# Chapter 11
# Socio-Economic Impacts of Jatropha Oil and Biodiesel in Mali

**Ousmane Ouattara, Tom Burrell, Mohamed Sokona and Ibrahim Togola**

**Abstract** The potential for oil and biodiesel from jatropha is of particular interest for Mali, as the country does not produce crude oil and the resources are currently devoted for the import of increasingly expensive and heavily subsidized fossil fuel products. In 2007, the government of Mali has adopted its National Strategy for the Development of Biofuels document (based on the National Energy Policy document and the Renewable Energy Strategy document) with the objective of replacing 20% of diesel oil consumption with jatropha oil and biodiesel by 2022. This has led to the establishment of the National Agency for Biofuel Development (ANADEB) in 2009, in order to facilitate the implementation of the strategy and the elaboration of legislative rules. Several initiatives have been implemented by various actors in Mali to use jatropha oil and biodiesel for rural electrification and the transport sector. However, the contribution to the national energy supply is still very low. Meanwhile, jatropha oil and biodiesel have been heavily criticized for negatively impacting smallholder farmers in terms of food security and from being subjected to land grabbing from large corporate investors. In addition, criticism is related to the claimed reduced carbon emissions and to the economic feasibility and viability of jatropha oil and biodiesel production. This study will therefore highlight the opportunities and risks that jatropha oil and biodiesel present for a country like Mali in greening its economy, creating rural employment (both farm and nonfarm) and creating additional income. This is done by analyzing two different models of value chains, including a decentralized short jatropha value chain and a centralized long jatropha value chain. Both presented models involve smallholder farmers. The study therefore aims to contribute to increase knowledge of the literature pertaining to the socioeconomic impacts of jatropha oil and biodiesel value chains.

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## 11.1 Introduction

Mali is a vast landlocked West African country with a population of 16.3 million inhabitants and is constantly ranking among the poorest countries in the world. Around 74 % of its population lives in the rural areas, while more than 50 % of the total population live below the poverty line of US$ 1.25 ppp (purchasing power parity) per day, relying heavily on barely mechanized agricultural activities for their livelihoods (UNDP 2013). While energy plays an important development role with the provision of energy services that can significantly improve livelihoods, the Malian energy mix is highly dominated by traditional biomass that is seldom used for productive uses, while most of the modern energy consumption is from imported fossil fuels. The production of biodiesel from jatropha seeds in Mali is therefore seen by many as a great opportunity to stimulate rural development, especially in the agricultural sector while greatly diversifying the country energy mix, and positively impact the economy by enhancing the jatropha oil and biodiesel value chain.

## 11.2 Case Study at the Local Level: Mali Biocarburant SA

Mali Biocarburant SA is located in the region, district, and municipality of Koulikoro about 57 km of East of Bamako. Information gathered from the case study was done through literature review and site visits.

Mali Biocarburant SA (MBSA) defines itself as being a pro-poor commercial enterprise (Lengkeek 2007). The company was founded in 2007 with the aim of producing jatropha-based biodiesel for the local and national market. As jatropha takes 3–4 years to reach maturity, the company started making biodiesel with imported palm oil.

Now, the company is being supplied with seeds from 4,500 local farmers grouped in a union (owning 20 % of the share of the company) and who cultivate jatropha intercropped with food and crops (e.g., with peanut, cotton, maize, sorghum). One of the key guiding principles of MBSA's approach is their reluctance to possess and operate large-scale monocrop jatropha plantations, but rather to focus on experimentation and seedling nurseries to provide adequate support (sound nursing and pruning techniques) to local farmers. In that respect, the company employs 30 field agents to promote intercropping (Fig. 11.1) and land reclamation activities,monitor closely fields, land-use changes through GPS technology, and agronomic production (improved and drought-resistant seeds).

The company is producing 2,000 l of biodiesel per day in a continuous process. It has a stocking capacity of 55,000 l. The biodiesel is sold at 0.79 €, while diesel is currently being sold at 0.93 €. Among the customers are car and diesel gen-set

**Fig. 11.1** Intercropping of jatropha with cotton in Mali. (Source: D. Rutz, WIP)

**Fig. 11.2** Multifunctional platform (MFP) at Mali Biocarburant SA (MBSA) in Mali. (Source: D. Rutz, WIP)

owners as well as small- and medium-scale industries. MBSA has been able to tap into the voluntary carbon market by promoting the carbon sequestered from established farmers' plantation and use the carbon revenues to further train and assist farmers. A number of farmers working with MBSA are women who greatly benefit from the additional income which contribute to their empowerment. In general, the households that use jatropha for intercropping have increased the revenues by either a minimum of 15 % in 5 years or an average of 76 €/ha. The press cake is currently used as a fertilizer for the plantation, but plans include the setup of biogas digesters with a mix of press cake and cow dung to produce biogas to run small-scale decentralized engines (multifunctional platforms, Fig. 11.2) in rural areas. Experimentation has already started on-site (Fig. 11.3) and should be expanded soon. Glycerine is used for soap production (Fig. 11.4) by women, further contributing to increase women revenues. The jatropha value chain is presented in Fig. 11.5

One of the major components to produce biodiesel (jatropha methyl ester) is methanol which is obtained from fossil sources and thus not produced in Mali. MBSA imports its entire methanol and, amidst the tax break, it is still quite expensive. On the other side, ethanol is produced in the country from sugarcane refineries

**Fig. 11.3** Biogas plant at Mali Biocarburant SA (MBSA) in Mali. (Source: D. Rutz, WIP)

**Fig. 11.4** Soap production at Mali Biocarburant SA in Mali. (Source: D. Rutz, WIP)

and the supply is expected to increase with ongoing public–private partnership projects in the sugarcane sector. This locally produced ethanol could be further processed in anhydrous ethanol and can be a good substitute to the imported methanol for the biodiesel conversion process. The company is currently experimenting the dehydration and use of ethanol onsite and assessing its economic feasibility.

## 11.3 Case Study at the Local Level: Garalo Bagani Yelen

The municipality of Garalo is located in the region of Sikasso, in the southernmost region of the country.

Garalo Bagani Yelen, which means translated Garalo Jatropha Lighting in Bambara language, is a project that resulted from the desire of the municipality of Garalo and its inhabitants to finally have access to electricity. The project was developed by Mali Folkecenter Nyetaa in partnership with AMADER (Malian Agency for

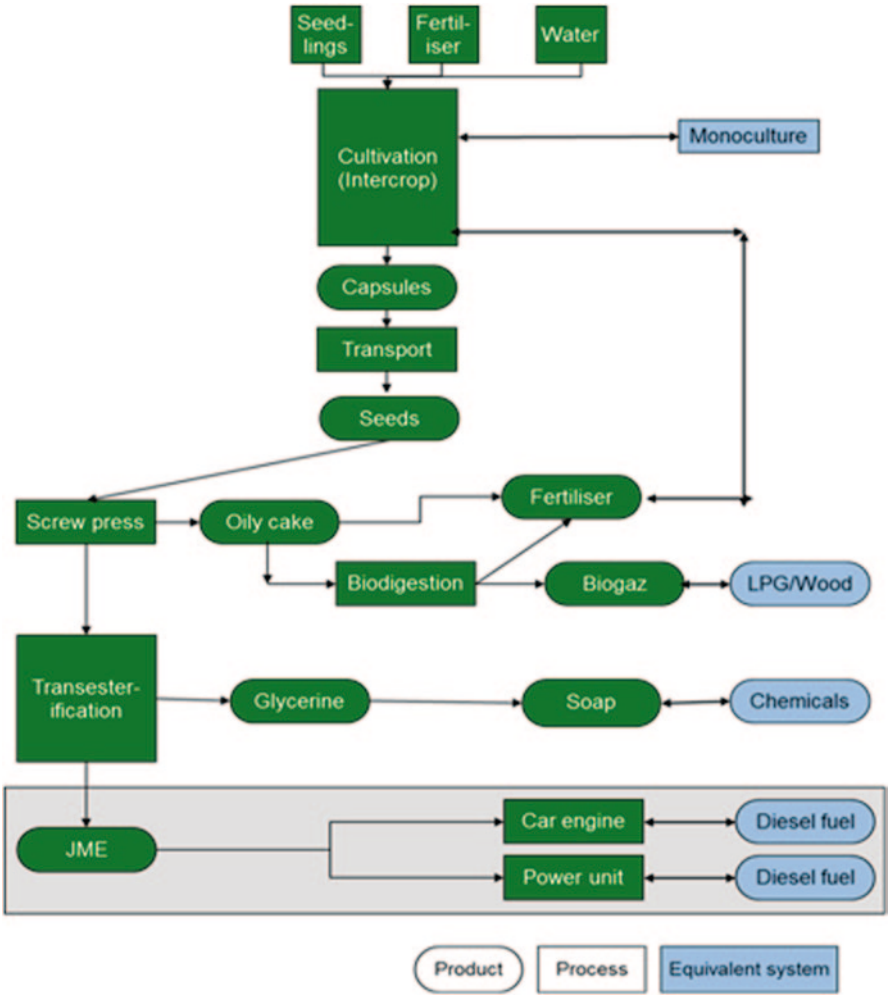


**Fig. 11.5** Flowchart of the Mali Biocarburant SA value chain

Domestic Energy and Rural Electrification), ACCESS (a local rural energy service company), FACT Foundation, Stichting Het Groene Woudt, and Stichting DOEN (Dutch technical and financial partners).

The project started in 2006 (Fig. 11.6) with the objective of providing electricity to 10,000 inhabitants in the commune through a hybrid power station (using both jatropha diesel and oil). The system includes seed-oil extraction presses and filtration equipment. The installed capacity of the electric power system is 300 kW and is designed to serve around 400 connections of which most are village households and small businesses. Activities that have been carried out in Garalo in the production of jatropha included the setting up of a 2-ha nursery that produced 320,000 seedlings in


**Fig. 11.6** Generator house of the project Garalo Bagani Yelen in Mali. (Source: R. Janssen, WIP)

2007, followed by 100,000 more in 2008 using organic fertilizers and well-prepared beds. The seedlings were transferred to farmers' field and were initially planted using a 3 m × 3 m spacing, but were later changed into 4 m × 4 m, 4 m × 5 m, and 5 m × 5 m plots to allow for adequate intercropping and for possible future mechanization of agriculture. For all fields, GPS coordinates were taken in order to have accurate record and to monitor the evolution of the various plantations (MFC Nyetaa 2008).

In 2008, the total planted area was 440 ha from which 80 ha was unsuccessful (82 % success rate) due to bushfire damages, bad maintenance of plants, and high density. Furthermore, 95 % of the 440 ha (418 ha) were planted by individual farmers (of which 6 % were owned by women) while the remaining 22 ha were collective farmers field of which 40 % (9 ha) were managed by women's group while the rest (13 ha) were managed by men's group. It is interesting to note that women-owned plantations are better managed than men's. About 27 % of the groups have put together financial accounting systems (largely women's groups) for managing income from the future sale of jatropha to the power plant.

However, jatropha is currently only marginally profitable for farmers in Garalo although the cost of labor for harvesting and dehusking the seeds was considered being lower than the selling price of 0.08 €/kg. Mali-Folkcenter Nyetaa and ACCESS are thus considering increasing the selling price to 0.11 €/kg to provide higher revenue to farmers. Furthermore, the main stakeholders are looking into the installation of dehusking hardware on the SJO-processing site to reduce farmer's labor cost. It is important to note, however, that yields have been lower than expected. Nevertheless, this is not related to the total yield of jatropha crops, as nearly all farmers did not carry out a full harvest in 2010. The highest yield harvested in Garalo was 800 kg/ha and the second highest was just 100 kg/ha. At 3 years old, the plants should be producing much higher yields according to the scientific literature (typically estimated at 1,500 kg/ha for an intercropped field). Another problem that farmers are facing is the threat of termites as they are, in general, not using pesticides to prevent attacks. Therefore, termites represent a threat to the viability of jatropha in Garalo (MFC Nyetaa 2007).

Due to this situation, it is important that significant improvements are made for the economic viability of the cultivation of jatropha before upscaling it nationally. Despite the production problems encountered, many farmers are supportive of the project, and this provides further opportunities to work with the farmers of Garalo to develop a model for jatropha production that is profitable and successful.

Regarding the power plant, the generator have been set up around the same time as agricultural activities started and have been running on diesel for 9 h a day (16:00 to 01:00). A full mechanical oil press, for pressing the jatropha seeds, with an oil filtration system was installed in 2010 with a maximum pressing capacity of 7 t/day. The currently used diesel (which represents 70–80 % of ACCESS operating costs) will be progressively replaced with SJO as adequate amount of feedstock is supplied. The current price is set at 0.32 €/kWh by AMADER. As of September 2011, the number of connected clients amounted to 350, increasing from 230 in June 2008. More than 90 % of the connected clients are households, while the remaining 10 % is divided between micro and small-scale enterprises, health services, local government building, and places of worship. In addition, public lighting is provided and every client is charged a small publiclighting fee to cover the costs. Although the bill recovery rate is quite high with an average of 90 %, it is often the case that they are collected in several installments (delay of up to 6 months) which can hinder operations. This is partly due to the fact that the major income-generating activity of households in the municipality is agriculture, characterized by seasonal income (with low to no disposable income at the end of the dry season). Therefore, there is a need to find new and innovative means of supporting households in diversifying their source of income, increase their yields (food or cash crop) or access to credits for bill payments, in order to maintain the operation. The jatropha value chain is presented in Fig. 11.7.

## 11.4 Sustainability Criteria and Certification of Biofuels in Mali

MFC is carrying out a project called “Mainstreaming Sustainability in the Biofuel Sector in Mali” in order to develop certification criteria for sustainable biofuel production in Mali. The project is funded by NL Agency and ANADEB (the Malian Biofuel Agency). ANADEB is also a strategic partner on the project, participating closely with MFC.

The project works with government institutions, the Chamber of Agriculture, the private sector (including with Mali Biocarburant—a Malian–Dutch Biodiesel joint venture), civil society (including the Malian National Jatropha Network of which MFC is the secretariat and the memberships include leading Malian research institutions), and farmers associations and cooperatives, as well as with other international bodies. Partners of this project coordinated by MFC are FACT Foundation from the Netherlands and WIP Renewable Energies from Germany. The expected results were:

- To develop sustainability criteria and a certification scheme to be adopted by ANADEB in order to lead to more sustainable biofuel production and added value for certified biofuels

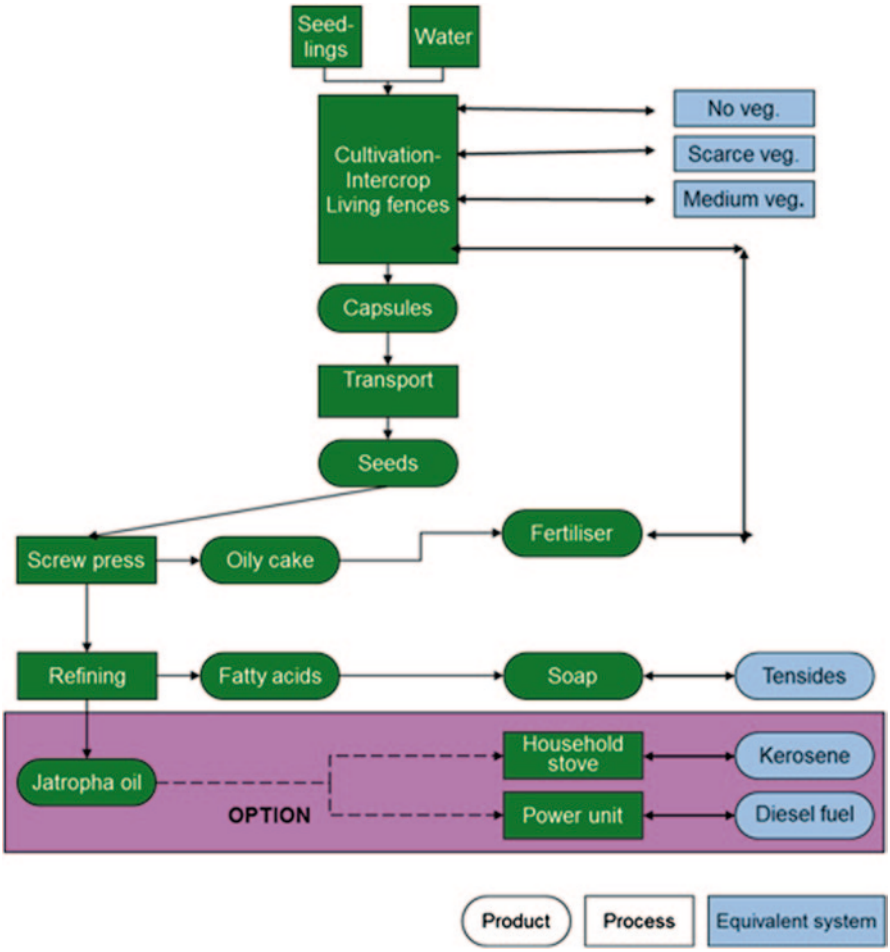


**Fig. 11.7** Flowchart of the Garalo Bagani Yelen supply chain

- To reduce undesired effects of biofuels due to more sustainable practices being promoted and adopted, through legislative support and through the cooperation with policy makers
- The main project activities included:
- Development of sustainability criteria and certification scheme
- Reduce the undesired effects of biofuels
- Set up an interactive and participatory multi-stakeholder consultation process which leads to the development of Malian sustainability criteria relevant in the local context (taking inspiration from the Dutch-testing framework for sustainable biomass, and other international initiatives); adoption of the sustainability criteria by ANADEB; setting up a certification scheme at ANADEB

- Involve high-level decision makers from government (including ministries responsible for energy and water, agriculture, environment, land tenure, employment, economy and finance, industry and trade, women, children, and the family), parliamentary commissions on rural development, energy and water, environment, and trade, and will thus support wider policy development in Mali and the subregion

To date, the project has created a multistakeholder cross-sector working group on sustainability in the biofuel sector. This was made up of four subgroups: the parliamentary group, technical services of the state, private sector, and civil society. The project carried out the largest biofuel media campaign Mali has ever seen. The project developed sustainability principles, criteria, and indicators, and a certification commission has been put in place. The administration of the commission will be carried out by ANADEB. Certain governmental institutions, which have relevant expertise, will be associated with the certification of the commission's work as required.

The commission is currently being provided with the tools it needs to carry out its tasks in the future.

## 11.5 Public Perception of Biofuels in Mali

In 2011, MFC carried out a study on the evaluation of public perception (PP) on biofuel development in Mali (MFC 2011).

Public perception is considered by the actors of the domain as a prerequisite of biofuel and bio-product support throughout the world since it determines public acceptance, and therefore the demand in biofuel/bio-products.

It was recognized that there are big differences on the way experts and the public perceive the risks associated with environmental issues. Therefore, subjective decisions (personal and exclusive decisions of experts: environment protection, poverty alleviation) must take into account the opinion of people. There is a growing awareness of decision makers about the importance of taking public opinion into account when making a decision, and about the need to properly inform the public on the possible advantages and drawbacks of biofuel projects, so that their perception and opinion can be more favorable.

The methodology used to carry out this study consisted of:

- Exploitation of existing studies on biofuels: This consisted in making documentary and internet research to identify the actors who intervened in the different variables, the external influences and crises, the cultural parameters which influence public perception on biofuel use, as well as that of national media on biofuel issues.
- A field survey among a sample of 30 persons who are not experts in the domain of biofuel development in Mali. Some of the surveyed persons (24) were selected among the urban population of Bamako and in Garalo (village located in the south of Mali in the Bougouni according to their age, sex, level of study and occupation).

In general, the interviewed persons think that the development of renewable energies and of biofuels is good because of the uncountable advantages that they (biofuels) present for developing countries, in particular in Mali. They can contribute to job creation, generation of income, and improvement of the living conditions of the rural populations through, e.g., electricity production. Another important aspect of the development of biofuels is the environmental protection against the negative effects of climate change (reduction of greenhouse gas emissions effects which contribute to global warming).

Their large-scale development in Mali would not only allow to fight against the poverty of rural populations but also to reach energy independence for the country from oil products. Ninety-five percent of the interviewed age group of 31–45 years is for the development of biofuels and 5 % against the development of biofuels.

Despite this support to the development of biofuels, some interviewed persons expressed worries about the success of the domain because of the difficulties encountered by some biofuel projects already implemented (in the country or locally).

## 11.6 Conclusion

It is shown that jatropha production in Mali offers a great opportunity to create local supply of energy, create additional income to rural farmers, contribute to local development, increase women participation in the value chain and increase their income, while contributing to a pathway towards a green economy. Although the models currently being developed have not caused any land conflicts or food security issues, the development of sustainability criteria based on these models is necessary to avoid any future negative impacts that are warranted due to the growing interest of large corporation in the sector. In addition, the expected growing prices of fuels will make the jatropha market more and more attractive and competitive. On the production side, data on yields are sparse and inconsistent partly due to the fact that jatropha is not yet fully domesticated. This stresses the need for stronger agricultural research for jatropha. Finally, the government, through ANADEB, must put in place a robust monitoring mechanism and develop sustainability criteria to ensure the sustainable growth of the field from established best practices.

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