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Research paper

Which smallholder farmers benefit most from biomass production for food and biofuel? The case of Gondola district, central Mozambique

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ABSTRACT

We analysed the influence of the mode of participation in biomass production for biofuels on food security of different farm types. We studied two modes of participation in biomass production: an outgrower scheme for sunflower and a jatropha plantation offering full time employment and assessed the four dimensions of food security: availability, access, stability and utilization in smallholder farms in Central Mozambique. We interviewed 80 households who were participating in the sunflower outgrower scheme, had a household member working on the jatropha plantation or were not participating with biofuel production. For each household we quantified four indicators: maize sales minus purchases, gross revenue, revenue diversity, and household dietary diversity scores. Involvement of smallholder farmers with biomass production for fuel had a positive or no impact on the four dimensions of food security at the farm level. Positive food security impacts from working on the biofuel plantation were improvements in availability for the larger farms and improvements in access for the smaller farms. Utilization of food was generally not impacted. Impacts on food security from the sunflower outgrower scheme were minor. There is scope to improve the outgrower scheme with services and inputs that increase sunflower yields and give positive spill-overs to other crops.

1. Introduction

Global demand for biomass for food and feed is increasing rapidly due to population growth [1,2] and increased welfare [3]. Concern about climate change and the need for energy independence has further increased the demand for biomass [4]. The quest for alternative energy sources has placed biofuel on the top of agendas of many national and multi-national government bodies [5]. Mozambique is seen as an important potential producer of biomass for biofuel (hereafter referred to as biofuel) due to its relative abundance of land and favourable agro-climatic conditions for production of biomass [6,7]. By 2008 the request for land for biofuel production in Mozambique was estimated at about 12 million hectares [6]. In 2009, the Mozambican biofuel policy was approved, highlighting the government's commitment in exploring opportunities for economic development for rural communities offered by increasing global biofuel demands [8].

In Mozambique approximately 70% of the population live in rural areas with smallholder farming providing their main source of food and income [9] and, 55% of the population live below the poverty threshold of 0.50 $ per day [10]. The PEDSA (strategic plan for agricultural development) emphasizes food security and rural incomes as main policy objectives [11]. However, the same resources used to produce food, e.g. land and labour, are needed to produce biomass for biofuel. This highlights the potential conflict between food security and increase biofuel production [12]. The wide diversity of smallholder farmers with respect to land and labour resources and livelihoods strategies determines different opportunities to improve food security as result of participating in biomass production for food and for cash, including biofuel [13]. In the context of smallholders in Mozambique, food security needs to be interpreted at the household level, accounting for a diversity of strategies employed by different farmers and their family members to secure access to food [14]. Engaging in on- and off-farm income

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earning opportunities to purchase food on the market is such a strategy, just as growing food and exchanging labour for food or cash.

In Mozambique, farmers can be engaged in biofuel production in outgrower schemes, in contractual arrangements with companies for production of specific crops, or as workers on biofuel plantations. We investigate how the food security of different smallholder farmers in central Mozambique is impacted by participating in biomass production for food and biofuel. We specifically look at a jatropha (*Jatropha curcas* L.) plantation and a sunflower (*Helianthus annuus* L) outgrower scheme. Our main objective is to aid policy makers who are searching for pathways to improve the livelihoods of smallholder farmers in Mozambique.

2. Material and methods

2.1. Site description and farming system

This study was conducted on the Manica plateau in Manica Province, central Mozambique. This region has experienced large amounts of foreign investment in biomass production for fuels due to its agro-ecological suitability for crop production [15]. We focussed on smallholders in two Administrative Post (Post) directly impacted by biofuel developments, Zembe (19.295 °S, 33.354 °E) and Matsinho (19.024 °S, 33.472 °E), located in Gondola district within the same agro-ecological region (Fig. 1). Chimoio city, the main urban market in the province is situated about 25 km from each of the two posts. Both posts experience two main seasons: a hot and wet season (November–March) and a cool and dry season (April–October). On average 880 mm of rainfall is received in an unimodal pattern that allows one main cropping season per year [16]. In Zembe, the total number of farms is 3844 and the average cultivated area is 1.7 ha per household. In Matsinho, the total number of farms is 7114 and the average cultivated area is 1.5 ha per household [17].

Table 1
Distribution of households between farm types and household characteristics per farm type for Zembe (based on Leonardo et al. 2015).

Variables	unit	Farm types			
		1	2	3a	3b
Distribution of households	%	17	44	15	23
Male headed households	%	100	83	50	42
Household size	#	8.1	5.4	4.9	4.0
Household labourers	#	3.8	3.7	3.1	2.6
Cultivated area	ha	2.1	1.5	0.8	0.8
Maize yield	t ha^{-1}	2.0	1.7	1.1	1.1
Maize household need	t y^{-1}	0.9	1.1	1.1	0.9
Food self-sufficiency[a]	–	4.6	2.4	1.0	0.9
Gross revenue	$ y^{-1}	830	510	190	160

[a] The food self-sufficiency ratio for maize was calculated as the annual on-farm maize production divided by the household's annual needs.

This study builds on a previous study on the diversity of smallholder farming systems and land and labour productivity in Zembe [18]. The study showed that access to labour during peak periods and cultivated area shapes the diversity of smallholder farming systems in Zembe and it distinguished four farm types: (1) large farms composed of households that cultivated more than 1.8 ha and only hired in labour (Farm type 1); (2) intermediate farms composed of households that cultivated between 0.9 and 1.8 ha and hired labour in and out (Farm type 2); (3) small farms that cultivated 0.9 ha or less and shared labour (Farm type 3a) and (4) small farms that cultivated less than 0.9 ha and only hired out labour (Farm type 3b). All four farm types shared the main goal of achieving maize self-sufficiency. Table 1 summarises key characteristics of the farm types. The large farms had more household members than the other farm types and produced more than four times the amount of maize that the household consumed per year.

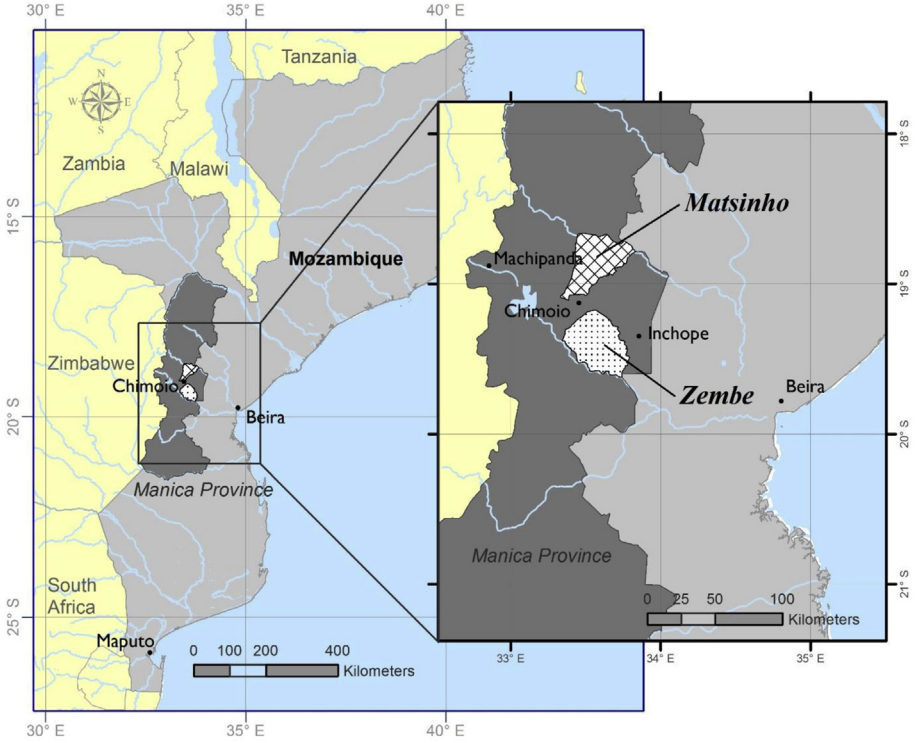

Fig. 1. Map showing the location of Matsinho and Zembe within Gondola district located in Manica, Province, Central Mozambique (ArcGIS and Microsoft office).