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Biodiesel value chain and access to energy in Ethiopia: Policies and business prospects

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ABSTRACT

Similar to many net oil importing Sub-Sahara African countries, Ethiopia's economy is rural and as it stands today it is far from being a fossil fuel based economy. Instead, the economy is largely powered by traditional burning of solid biomass. Despite its small share in the overall energy supply (7%), imported fuel absorbs half of Ethiopia's foreign currency earnings. The common justifications behind the development of biofuels such as energy source diversification, foreign currency saving, rural poverty alleviation through employment and technology transfers were all appealing for Ethiopian policy advisers. In 2007, mostly influenced by the global discourse, Ethiopia launched a biofuel expansion strategy and a massive ad hoc investment promotion of two biodiesel crops: castor and jatropha. In this paper, we synthesize the various biodiesel development initiatives and modes of production, and point out at the gaps in policy formulation and project implementation. Evaluating the prospect and constraints for biodiesel production in Ethiopia, we conclude that most of the prerequisites for a viable biodiesel industry still need to be met. We identify key areas and priorities to further strengthen the development of the biodiesel sector.

Contents

1. Introduction

Energy consumption disparity across the globe is dramatic. Three-fourth of the world's poor consume only 10% of the global energy supply [1]. The majority of those energy-poor households live in net oil-importing Sub-Saharan Africa (SSA) where Ethiopia is ranked at the bottom of the global energy poverty index [2]. Kebede et al. [3] reports that a 1% increase in GDP requires a 0.55% increase in energy use in SSA, suggesting that any increase in the current per capita GDP in SSA relies greatly on an increased use of energy. Observations strongly suggest that energy poverty drags back poverty reduction efforts, particularly in low-income countries [4,5].

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Diversification of energy resources has increasingly been viewed as a way to improve energy access and security.[1] Bioenergy and especially that of biofuel evolved as a natural candidate to diversify energy sources away from fossil fuels. Many African countries (Mozambique, Tanzania, Ethiopia, Angola, Malawi and Zimbabwe among others) embraced the excitement of biofuels and pursued large-scale deals. A few countries (such as Zimbabwe or Malawi) started a number of biofuel initiatives as early as in the 1980s but the combined effects of climate change, volatility of fuel prices and the recent food crisis and global economic downturn have triggered a sense of urgency among policy makers, industries and development practitioners to find sustainable and viable solutions in the area of biofuels. This sense of urgency is reflected in the rapid expansion of global biofuel production, markets and policies over the past few years [7]. However, several critics argue that most investment deals have been carried out in a non-transparent, piecemeal and fragmented manner, and that most (if not all) stakeholders involved have lost from the situation [8].

In that regard, Ethiopia is a relevant example for studying the evolution and potential of biofuels in SSA. Enthralled by the various commonly portrayed opportunities lying ahead of the development of biofuels (such as energy source diversification, foreign currency saving, rural poverty alleviation and technology transfers), the Ethiopian government launched an extensive biofuels expansion strategy and an ad hoc investment promotion program in 2007 for two biodiesel crops: castor and jatropha.[2] These two crops were especially promoted for their expected adaptability and capacity to grow on marginal lands and under drought conditions [9]. A few years later, the government substantially downsized its promotion effort as a result of the overwhelming concern about competition between food and biofuel crop production. An extended review on the food-versus fuel debate is out of the scope of this paper, but interested readers can refer to Rajagopal and Zilberman [10], Mitchell [11] and FAO [12] among others for a thorough review of the macro level studies on the impact of biofuels; and to Oladosu and Msangi [13] for discussions around the interactions between biofuels and food markets.

We argue that these concerns and fears about the development of biofuels are not well-founded in the case of Ethiopia or should at least be more nuanced. First, the biodiesel sector exhibits an underdeveloped value chain that mostly focuses on unprocessed feedstock export. Large-scale production and use of biodiesel is unrealistic in the short-term. Second, oil from biodiesel feedstock offers a potential in remote and dispersed areas where it can be used for cooking, lighting and agricultural equipment, at the local level and at a smaller scale. In contrast to most anti-biofuel views, there is now a revived interest in decentralized renewable energy provision to solve the energy crisis in more-isolated and poorly integrated areas [14]. Some view biodiesels (or vegetable oils in general) as unique local resources in the rural energy mix. For example, Brazilian public policy identifies biodiesels as 'social fuels' for their role in integrating smallholder farmers into the supply chain while making local energy production available for local use [15–17].

In this paper, by synthesizing the various biodiesel business models that are in place in Ethiopia, we aim to show how biofuel investments can be reorganized and strengthened to contribute to the rural energy mix where they are found to be comparatively beneficial. The analysis that follows draws on evidence from key informant interviews[3], government legislation documents, strategy papers and data from company reports. Furthermore, we conducted observational assessments and triangulations by visiting feedstock production sites. Our analysis only focuses on biodiesel initiatives from non-edible feedstocks for two reasons. First, given the fact that the government's strategy excludes the use of edible crops for fuel production, we find it relevant to focus on non-edibles. Second, the ethanol sector to date is a single-stand state-owned bioenergy enterprise that lacks the heterogeneity needed to study the economics of ethanol as an energy source in depth.

Following this introduction, Section 2 analyses current access to energy in Ethiopia, describes the government biofuel strategy and reviews the potential source crops identified as relevant for biodiesel production. Section 3 outlines the framework used to analyze biodiesel potential and current investment initiatives. Section 4 presents the inventory of biodiesel investment initiatives and synthesizes their specific contributions. Section 5 discusses the policy environment, past experience and future prospects. We present concluding remarks in Section 6.

2. Background on biofuels in Ethiopia

2.1. Access to energy in Ethiopia

Ethiopia is a net energy importer and is viewed as the number one "energy poor country" in the world [2]. According to IEA [6], only 23% of households had electricity connection in 2012, with this rate being 11% in rural areas. Looking at public investments, Ethiopia suffers from a persistent lack of infrastructural development, particularly in the area of energy supply [18,19]. Most of the rural areas do not have access to electricity from the local grid, and their energy need is entirely dependent on locally available biomass resources and on expensive imported fossil oil to some extent [20].

Solid biomass has been a prime source of energy (above 91%) for decades (Fig. 1A). Rural energy demand is mainly used for lighting, cooking and the powering of household appliances such as televisions, audio systems and electric motors for grinding food [21]. As shown in Fig. 1B, energy consumed for productive uses such as for manufacturing, mechanical energy for agriculture or irrigation, or transport, is negligible (with less than 1% share in total energy consumption of the country).

According to a recent welfare monitoring survey [22], the lion's share of solid biomass energy (which includes fuel wood, charcoal, dung, and crop residues) is consumed for residential cooking purposes in rural areas (Table 1). When looking at sources of energy for lighting in rural areas (Table 2), kerosene use represents about 60–70% of it, and very few families can afford to use petrol or diesel generators.

A number of studies analyze in detail the health, social and environmental problems associated with the direct burning of solid biomass [14,23]. Reported data shows that in SSA countries, indoor air pollution accounts for the burden of disease in the range of 3.7–6.6%, making it the most important risk factor after

[1] There is no single internationally-accepted definition of energy access but it is generally defined as access to electricity and clean or modern cooking facilities [6].

[2] This paper mainly focuses on biodiesel. Biodiesel is one form of biofuel. In this paper, we use the term biofuels to refer to a broader class of liquid fuels. It includes ethanol obtained from starch bearing energy crops such as sugar cane, grain, or sugar beet and biodiesel obtained from pressing oil bearing crops such as castor oil and jatropha.

[3] The following stakeholders were interviewed: officials from the Ministry of Agriculture and Rural Development, from the Ministry of Water and Energy, from the Ethiopian institute of Agricultural Research and from the Ethiopian Investment Agency; researchers from the Africa Horn of Africa Regional Environmental Centre at the Addis Ababa University; managers from all biodiesel projects (private businesses and PPP); members of civil society organizations.