



Jatropha! A socio-economic pitfall for Mozambique



Justiça Ambiental &
União Nacional de Camponeses
July , 2009
For SWISSAID

Coordination : Justiça Ambiental (JA) e União Nacional de Camponeses (UNAC)

Written by: Daniel Ribeiro e Nilza Matavel

Research Team: Anabela Lemos, Daniel Ribeiro, Diamantino Nhampossa,,
Leandro Marcos and Nilza Matavel

Support Team: Arsénio Banze, Fredson Guilengue, Joshua Dimon, Rehana Dada,
Sandra Janela and Sílvia Dolores

Photos: Daniel Ribeiro, Dino Ribeiro, e Nilza Matavel

Financed by: SWISSAID

Maputo, July of 2009





ACRONYMS

CEPAGRI	Centro de Promoção de Agricultura (Center for Promotion of Agriculture)
DUAT	Direito de Uso e Aproveitamento de Terra (Right to Use and Develop the Land)
FAO	Food and Agriculture Organization of the United Nations
GEXSI	The Global Exchange for Social Investment
INE	Instituto Nacional de Estatística (National Statistics Institute)
MINAG	Ministry of Agriculture
ME	Ministry of Energy
PROAGRI	Programa Nacional de Desenvolvimento Agrícola de Moçambique, (National Program for Agricultural Development in Mozambique.
ROSA	Rede de Organizações Para Soberania Alimentar (Network of Organizations for Food Sovereignty)



Contents

ACRONYMS	3
List of Figures	4
List of Tables.....	5
Executive Summary	6
1. Introduction.....	9
2. Context.....	12
2.1. Jatropha: Basic facts and uses.....	12
2.2. Mozambique: General data	13
2.3. Mozambique : Food and energy sovereignty and Jatropha.....	13
2.4. Access to land in Mozambique	16
2.5. National policy and strategy for biofuels.....	17
3. Methodology	19
3.1. Location and description of the study areas.....	19
3.2. Methods.....	23
3.3. Constraints and limitations.....	24
4. Results.....	25
4.1. Subsistence farming and Jatropha.....	26
<i>Food survey and development limitations</i>	26
<i>Pests</i>	28
<i>Cash crops and markets</i>	29
4.2. Industrial farming and Jatropha	29
<i>Case Studies</i>	30
<i>Energem Renewable Energy, LDA</i>	30
<i>ESV Bio Africa</i>	33
<i>Sun Biofuels and MoçamGalp</i>	36
4.3. Limitations and markets.....	37
5. Conclusions.....	39
Recommendations.....	41
6. References.....	43
Annexes.....	45

List of Figures

Figure 1. Examples of Jatropha projects in Mozambique. TOP LEFT: Energem – Gaza; TOP RIGHT: CHEMC agric – Inhambane; BOTTOM LEFT: Sun Biofuels – Manica; BOTTOM RIGHT: D1 Oils – Maputo.....	11
Figure 2. Jatropha curcas – Moamba District.....	12
Figure 3. A subsistence crop of maize.....	14
Figure 4. Cleared forest and kiln for the production of charcoal.....	15
Figure 5. Locations of Study Sites.....	19
Figure 6. Moamba District.....	19
Figure 7. LEFT - The local farmers and research team member, settlement of Zifuwa, Moamba District ; RIGHT – A failed Subsistence crop pf maize mixed with Jatropha.....	20
Figure 8. Bilene District.....	20
Figure 9. Interview with Energem laborers, Dzeve community, Bilene District.....	21



Figure 10. Panda and Jangamo Districts.....21
Figure 11. LEFT - ESV BioAfrica jatropha plantation; RIGHT - Member of research team on Chemc Agric jatropha plantation.....22
Figure 12. Gondola District.....22
Figure 13. LEFT - Laboers in Sun Biofuels jaropha plantation; RIGHT- MoçamGalp planation.....22
Figure 14. Farmer on farm with peanuts, Moamba district.....25
Figure 15. Farmer with jatropha seeds, Moamba district.....27
Figure 16. Jatropha with pests, Moamba district.....28
Figure 17. Location of Energem Plantation.....31
Figure 18. Energem Plantation, Dezeve community, Bilene District.....31
Figure 19. Jatropha with pests on Energem.....32
Figure 20. Tubewell opened by Energem without water pumps, Chilengue community.....32
Figure 21. Location of ESV Bio Africa Plantations.....33
Figure 22. ESV Bio Africa Nursery, Panda District.....34
Figure 23. LEFT: Bachir jatropha nursery; RIGHT: Chemc Agric jatropha project.....35
Figure 24. Location of Sun Biofuels and MoçamGalp Plantations.....36
Figure 25. LEFT: Sun Biofuels jatropha plantation; RIGHT: MoçamGalp plantation.....37

List of Tables

Table 1. LD50 of the seeds of Jatropha curcas for different animals (Wamusse 2008 - Adapted from TERI 2006) 13
Table 2. Main findings of the field study and differences between small Farmers plantation and Industrial plantation 38
Table 3. List of Jatropha Projects in Mozambique 46
Table 4. List of institutions contacted during the selection of study area.... 49



Executive Summary

In Mozambique, the debate on agrofuels has steadily advanced over the last five years, fueled by industry speculation and demand, grand promises and foreign interests. Investors have applied for rights to close to 5 million hectares in Mozambique in 2007 alone, nearly one-seventh of the country's officially defined "arable" land and is rushing to create favorable conditions for investors at the cost of civil rights of Mozambicans. A good example of this was clear with the World Bank funded National Policy and Strategy for Biofuels that purposely blocked civil society participation, lacked transparency and was only made publicly available once complete and approved by parliament.

Because of Africa's water scarce climate and the continent's large extent of supposedly 'marginal' land, Jatropha has been given the most attention as a potential agrofuel crop. However, many question the claimed benefits of Jatropha and believe that the current rush to develop Jatropha production on a large scale is ill-conceived, under-studied and could contribute to an unsustainable trade that will not solve the problems of climate change, energy security or poverty. Therefore, this study evaluates Jatropha production in Mozambique and the most common claims made in favor of Jatropha in order to delineate the differences between the rhetoric and reality.

Myth No. 1: Jatropha grows well on marginal land and can produce high yields on poor soils

Unfortunately, no cases from the literature or from any of the communities, industry experts or individuals interviewed could even mention a single example of this being true in Mozambique. On the contrary, almost all of Jatropha planted in Mozambique has been on arable land, with fertilizers and pesticides, but have still fallen short of the claimed growth rates and yields.

Furthermore, one of the main factors for Mozambique's projected potential for jatropha production is its "claims" of extensive stretches of "unused arable and marginal land". Not only are these claims believed by many experts to be grossly overestimated, at an industrial level, one must take into consideration that around 70% of Mozambique is covered in forest and woodlands [34] and most large scale agriculture projects are going to replace natural vegetation. In the current climate change crisis the lose of the major carbon sinks like forest have to been taken seriously and agrofuels in Mozambique is a threat in the combat to decrease the counties carbon foot print. In addition, it doesn't take into account neither the ecosystem services, such as sustaining local hydrology, replenishment/maintenance of soil nutrients and maintaining biodiversity; nor the resource contribution to livelihoods, such as animal protein, fruit, firewood and building material. The large extensions of these functioning ecosystem is vital in coping with the livelihood requirements of rural communities and the lose of these area to large scale agriculture will intensify the community impacts.



Myth No. 2: Jatropha requires low water use and minimal maintenance

In Mozambique it was found that irrigation was required during the early development phase, even in areas where the rainfall ranged between 800mm and 1400mm. In the southern region of the country where the lower range is around 600mm, constant irrigation was often required and even some areas that received around 800mm of rain still found it useful to irrigate their crops. In one of the districts visited there were already concerns of the impacts of the large amounts of irrigation water used by the large scale farming company in the area.

Myth No. 3: Jatropha is resistant to disease and pests

This study found extensive evidence pointing to Jatropha's vulnerability to diseases and problems with fungi, viruses, and insect pests. In cases where the plants were heavily infested the plant would stop producing leaves and stay in a state of stress, which left the farmer with no choice other than to remove the plant. The extensive use of fertilizers and pesticides has still not solved these problems. Even of greater concern in Mozambique is the growing evidence from both the subsistence farmers, and experts, of Jatropha pest spreading to surrounding food crops. More research is required to better understand the extent and impacts to subsistence farmers and food sovereignty in general, but the current food deficit, weak support and lack of "safety nets" characteristic of the subsistence farming sector makes even minor impacts serious.

Myth No 4: Jatropha does not present any risk to food security but is a development opportunity for subsistence farmers

In Mozambique Jatropha is planted in direct replacement of food crops by subsistence farmers, and given that around 87% of Mozambicans are subsistence farmers and produce 75% of what they consume, major concerns arise when one considers the plan to encourage subsistence farmers to plant large amounts of Jatropha. This concern is even further exacerbated because subsistence farmers have very weak links to markets and their lack of storage capacity, communication and information makes it difficult to benefit from cash crops. As the lowest link in the agricultural value chain, when food agricultural markets crash or slump in Mozambique, the price risks are passed down to small farmers. While subsistence farmers are somewhat resistant to food price fluctuations because they produce such a high percentage of their food consumption, non consumable cash crops like Jatropha will change this.

The land law designed to protect local communities has been manipulated by Government by unconstitutional decrees weakening communities land rights. In addition, the law identifies the importance of local community leaders in dealing with community right, as well as, the prevention and resolution of conflicts at a local level, but this is abused by investors and Government through bribes to leaders to gain community consent without community consultation. When they do take place, community consultations are often not transparent and loaded with promises that are never delivered. These abuses are facilitated by weak



dissemination of community rights, information and lack of translation of documents into local languages. When abuses are uncovered, resolution is usually very difficult, especially for communities that lack the resources and information around the legal processes. These problems have made large land grabs of community land a likely reality in Mozambique's drive for jatropha production.

Conclusions and Recommendations

The report concludes that the dominant arguments about Jatropha as a food-security safe biofuel crop, a source of additional farm income for rural farmers, and a potential driver of rural development were misinformed at best and dangerous at worst. While further independent research will give more detail, this investigation seriously challenges Jatropha as providing for sustainable fuel and development in Mozambique. Given the trend in evidence emerging internationally demonstrating the failures of Jatropha to meet expected outcomes, and in fact endangering food sovereignty and rural livelihoods, this report recommends that support for Jatropha development in Mozambique be halted until some of the major development issues surrounding subsistence farming are addressed and rural communities obtain food sovereignty. A similar conclusion was reached by Mozambique's civil society, and subsistence farmers, in 2008, resulting in the emergence of a declaration with specific recommendations that should be respected, including prioritizing of food production, greater support for subsistence farmers, increased support for cooperatives, ensuring farmers' rights, respecting community land rights, and promoting food sovereignty.



1. Introduction

Agrofuels are being promoted as one of the main alternatives to the limited and dwindling fossil fuel reserves, and industrialised countries have encouraged the expansion of agrofuel production by mandating ambitious renewable fuel targets that far exceed their own agricultural capacities. Agrofuels are projected to provide 5.75% of Europe’s transport fuel by 2010, and 10 percent by 2020, while the United States is aiming for 35 billion gallons a year. To achieve these targets, Europe would need to plant 70% of its farmland to agrofuel crops and the U.S.A. would have to process their entire corn and soy harvest for fuel. This is unrealistic and would disrupt these nation’s food supply systems. The industrialised world is therefore looking to the global South to meet their agrofuel needs, with very little consideration and understanding of the impacts, and unproven climate benefits. Southern governments appear eager to oblige, based on loose promises of development opportunities. Indonesia and Malaysia are aggressively expanding oil palm plantations in an attempt to supply up to 20 percent of the EU biodiesel requirements. In Brazil, fuel crops already take-up an area the size of the Netherlands, Belgium, Luxembourg and Great Britain combined in order to supply mainly local demand, but with the increased global demand the government is now planning a five-fold increase in land usage for agrofuels. Their goal is to replace 10 % of the world’s fossil fuel derived gasoline with agrofuels by 2025[1].

In Mozambique, the debate on agrofuels has steadily advanced over the last five years, fueled by industry speculation and demand, grand promises and foreign interests. Visits from influential leaders, such as Brazilian President Luiz Inácio Lula da Silva in 2005, have further solidified agrofuels as one of Mozambique’s paths to development. The government’s initial plans called for small and medium-scale production carried out primarily by family (subsistence) farmers. As in the Brazilian biodiesel program, companies would then purchase feedstocks from those farmers and thereby increase rural incomes. The central stated objective was to reduce domestic dependence on fuel imports, while also increasing local food production [2]. Since then, investment proposals in the agrofuel sector have increased and diversified, with several multinationals from different countries having shown interest in agro-industrial business in Mozambique, primarily focusing on sugarcane and Jatropha. Agrofuel investors have applied for rights to close to 5 million hectares in Mozambique in 2007 alone, nearly one-seventh of the country’s officially defined arable land. This doesn’t include the 40 million plus hectares of so-called ‘marginal’ land with some crop potential that the government considers potentially usable for agrofuels [3].

Because of Africa’s water scarce climate and the continent’s large extent of ‘marginal’ land, Jatropha has been given most attention as a potential agrofuel crop because of the perceived benefits of this plant over other crops. There is a misconception that Jatropha is well adapted for ‘marginal’ land, that it is high-yielding in poor soils, has low water use, and is pest resistant. Even Mozambican president Armando Guebuza, during



his presidential rallies in 2007, actively promoted Jatropha and led a pro-Jatropha campaign, divulging only the perceived benefits and advantages of cultivating the plant [4]. Other promoters of Jatropha consider it to be Africa's solution to energy independence and poverty eradication [5].

However, international studies and social movements began to raise strong concerns about the reliability of these claimed benefits [6]. Local farmers began to question the information from industry and government, and news reports exposed some of the problems associated with Jatropha. According with União Nacional de Camponeses (UNAC), the farmers revealed the difficulties of planting Jatropha in 'marginal' land, which includes slow growth rates, low yields and pests. These are farmers who believed in the promises made, invested in Jatropha production, and got no return.

Problems also became apparent with large scale agrofuel investors and the methods employed to access land. Of major concern is the lack of public participation, disregard for local culture and practices, false promises, corruption, land conflicts and resource grabs. A well studied case that highlights these practices is that of ProCana Ltd, a 30 000 hectare sugarcane project along the Limpopo river that is projected to produce 120 million liters of ethanol. The land chosen for the project, in the District of Chókwé, is not only highly fertile communal grazing land, but had also already been allocated to communities who had agreed to be relocated from their current homes within the Great Limpopo Transfrontier Park because of human-animal conflict. When the local communities realised that they would lose their grazing land the risk of conflicts emerged. In an attempt to mitigate, ProCana obtained adjacent land for grazing, but this further increased the land conflicts in the area because that land already belonged to another community's conservation park project. Nevertheless, in late 2007 President Armando Guebuza cut the ribbon for the project [7]. Even more problems began to emerge. Farmers opposed the project, arguing that it could create a regional environmental disaster as a result of excessive water consumption; the plantation requires over 400 million cubic metres of water [8]. Such situations are not uncommon with agrofuel investment in Mozambique.

This study evaluates Jatropha production in Mozambique. It is believed that the current rush to develop Jatropha production on a large scale is ill-conceived, under-studied and could contribute to an unsustainable trade that will not solve the problems of climate change, energy security or poverty. Large-scale Jatropha production will have a negative impact on food sovereignty and the ecology of the country. In Mozambique, there are Jatropha projects in the southern provinces of Inhambane and Gaza, the central provinces of Sofala and Manica, and in the northern province of Nampula.

Therefore, a good indication of the situation in the country can be gained by identifying the areas with Jatropha plantations in the south and centre of Mozambique and analysing the production in these areas. In addition, the more arid southern part of the country experiences growing food sovereignty concerns, and the

Jatropha! A socio – economic pitfall for Mozambique



negative impacts of Jatropha would exacerbate the situation significantly. The Mozambican government has been promoting itself as a southern African agrofuel hub and has attracted much interest from investors. Some of the large Jatropha companies already in Mozambique are ESV Bio Africa, Energem Renewable Energy LDA, Enerterra, Deulco Energias Renovaveis, MoçamGalp, Sun Biofuels, and AVIAM. Most have links with multinational corporates, for example Energem Renewable Energy LDA is part of Deluco Mozambique LDA, and Deulco Mozambique LDA makes up 70% of Energem Biofuels Limited (EBL). EBL is the alternative energy division of Energem Resources Inc. And Energem Resources Inc is a Canadian Company. (Annex 1 lists Jatropha projects in Mozambique). It is vital that the costs and benefits of Jatropha production at a community and industrial level are thoroughly researched to ensure good decision-making for agrofuels.



Figure 1. Examples of Jatropha projects in Mozambique. TOP LEFT: Energem – Gaza; TOP RIGHT: CHEMC agric – Inhambane; BOTTOM LEFT: Sun Biofuels – Manica; BOTTOM RIGHT: D1 Oils - Maputo



2. Context

2.1. Jatropha: Basic facts and uses

Jatropha curcas is a tall shrub of the Euphorbiaceae family that reaches between 2 to 6 metres in height. The plant has green leaves, 6 to 15 cm size, and presents small yellow-greenish flowers. It produces oval fruits averaging 1,8 cm in length and 1,2 cm in width, usually containing 3 seeds (Figure 2). *Jatropha* is indigenous to central America and the northern parts of South America and was distributed to other tropical regions by

European sailors as early as the 16th century [9]. It now grows in tropical regions throughout the world. *Jatropha* seed is high in oil content, and this is what is processed for agrofuel, specifically biodiesel. The oil is also used in domestic lamps and stoves, and the plant has medicinal uses.

Jatropha is known to be resistant to periods of stress (cold weather, drought and low radiation) partly due to its ability to relocate its nutrients in its stem and root system. This ability to survive in stressed environments has led to the assumption that it is a good crop for marginal lands, but survival in these conditions does not imply that it can yield high or sustainable quantities of oil, especially considering

that its main survival mechanism under conditions of stress is to relocate its resources away from the leaves, flowers and fruits/seeds. The productivity and profitability of the plant therefore depends on the agroclimatic conditions of the area where it is cultivated. In order to get a good quantity of high quality seeds, *Jatropha* must be grown in fertile land or with additional nutrition, must be grown in areas with high rainfall or irrigated, and requires efficient pest control implementation [10].

In Mozambique, one of the main uses of *Jatropha* is as a hedge or living fence because it is toxic and therefore not browsed by cattle. Its toxicity is due to toxalbumin of nomecurcin (toxic protein) present in its seeds, which is irritating to the gastrointestinal mucosa and also hemoagglutinating. The main toxic manifestations may be cited as: severe gastro-intestinal disturbances such as nausea, vomiting, intense abdominal pain and diarrhoea with bloody stool.

“A total of 17 children between 5 and 9 years of age were admitted to the Mavalane General Hospital on the night of Wednesday, April 1st with symptoms of *Jatropha* poisoning, commonly known as “galamaluco”. The children are all residents in the Quarter 18 of the Polana Caniço “B” Area, outskirts of Maputo” (Notícias, 3rd April 2009).



Figure 2. *Jatropha curcas* - Moamba District



Several experiments with different animal species showed that *Jatropha* seed is toxic. The following table shows the minimal lethal dosage (LD50) of seed for different animal species. The LD50 of the oil to the rats orally was estimated at 4 mg/kg (Table 1). The isolated toxic fraction when applied to the skin of the rats and rabbits causes serious irritating reactions followed by necroses¹ [11]

Table 1. LD50 of the seeds of *Jatropha curcas* for different animals (Wamusse 2008 - Adapted from TERI 2006)

Animal	Quantity of seeds		Estimation of cure Intangible (mg total)	Days
	g/Kg	g total		
Lamb	7,4	67	466	9
Goat	1,5	8	55	12
Calf	3,0	36	248	12

2.2. Mozambique: General data

Mozambique is situated on the African Oriental Coast, between the Rovuma river mouth (10° 30’S) and the South African border (26° 49’ S). It includes an area of approximately 784 755 km², bordering with Tanzania on the north, Malawi, Zambia, Zimbabwe, South Africa and Swaziland on the west, South Africa on the south and the Indian Ocean on the east. The country is divided into ten provinces: Cabo Delgado, Niassa, Nampula, Zambézia, Tete, Manica, Sofala, Inhambane, Gaza, and Maputo.

The climate is predominantly semi-arid, with 80% of the area being classified as tropical semi-arid and 15% as a sub-humid zone. The extreme zones (arid and humid) constitute respectively 2% and 3% of the total area of the country. In the southern region (provinces of Maputo, Gaza and Inhambane) the annual precipitation averages 600 mm – 800 mm and the annual temperature averages 23° C in coastal regions and 25° C in the interior [12]. This region, when compared to the northern and central regions of the country, has a relative scarcity of water resources and lower levels of agricultural production [13]. In the central region (provinces of Sofala, Manica and Zambezi) the annual precipitation averages 800 mm – 1 200 mm and the annual temperature averages 20° C - 25° C. This region has the highest agricultural output and the largest hydrological reserves. The northern region has an annual precipitation averaging 800 mm – 1 400, annual temperature averages 20° C - 26° C and is known for its forest reserves [12].

2.3. Mozambique : Food and energy sovereignty and *Jatropha*

Most of the Mozambican rural population is dedicated to the production of food. Food production is not only a survival strategy for farmers, but is also one of the few economic activities within their reach. Despite food being produced on the basis of various agro-ecological production by the majority of the population (87%),

¹ Necroses: Death or discoloration of leaf tissue resulting from infection by a pathogen agent.



the country lives with cyclic hunger and malnutrition, especially in the southern region [13]. An estimated 64% of Mozambique's rural population and 51% of its urban population (National Directorate 2004) lives below the absolute poverty line. Even though government has a national food sovereignty strategy (1998) and other policies such as PROAGRI identify small scale food production as vital for development and poverty eradication, the reality is far from ideal. Very little progress has been made on the well known problems faced by small scale rural farmers such as: links to markets; storage and processing; availability of subsidies; access to improved technologies and equipment; and irrigation.

There are areas of improvement when one compares agricultural production immediately after the civil war in 1992, when Mozambique produced only 20% of its food requirements (1992/1993), to a decade later when the nation was



Figure 3. A subsistence crop of maize

meeting about 80% of its food requirements. This improvement was a result of the combination of peace, government programs in the 1980's and early 1990's that supported the small rural farming sector, and the absence of severe prolonged droughts. However, in the last ten to fifteen years, farmers have been forgotten in the midst of the implementation of programs of economic readjustment, liberalisation of the domestic market, and the government shift towards industrialised large scale farming (something regularly backed by the World Bank and IMF). In addition to causing numerous land conflicts, these policies force the domestic agricultural producers to choose between competing against subsidised imports, or to seek alternative occupations in the cities.

At present there is a 567 000 ton deficit of food requirements in the southern region and a 222 000 ton deficit in the central region, with only the northern region showing a surplus (National Directorate of Commerce 2004). The average energy value of available food is around 2 000 Kcal per person per day. About a quarter of children are underweight, about 40% of the population is undernourished, and the average life expectancy is about 40 years. The gains made since the end of the civil war have stagnated and are even at risk of being undone as a result of the government's focus on large scale industrialised agriculture and the consequent weakening support to rural farmers. Rural development policies aim to combat poverty, but exclude the poor and implement programs that are against their interests. Farmers are faced with an agenda that tends to favour the privatisation of natural resources and basic services. These trends are threatening the economic and cultural survival of many rural producers.



Mozambique also has major energy sovereignty challenges that need to be addressed, and Jatropha has been projected as one of the solutions. Mozambique imported 750 million USD of fuel in 2008, over 300 million USD more than in 2004 [14]. Petroleum products and natural gas constitutes only 8.03% of the total energy consumption in the country, which was about 7.9 million tons of oil equivalent (toe) - about 0.425 toe per capita in 2004. The main energy source is firewood and charcoal, accounting for 89.94% (Figure 4), while hydroelectricity and coal contribute only 2.03% [15].



Figure 4. Cleared forest and kiln for the production of charcoal.

However, the lack of access to more sustainable energy sources is due not to the country's production or projected capacity, but its policies and priorities. Mozambique's output from the two gas fields in southern Inhambane province is 120 million GigaJoules (GJ) and is on the increase to 183 GJ per annum, with other gas reserves such as Pande, Temane and Buzi projected for exploration, to result in estimated gas reserves of 700x10⁹ m³ [16]. The estimated hydropower potential for Mozambique is as high as 14 000 MW, with the current hydropower production being 2 488 MW.

The 2 075 MW produced from the Cahora Bassa dam alone is enough to meet the country's entire energy needs, but only about 1% of the Mozambican rural population and 14% of the total population has access to electricity. In addition, not everyone who has access to electricity has the resources to pay for it. The bulk of both gas and hydropower produced in Mozambique is exported to neighbouring South Africa, with insignificant amounts allocated locally. Therefore, the country is still not able to meet its population's energy needs, despite having the potential to do so.

This is due partly to the open free market approach imposed by the international financial agencies that fund more than 50% of the government annual budget [17]. The local market is considered to be weak and is out-competed by foreign markets with better prices. In addition, government revenues from these exports are mismanaged and not invested significantly into solving the food & energy sovereignty crisis. The result is that the country enjoys neither food nor energy sovereignty, for reasons related to the lack of conception, implementation and management of public policies oriented to the needs of the country. Jatropha is expected to follow a similar pattern, with the majority of the production planned to feed foreign markets such as Europe.



2.4. Access to land in Mozambique

Mozambique's land law had a widespread consultation and resulted in a good balance between peasant rights and private investment, to “safeguard the diverse rights of the Mozambican people over the land and other natural resources, while promoting new investment and the sustainable and equitable use of these resources”. At a local level the land law included the recognition of customary rights over land, rights acquired through occupation, and various inheritance systems. The advantage to rural communities is that the land law does not require formal land rights entitlement and rigid processes for acquiring land rights, and communities do not pay land taxes. However, if a community wants to formally obtain their land rights they can follow a process known as demarcation which requires that a map is sketched that the neighbouring communities approve. Following this, it is automatically approved and registered in the land registry, and a certificate is issued. To strengthen community rights and facilitate land management, some NGO’s have focused on assisting communities to obtain their certificates.

The availability of land is an essential requirement for the development of agro-industrial projects. In Mozambique the land is owned by the State, and the Right to Use and Develop the Land (DUAT) is awarded to individuals or legal entities (domestic and foreign) in accordance with its social and economic order. This DUAT is valid for 50 years and can be renewed. The law defines three ways in which people can gain land use rights:

- individuals and communities have the right to land they have traditionally occupied,
- Mozambicans have a right to land which they have occupied ‘in good faith’ for at least 10 years, and
- people and companies can be authorised by the government to use land.

As for the authorisation, foreign people, local individuals, companies or legal entities can apply for a DUAT once:

- The community consultation has been made;
- The investment project has been approved;
- In the case of individuals, provided they reside for at least five years in the Republic of Mozambique;
- In the case of Legal Entities, provided they are incorporated or registered in the Republic of Mozambique

Regarding the allocation of areas, Resolution 70/2008 says:

- The applications for DUAT of areas up to 1,000 hectares must be submitted to the Provincial Governors;
- The applications for DUAT of areas between 1,000 and 10,000 hectares must be submitted to the Minister of Agriculture and Fisheries;
- The applications for DUAT that go beyond the jurisdiction of the Minister of Agriculture and Fisheries must be authorized by the Council of Ministers.



The law identified the importance of local community leaders in the prevention and resolution of conflicts at a local level. The last component has been abused by investors through bribes to leaders to gain community consent without community consultation. When they do take place, community consultations are often not transparent and loaded with promises that are never delivered. These abuses are facilitated by weak dissemination of information and lack of translation of documents into local languages. When abuses are uncovered, resolution is usually very difficult, especially for communities that lack the resources and information around the legal processes. In recent years decrees have been issued to shift the balance towards private investors. For example the decree of October 2007 changed the delimitation process by imposing approval of land based on size as required by the land rights application (<1000 hectares provincial level and >1000 hectares ministerial level). Part of the reason for this is that Mozambique has no unallocated or free land, because one community's land ends where the next starts. This can create very large community areas, and this was creating concern in the government. Even though the land law recognises customary rights over land and rights acquired through occupation, and doesn't require formal land title, large land grabs (especially by government individuals) were still easy because the community boundaries were questioned due to the low use or large area. However, once land is delimited, land grabbing is far more complicated, therefore the focus of some NGO's around supporting community delimitations. These changes in the land law have weakened community ability to protect their land, but the high level of corruption is by far still the main problem. It not only prevents communities from defending the land that they live and depend on, but also creates a sense of insecurity and disownership among the rural poor whose identity, culture and being is intricately linked to the land. This has led to individuals using land less sustainably and with less regard. In some interviews² with communities it's not uncommon to hear phrases such as, "Why protect what other are going to steal," or, "Its mine until the government wants it," or, "I must take what I can from my land before it's stolen by others".

2.5. National policy and strategy for biofuels

The National Policy and Strategy for Biofuels, approved on 24 March 2009 by the Council of Ministers, was published on 21 May 2009 in the Bulletin of the Republic.

The Strategy is an instrument that specifically focuses on the promotion of ethanol (sugarcane and sweet sorghum) and biodiesel (Jatropha and coconut) for the production of liquid fuels to be used mainly in transport, as well as for other energy purposes.

According to this document, biofuel development in Mozambique will be based on:

- Biofuels as an essential activity for the private sector that can be developed by public-private partnerships;
- Encouragement of international cooperation through the strengthening of existing links between institutions;

² Interviews in a Preliminary Survey of the Problems of Forests in Cabo Delgado



- Strengthening of cooperation with development partners, taking into consideration the growing diversity between south-south and north-south links;
- Strengthening the implementation of mechanisms and instruments of the Kyoto Protocol to encourage the rapid development of production and use of biofuels, contributing to an effective reduction of emission levels of greenhouse gases

The Action Plan of this strategy identifies actions for biofuel development in Mozambique.

Demand for biofuels :

- Establish appropriate mechanisms to secure the development of the country's biofuel industry;
- Prepare legislation to alter the TSC taxation modules;
- Prepare legislation on co-generation of electricity;
- Prepare the criteria for sustainability of biofuels;
- Contribute to the establishment of a regional agreement between the SADC countries;

Opportunities of Biofuels:

- Establish programs for technical cooperation between partners;
- Adopt mechanisms to secure the availability of biofuels based on the provisions within the gradual introduction plane.

Price fixation mechanisms:

- Develop an operational manual for the bids of the program for purchase of biofuels (PCB);
- Develop a method for price fixation for the PCB reference.

Management of social/environmental impacts and develop sustainability criteria.

Institution framework

- Create a national biofuel commission;
- Establish a national program for biofuel development (PNDB);
- Establish a program for purchase of biofuels (PCB);
- Prepare credential criteria for the certification of service providers.

Formation of social capital

- Support and establish entities for certification of service providers ;
- Develop biofuels quality norms;
- Develop specifications for the importation of flex-fuel vehicles.



3. Methodology

3.1. Location and description of the study areas

The study was mainly focused in the south due to the drier climate and larger percentage of marginal land, to which it has been claimed that Jatropha is well adapted. In addition to this, the south has the largest food deficit and food sovereignty concerns, and would be most sensitive to the negative impacts of agrofuels. At the start of the project, the southern part Mozambique was also thought to have a higher number of Jatropha projects. Other secondary reasons were the facility of travel to the areas of study; proximity to the institutions involved in the research was important given the time-frame of study. The main identified districts with Jatropha plantations in the south and centre of Mozambique were the districts of Moamba, Bilene, Panda, Jangamo, and Gondola.



Figure 5. Locations of Study Sites



Figure 6. Moamba District

District of Moamba

Moamba is situated in the north of Maputo province; its capital is the Moamba Village. Its geographical boundaries are the Massintonta River on the north, the Namaacha District on the south, the districts of Manhiça and Marracuene on the east, and on the west an artificial borderline with the South African province of Mpumalanga. It has an area of 4 628 km², and is transected by the Incomati River and some of its tributaries, Massintinta and Sábié (Figure 6). The climate is dry, with an annual average temperature that ranges between 23° - 24°C, and an annual rainfall between 580 mm – 590 mm. Two community plantations were visited in this district, one on the settlement of Goane 1 and the other on the settlement of Zifuwa (Figure 7).



Figure 7. LEFT - The local farmers and research team member, settlement of Zifuwa, Moamba District ; RIGHT– A failed Subsistence crop pf maize mixed with Jatropha

District of Bilene

Bilene is situated in the southern part of the Gaza province, covering an area of 2 719 km². Its capital is the village of Macia. Its geographical boundaries are the district of Chókwé on the north, the districts of Chibuto and Xai-Xai on the east, the Indian Ocean on the south, and on the west it is limited by the districts of Manhiça and Moamba (Figure 8). In the sub-coastal band the average annual temperature ranges from 24° to 26°C and the average annual precipitation is between 800 – 1 000 mm, which makes the climate of sub-humid type. However, in the interior regions, the climate is semi-arid and the rainfall ranges between 500 and 800mm. In this district, industrial plantations on the administrative post of Bilene belonging to the company Energem were visited. We also visited the communities that previously owned the land, and the communities neighbouring the plantation (Figure 9).



Figure 8. Bilene District



Figure 9. Interview with Energem laborers, Dzeve community, Bilene District

District of Panda

Panda is in the west of the Inhambane Province, is limited on the north by the district of Funhalouro, by the district of Inharrime on the south, by the Homoíne District on the east and on the west by the Gaza Province (Figure 10). It presents an area of 6 852 km², with tropical-dry climate, which adversely affects agricultural production (mainly rain-fed agriculture). The average annual temperature varies between 18° - 35°C, and the average precipitation is 750 mm. In this district the industrial plantations belonging to the company ESV BIO AFRICA, in the town of Inhamusse, were visited, as well as the communities surrounding the plantation (Figure 11).

District of Jangamo

Jangamo is situated in the central part of the Inhambane Province, having as the capital the village of Jangamo. Its geographical boundaries are the municipalities of Inhambane and Maxixe on the north, the Indian Ocean on the east, the Inharrime District on the south and on the west the Homoíne District (Figure 10).



Figure 10. Panda and Jangamo Districts

It has an area of 1 294 km², the climate is tropical-humid and the average annual precipitation ranges between 800 – 1400 mm. In this district the industrial plantations belonging to the company CHEMC Agric, on the agglomerate of Guifugo, were visited and local communities were interviewed (Figure 11).



Figure 11. LEFT - ESV BioAfrica jatropha plantation; RIGHT - Member of research team on Chemc Agric jatropha plantation

District of Gondola

Gondola is located in the province of Manica. Its geographical boundaries are the Macossa and Bárue districts on the north, the Manica District on the west, the Sussundenga and Buzi districts of the Sofala province on the south, the Nhamatanda District on the east, and on the northeast, the Gorongosa district. (Figure 12) The climate is a dry sub-humid and the average annual precipitation ranges from 850 - 1100 mm. The district is crossed by six rivers; namely, Pong, Revue, Mussangadze, Mudzingadzi, Thôa and Change. In this district industrial plantations belonging to the company Sun Biofuels and MoçamGalp in the neighbourhoods of Gondola Antena and Gondola Cutche respectively were visited (Figure 13).



Figure 12. Gondola District



Figure 13. LEFT - Laboers in Sun Biofuels jatropha plantation; RIGHT - MoçamGalp plantation



3.2. Methods

Phase I – Bibliographic research

This consists of the research, bibliographical analysis and synthesis of existing information about Jatropha and general supporting information. In addition, interviews were conducted with experts in the agrofuel field. The information was gathered from diverse sectors including the media, governmental institutions, and research institutions (Annex 2 lists institutions contacted during the selection of study area). This also helped us select the specific Jatropha developments analysed in the study.

Phase II – Field Work

This phase consists of visiting the identified plantations (2 communitarian and 5 industrial). Of the 9 communities visited, 2 were proprietors of the plantations and the rest are located on the surroundings of the industrial plantations. It was possible to conduct 27 formal questionnaires and interview approximately a further 50 individuals (including some company managers). Pictures were taken and GPS was used to mark the coordinates of the visited plantations.

Phase III – Analysis and interpretation of the collected data

The following parameters were used to analyse the collected information:

1. Land Use Cultivation Factors

- Plantation area;
- Production Model;
- Amount of water for irrigation by hectare;
- Number of plants by hectare;
- Amount of production by hectare;
- Storage system and seed processing.
- Access to land process,
- Land use before the project;
- Land use conflicts; and
- Proximity to protected areas, nature parks.

2. Actors of the value chain

- Main actors in the business of agrofuels;
- Subsidy or government programs for the production of Jatropha;
- Costs, benefits and profits of the production of Jatropha for the peasants;
- Final destiny for the oil produced;
- Destiny and percentage of the oil produced; and



- Jatropha used for urban/rural electrification.

3. Access to information

- Access to food;
- Information about the Jatropha shared with the peasants; and
- labour rights;

3.3. Constraints and limitations

- Lack of access to information: In Mozambique there is a deficit at institutional level concerning the provision of information to civil society, which inhibited the gathering of information about the number and origin of industrial Jatropha plantations in the country.
- It was difficult gather, synthesise and analyse information to elaborate this study because of a lack of official information, updated databases, and national studies related to the subject.
- The collection of information about the communities who live proximal to the plantations visited was made more difficult because of language - many community members could not speak Portuguese. There is also a fear of being ‘punished’ or hurt if they cooperate with the interviewers.
- It was difficult to identify and select plantations to visit because some state institutions limited our access to information.
- It was difficult to access information to elaborate this study because public consultation for the elaboration of the national strategy was not inclusive, and was only recently made available to the public.



4. Results

Mozambique's agricultural sector contributes 23% to the country's GDP³ and is the primary source of livelihoods in the country. While only around 3.6 million hectares of the total 36 million hectares of Mozambique's arable land is being used for farming, this figure distracts from both the ecosystem services the remaining arable land, often forested, provides, and from the fact that a significant amount of the 3.6

Photo: Dino Ribeiro

million hectares is shifting cultivation, and thus not static from year to year. 97% of the cultivated land in Mozambique is comprised of family-based small-scale farms. In total, this sector has around 3 million families with a average farm size of about 1.24 hectares and very rarely exceeding 5 hectares. Of these 3 million farming families, 87% are dependent on agriculture for their livelihoods and self-produce 75% of their food requirements, with a very low percentage of households marketing their food crops. Nevertheless, small farmers produce about 95% of the country's agricultural GDP [18].

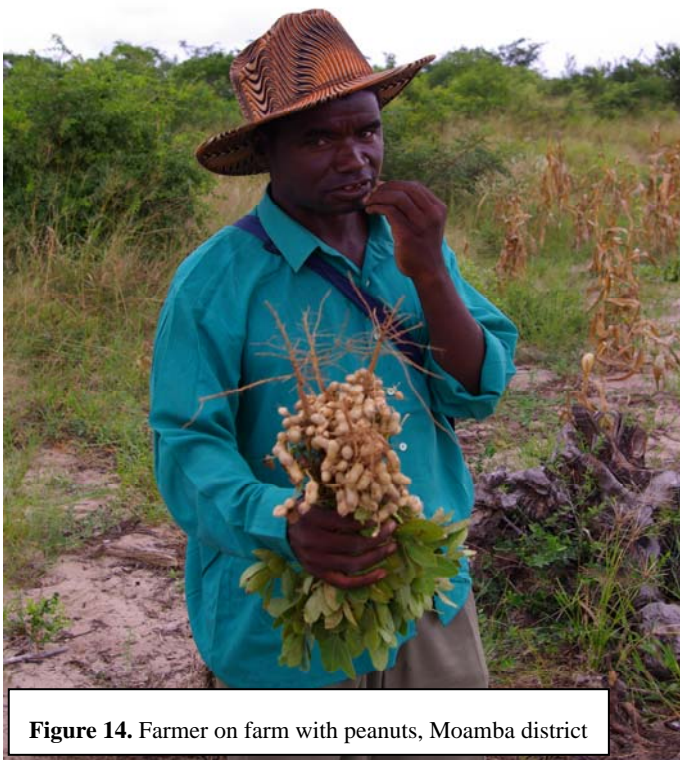


Figure 14. Farmer on farm with peanuts, Moamba district

Over 80% of the total area of cultivated land is used for the production of food crops, with the main crops being maize, beans, sorghum, cassava and rice. For the remaining 20%, the main cash crops are cotton, cashew nuts, sugarcane,

tobacco, tea, sisal and sesame[19]. The small-scale production system is characterised by manual work, use of rudimentary cultivation techniques, dry farming systems dependent solely on rainfall and without use of chemicals, while the large-scale plantation system is characterised by mechanisation, large-scale irrigation and chemical input usage.

With regards to Jatropha, the trend until recently has been to plant it as hedges or a living fence because it is not browsed by cattle. In 2004 information demonstrating the agrofuel properties of Jatropha started to become more available and by 2006 some communities were beginning to plant Jatropha as a cash crop [20]. The only government data available on Jatropha is for the 2007 season, which indicated an estimated 2,030 hectares of Jatropha planted and 64 nurseries averaging 3,000 plants resulting in a total of over

³ gross domestic product



190,000 plants [21]. However, the government study is unreliable and out-dated. For example, no information was included on the amount of Jatropha planted by the private sector or the number of existing Jatropha nurseries for over 80 of the 129 districts in Mozambique. Additionally, the government has recently acknowledged the weaknesses of this study and recognises the need for more updated studies.

4.1. Subsistence farming and Jatropha

The government study identified close to 1,000 hectares of Jatropha planted by subsistence farmers, with Nampula, Manica and Inhambane provinces having the highest Jatropha coverage of 202.5 ha, 181.1 ha and 140.8ha, respectively [22]. Many of the rural farmers who planted Jatropha in 2007 abandoned it in the following years due to the difficulties with farming Jatropha and the lack of markets for Jatropha seed. The campaigns for Jatropha, such as that of the president, combined with the projected high price of 50 MTN/kg (~ 2 USD/kg) during 2006 (over 1.5 USD/kg higher than other food crops like maize, beans and cassava) created an initial interest in farming Jatropha, but farmers subsequently turned away from it [23]. The number of subsistence farmers and hectares covered is currently unknown, but based on interviews conducted, it is possible that the values could have increased from that of 2007, mainly from new farmers experimenting with Jatropha rather than farmers increasing their already existing cultivation of Jatropha.

Food survey and development limitations

Based on the interviews and the vast knowledge-base of the national farmers union (UNAC), the subsistence farming sector doesn't plant Jatropha in marginal soils, but in good arable soils, directly replacing food crops (Figure 15). The reason for this is that subsistence farming in Mozambique is very labor intensive, making time one of the limiting factors determining the maximum area that a farmer and the family can manage. Farmers don't have the resources and capacity to cope with extra fields of Jatropha and will have to choose between the different crops, making each crop a direct competitor. Basic tasks such as obtaining water and firewood use valuable time that could be used for increasing the manageable farming area of a family unit. Other issues linked to the rural farming capacity that have to be taken into consideration are health, size of family unit, community structure (e.g. saved time from shared parenting) and many other issues. At present, subsistence farming is under stress to achieve food sovereignty partly due to the limited farming capacity imposed by the lack of development of the basic human needs of health, water, sanitation, energy and education.

Additional problems that rural communities face even when food sovereignty is achieved and surplus is possible, are the numerous obstacles faced in maximising benefits from these good years in order to develop a safety net against the bad years. The lack of infrastructure such as roads, communication systems and transport routes make it complicated to get their surplus production to local markets or even communicate with intermediate buyers to coordinate possible links with smaller sub-markets [24]. At both the local level



and the national level there are serious problems with storage limitations, but at the local rural level there is an additional lack of information around methods and forms of storage that has particular implications for dealing with Jatropha.

Jatropha's value as a biofuel is its capacity to produce seeds with a high oil content, but the quality and quantity of oil extracted from Jatropha seeds depends on numerous factors, two of the most important being the method of storage and the time taken to extract the oil. In the case of rural communities, where there is



Figure 15. Farmer with jatropha seeds, Moamba district

no capacity to extract the oil, the suggested step after harvesting is to dry the seeds in the sun for a week and then store the seeds in nylon bags. This method yields lower quantities of oil than is ideal, but more seriously impacts the quality of the oils, which decreases as time passes, becoming more and more acidic. The maximum period that the seeds can be stored before the level of acidity is too high is around 3 months [25]. Buyers are well aware of these limitations, but most communities are not aware of this nor have they even been trained to store the seed in this form. In contrast, Jatropha seeds planned for replanting have to be dried in the shade before

storage and the probability of germination decreases with time, thus making it very important to replant as soon possible using a lot of water during the early phase of development. This additional care is not mentioned during the campaigns and rural farmers who were expecting an easy, low-maintenance crop ended up using valuable time to keep their investments alive. Major risks are imposed on rural farmers by both the storage requirements and the lack of efficient links to markets, which slows down the flow of goods from producer-to-buyer.

In 2008, civil societies, the farmers union (UNAC), and subsistence farmers from around Mozambique got together to discuss the many concerns around agrofuels in Mozambique and released a declaration stating that the race towards agrofuels would cause land conflicts and exploitation of farm labor, and create an excessive dependence on chemical-based farming (with environmental impacts). It recommended the prioritisation of food production, greater support for subsistence farmers, increased support for cooperatives, that farmers' rights are ensured, respect for the land law and land rights, and the guarantee of transparency (Annex 3, full statement). In general it was believed that the race towards agrofuels was harmful to



Mozambique’s people, especially subsistence farmers, and that the country was not ready to move towards small-scale agrofuel farming such as Jatropha while food sovereignty is not yet a reality.

Pests

Another risk of concern is that of pests. Information from various individuals (UNAC and JA field staff ; specialists such as Eng. Gagnaux, journalists who have visited or interviewed these communities, etc) and all the communities visited during this study revealed that the Jatropha plants were infested with pests, especially in the southern region. The highest occurrence of pest infestation was during the rainy season which normally coincides with the fruit crop season. In cases where plants were heavily infested, they would stop producing leaves and remain in a state of stress, which left the farmer with no choice but to remove them (Figure 16). Additionally, interviews revealed a lack of local government capacity to assist farmers in pest treatment.



Figure 16. Jatropha with pests, Moamba district

“When the population goes to the District Services of Economic Activities looking for solutions to attack plagues, the authorities claim not to have the knowledge of technologies to treat the plant (Jatropha) because this is a new plant and they had no training in plague treatment techniques before implementation” (Interview in Moamba District with Community of Goane 1, 10th March of 2009)

Particularly worrying is that in interviews with subsistence farmers in Moamba District, regular accounts of Jatropha pests spreading to other food crops such as sorghum, maize, and peanuts were mentioned. Although the majority of the pests associated with Jatropha should be host-specific and not attack other food crops, increasing evidence suggests that this may not be the case. In interviews with Eng. Gagnaux, who wrote her undergraduate thesis on the entomofauna related to Jatropha in Mozambique, she noted that if Jatropha is cultivated in combination with food crops, or close to them, there is a risk of Jatropha pests contaminating other crops. Additionally, of particular relevance to Mozambique, the Jatropha Handbook (2006) states *“that [Jatropha] could possibly contain viruses harmful to cashew nut trees, which occur in large quantities all over the country”* (page11).



Of the forty pests covered in the Eng. Gagnaux study, eight had never before been seen in Mozambique, which the author found to be concerning. However, the Jatropha plants from which the insects were collected were in their vegetative or flowering phase, so it is possible that even more pest species could be found in the stages of fruit development and maturation. In addition, Eng. Gagnaux raised the possibility of Jatropha behaving as a plant parasite by consuming the nutrients of other plants in the area, making Jatropha potentially risky for small-scale farmers dependent on nearby food crop plots.

Cash crops and markets

The subsistence farmers visited don't have much information about Jatropha: they know that the plant produces oil to make biodiesel, that they can sell it, and that its seeds must not be eaten because they are toxic. Therefore, they are very vulnerable to the extensive marketing campaign around Jatropha and this has generated interest from subsistence farmers for using it as cash crop. In general, the leaning to grow cash crops is more dominant in the central and northern region of the country where rainfall is higher and high value cash crops such as tobacco, sugar cane and cotton can be cultivated. However, even in these regions the weak links to markets limit community investments in high value cash crops. The other forms of cash crops are chosen primarily because of the ease of storage, as this allows communities to wait until prices are good and/or wait out oscillating transient sales opportunities (e.g. sales to trucks that pass through communities to collect various products at various times). Jatropha has been marketed as both a high value cash crop and one that stores well.

This creates two types of concerns when dealing with Jatropha. In cases where communities are close to industrial buyers, one concern is that it will follow a similar path to that of farmers who have shifted to sugarcane production to supply a neighbouring plantation. The subsistence farmer obtains seeds and chemicals on loan and this is usually deducted from the price when the harvest is sold, but lack of experience with these new crops combined with the climate risks that regularly occur lead to lower yields than expected and the subsistence farmer falls into a growing cycle of debt [33]. The other concern is that the false information about Jatropha's ease of storage will attract subsistence farmers who are not close to markets, which would could cause subsistence farmers to lose large amounts of time and resources on a crop that has no possibility of providing for them.

4.2. Industrial farming and Jatropha

With around 90% of its arable land free of agricultural activity, favourable natural climatic conditions, large and fast growing regional markets for liquid fuels, and a positive investment climate with government-backed incentives and guarantees, Mozambique is considered to have huge potential for large-scale industrial farming, and has attracted strong interest from agrofuel investors. It has been estimated that by the end of 2007 agrofuel investors had applied for rights to as much as 5 million hectares of arable land and there are unverified reports that government received over 3 000 agrofuel-related proposals during 2007 alone [26].



Based on the current data (Annex 2 : Table of Jatropha projects in Mozambique) there are presently 183 137 ha of arable land allocated to Jatropha production. 47% (87 000 hectares) of this is from the 4 projects analysed during this study (Energem Renewable Energy, LDA, ESV Bio Africa, Sun Biofuels and MoçamGalp) which have already planted 9 907 hectares. This is just the beginning and government is strongly committed to the success of the agrofuels program with projections of biodiesel production between 106 2265 tons (worst case scenario) and 273 811 tons (optimal projection) by the year 2025 [27]. The vast majority of the current Jatropha projects are found in the southern provinces of Inhambane and Gaza; the central provinces of Sofala and Manica; and in the northern province of Nampula.

Mozambique's petroleum company Petromoc, LDA. is one of the larger investors with proposals to invest in both ethanol and biodiesel production units, one in the central region of the country and one in the southern region. The estimated investment is projected to cost over 58 million USD: 28 million USD for the ethanol processing plant, with a production capacity of 27 000 tons of raw material per year resulting in 33 000 m³ of ethanol; and 38.2 million USD for the biodiesel processing plant, with a production capacity of 35 000 tons of raw material per year resulting in 40 000 m³ of ethanol. The total operational costs have been put as low as 0.33 USD/liter for ethanol and 0.41 USD/liter for biodiesel [28].

Case Studies

In all the industrial projects visited, Jatropha is planted on large expanses of arable land and all make use of chemical based fertilizers (e.g. N-P-K 12-24-12, 46 Urea) and pesticides (mainly petroleum based). Despite the use of pesticides, pests are still regularly apparent and are a major problem as noted above, forcing some of these projects to experiment with different mixes of pesticides, stronger chemicals and other types of controls such as hormone treatments.

Energem Renewable Energy, LDA

Energem has been allocated 60 000 hectares in Gaza province that was previously community farming and grazing land (Figure 17). The project uses seeds from Malawi, but are considering experimenting with seeds from other regions due to slow growth rates, pest problems and lower than expected yields from their current crops. At present each hectare contains 1 716 plants and is irrigated with groundwater from boreholes. During the development phase of the plants they use 7 500 liters per hectare per day resulting in 108 525 500 liters per day for the total 1 447 hectares of currently cultivated area (Figure 18). Most communities do not depend directly on groundwater significantly, and this was therefore not considered to have an immediate short-term impact on their water supply, but groundwater levels influence the hydrology of the area. In addition, the town of Bilene and some rural farmers do depend on groundwater, and there are concerns about salt water intrusion into groundwater and fresh water bodies due to the area's proximity to the ocean.

Jatropha! A socio – economic pitfall for Mozambique



Energem both directly plants from seed, and transplants seedlings grown in nurseries. The trend in the industrial farming of Jatropha in Mozambique has been towards nurseries and transplanting of seedlings. This allows the farmer to meet the higher water/nutrients requirements and cope better with the higher sensitivity during the early growth phase. For example, Energem's success rate for seed germination is well below 10%. More recently the industry has been looking into cuttings (pieces cut from a parent plant) to decrease the time and cost of growing healthy seedlings. Once a plant has reached a pre-determined size, usually after its first flowering, it is pruned to increase the number of branches. There are strong correlations between the number of branches and the amount of fruit, as fruit grows mainly on the ends of branches. At Energem the pruning is planned for the first 4 to 5 years of plant growth, after which, ideally, each plant would have close to 100 branches and be able to produce around 1 kg of seeds per plant per harvest, which is considered a good economically sustainable yield.

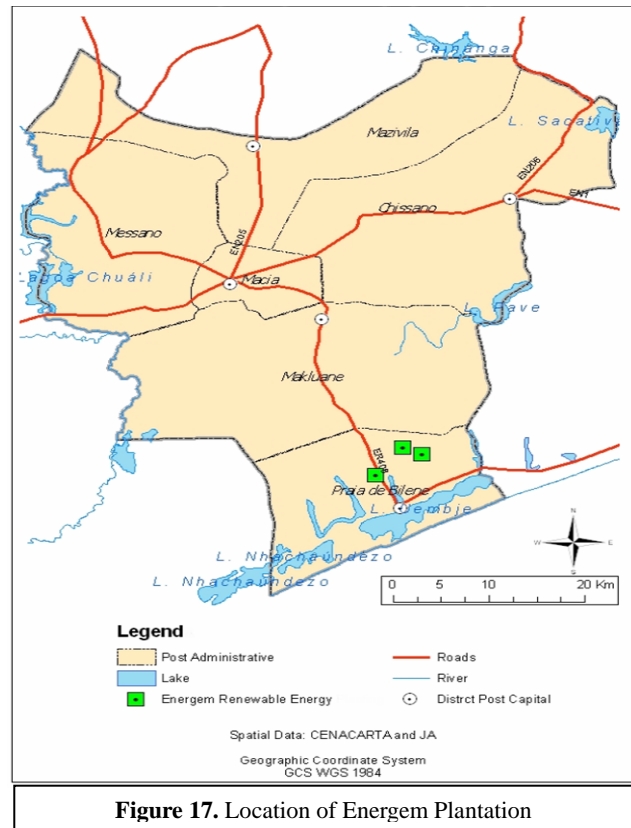


Figure 17. Location of Energem Plantation



Figure 18. Energem Plantation, Dezeve community, Bilene District

Jatropha! A socio – economic pitfall for Mozambique



Unfortunately, the growth has been much slower than predicted and after 2 to 3 years of growth most plants have only 18 to 30 branches and are producing well below the required amount. At this rate the plants are still 3 to 5 years away from producing the amounts of seed predicted. Further delays have been caused by major pest attacks that have caused plants to become stressed, lose all their leaves and stop flowering, forcing Energem to replant entire fields, starting the process all over again (Figure 19).

Another issue is that of Energem’s relationship with the local communities. The land was acquired through DUAT by means of community consultations/negotiations that were done mainly between the Regulo⁴ and Energem. In the process, Energem made numerous promises to develop the area in exchange for the land, but after two years of inaction, the communities are becoming restless about the delays with delivering on the promises (Figure 20).

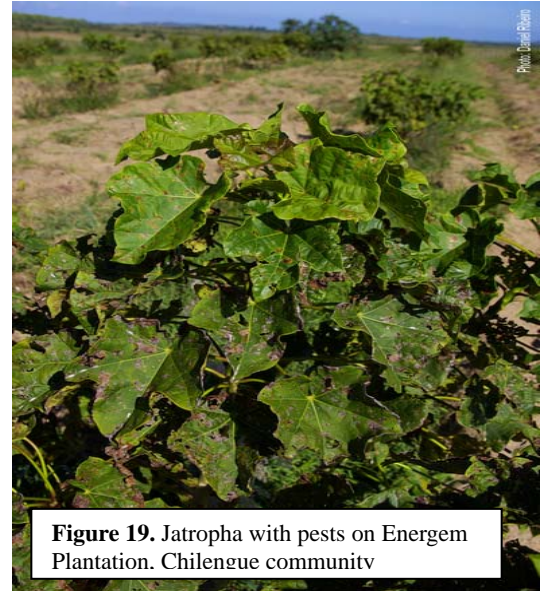


Figure 19. Jatropha with pests on Energem Plantation. Chilengue community

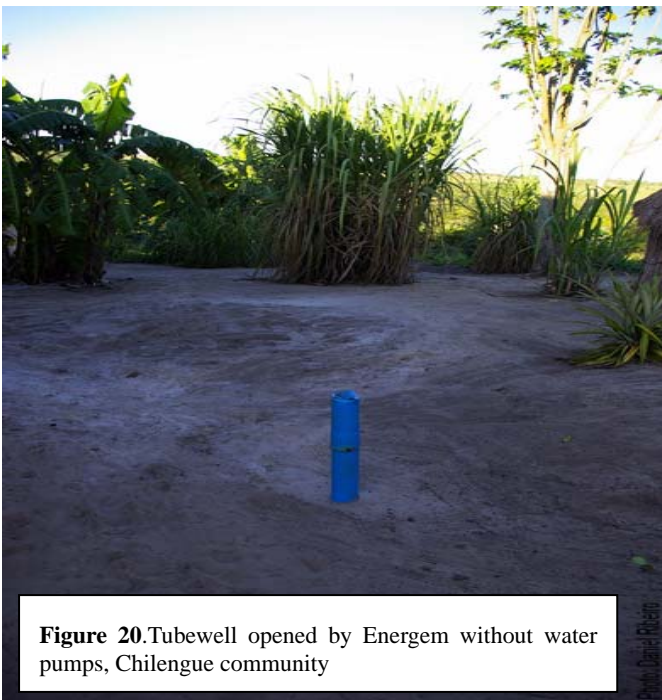


Figure 20. Tubewell opened by Energem without water pumps, Chilengue community

“When the company arrived here, they promised to build schools, hospitals, make water holes, help widow women and abandoned children and provide scholarships for the young men, but it has been two years and almost nothing was done. The one thing done was water holes but they did not install water pumps... how is it going to be possible to get the water from the hole? When we complain they say that by the end of this year the hospital will be ready but until now we haven’t seen any movements to build anything. The record of the public consultation is in the hands of the company and with the local authorities” (Interview in Bilene District with Community of Chilengue, 9th April of 2009).

⁴Regulo is a communitarian lider that represents the maximum authority at a communitarian level, and his considered by the population as the most knowledgeable person and capable of resolving the community interests.



One of the weaknesses in the community consultations/negotiations raised by the individuals interviewed was the role of the Regulo who is believed to be corrupt. The research team did notice the well-above-average standard of living when compared to all other Regulos interviewed in this study. Numerous stories were told of the Regulo being involved in community land transfers of a single plot of land to more than one private investor that resulted in one of the investors losing their investment. One such conflict exists with a small subsection of Energem's land and another independent conflict is believed to be in court (Interview with a tourist operator in Bilene). However, the Regulo is an important district member of the governing party Frelimo and is feared by the local communities, and many community individuals mentioned the pressures they faced to hand over their land.

“The Regulo of the Chilengue Location put pressure on the population to sell their land to Energem Company, declaring that the company, besides giving money to buy that piece of land, would grab up another area for the people to farm” (Interview in Bilene District with Community of Chiixo, 9th April of 2009).

Independent of the level of corruption of the Regulo, it is clear the local communities are not receiving any major development from Energem in the form of schools, hospitals or water and sanitation. However, one of the benefits for the communities in the area has been the increased employment. An estimated 500 jobs (permanent and seasonal) have been created in the area by Energem and this is expected to increase with the increase in Jatropha coverage [29]. The average worker receives 1 650 MT per month (+/- 60 USD) and has a working day that starts early and ends early, leaving some daylight hours to attend to personal fields. However, the salaries, despite meeting the minimum wage, are too low to allow for workers to improve their standard of living.

ESV Bio Africa

The ESV biodiesel project is located in Inhambane province and covers an area of 11 000 hectares, of which 7 400 hectares have been already planted. ESV also uses seeds from Malawi and plants an average of 1 250 plants per hectare (Figure 21). They do not plant seeds directly, but use nurseries and then transplant the seedling to the fields. Plants are manually irrigated during the early phase of development while in the nurseries (Figure 22). The water is sourced from the Inhassaune river and the nursery consumes 10 000 litres per day. Once the seedlings have been transferred to the field they are not irrigated and depend solely on natural rainfall.

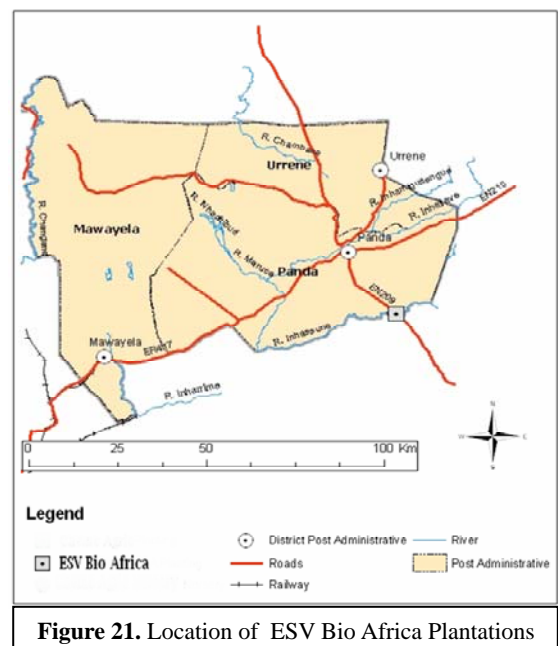




Figure 22. ESV Bio Africa Nursery, Panda District

ESV acquired the land in the same way as Energem (DUAT through negotiation with the Regulo), but the communities were content with the role of their Regulo in the negotiations and were more involved than in the Energem case. The main issues raised were around the extent to which ESV delivered on its promises. For example, the company started the process to improve the existing school and hospital, but stopped due to the financial crisis. In addition, the community benefited from new water supply points and in minor social support such as for occasional funeral costs. The company originally employed around 1 350 workers and paid permanent workers 1 950 MT per month (72 USD) and seasonal workers 1 250 MT per month (46 USD). However, many workers have left because of more than nine months of non-payment of salaries. The majority have remained at the request of the provincial government.

“The workers have no salary for nine months, and as consequence they organised a manifestation. To calm down the tense sufferers, the Permanent Provincial Secretary of the Ministry of Labour travelled to the locality and explained that it was a question of financial crisis that would soon be resolved as the owner was already looking for partnerships to resolve the problems, and appealed that the workers did not abandon their working places” (Interview in Panda District with Community of Inhassune, 19th May of 2009)

Originally the local farmers saw the job opportunity as a form of secure and constant income to compensate for the farming risks. For example, 20 of the country’s districts are highly prone to drought; 30 to flooding; another 7 to both; and over all, 48.2% of the population is prone to one or both risks [30]. The income from the wages are lower than what can be obtained from an average to good farming year, but higher than the revenue from a bad farming year. Furthermore, the revenue from farming was more seasonal, with a low revenue phase that caused problems. By combining the farming with the wages, the family unit could benefit from both the peaks from farming and the constant predictability from the job. However, both here and in other areas visited, the communities underestimated the decrease in the farming area they could manage, and

Jatropha! A socio – economic pitfall for Mozambique



farming areas used by these family units decreased from comfortably above 1 hectare to about 0.5 hectares. Therefore, these families have suffered even more from the lack of wages during the last 9 months.

ESV Bio Africa is currently in a financial crisis due to the longer than expected time it has taken to make the plantations stable and productive, the high cost, lower than expected outputs, and market fluctuations. This has left the company in need of further investment and they are even considering selling.

“... the Group announced that it is currently awaiting a formal offer for the sale of our Mozambique operations, but at the same time it is also considering off-take arrangements for the supply of Jatropha oil, commencing with this year's crop, with interested parties in the European biofuel industry, based on the strategy to expand and manage operations”
ESV GROUP, 2009.

Other companies have also been seriously affected, and two other companies that we visited, CHEMC agri and Bachir Jatropha, were completely paralysed (Figure 23). All companies visited and experts interviewed mentioned the risks involved in investing in Jatropha because it is a new crop and there is relatively little information about its large scale farming applications. This is further complicated by Jatropha's varied dynamics in different areas. A lot of funds need to go into research before an economically sustainable large-scale industrial farming setup is achieved for the different regions in Mozambique. Because markets for agrofuels are still young, petroleum prices have crashed, and the global recession is worsening, agrofuel investors are facing a particularly risky situation.



Figure 23. LEFT: Bachir jatropha nursery; RIGHT: Chemc Agric jatropha project

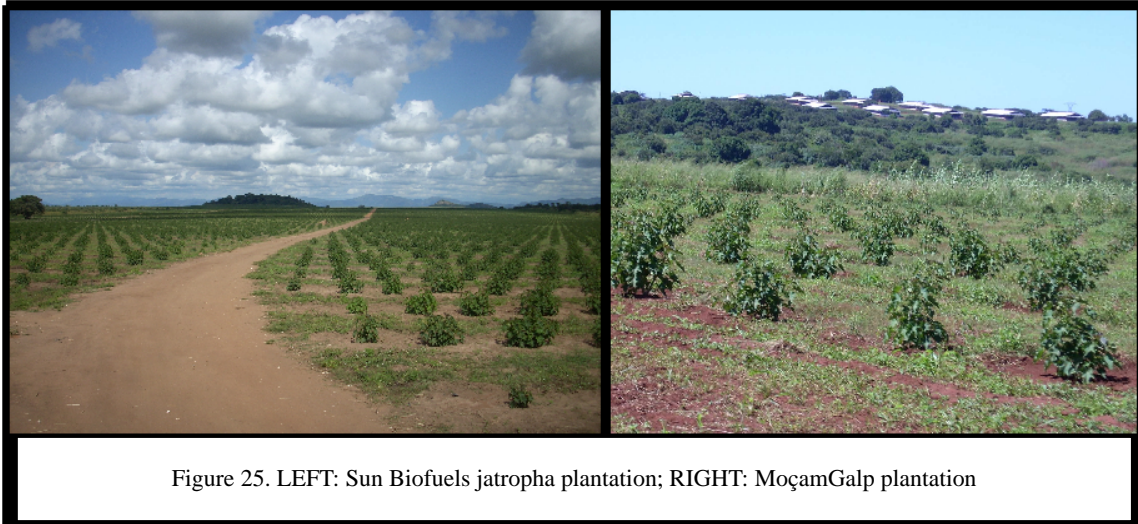


Figure 25. LEFT: Sun Biofuels jatropha plantation; RIGHT: MoçamGalp plantation

4.3. Limitations and markets

Based on the interviews and literature, Jatropha is not the miracle crop it has been marketed to be, but actually has very specific requirements and limitations. Local experts have realised this and mentioned that Jatropha actually requires soils with good nutrients, pH >5, good levels of nitrogen, potassium and calcium in order to produce good yields. A lot of care is needed during the first 18 months when the plant requires large amounts of water (at least 5 to 7 litres per day), this being a crucial phase for the plant's survival. During this development phase the plant will produce its first fruits, but only reaches peak production in 4 to 5 years, after which it can remain productive for up to 40 years [31]. The recommended rainfall is between 600 mm – 1300 mm, but only areas with rainfall levels above 800 mm have shown any signs of sustainability. However, the truth is that there is still not enough information, and many industrial farmers are having major problems due to a lack of understanding of the agroecology and economics of Jatropha, especially as obscured by the false marketing of the crop.

“ Planting Jatropha requires a lot of investment, from the training of staff through to control of pests. I have been in various industrial Jatropha projects and sincerely, not one of them seemed sustainable because there wasn't adequate training. I have offered my services to develop the capacity, but they (the projects) reject it and think its just one more expense” (Director of Bashir Jatropha)

The setbacks keeping Jatropha from functioning at an industrial level have delayed the formation of a local market for the seeds and prevented the subsistence farmers who responded to the Jatropha campaign from being able to sell any of the seeds they have produced. However, even the market that was predicted was an



export market served primarily by the large producers, and vulnerable to fluctuations in the international price of seed, biodiesel, and competing fuels, including the incredible price volatility of petroleum. Thus, small-scale producers would be subject to a quite unpredictable market, and one that does not even serve the domestic market of the country.

Table 2. Main findings of the field study and differences between small Farmers plantation and Industrial plantation

	small Farmers	Industrial Plantation
Land use cultivation Factors	<ul style="list-style-type: none"> - Small land extensions - Fertile land - Combined with food products - Few plants - No irrigation is practiced - Regular pests - <i>DUAT</i> 	<ul style="list-style-type: none"> - Long land extensions (the visit plantations vary from 60 hectares to 7400 hectares) - Fertile Land - Chemical based fertilizers - 1250-1716 plant/ha (South of the country) - 1250-1667 plants/ha (Centre of the country) - Manual and Industrial irrigation (South of the country) - Manual irrigation in the beginning of the plantation process (Centre of the country) - Regular pests - Chemical based pesticides - Purchase of infra-structures - <i>DUAT</i>
Actors of the value chain	<ul style="list-style-type: none"> - Lack of market -No benefits Jatropha of production of 	<ul style="list-style-type: none"> - International Market
Access to information	<ul style="list-style-type: none"> - No access to information on negative impacts of Jatropha 	<ul style="list-style-type: none"> - Promises to built schools, hospitals, make water holes do not come true (in Bilene District) - labour hours are not respected (in Gondola District) - Delayed salary (in Panda District) - Minimal wage (in Gondola District)



5. Conclusions

Jatropha has been the subject of much hope and speculation for both rural development objectives and alternative energy interests for Africa [32]. However, the evidence emerging in Mozambique around current Jatropha developments is contradicting the bulk of the promising claims made by promoters of Jatropha.

Grows well on marginal land and can produce high yields on poor soils?

Africa has large areas of ‘marginal’ land, and the claims that Jatropha can grow in marginal lands and still produce good yields has been a major driving force behind its choice as one of the main crops for Mozambique’s agrofuel strategy. Unfortunately, no cases from the literature or from any of the communities, industry experts or individuals interviewed could mention even a single example of this being true in Mozambique. To the contrary, nearly all Jatropha plantations in Mozambique have been on arable land, and have still fallen short of the claimed growth rates and yields.

Mozambican experts such as Dr. Bashir admit that Jatropha needs specific conditions and care to produce good yields, such as soils with good nutrient levels, a soil pH >5, and good amounts of nitrogen, potassium and calcium. Additionally, studies have actually shown that Jatropha is unlikely to produce a high yield on marginal lands or soils with low nutrients (e.g. Jatropha: wonder crop – Experience from Swaziland). In general it is very hard to predict what yields will be produced in different areas, and case-specific studies will be important to determine Jatropha’s viability for any specific area of interest. Both government and industry is aware of the diverse studies, but still choose to make these claims without researching the local reality. Of even more concerning is that there are cases of large-scale industrial Jatropha farms that have followed all the recommended methods, including extensive use of fertilizers, pesticides and irrigation, but are still showing slow growth rates and not achieving sustainable yields. If anything, current research and studies in Mozambique are showing the promises of high yields in poor soils to be a myth. At the very least it is clear that more independent research is required.

Additionally, at an industrial level one must also take into consideration that around 70% of Mozambique is covered in Forest and woodlands[34] and most large scale agriculture projects are going to replace natural vegetation (on the estimated 32 million available hectares). Furthermore, the measure of “available” land does not take into consideration the shifting cultivation nature of subsistence farming in Mozambique, which means if forested lands surrounding current agricultural areas were used for Jatropha, farmers would cut additional forest lands when shifting plots. Therefore, the claims of large areas of “unused” arable land doesn’t take into account either the ecosystem services or the resource contribution of these lands to livelihoods. In the current climate change crisis the loss of major carbon sinks like forests have to be taken seriously and agrofuels in Mozambique is a threat in the drive to decrease the country’s carbon footprint.



Requires low water use and minimal maintenance?

It is often claimed that Jatropha can grow in arid areas, but in Mozambique it was found that irrigation was required during the early development phase, even in areas where the rainfall ranged between 800mm and 1400mm. In the southern region of the country where the lower range is around 600mm, constant irrigation was often required and even some areas that received around 800mm of rain still found it useful to irrigate their crops. In one of the districts visited there were already concerns of the impacts of the large amounts of irrigation water used by the large scale farming company in the area.

Communities that experimented with Jatropha had to provide 5 to 7 liters per day per plant. In some areas these water requirements competed with family water use, forcing women and children to make extra trips for water. In cases where Jatropha was not watered, especially in the early phases of development, the germination rate was extremely low and plants were more prone to disease, stress and shock.

Resistant to disease and pests?

There is increasing evidence of Jatropha's vulnerability to disease (e.g. leaf spot, collar rot and root rot) and problems with fungi, viruses, and insect pests. In Mozambique, interviews confirmed Jatropha's lack of resistance to disease and pests, with greater vulnerability of the plants the lower the rainfall and the higher the environmental stressors (e.g. soil quality, nutrient absence, etc.). The highest occurrence of pest infestation is during the rainy season that normally coincides with the fruit crop season. In cases where plants were heavily infested, they would stop producing leaves and remain in a state of stress, which left the farmer with no choice but to remove them.

In Mozambique, a further problem with Jatropha pests and diseases is that it is evident that they are spreading to other crops, which is of great concern. One report showed a Jatropha-based disease spreading to cashew nuts; communities consistently recounted cases of Jatropha pests spreading to other food crops such as sorghum, maize and peanuts; and an increasing number of experts are raising similar concerns. The impact on food sovereignty due to crop losses from pests and diseases are severe, and almost all subsistence farming is without chemical support, making this sector particularly vulnerable to new pests and diseases. However, based on the industrial Jatropha plantations, even with the use of pesticides, it is difficult to control the numerous infestations that Jatropha is prone to. At present, government and industry has no solution to these problems and internationally the problem has been serious enough for Bayer CropScience, in partnership with Daimler, to reportedly invest in developing herbicides, insecticides and fungicides specifically for Jatropha. However, if Jatropha does turn out to require substantial levels of fossil-fuel based chemical pesticides and fertilizers, the energy balance may turn negative.



No risk to food sovereignty and a development opportunity for subsistence farmers?

Jatropha is planted in direct replacement of food crops by subsistence farmers, and given that around 87% of Mozambicans are subsistence farmers and produce 75% of what they consume, major concerns arise when one considers the plan to encourage subsistence farmers to plant large amounts of Jatropha. This concern is even further exacerbated when one looks into the weak links subsistence farmers have to local and national markets. As the lowest link in the agricultural value chain, when food agricultural markets crash or slump in Mozambique, the price risks are passed down to small farmers. Currently subsistence farmers are somewhat resistant to food price fluctuations because they produce such a high percentage of their own food consumption, but non-consumable cash crops like Jatropha will change this.

Jatropha will have detrimental impacts on livelihoods in Mozambique if the development and infrastructural limitations of the country are not considered. Subsistence farmers require increased access to basic services (e.g. water, electricity, extension services, education, etc.) before they can increase their farming capacity as the lack of these services means they do not have surplus time to add acreage to their current farms. These limitations force subsistence farmers to replace one crop with another, rather than add acreage, which in the case of Jatropha would generate competition between a cash crop and food crops. In addition to basic development, more support has to go directly into the small scale farming sector in Mozambique before the high risks of Jatropha can be mitigated (e.g. micro credits, support and training around farming cooperatives, training around farming methods and market links and information, storage capacity and knowledge to allow farmers to wait for better prices, basic services, and so on). Jatropha does not present a development opportunity, but rather requires substantial development in the subsistence farming sector to be successful.

Recommendations

This research concludes that Jatropha in Mozambique has not met any of the expectations created, and is at high risk of worsening livelihoods and food sovereignty in rural areas. The dominant arguments about Jatropha as a food-security safe biofuel crop, a source of additional farm income for rural farmers, and a potential driver of rural development, were found to be misinformed and incomplete when compared to evidence from current Jatropha developments in Mozambique. The government is not prepared to deal with the likely consequences of Jatropha development and the national biofuel strategy does not include a strategic environmental assessment on the impacts of Jatropha. The marketing around Jatropha is obscuring the reality and the general public needs to be better informed about the truths of Jatropha. While more independent research is certainly needed, this investigation seriously challenges the hope for Jatropha as a silver bullet for fuel and development in Mozambique.

Given the trend in evidence emerging internationally demonstrating the failures of Jatropha to meet expected



outcomes, and in fact endangering food sovereignty and rural livelihoods, it is recommended that support for Jatropha development in Mozambique be halted until some of the major development issues surrounding subsistence farming are addressed and rural communities obtain food sovereignty. A similar conclusion was reached by Mozambique's civil society, and subsistence farmers, in 2008, resulting in the emergence of a declaration with specific recommendations that should be respected. Europe and the United States should look inward for their energy sustainability solutions rather than towards Africa, including through demand-side management and increases in automotive and industrial energy efficiency. Only after these initial steps have been taken should research be conducted on the potential contributions of agrofuels to global sustainable energy balances, and these studies should first and foremost ensure that food sovereignty is not sacrificed.



6. References

- [1] - GIMÉNEZ, E.H. (2007). *Biofuels: The Five Myths of the Agro-fuels Transition*. Available in www.globalresearch.ca/index.php?context=va&aid=6188.
- [2] - Action Aid International (2008). *Food, Farmers and Fuel: Balancing Global Grain and Energy Policies with Sustainable Land Use*. p 17-18.
- [3] - WELZ, A.(2009). *Ethanol's African Land Grab*. Available in <http://www.motherjones.com/environment/2009/03/ethanols-african-landgrab#com>
- [4] - REPÚBLICA DE MOÇAMBIQUE (2009). *Política e Estratégia de Biocombustíveis*. Publicada no Boletim da República, I série - n° 20, Resolução 22/2009 de 21 de Maio. p 14. Política e Estratégia aprovada pelo Conselho de Ministros a 24 de Março de 2009, Ministério da Energia.
- NAMBURET S. (2006) *Mozambique Bio-Fuels*. Power point presentation in African Green Revolution Conference, Oslo – Norway (31 August – 02 September 2006).
- [5] – ESV Group Plc, SGC Group, Sun Biofuels UK and Ennergem Resources Inc
- [6] - Friends of The Earth (2009). *Jatropha: wonder crop – Experience from Swaziland*. Swaziland
- Action Aid (2008). *Food, Farmers and Fuel: Balancing Global Grain and Energy Policies with Sustainable Land Use*.
- African Centre for biosafety
- [7] - RIBEIRO, D.(2007). *Queimar ou Comer*. in *Jornal O País - O País Verde*.
- WELZ, A.(2009). *Ethanol's African Land Grab*. Available in <http://www.motherjones.com/environment/2009/03/ethanols-african-landgrab#com>
- [8] - CAMONA, F. (2007). *Iminente asfixia do Celeiro da Nação*. in SAVANA. Disponível em : http://macua.blogs.com/moambique_para_todos/files/imminente_asfixia_do_celeiro_da_ao.doc
- [9] - FACT FOUNDATION (2006). *Jatropha Handbook*. First Draft. p 5.
- [10] - CEPAGRI (2008). *Nota de Reflexão sobre Jatropha e a Produção de Biodiesel*. Ministério da Agricultura. Moçambique.
- Interview with Director of Bachir Jatropha, 200
- [11] - WAMUSSE, S. (2008). *Proposta de unidades territoriais para a produção de biocombustíveis em Moçambique - Estudo caso da Jatropha*. p 21. Tese de Licenciatura. Maputo, Universidade Técnica de Moçambique
- [12] - MICOA (2007). *Estratégia Ambiental Para o Desenvolvimento Sustentável de Moçambique* Aprovada pelo Conselho de Ministros a 27 de Julho de 2009. p 9.
- Direcção Nacional de Água [web page] (2009 disponível em www.dnaguas.gov.mz) acessada Março de 2009.
- Instituto Nacional de Estatística [web page] 2006 disponível em www.ine.gov.mz) acessada Março de 2009.
- GARRET, J, CASSAMO, S. RUEL. M. (1997). *Segurança alimentar e nutrição em Moçambique Características, determinantes e previsões estratégicas in Poverty and Well-Being in Mozambique 1996-97*. Moçambique
- [13]- União Nacional de Camponeses (2006) . *Retrato e Análise da Soberania Alimentar em Moçambique*. Maputo
- [14]- <http://www.topnews.in/mozambique-tackles-high-energy-bill-rural-darkness-21383490>



- [15] - AfDB & OECD (2004) *African Economic Outlook*, Tunis, Paris.
- [16] - Ministry of Mineral Resources and Energy (2000). *Mozambique leads southern Africa in energy resources Wide scope for investment in rapid development*. Available in <http://www.sovereign-publications.com/mozambique.htm>
- [17] - IMF (2004). *IMF Approves in Principle 16.6 million USD PRGF Arrangement for Mozambique*. Washington.
- [18] - Coughlin P. E., 2006, *Agricultural Intensification in Mozambique - Infrastructure Policy and Institutional Framework. When Do Problems Signal Opportunities?*, EconPolicy Research Group, Lda., Maputo and African Food Crisis Study (Afrint), Department of Sociology, Lund University.
- [19] - <http://coin.fao.org/cms/world/mozambique/en/CountryInformation/Agriculture.html>
- [20] - GFU and GTZ (2004). *Case Study “Jatropha Curcas” India* . Frankfurt
- NAMBURET S. (2006) *Mozambique Bio-Fuels*. Power point presentation in African Green Revolution Conference, Oslo – Norway (31 August – 02 September 2006).
- [21] - CEPAGRI (2008). *Nota de Reflexão sobre Jatropha e a Produção de Biodisel*. p 10 Ministério da Agricultura. Moçambique.
- [22]- CEPAGRI (2008). *Nota de Reflexão sobre Jatropha e a Produção de Biodisel*. p 10 Ministério da Agricultura. Moçambique.
- [23] -ESISAPO (2006). *Boletim semanal do sistema de informação de mercados agrícola da Província de Nampula*. p 2. Edição N° 219 Nampula, 14 de Novembro de 2006. Direcção Provincial da Agricultura.
- [24]- ROSA (2005). *Alcançando a Segurança Alimentar e Nutricional em Moçambique - Contribuição da Sociedade Civil para PARPA II* . p 3 Moçambique.
- [25] - Interview with Director of Bachir Jatropha, 2009
- [26]- WELZ, A.(2009). *Ethanol's African Land Grab*. Available in <http://www.motherjones.com/environment/2009/03/ethanols-african-landgrab#com>
- [27] - CEPAGRI (2008). *Nota de Reflexão sobre Jatropha e a Produção de Biodisel*. p 9. Ministério da Agricultura. Moçambique.
- [28] - NAMBURET S. (2007) *Mozambique Bio-Fuels*. Power point presentation in African Green Revolution Conference, Oslo – Norway (31 August – 02 September 2006).
- [29] – Interview with local community and workers of company
- [30] - http://www.fao.org/fileadmin/templates/tc/tce/pdf/Mozambique_factsheet.pdf
- [31] - Interview with Director of Bachir Jatropha, 2009
- [32] - FROST & SULLIVAN(2007). *Sub-Saharm African Biofuels Market*. United States
- www.howtoadvice.com/Preview/Iagtlfm
- [33] WorkShop on Reflection and Experience Exchange regarding Agrofuels, Biofuels and the Green Revolution in Mozambique, Africa Centre for Biosafety, JA and UNAC. Maputo 13 & 14 October, 2008.
- [34] Direcção Nacional de Terras e Florestas (2007). *Avaliação Integrada das Florestas de Moçambique*. Ministério da Agricultura. p Moçambique



ANNEXES



Annex 1. List of Jatropha Projects in Mozambique

Table 3. List of Jatropha Projects in Mozambique

Name of Project	Source	Company	Location	Ha Allocated	Ha (2009)	Observation
Deuco Jatropha	1	Deulco Energias Renováveis LDA	Maputo Province			Deulco Energias Renováveis LDA is affiliation of Deulco Jatropha BioDiesel Project in Mozambique. Deulco Jatropha BioDiesel Project is a part of Deulco Renewable Energy - South African Company.
ECOMOZ	2	Joint initiative between Petromoc, Biomoz, Hende Wayela, Bioenergia and other stakeholders	Maputo Province	21000		Biomoz, Hende Wayela and Bioenergia are the sources of material, Ecomoz produces the bio-diesel, and Petromoc distributes it.
Moçambique - Inhluvuka	3	D1 Oils	Maputo Province	5 348		Joint venture between South African Demetrius Pappadopoulos who is the CEO of D1 Oils Africa together with the Swaziland citizen originally from Mauritius Gaetan Ng Chiu Hing Ning, who is DI Oils' head in Swaziland
AGROFER	3	AGROFER	Gaza Province			
Energem Jatropha	4	Energem Renewable Energy, LDA.	Gaza Province	60 000	1447	Energem Renewable Energy LDA it is part of Deulco Mozambique LDA, and Deulco Mozambique LDA is 70% of Energem Biofuels Limited ("EBL"). Energem Biofuels Limited ("EBL") is the alternative energy division of Energem Resources Inc. Energem Resources Inc is a Canadian Company.
ESV Bio- Africa	4	ESV Bio - Africa	Inhambane Province	11 000	7400	ESV Bio- Africa is affiliation of ESV Group Plc in Mozambique. ESV Group Plc – is a Ukrainian Company

Bachir Jatropha	4	Bashir Jatropha	Inhambane Province			
C3	5	Climate Change Corporate	Inhambane Province			
Deulco Jatropha	6	Deulco Energias Renováveis LDA	Inhambane Province	10 000		Deulco Energias Renováveis LDA is an affiliation of Deulco Jatropha BioDiesel Project in Mozambique. Deulco Jatropha BioDiesel Project is a part of Deulco Renewable Energy - South African Company.
Enerterra	3	SGC Energia	Sofala and Nampula Province	20 000		SGC Energia is a Portuguese company
ADPP/ Fact Foundation	5		Sofala Province			
Elaion África	7	Elaion África LDA	Sofala Province	1000		Elaion África LDA is a partnership between Elaion Ag anda Markus Speiser. Elaion Ag is a Germmany company
GalpBuzi	8	Galp Energia	Sofala Province	5000		GalpBuzi in a joint venture between a National company of Buzi (distrity) and Galp Energia . Galp Energia is a Portuguese company.
Deulco Jatropha	1	Deluco Mozambique LDA	Sofala Pronvice	5000		Deulco Energias Renováveis LDA is affiliation of Deulco Jatropha BioDiesel Project in Mozambique. Deulco Jatropha BioDiesel Project is a part of Deulco Renewable Energy - South African Company.
MocamGalp	4		Manica Province	10 000	60	Joint venture between Visabeira and Galp Energia. Visabeira and Galp Energia are Portuguese companies
Sun Biofuels	4	Sun Biofuels Mozambique	Manica Province	6000	1000	Sun Biofuels Mozambique is an affiliation to Sun biofuels in Mozambique. Sun biofuels is a UK company
Enviortrade	5	Comercial	Manica Province			

Government of Nampula Province Scheme	5	Public project	Nampula Province			
Aviam	8		Nampula Province	10 000		Aviam is an Italian Company
Luambala Jatropha	3	Silvestria Utveckling AB and Chikweti Forests of Niassa.	Niassa Province	8 789		
Eagle Farm	9	Viridesco Ltd	Niassa Province	10 000		Viridesco Ltd is a U K company
Total				183 137	9 907	

1 - Deulco Web Page (www.deulco.com)

2 - ProBec⁵ Data

3 - CEPAGRI ⁶Data

4 - Interview done during the study

5 - The Global Exchange for Social Investment (GEXI) in Global Market Study on Jatropha

Project Inventory: Africa

6- Minister of Energy (Salvador Namburete) presentation, in Oslo – Norway (31 August – 02 September 2006)

7 – Elaion Web Page (www.elaion-ag.de)

8 - Public Source – Jornal Notícias (<http://www.jornalnoticias.co.mz/pls/notimz2/getxml/pt/contentx/725250>)

9- Viridesco Web Page (www.viridesco.com)

⁵ ProBec (The Program for Basic Energy and Conservation) is a SADC project and implementing agency is GTZ German Development Co-operation

⁶ CEPAGRI (Centro de Promoção Agrícola) it is part of Ministry of Agriculture.

Annex 2. List of Institution contacted during the selection of study area

Table 4. List of institutions contacted during the selection of study area

Name of Institution	Results	Date of Answer
Fundação para o Desenvolvimento da Comunidade - FDC*	No answer	
Direcção Nacional de Promoção do Desenvolvimento Rural – DNPDR*	. No answer	
Serviços Agrários*	No answer	
Instituto Nacional de Gestão de Calamidades – INGC*	No answer	
Cruzeiro do Sul*	No answer	
Instituto de Investigação Agrária de Moçambique*	- had no information, but passed the letter to the Direcção Nacional dos Serviços Agrário and the Centro de Promoção Agrícola	06/04/2009
Centro de Promoção Agrícola	Table with Jatropha projects of Mozambique.	27/ 04/ 2009
Direcção Nacional dos Serviços Agrário	This institution sent the report about Jatropha production in Moçambique	07/05/2009
GTZ - ProBec	Done one interviews	5/02/2009

*These institutions received a letter on 02/03/09. In this letter UNAC and JA, explained the scope of the study.

Annex 3. Declaration of Civil Society



DECLARATION

Justiça Ambiental (JA!), União Nacional de Camponeses (UNAC), Kulima, some farmers from the Massingir district and Zambézia province, some members of international organizations such as the African Centre for Biosafety (ACB), Trust for Community Outreach and Education (TCOE) and the Center for Food Safety (CFS) and some NGOs' whose signatures on this declaration are still to be confirmed have met on the 13th and 14th October for a reflection and experience exchange regarding agrofuels, biofuels and the green revolution in Mozambique.

On this meeting, it was clear that what is intended to be a mass production in Mozambique are agrofuels and not biofuels, according to the concept of each one of these terms, defined in Bonn – Germany in May 2008 at the World Biodiversity Conference, where agrofuels is the monoculture plantation for the large scale industrial production of fuel, while the term biofuels is referred to the fuel production from organic material (not in large scale).

Still on this conference, the following aspects were identified as the main causes for the unrestrained race for the agrofuels in Mozambique:

1. The beginning of a domination and control of the world process by the multinationals searching for more financial and economic power.
2. Concentration of both the most valuable natural resources and the decision-making power on the hands of a small elite of the Mozambican society.
3. Facility in land expropriation.
4. Exploitation of farmers' labor.
5. Facility in obtaining big financing.
6. Multinationals' control on the production of seeds, fertilizers, pesticides and genetically modified organisms.
7. Corruption.

We are not in support of the form of implementation of the green revolution in Mozambique. We believe an integrated work at a national level is necessary in order to find alternatives for Africa regarding the green revolution; alternatives that must be substantiated in local ecosystems and in the fight for food sovereignty.

More communication between farmers, learning and researching.

Non Governmental Organizations promoting campaigns to support agricultural biodiversity policies and the rights of all small farmers, the pillar of our society.

Considering the mentioned above, this group would like the Government to take the following actions regarding the agrofuel production and the green revolution in Mozambique:

1. Present a participative program, with its policies and its position around agrofuel production and the green revolution in Mozambique.
2. This program should be of public knowledge. Its elaboration process shall include the civil society's participation, with greater emphasis on the farmers.
3. The program shall always grant the land concessions in the terms of the ruling law related to land use in the country.
4. The government shall prioritize the food production instead of the agrofuel production.
5. Support small scale agriculture, organic agriculture, avoiding pesticides, fertilizers and genetically modified seeds.
6. Stimulate the creation of small cooperatives in order for the farmers to become self-sufficient.
7. Create mechanisms for the use, respect and fulfillment of the legal instruments that will allow the farmers to defend themselves in case of land conflict.
8. Assure the farmers' rights of having a healthy agriculture according to the local habits and customs.
9. Guarantee a better transparency in the whole process, involving the farmers on the decision making, informing the farmers about the impacts and benefits, respecting and protecting the farmers and not the multinationals and the foreign investment.

Justiça Ambiental (JA!), the União Nacional de Camponeses (UNAC) and Kulima are Mozambican organizations that believe and fight for:

1. The respect and fulfillment of the Mozambican laws, as well as assure the well-being and the peoples' right of access to basic alimentation, drinking water, health and education and a healthy environment.
2. Communal education, to guarantee the communities are prepared to resist the invasion of big multinational enterprises.
3. A bigger involvement from the civil society on the policies and on the national legislation.
4. The protection of the land right, the right of the community to fight against the agrofuel production through the valorization of the land, defending that the land is an acquired right and not something negotiable, with the vision of the world we want to live in and pass for our children and the generations to come.
5. Energy alternatives that are really ecologic and sustainable like the solar, the wind, the use of biodigester and green plantations.
6. The development of our country and the eradication of poverty will only be reached if the government sets the people as its priority, and not the mega investments that bring no benefit for the Mozambican people.



**Friends of
the Earth
Mozambique**

