereby farmers are integrated in the value chain through outgrower management companies, who, to varying degrees, provide farmers with support for land development, agricultural inputs, extension services, labour at the fields, harvesting and transport services [42]. Some of the outgrowers are under irrigation in large plantation blocks, with each outgrower having an individual field within the plantation. In this case, funding for the project infrastructure was obtained through the Dwangwa Cane Growers Trust (DCGT). In addition, there are also individual farmers growing sugarcane on their private smallholder farms under rainfed conditions. The Trust and associations oversee sales to Illovo.

The jatropha sites in Malawi are situated around the city of

Please cite this article in press as: S. Mudombi, et al., Multi-dimensional poverty effects around operational biofuel projects in Malawi, Mozambique and Swaziland, Biomass and Bioenergy (2016), http://dx.doi.org/10.1016/j.biombioe.2016.09.003